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Abstract

The empirical literature finds mixed evidence on the existence of positive productivity externalities in the host country generated by foreign multinational companies. We propose a mechanism that emphasizes the role of local financial markets in enabling foreign direct investment (FDI) to promote growth through backward linkages, shedding light on this empirical ambiguity. In a small open economy, final goods production is carried out by foreign and domestic firms, which compete for skilled labor, unskilled labor, and intermediate products. To operate a firm in the intermediate goods sector, entrepreneurs must develop a new variety of intermediate good, a task that requires upfront capital investments. The more developed the local financial markets, the easier it is for credit constrained entrepreneurs to start their own firms. The increase in the number of varieties of intermediate goods leads to positive spillovers to the final goods sector. As a result financial markets allow the backward linkages between foreign and domestic firms to turn into FDI spillovers. Our calibration exercises indicate that a) holding the extent of foreign presence constant, financially well-developed economies experience growth rates that are almost twice those of economies with poor financial markets, b) increases in the share of FDI or the relative productivity of the foreign firm leads to higher additional growth in financially developed economies compared to those observed in financially under-developed ones, and c) other local conditions such as market structure and human capital are also important for the effect of FDI on economic growth.

1 Introduction

There is a widespread belief among policymakers that foreign direct investment (FDI) generates positive productivity effects for host countries. The main mechanisms for these externalities are the adoption of foreign technology and know-how, which can happen via licensing agreements, imitation, employee training, and the introduction of new processes, and products by foreign firms; and the creation of linkages between foreign and domestic firms. These benefits, together with the direct capital financing it provides, suggest that FDI can play an important role in modernizing a national economy and promoting economic development. Yet, the empirical evidence on the existence of such positive productivity externalities is sobering.[1]

The macro empirical literature finds weak support for an exogenous positive effect of FDI on economic growth.[2] Findings in this literature indicate that a country's capacity to take advantage of FDI externalities might be limited by local conditions, such as the development of the local financial markets or the educational level of the country, i.e., *absorptive capacities*. Borensztein, De Gregorio, and Lee (1998) and Xu (2000) show that FDI brings technology, which translates into higher growth only when the host country has a minimum threshold of stock of human capital. Alfaro, Chanda, Kalemli-Ozcan and Sayek (2004), Durham (2004), and Hermes and Lensink (2003) provide evidence that only countries with well-developed financial markets gain significantly from FDI in terms of their growth rates.

The micro empirical literature finds ambiguous results for the effect of FDI on firm's productivity. This literature comes in three waves. Starting with the pioneering work of Caves (1974), the first generation papers focus on country case studies and industry level cross sectional studies.[3] These studies find a positive correlation between the productivity of a multinational enterprise (MNE) and average value added per worker of the domestic firms within the same sector.[4] Then comes the second generation

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[1]See Blomstrom and Kokko (1998), Gorg and Greenway (2004), Lipsey (2002), Barba Navaretti and Venables (2004), and Alfaro and Rodriguez-Clare (2004) for surveys of spillover channels and empirical findings.

[2]See Carkovic and Levine (2002).

[3]See also Blomstorm (1986).

[4]A multinational enterprise (MNE) is a firm that owns and controls production facilities or other income-generating assets in at least two countries. When a foreign investor begins a green-field operation (i.e., constructs new production facilities) or acquires control of an existing local firm, that investment is regarded as a direct investment in the balance of payments statistics. An investment tends to be classified as direct if a foreign investor holds at least 10 percent of a local

studies, which use firm level panel data. However, most of these studies find no effect of foreign presence or find negative productivity spillover effects from the MNEs to the developing country firms.[5] The positive spillover effects are found only for developed countries.[6] Based on these negative results, a third generation of studies argues that since multinationals would like to prevent information leakage to potential local competitors, but would benefit from knowledge spillovers to their local suppliers, FDI spillovers ought to be between different industries. Hence, one must look for vertical (inter-industry) externalities instead of horizontal (intra-industry) externalities. This means the externalities from FDI will manifest themselves through forward or backward linkages, i.e., contacts between domestic suppliers of intermediate inputs and their multinational clients in downstream sectors (backward linkage) or between foreign suppliers of intermediate inputs and their domestic clients in upstream sectors (forward linkage).[7] Javorcik (2004) and Alfaro and Rodriguez-Clare (2004) find evidence for the existence of backward linkages between the downstream suppliers and the MNE in Lithuania and in Venezuela, Chile, and Brazil respectively.[8] These results are consistent with FDI spillovers between different industries.

The purpose of this study is twofold. First, in a theoretical framework, we formalize the mechanism through which FDI leads to a higher growth rate in the host country via backward linkages, which is consistent with the micro evidence found by the third-generation studies described above. The mechanism depends on the extent of the development of the local financial sector. Financial markets act as a channel for the linkage effect to be realized and create positive spillovers, which is consistent with the macro literature cited above that shows the importance of absorptive capacities. We are not

firm's equity. This arbitrary threshold is meant to reflect the notion that large stockholders, even if they do not hold a majority stake, will have a strong say in a company's decisions and participate in and influence its management. Hence, to create, acquire or expand a foreign subsidiary, MNEs undertake FDI. In this paper, we often refer to the MNE and FDI interchangeably.

[5] See Aitken and Harrison (1999).

[6] Haskel, Pereira and Slaughter (2002), for example, find positive spillovers from foreign to local firms in a panel data set of firms in the U.K.; Gorg and Strobl (2002) find that foreign presence reduces exit and encourages entry by domestically owned firms in the high-tech sector in Ireland.

[7] Hirschman (1958) argues that the linkage effects are realized when one industry may facilitate the development of another by easing conditions of production, thereby setting the pace for further rapid industrialization. He also argues that in the absence of linkages, foreign investments could have limited or even negative effects in an economy (the so-called enclave economies).

[8] See also Kugler (2006).

aware of any other study that is consistent with both micro and macro empirical evidence.

In a small open economy, final goods production is carried out by foreign and domestic firms, which compete for skilled labor, unskilled labor, and intermediate products. To operate a firm in the intermediate goods sector, entrepreneurs must develop a new variety of intermediate good, a task that requires upfront capital investments. The more developed the local financial markets, the easier it is for credit constrained entrepreneurs to start their own firms. The increase in the number of varieties of intermediate goods leads to positive spillovers to the final goods sector. As a result, financial markets allow the backward linkages between foreign and domestic firms to turn into FDI spillovers.[9] Our model also implies the existence of horizontal spillovers in the final goods sector since the greater availability of intermediate inputs not only benefits the foreign firms but also raises the total factor productivity of the domestic firms in the final goods sector, thus creating a horizontal spillover as an indirect result of the backward linkage.

In the second half of the paper, we use the model to quantitatively gauge how the response of growth to FDI varies with the level of development of the financial markets. To the best of our knowledge, this paper is unique in this respect. We find that a) holding the extent of foreign presence constant, financially well-developed economies experience growth rates that are almost twice those of economies with poor financial markets, b) increases in the share of FDI or the relative productivity of the foreign firm leads to higher additional growth in financially developed economies compared to those observed in financially under-developed economies. The calibration section, additionally, highlights the importance of local conditions such as market structure and human capital, the so-called absorptive capacities, for the effect of FDI on economic growth. For example, we find larger growth effects when goods produced by domestic firms and MNEs are substitutes rather than complements. By varying the relative skill endowments—while assuming that MNEs use skilled labor more intensively—we obtain results consistent with Borensztein, De Gregorio, and Lee (1998) who highlight the critical role of

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[9]In our model, linkages are associated with pecuniary externalities in the production of inputs. In contrast to knowledge spillovers, pecuniary externalities take place through market transactions, see Hirschman (1958). Hobday (1995), in a case study of developing East Asia, finds many situations in which MNEs investment created backward linkages effects to local suppliers.

human capital.

Theoretical models of FDI spillovers via backward linkages include Rodriguez-Clare (1996), Markusen and Venables (1999), and Lin and Saggi (2006). None of these models investigate the critical role played by local financial markets and neither do they focus on the dynamic effects of FDI spillovers. Instead, these are static models. Our model closely follows Grossman and Helpman's (1990, 1991) small open economy setup of endogenous technological progress resulting from product innovation via increasing intermediate product diversity. We modify their basic framework to incorporate foreign- owned firms and financial intermediation. The standard Grossman-Helpman setting is preferred since it provides the most transparent solution. Further, models of FDI such as the ones mentioned above also use the intermediate product variety structure in a static setting, thus making it a natural choice when moving to a dynamic framework.[10] Recently, Aghion, Howitt, and Mayer-Foulkes (2005) have modeled technology transfers with imperfect financial markets in a Schumpeterian growth model. Their model is different than ours in the sense that they focus on credit constraints impeding international technology transfers (and hence international convergence), while we focus on the role of financial markets easing the credit constraints and allowing linkages between multinational firms and local suppliers in the host country to materialize. Thus, we are concerned with linkages within an economy once FDI has taken place. In a related paper that is closer to the spirit of our paper, Aghion, Comin, and Howitt (2006) develop a model that highlights the role of local savings in attracting and complementing foreign investment which spurs innovation and growth.

The importance of well-functioning financial institutions in augmenting technological innovation and capital accumulation, fostering entrepreneurial activity and hence economic development has been recognized and extensively discussed in the literature.[11] Furthermore, as McKinnon (1973) stated, the development of capital markets is "necessary and sufficient" to foster the "adoption of best-practice technologies and learning by doing." In other words, limited access to credit markets restricts entrepreneurial development. In this paper, we extend this view and argue that the lack of development of the local

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[10]Gao (2005) also incorporates FDI into a growth model that closely follows Grossman and Helpman (1991). The author neither models the role of domestic financial markets nor relates the model to empirical evidence.

[11]See Goldsmith (1969), Greenwood and Jovanovic (1990), and King and Levine (1993a,b), among others.

financial markets can limit the economy's ability to take advantage of potential FDI spillovers in a theoretical framework, a premise which is already supported by empirical evidence. Our results on the importance of the financial markets thus contributes to an emerging literature that emphasizes the importance of the local policies and institutions in limiting the potential benefits that FDI can provide to the host country.[12]

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 performs a calibration exercise using values for the parameters from the empirical literature. Section 4 concludes.

2 The Model

2.1 Households

Consider a small open economy. The economy is populated by a continuum of infinitely lived agents of total mass 1. Households maximize utility over their consumption of the final good,

$$U_t = \int_t^\infty e^{-\rho(\tau-t)} \log u(C_\tau) d\tau, \tag{1}$$

where $u(.)$ is a continuously differentiable strictly concave utility function, ρ is the time preference parameter, and C_τ denotes consumption of the final good at time τ. The final good, denoted by Y_t, is a numeraire and is freely traded in world markets at a price p_t which we normalize to 1. The total expenditure on consumption is thus given by $E_\tau = p_\tau C_\tau = C_\tau$. Households maximize utility subject to the following intertemporal budget constraint,

$$\int_t^\infty e^{-r(\tau-t)} E_\tau d\tau \leq \int_t^\infty e^{-r(\tau-t)} w_\tau d\tau + A_t, \tag{2}$$

where A_t denotes the value of the assets held by the household at time t, and w_τ is the wage income. The intertemporal budget constraint requires that the present value of the expenditures, E_τ, not exceed the present value of labor income plus the value of asset holdings in the initial period. The solution

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[12]For example, lack of adequate contract and property rights enforcement can limit the interaction between foreign and local firms. A foreign firm can decide instead of buying inputs in the host country to produce them within the boundaries of the firm or import them, restricting their local activities to hiring labor. See Antras (2003), and Lin and Saggi (2006).

of this standard problem implies that the value of the expenditures must grow at a rate equal to the difference between the interest rate and the discount rate. However, if this rate of growth of expenditure is different from the endogenous rate of growth of the economy then either the transversality condition is violated or the economy no longer remains a small open economy. To rule out these possibilities, we assume that households are credit constrained and can borrow at most a fixed fraction of their current income. Further, we assume that this constraint is binding, and therefore the actual rate of growth of expenditures is proportional to the rate of growth of income:[13]

$$\frac{\dot{E}}{E} \propto \frac{\dot{Y}}{Y}$$

2.2   Production

2.2.1   The Final Goods Sector

Final good production combines the production processes of domestic and foreign firms denoted respectively by $Y_{t,d}$ and $Y_{t,f}$, which are not traded. Let $p_{t,d}$ and $p_{t,f}$ denote their respective prices. The aggregate production function for this composite final good is given by,

$$Y_t = [Y_{t,d}^{\rho} + \mu Y_{t,f}^{\rho}]^{1/\rho}, \tag{3}$$

where $\rho \leq 1$ and $\varepsilon = 1/(1-\rho)$ represents the elasticity of substitution between $Y_{t,d}$ and $Y_{t,f}$. We do not model the decision of foreign firms to enter the market. Therefore, the aggregator of foreign and domestic firms' production serves as an artifact that allows us to capture the interaction of foreign and domestic firms in an economy.[14] We can exogenously vary μ to capture realistic shares of foreign and domestic firms in the final output. If $\varepsilon = \infty$, foreign and domestic firms produce perfect substitutes; $\varepsilon = -\infty$, they produce complements. If $\varepsilon = 1$, the production function for the final good becomes Cobb

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[13]This is only an assumption of convenience since, as we will see later, the entrepreneurs are also credit-constrained and we would rather treat both groups the same to rule out any gains from arbitrage. This assumption also ensures that the consumption side of the economy has no implications for the production side. Hence, there is no difference between assuming a household cannot borrow forever and a household cannot borrow over a certain fraction.

[14]For a similar setup, see Markusen and Venables (1999).

Douglas.

Profit maximization yields,

$$\frac{p_{t,f}}{p_{t,d}} = \mu \left[\frac{Y_{t,d}}{Y_{t,f}}\right]^{1-\rho}.$$

(4)

The cost function is given by,

$$C\left(Y_t, p_{t,f}, p_{t,d}\right) = Y_t \left[p_{t,d}^{1-\varepsilon} + \mu^\varepsilon p_{t,f}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}.$$

Setting the price equal to marginal cost,

$$1 = \left[p_{t,d}^{1-\varepsilon} + \mu^\varepsilon p_{t,f}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}},$$

which allows us to derive an expression between the price of the domestic firm and foreign firm goods,

$$p_d = \left(1 - \mu^\varepsilon p_f^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}.$$

(5)

2.2.2 Foreign and Domestic Firms Production Processes

Both foreign and domestic firms' production processes combine unskilled labor, skilled labor, and a composite intermediate good. The intermediate good is assembled from a continuum of horizontally differentiated goods. Unskilled and skilled labor are not traded and available in fixed quantities L and H, correspondingly. Competition in the labor market ensures that unskilled and skilled wages, $w_{t,u}$ and $w_{t,s}$, are equal to their respective marginal products. To capture the importance of proximity between suppliers and users of inputs, we assume that all varieties of intermediate goods are non-traded.[15]

Domestic production is characterized by,

$$Y_{t,d} = A_d L_{t,d}^{\beta_d} H_{t,d}^{\gamma_d} I_{t,d}^{\lambda},$$

(6)

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[15]This is a common assumption used to capture transportation costs or local content requirements; see Grossman and Helpman (1990), Markusen and Venables (1999) and Rodriguez-Clare (1996). Alternatively, one could assume that there are some intermediate goods that are tradable and others that are non-tradable. Our results will hold as long as each intermediate good enters both domestic and foreign production functions with the same intensity.

with $0 < \beta_d < 1$, $0 < \gamma_d < 1$, $0 < \lambda < 1$ and $\beta_d + \gamma_d + \lambda = 1$. $L_{t,d}$, $H_{t,d}$, and $I_{t,d}$ denote, respectively, the amount of unskilled labor, skilled labor, and the composite intermediate good used in domestic production at any instant in time, and A_d represents the time invariant productivity parameter.

Foreigners directly produce in the country rather than license the technology. The industrial organization literature suggests that firms engage in FDI not because of differences in the cost of capital but because certain assets are worth more under foreign than local control. If lower cost of capital were the only advantage a foreign firm had over domestic firms, it would still remain unexplained why a foreign investor would endure the troubles of operating a firm in a different political, legal, and cultural environment instead of simply making a portfolio investment. Graham and Krugman (1991), Kindleberger (1969), and Lipsey (2003) show that investors often fail to bring all the capital with them when they take control of a foreign company; instead, they tend to finance an important share of their investment in the local market. An investor's decision to acquire a foreign company or build a plant instead of simply exporting or engaging in other forms of contractual arrangements with foreign firms involves two interrelated aspects: ownership of an asset and the location to produce.[16] First, a firm can possess some ownership advantage—a firm-specific asset such as a patent, technology, process, or managerial or organizational know-how—that enables it to outperform local firms. And this is one of the reasons why researchers fail to find evidence of horizontal spillovers since this means that a foreign firm will seek to use this special asset to its advantage and prevent leakages of its technology. Hence, we model potential benefits from FDI as occurring via linkages and not through technology spillovers. Second, domestic factors, such as opportunities to tap into local resources, access to low-cost inputs or low-wage labor, or bypass tariffs that protect a market from imported goods can also lead to the decision to invest in a country rather than serve the foreign market through exports.[17]

Since our objective in this paper is to understand the effects of foreign production on local output and the role of financial markets, and not the decision to invest abroad, we model the frictions of doing

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[16]This approach to the theory of the multinational firm is also known as the OLI framework— ownership advantage, localization, internalization. See Dunning (1981).

[17]For models that endogenize the FDI decision, see Helpman (1984), Markusen (1984), and Helpman, Melitz, and Yeaple (2004).

business in the domestic economy with the parameter ϕ.[18] Thus, foreign firms use the following Cobb Douglas production function,

$$Y_{t,f} = \frac{A_f}{\phi} L_{t,f}^{\beta_f} H_{t,f}^{\gamma_f} I_{t,f}^{\lambda}, \tag{7}$$

with $0 < \beta_f < 1$, $0 < \gamma_f < 1$, and $\beta_f + \gamma_f + \lambda = 1$. Like before, $L_{t,f}, H_{t,f},$ and $I_{t,f}$ denote, respectively, the amount of unskilled labor, skilled labor, and the composite intermediate good used in foreign production at any instant in time, and A_f represents the time invariant productivity parameter.

Unskilled and skilled labor have different shares within the domestic and foreign production, though the total labor share is assumed to be the same across both types of firms. This reflects the common observation that the share of labor tends to be around two-thirds of total factor payments while at the same time permitting different skill intensities within domestic and foreign production. A corollary of assuming the same total labor share is,

$$\gamma_f - \gamma_d = \beta_d - \beta_f. \tag{8}$$

The composite intermediate good is assembled from differentiated intermediate inputs. Following Ethier (1982), we assume that, for a given aggregate quantity of intermediate inputs used in the final good production, output is higher when the diversity in the set of inputs used is greater. This specification captures the productivity gains from increasing degrees of specialization in the production of final goods.

$$I_{t,d} = I_{t,f} = I_t = \left[\int_0^n x_{t,i}^{\alpha} di \right]^{1/\alpha}, \tag{9}$$

where $x_{t,i}$ is the amount of each intermediate good i used in the production of the final good at time t, and n is the number of varieties available. Let p_i denote the price of a variety i of the intermediate good x. The CES specification imposes constant and equal elasticity of substitution ($1/(1-\alpha)$) between a pair

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[18]Burnstein and Monge-Naranjo (2005) assume taxes on foreign firms to be the barrier in each country. We allow a broader interpretation, as foreign firms need to bear a wide range of costs/risks of doing business abroad, including sovereign risk, taxes, and infrastructure and dealing with different institutions and cultures. We also considered an alternative scenario where MNEs receive a net price p_f/ϕ where $\phi > 1$, reflecting these disadvantages, obtaining similar results.

of goods. Each variety of intermediate good enters the production function identically and the marginal product of each variety is infinite when $x_{t,i} = 0$. This implies that the firm will use all the intermediate goods in the same quantity, thus $x_{t,i} = x_t$. Let $X_t = n_t x_t$ be the total input of intermediate goods employed in the production of the final good at time t, then we can rewrite $I_t = n_t^{\frac{1-\alpha}{\alpha}} X_t$. Domestic production is given by,[19]

$$Y_d = A_d L_d^{\beta_d} H_d^{\gamma_d} X_d^{\lambda} n^{\frac{\lambda(1-\alpha)}{\alpha}}, \tag{10}$$

and foreign production by,

$$Y_f = \frac{A_f}{\phi} L_f^{\beta_f} H_d^{\gamma_f} X_f^{\lambda} n^{\frac{\lambda(1-\alpha)}{\alpha}}. \tag{11}$$

Thus, raising the varieties of intermediate inputs n, holding the quantity of intermediate goods constant, raises output productivity. Using the cost function and the fact that in a symmetric equilibrium all intermediate goods are priced similarly, $p_i = p_x$, we can write the equilibrium conditions for the domestic and foreign firms respectively as,

$$p_d = \frac{A_d^{-1} \beta_d^{-\beta_d} \gamma_d^{-\gamma_d}}{\lambda^{\lambda}} w_u^{\beta_d} w_s^{\gamma_d} p_x^{\lambda} n^{\frac{\lambda(\alpha-1)}{\alpha}}, \tag{12}$$

$$p_f = \frac{\phi A_f^{-1} \beta_f^{-\beta_f} \gamma_f^{-\gamma_f}}{\lambda^{\lambda}} w_u^{\beta_f} w_s^{\gamma_f} p_x^{\lambda} n^{\frac{\lambda(\alpha-1)}{\alpha}}. \tag{13}$$

2.2.3 The Intermediate Goods Sector

The intermediate goods sector is characterized by monopolistic competition. There exists an infinite number of potential varieties of intermediate goods, but only a subset of varieties is produced at any point in time as entrepreneurs are required to develop a new variety. Since the set of potential intermediate goods is unbounded, an entrepreneur will never choose to develop an already existing variety. Therefore, variety i of x is produced by a single firm which then chooses the price p_i to maximize profits. Firms

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[19]Since we will focus exclusively on the balanced growth path, we omit the time subscript for the rest of the paper.

take as given the price of competing intermediate inputs, the price of the final good, and the price of the factors of production. In a symmetric equilibrium all intermediate goods are priced similarly, $p_i = p_x$. Hence, profit maximization in every time period for each supplier of variety i implies,

$$\max \ \pi_i = p_x x_i - c_x(w_u, w_s, x_i) x_i, \tag{14}$$

where $c_x(w_u, w_s, x_i)$ represents the cost function and $x_i = x_d + x_f$ is the sum of the demand for the intermediate product i by domestic and foreign firms respectively.

Production of intermediate goods requires both skilled and unskilled labor according to the following specification,

$$x_i = L_{x_i}^{\delta} H_{x_i}^{1-\delta}. \tag{15}$$

Hence, the cost function for the monopolist is given by,

$$c\left(w_u, w_s, x_i\right) = \delta^{-\delta}(1-\delta)^{-(1-\delta)} w_u^{\delta} w_s^{(1-\delta)} x_i. \tag{16}$$

Profit maximization yields the result that each variety is priced at a constant markup $(1/\alpha)$ over the marginal cost.[20] Hence, the price of each intermediate good is given by,

$$p_x = \delta^{-\delta}(1-\delta)^{-(1-\delta)} \frac{w_u^{\delta} w_s^{(1-\delta)}}{\alpha}. \tag{17}$$

The fraction that domestic firms spend on all intermediate goods is given by the corresponding share in the production function, $\lambda p_d Y_d$. This implies that for each intermediate good, the amount spent by domestic firms is given by $\lambda p_d Y_d / n$. Similarly, the amount that foreign firms spend on these goods is given by $\lambda p_f Y_f / n$. The sum of amounts spent by foreign and domestic firms is the total revenue of the intermediate producer,

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[20]See Helpman and Krugman (1985), chapter 6.

$$p_x x_i = \frac{\lambda p_d Y_d}{n} + \frac{\lambda p_f Y_f}{n}. \tag{18}$$

Therefore, we can write the *operating* profits per firm as,

$$\pi_i = \frac{(1 - \alpha)}{n} \left[\lambda p_d Y_d + \lambda p_f Y_f \right]. \tag{19}$$

What is the value of introducing new intermediate goods and thus the value of the monopolistic firm? Let v_t denote the present discounted value of an infinite stream of profits for a firm that supplies intermediate goods at time t,

$$v_t = \int_t^\infty e^{-r(s-t)} \pi_s ds.$$

Equity holders of the firm are entitled to the stream of future profits of the firm. They make an instantaneous return of $(\pi_t + \dot{v})$, (profits and capital gain). They can also invest the same amount in a risk-free bond and receive return $r v_t$ (the prevailing market interest rate). Arbitrage in capital markets ensures that,

$$\pi + \dot{v} = rv \Rightarrow \frac{\pi + \dot{v}}{v} = r. \tag{20}$$

Thus, the rate of return of holding ownership shares is equal to the interest rate.[21]

2.2.4 Introduction of New Varieties and Financial Markets

In order to operate a firm in the intermediate good sector, entrepreneurs must develop a new variety of intermediate goods. The introduction of each new variety requires some initial capital investment according to the following specification,

$$\dot{n} = \frac{K}{a} n^\theta. \tag{21}$$

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[21]Note that the arbitrage condition does not contradict our assumption of credit-constrained households since they can choose to lend to firms or invest in a risk free bond.

In contrast to Grossman and Helpman (1991), who assume that new varieties are developed with two inputs, labor and general knowledge, we opt for one input only, capital, to simplify the analysis.[22] Our main results do not depend on this simplifying assumption. The main implication of this simplification is that our results are less dependent on the production parameters of the innovation sector. This has important advantages for our calibration exercise, as the stylized facts of the innovation and imitation processes are not well documented. Our central argument is that entrepreneurs face difficulties in obtaining, for example, loans to set up firms and this prevents the creation of backward linkages even under the presence of FDI. Assuming only capital is used for these setup costs then allows us to focus better on this issue.

The introduction of a new variety depends on the existing stock of varieties. We introduce the parameter θ since this allows a more general production structure. A value of $\theta < 0$ suggests a "fishing out" effect (increasing complexity in introducing new varieties) while a value of $\theta > 0$ implies positive externalities ("standing on the shoulder of giants"). At this stage, we do not postulate an exact value of θ.[23] This will be pinned down by conditions required to satisfy balanced growth. Finally, a can be viewed as the level of efficiency in the innovation sector.

The initial capital investment must be financed by borrowing from domestic financial institutions. The domestic financial system intermediates resources at an additional cost, as in Edwards and Vegh (1997). This cost reflects the level of development of the domestic financial markets where lower levels of development are associated with higher costs. These costs manifest themselves in a higher borrowing rate, i which is greater than the lending rate, r. As King and Levine (1993a) mention, this wedge could reflect taxes, interest ceilings, required reserve policies, high intermediation costs due to labor regulation, or high administration costs, etc. This simplification allows us to focus on the main theme of the paper: the role of financial markets in allowing FDI benefits to materialize. Thus, this assumption should

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[22]Grossman and Helpman (1991) assume that the greater the stock of general knowledge among the scientific community, the smaller the input of human capital needed to invent a new product. They assume $\dot{n} = KL/a$, where K represents the stock of general knowledge capital and not physical capital like in our model. Hence, in our model, in incurring setup costs, intermediate firms do not compete for labor inputs against the final good sector.

[23]For more on the implications of these alternative assumptions, see Jones (1995). While we do not postulate an exact value, we will work under the assumption that $\theta \neq 1$. Also for convenience, the discussion will treat θ as positive.

be regarded as a shortcut to more complex modelling of the financial sector. The reader is referred to the appendix for a cost verification approach following King and Levine (1993b) that yields similar implications. Our qualitative results will be the same under this framework.

Given n^θ and a, if an entrepreneur wants to introduce one variety at any instant in time, the amount of capital needed will be $K = a/n^\theta$, so that $\dot{n} = 1$. Therefore, the cost of introducing a new variety is

$$\frac{ia}{n^\theta}. \tag{22}$$

There is free entry into the innovation sector. Entrepreneurs will have an incentive to enter if $\frac{ia}{n^\theta} < v$. However, this condition implies that the demand for capital will be infinite, which cannot be an equilibrium solution. Hence, we can rule out this condition ex-ante. If, on the other hand, $\frac{ia}{n^\theta} > v$, entrepreneurs will have no incentive to engage in innovation. This possibility cannot be ruled out ex-ante but would lead to zero growth. Therefore, in equilibrium, if there is growth in the number of varieties it must be the case that,

$$\frac{ia}{n^\theta} = v \text{ iff } \dot{n} > 0. \tag{23}$$

This also implies,

$$\frac{\dot{v}}{v} = -\theta \frac{\dot{n}}{n},$$

i.e., more innovation reduces the value of each firm. Using this expression and the arbitrage condition in the capital markets, $\frac{\pi}{v} + \frac{\dot{v}}{v} = r$, we can rewrite equation (20) as,

$$\frac{\pi}{v} - \theta \frac{\dot{n}}{n} = r. \tag{24}$$

Using firm profit equation (19), equation (23), and equation (24) we obtain,

$$\frac{(1-\alpha)\lambda}{ia} \left[\frac{p_d Y_d}{n^{1-\theta}} + \frac{p_f Y_f}{n^{1-\theta}} \right] - \theta \frac{\dot{n}}{n} = r. \tag{25}$$

In order to simplify, we define $\frac{Y_d}{n^{1-\theta}} = \tilde{Y}_d$ and $\frac{Y_f}{n^{1-\theta}} = \tilde{Y}_f$ as efficiency units of outputs and get,

$$\frac{\dot{n}}{n} = \frac{(1-\alpha)\lambda}{\theta i a} \left[p_d \tilde{Y}_d + p_f \tilde{Y}_f \right] - \frac{r}{\theta} \tag{26}$$

As it is standard in this class of models, the growth rate of varieties, $\dot{n}/n$, ultimately pins down the growth rate of both domestic output and foreign output and thus aggregate output as well.

2.3 General Equilibrium and the Balanced Growth Path

Using the efficiency unit adjusted output levels, $\tilde{Y}_d$ and $\tilde{Y}_f$, we can also rewrite equation (4) as,

$$\frac{p_f}{p_d} = \mu \left[\frac{\tilde{Y}_d}{\tilde{Y}_f} \right]^{1-\rho}. \tag{27}$$

And we can rewrite equation (21) as,

$$\frac{\dot{n}}{n} = \frac{1}{a} \frac{K}{n^{1-\theta}} = \frac{1}{a} \tilde{K},$$

where $\tilde{K}$ is the capital stock per efficiency unit.

Substituting the price for intermediate inputs (17) into the equilibrium conditions for the domestic (12) and foreign production (13), and defining efficiency wages for both skilled and unskilled labor as $\tilde{w}_s = w_s / \left(n^{\frac{(1-\alpha)\lambda}{\alpha}} \right)$ and $\tilde{w}_u = w_u / \left(n^{\frac{(1-\alpha)\lambda}{\alpha}} \right)$, for the domestic and foreign sector, respectively, we obtain the following expressions,

$$p_d = \frac{A_d^{-1} \beta_d^{-\beta_d} \gamma_d^{-\gamma_d}}{\lambda^\lambda} \left(\frac{\delta^{-\delta}(1-\delta)^{-(1-\delta)}}{\alpha} \right)^\lambda \tilde{w}_u^{\beta_d + \delta\lambda} \tilde{w}_s^{\gamma_d + (1-\delta)\lambda} \tag{28}$$

$$p_f = \frac{\phi A_f^{-1} \beta_f^{-\beta_f} \gamma_f^{-\gamma_f}}{\lambda^\lambda} \left(\frac{\delta^{-\delta}(1-\delta)^{-(1-\delta)}}{\alpha} \right)^\lambda \tilde{w}_u^{\beta_f + \delta\lambda} \tilde{w}_s^{\gamma_f + (1-\delta)\lambda} \tag{29}$$

Equilibrium conditions in the labor market imply that the labor employed by the domestic, the foreign, and the intermediate goods production processes add up to the total labor supply in the economy. This implies, for skilled and unskilled labor, respectively,

$$L_d + L_f + nL_x = L, \tag{30}$$

$$H_d + H_f + nH_x = H. \tag{31}$$

Using the cost functions for the domestic, foreign and intermediate goods sector and Shephard's Lemma, we can rewrite these two constraints as,

$$\frac{(\beta_d + \delta\alpha\lambda)\, p_d Y_d}{w_u} + \frac{(\beta_f + \delta\alpha\lambda)\, p_f Y_f}{w_u} = L,$$

$$\frac{(\gamma_d + (1-\delta)\alpha\lambda)\, p_d Y_d}{w_s} + \frac{(\gamma_f + (1-\delta)\alpha\lambda)\, p_f Y_f}{w_s} = H.$$

Using our output and wage equations in terms of efficiency units, we can rewrite both constraints as,

$$\frac{(\beta_d + \delta\alpha\lambda)\, p_d \tilde{Y}_d n^{1-\theta}}{\tilde{w}_u n^{\frac{(1-\alpha)\lambda}{\alpha}}} + \frac{(\beta_f + \delta\alpha\lambda)\, p_f \tilde{Y}_f n^{1-\theta}}{\tilde{w}_u n^{\frac{(1-\alpha)\lambda}{\alpha}}} = L,$$

$$\frac{(\gamma_d + (1-\delta)\alpha\lambda)\, p_d \tilde{Y}_d n^{1-\theta}}{\tilde{w}_s n^{\frac{(1-\alpha)\lambda}{\alpha}}} + \frac{(\gamma_f + (1-\delta)\alpha\lambda)\, p_f \tilde{Y}_f n^{1-\theta}}{\tilde{w}_s n^{\frac{(1-\alpha)\lambda}{\alpha}}} = H.$$

Along the balanced growth path, labor shares must be constant. This means that $\left(p_i \tilde{Y}_i n^{1-\theta}\right)/\tilde{w}_j n^{\frac{(1-\alpha)\lambda}{\alpha}}$ $(i = d, f; j = u, s)$ should be constant. There are two ways to achieve this. The first is to assume that prices, p_i, grow at the rate $\left(\frac{(1-\alpha)\lambda}{\alpha} - (1-\theta)\right)\frac{\dot{n}}{n}$. This assumption still implies that p_d/p_f would be constant since none of these parameters reflect sectoral differences and the relative price would thus be driven by other factors (mainly ρ and μ). An alternative would be to impose $\frac{(1-\alpha)\lambda}{\alpha} = 1 - \theta$. Although this assumption has the disadvantage of being a knife-edge condition, on the other hand, it does offer a big advantage. It allows us to back out the value of θ, for which empirical measures are not available (measures for λ and α on the other hand are easily available from the literature). This condition still implies that p_d/p_f would be constant. Therefore, we assume that this condition holds. Thus, we can rewrite the above as,

$$\frac{(\beta_d + \delta\alpha\lambda)\, p_d\tilde{Y}_d}{\tilde{w}_u} + \frac{(\beta_f + \delta\alpha\lambda)\, p_f\tilde{Y}_f}{\tilde{w}_u} = L, \tag{32}$$

$$\frac{(\gamma_d + (1-\delta)\alpha\lambda)\, p_d\tilde{Y}_d}{\tilde{w}_s} + \frac{(\gamma_f + (1-\delta)\alpha\lambda)\, p_f\tilde{Y}_f}{\tilde{w}_s} = H. \tag{33}$$

Now we can solve for all the endogenous variables and derive the equilibrium balanced growth. In order to be able to solve the equilibrium growth rate of varieties, $\frac{\dot{n}}{n}$, we need to solve the set of prices $\{p_d, p_f, \tilde{w}_u, \tilde{w}_s\}$ and the outputs of the domestic and foreign sectors, $\left\{\tilde{Y}_d, \tilde{Y}_f\right\}$. To solve for the prices and the outputs, we use equations (4), (5), (28), (29), (32) and (33). These equations can be solved in a sequential order. The details are presented in the appendix. While we can solve for the FOCs and derive implicit relationships, because of equation (5), we cannot derive explicit solutions for the endogenous variables in terms of the parameters.

Our model exhibits some of the standard properties of product variety-based endogenous growth. Combining the above with equation (26),

$$\frac{\dot{n}}{n} = \frac{(1-\alpha)\lambda}{\theta ia}\left[p_d\tilde{Y}_d + p_f\tilde{Y}_f\right] - \frac{r}{\theta}$$

we can see that, the scale effect is very much present—larger endowments (L and H) will lead to larger output and thus to higher growth rate. Furthermore, higher λ, which is the share of intermediate input costs in final output production, also drives up the growth rate of n by the same reasoning. Similarly, lower substitutability among intermediate goods (α) increases the growth rate since it raises the profitability of new intermediate goods. An increase in either, A_f, or μ, will lead to a reallocation of resources away from the domestic firm to the foreign firm. Therefore, the instantaneous effect will be a decline in domestic firms' share in output. In the long run, both domestic and foreign firms will benefit from the higher growth rate. However, in the short-run, the horizontal spillovers in the final goods sector, which indirectly result from the backward linkages between the foreign firm and the intermediate goods sector, exist only for the surviving domestic firms. This is an additional contribution of our setup, which can shed light on why empirical studies fail to find evidence of positive horizontal

spillovers for developing countries and even find negative spillovers in some cases.[24]

Moving on to the role of the financial markets, one can see that the lending rate and the borrowing rate have negative effects on the growth rate. The negative effect of the lending rate r is standard—a higher r reflects a greater opportunity cost of investing in a new variety and thus reduces the growth of varieties. The negative effect of the higher borrowing rate, i, is more novel. It reflects the higher per unit cost of initial capital investment (because of inefficiencies in financial markets) and thus also unambiguously reduces the growth rate.

If we restrict ourselves to the special case of where the aggregator is a Cobb Douglas function (or perfect substitute case), we can solve explicitly for all the endogenous variables. We turn to these next to get a sense of the qualitative implication of the model.

The Special Case of Cobb Douglas Production Function

The Cobb Douglas case is CES with $\rho \to 0$. We can rewrite the aggregator for the domestic and foreign output as,

$$Y = Y_d^{\frac{1}{1+\mu}} Y_f^{\frac{\mu}{1+\mu}}, \tag{34}$$

$$Y = Y_d^{\eta} Y_f^{1-\eta}, \tag{35}$$

where $\mu = (1 - \eta)/\eta$ for simpler notation. Note that profit maximization here implies that

$$\frac{p_d}{p_f} = \frac{\eta}{1 - \eta} \frac{Y_f}{Y_d}. \tag{36}$$

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[24]While our model is very much in the spirit of traditional endogenous growth models, more recently there has been a trend to move towards models that suggest a long run exogenous growth rate with endogenous growth in transition (e.g. see Aghion et al (2005)). This class of models implies, that in the long run, differences in financial markets or extent of FDI would be reflected in transition paths or differences in relative income levels instead. We have not adopted this scheme a) because focusing on relative income levels abstracts from some of the dynamic spillovers that are interesting when one talks about FDI and growth, b) the product variety models do not easily lend themselves to endogenous growth in transition and exogenous growth in the steady state.

As for the cost function and equilibrium conditions,

$$C(y, p_d, p_f) = \eta^{-\eta} (1 - \eta)^{-(1-\eta)} p_d^{\eta} p_f^{(1-\eta)} Y = 1,$$

$$\Rightarrow p_d = \eta (1 - \eta)^{\frac{(1-\eta)}{\eta}} p_f^{\frac{-(1-\eta)}{\eta}}. \tag{37}$$

Recalling the arbitrage condition,

$$\frac{(1 - \alpha) \lambda}{ia} \left[p_d \tilde{Y}_d + p_f \tilde{Y}_f \right] - \theta \frac{\dot{n}}{n} = r.$$

Using (36), the previous expression as,

$$\Rightarrow \frac{(1 - \alpha) \lambda}{ia (1 - \eta)} p_f \tilde{Y}_f - \theta \frac{\dot{n}}{n} = r. \tag{38}$$

We can solve the model completely, using equations (28), (29), (32), (33), (36), and (37). The details are worked out in the appendix. The main equation of interest is (68) in the appendix, renumbered here as (39)

$$\left(\frac{(1 - \alpha) \lambda}{ia} \right) \left(\frac{\tilde{w}_s H}{\eta (\gamma_d + (1 - \delta)\alpha\lambda) + (1 - \eta) (\gamma_f + (1 - \delta)\alpha\lambda)} \right) - \theta \frac{\dot{n}}{n} = r, \tag{39}$$

where $\tilde{w}_s H = \Delta \Upsilon \Lambda_d^{\eta} \Lambda_f^{1-\eta} (\Phi L)^{\Psi_\beta} H^{\Psi_\gamma}$; $\Upsilon = \eta^{\eta} (1 - \eta)^{(1-\eta)}$; $\Lambda_d = \left(A_d \beta_d^{\beta_d} \gamma_d^{\gamma_d} \right)$; $\Lambda_f = \left(A_f \beta_f^{\beta_f} \gamma_f^{\gamma_f} \right) / \phi$; $\Phi = \frac{\eta(\gamma_d + (1-\delta)\alpha\lambda) + (1-\eta)(\gamma_f + (1-\delta)\alpha\lambda)}{\eta(\beta_d + \delta\alpha\lambda) + (1-\eta)(\beta_f + \delta\alpha\lambda)}$; $\Psi_\beta = \eta (\beta_d + \delta\lambda) + (1 - \eta) (\beta_f + \delta\lambda)$; $\Psi_\gamma = \eta (\gamma_d + (1 - \delta)\lambda) + (1 - \eta) (\gamma_f + (1 - \delta)\lambda)$.

There are a couple of conclusions one can draw from the Cobb Douglas case. First, higher productivity of either domestic or foreign firms raises the growth rate in the economy since, all else being equal, a higher A_f and a higher A_d both tend to raise growth. The equation for $\tilde{w}_s H$ above, is also increasing in both L and H. Essentially, an increase in any of these four exogenous parameters increases

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the profits from introducing new intermediate goods and thus causes the growth rate to rise. However, note that even if A_f increases relative to A_d (i.e. a higher productivity gap between the domestic and the foreign producer) this will not increase the share of the foreign producer in the market. This is the clear drawback of using a Cobb Douglas specification. Second, the effect of a higher share of foreign production, $(1 - \eta)$, on aggregate growth is ambiguous. The ambiguity can be attributed to the term, $\Upsilon = \eta^\eta (1 - \eta)^{(1-\eta)}$ which is a U-shaped function of η that is minimized at $\eta = 0.5$. For most of the countries in the world $\eta > 0.5$ and for most developing economies it would be near to 1. Therefore, even if there is a productivity gap between the domestic and the foreign producer, the term Υ, which is independent of this gap, could drive down the growth rates.

The Special Case of Perfect Substitutes

CES aggregators allow for finite elasticities of substitution. But what if the two outputs were perfect substitutes? Perfect substitutes is of course a special case of the CES with $\rho \to 1$ (and for simplicity assume that $\mu = 1$ as well). In this situation, it is easier to bypass the aggregator (since both products will have the same price and are indistinguishable) and assume that they are traded in the international market with the world price normalized to 1. One might wonder if the domestic sector would survive at all given the technological superiority of the foreign firms. However, note that the production function parameters for the domestic and foreign firms are different allowing for both firms to co-exist while setting the marginal costs equal to the price of the final good, since the relative marginal costs are not completely driven by productivity differences. The explicit solution for the perfect substitute case is worked out in the appendix.

Next, we turn to the calibration exercises, where by using empirical estimates of our parameters we quantitatively study the comparative static effects we have discussed so far.

3 Calibration Exercise

The purpose of the calibration exercise is to study the quantitative growth effects of FDI, focusing on different levels of financial market development. We begin with a description of the parameters used in the analysis.

Financial Development: We group countries based on their financial market development levels. Different measures have been used in the literature to proxy for financial market development. The broader financial market development measures, such as the monetary-aggregates as a share of GDP and the private sector credit extended by financial institutions as a share of GDP, capture the extent of financial intermediation; interest rate spreads, on the other hand, capture the cost of intermediation. Given that the spread between the lending and borrowing rates better captures the spirit of our model, we prefer it as the measure for the development of the financial markets.[25] We find that the alternative measures of financial market development, such as the size of the financial market, the share of private sector credit in total banking activity, and the overhead costs are all highly correlated with interest rate spreads. Hence, different measures yield similar results.[26] The average spread for the low financially developed (poor) countries, medium financially developed (middle income) countries and the high financially developed (rich) countries between 2000 and 2003 are 14.5%, 8.5%, and 4.5%, respectively.

Elasticity of Substitution: In our model, ρ relates to the elasticity of substitution between goods produced by foreign and domestic firms. Evidence regarding the appropriate choice of the elasticity of substitution parameter ρ is sparse, given that such depiction of final goods production is an artifact to capture the interaction between foreign and domestic firms. The evidence that is closest to the spirit of our model is from the consumption literature that uses a constant elasticity of substitution utility function between varieties of domestic and foreign goods, or between tradable and nontradable goods. Ruhl (2005) provides a detailed overview of the Armington elasticity, i.e., the elasticity of substitution between foreign and home goods, and finds that an appropriate value for ρ is around

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[25]Erosa (2001) defines the financial intermediation cost as the resources used per unit of value that is intermediated, which is the total value of financial assets owned by the financial institutions. He measures the financial intermediation cost as the spread between the lending and borrowing rates.

[26]Alternative measures are from Levine et al. (2000).

0.2.[27] While our benchmark analysis is based on the CES production function with $\rho = 0.2$, we also undertake robustness analysis by allowing ρ to vary between -0.9 and 0.9. In section 3.2, we present the quantitative characteristics of the model for the Cobb Douglas case ($\rho = 1$).

The share of intermediate goods in the production of the final good (λ) is assumed to be the same across the two production technologies. The formulation of the production technology allows setting the share of the intermediate goods equal to the share of physical capital in final goods production. Following Gollin (2002), we set this share equal to 1/3. The remaining 2/3 is accounted by skilled and unskilled labor. The remaining parameters used in the benchmark analysis are chosen such that those for the domestic firm capture the characteristics of the production technologies available in the developing countries; whereas, those for the foreign firm capture the characteristics of the production technologies available in the industrial countries.

Domestic Firms: According to Weil (2004), the share of wages paid to skilled labor is 49% for the developing countries. We take this value to be that of domestic firms, suggesting that of labor's 2/3rd share in final goods production, 49% is due to skilled labor. Therefore, we set the share of skilled labor in domestic firms, γ_d, at 32%. In parallel, the share of unskilled labor in domestic firms, β_d, is set at 35%. For the benchmark analysis, we set the total factor productivity A_d equal to 1.

Foreign Firms: The share of skilled and unskilled labor costs in output of the foreign firm is calculated in a similar fashion. Following Weil (2004), the share of wages paid to skilled labor is taken as 65% in industrial countries. Accordingly, the share of skilled labor in the foreign firm's production, γ_f, is set equal to 40%. Similarly, the share of unskilled labor, β_f, is set equal to 27%. Thus, $\gamma_f > \gamma_d$.[28] As a benchmark, the productivity of the foreign firm, A_f, is initially set to be twice that of the domestic firm following Hall and Jones (1999), who show the productivity parameter for a very large sample of non-industrial countries is around 45% of the productivity parameter of the U.S. With respect to the

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[27]A wide range of estimates are available from trade and business cycles literatures ranging between 0 and 0.5. Ruhl (2005) argues that a model with temporary and permanent trade shocks can replicate both the low elasticity of substitution figures used by the international real business cycle studies and the high elasticity of substitution values found by the empirical trade studies. Such an encompassing model justifies a value of ρ around 0.2.

[28]As Barba Navaretti and Venables (2004) note, there is ample evidence that foreign firms employ more skilled personnel than domestic firms. They also tend to be larger, more efficient, and pay higher wages.

cost of doing business that the foreign firms face, ϕ, our benchmark case is one where there is no such cost. However, note that an increase in the cost of doing business is equivalent to lower productivity of foreign firms. Thus, by considering variations in relative productivities, we can also infer implications for the variations in cost of doing business.

Share of Foreign Production: The share of foreign production to total output is not exogenous in the CES production function case and the choice of μ implicitly determines this share. As such, the benchmark value for μ is determined to allow for the matching of the relative output values to the real data. Lipsey (2002) estimates that in 1995 the share of world production due to FDI flows was at best 8%.[29] Keeping this in mind, we set $\mu = 0.1$ as our benchmark value since, as we shall see later, it produces a share of approximately 6%. In the Cobb Douglas production function case, we round off the share of foreign firms in total output to 5% (i.e. $\eta = 0.95$).

Intermediate Goods Sector: Based on the work of Basu (1996), the mark-up is assumed to be 10%, and hence the value of the reciprocal of (1+mark-up) is given by $\alpha = 0.91$. Given the lack of any estimate, the share of unskilled labor in the production of the intermediate goods, δ, is taken as 0.5.

The Stock of Skilled and Unskilled Labor: H and L, respectively, are set following Duffy, Papageorgiou, and Perez-Sebastian (2004). The authors argue that there is an aggregation bias caused by differences in terms of efficiency units of the different types of labor. To overcome this bias, they weigh the length of education by the returns to schooling, and compute what they call "weighted" labor stock data. We calculate averages of their data for the low financially developed (poor) countries, medium financially developed (middle income) countries, and the high financially developed (rich) countries. Accordingly, we set the ratio of unskilled labor to skilled labor equal to 12 for the poor countries, 9 for the middle income countries, and 5 for the rich countries. To rule out the possibility of scale effects driving differences in growth rates, we assume that $H + L = 1$. The shares of the two factors are allocated according to these three ratios so that they sum to 1 (e.g., for poor countries $H = 0.077$ and $L = 0.923$).

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[29]Mataloni (2005) finds that foreign owned companies were responsible for 12% of GDP in Australia, 5% in Italy, 7% in Finland, 19% in Hungary, and 22% in the Czech Republic.

Additional Parameters: The cost of introducing a new variety, a, is taken to be a free parameter. The model is calibrated to allow for the financially well-developed country growth rates to match the U.S. growth rate. Given the fact that the U.S. is often considered to be the technological leader, one can assume that the productivity of foreign firms in the U.S. is no different than the productivity of the domestic U.S. firms, so that $A_f/(\phi A_d) = 1$, to back out a. The U.S. growth rate of real GDP was approximately 3.5% for the period 1930–2000. This condition and the other parameters above pin down $a = 15$ for the CES production function case with $\rho = 0.2$, and $a = 60$ for the Cobb Douglas production function case. We use the value of $a = 15$ also in the sensitivity analysis of the CES case when we allow the ρ value to range between -0.9 and 0.9.

The risk-free interest rate is assumed to be 5%. Finally, the parameter capturing the ease of developing new variety of products, θ, is limited by other parameter choices given the following formulation: $\theta = 1 - (\lambda(1 - \alpha)/\alpha)$. Table 1 summarizes all the parameter values.

We consider two scenarios that reflect the benefits of FDI. The first scenario is an exogenous increase in the share of FDI due to increases in μ. Increases in μ in the CES aggregator lead to a higher share of foreign output in GDP. This exercise answers the straightforward question: What happens to the overall growth rate of the economy if the more productive MNE's produce a higher share of output? The second scenario is where advances in innovation in the parent country are transmitted through FDI to the host country. These technological benefits of FDI are captured through the productivity parameter of the foreign firm (i.e, an increase in A_f). Our initial tests are based on the effects of a 15% increase in the productivity of the foreign firm relative to the domestic firm. Starting with our benchmark value of $A_f/\phi A_d = 2$, this would mean a new value of $A_f/\phi A_d = 2.3$ ($\phi = 1$ in both cases). Later on when undertaking sensitivity tests, we consider a range of values between 1.15 and 2.6. The lower bound of 1.15 is based on Aitken and Harrison's (1999) finding that as a plant goes from being domestically owned to fully foreign owned, its productivity increases by about 10% to 16%. Given there is no consensus in the empirical estimates, in our analysis, we use a wide of values thus providing a more comprehensive picture.

Returning to the initial assumptions of $A_f = 2A_d$, and $\phi = 1$, note that our consideration of a

range for $A_f/\phi A_d$ from 1.15 to 2.6 can also be implicitly used to understand the effects of variations in the cost of doing business, ϕ, when $A_f = 2A_d$. Thus, $A_f/\phi A_d = 2.6$ would correspond to $\phi = 0.77$, and $A_f/\phi A_d = 1.15$ to $\phi = 1.74$. A value of $\phi < 1$ might reflect a situation where the host country government enacts policies to attract FDI (e.g., fiscal or financial incentives, special laws to bypass cumbersome bureaucratic regulations that domestic firms are ordinarily subjected to), whereas $\phi > 1$ could reflect the usual additional costs of business discussed earlier. Thus, $\phi = 1.74$ would then reflect costs that are high enough such that the overall efficiency of foreign firms is only 15% greater than that of domestic firms despite the former having a technological advantage that is "twice" that of the latter.

Under both of these scenarios, H/L ratios are held fixed for each country in the benchmark analysis. Hence, the resulting differences in the growth rates do not reflect human capital differences, rather they reflect variations in FDI. Both scenarios are studied separately for the CES and the Cobb Douglas production function cases, in sections 3.1 and 3.2, respectively.

3.1 CES Production Function

The benchmark results for the CES production function with $\rho = 0.2$ are reported in table 2. As table 2 indicates, when $\mu = 0.1$, foreign production equals around 6.5% of domestic production, while, when $\mu = 0.2$, the same ratio increases to around 15.5%. These two values correspond to the share of foreign production in total production to be 6.1% and 13.4%, respectively.[30] Hence, as alluded to earlier, we use $\mu = 0.1$ in most of the analysis. However, for the sake of completeness, the tables also list results for increments of 0.1 for μ until $\mu = 0.6$.[31]

3.1.1 Changes in Relative Productivities and Shares of MNE

The first scenario capturing an increase in the foreign presence is an exogenous increase in the FDI share (higher μ). Table 2 lists the growth rates for the three different levels of financial development in addition

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[30]The tables report the ratio of foreign production to domestic production, i.e., $\frac{P_f Y_f}{P_d Y_d}$. Using these share values it is possible to impute the share of foreign production in total production, i.e., $\frac{P_f Y_f}{P_d Y_d + P_f Y_F}$. For example, if foreign production is 6.5% of domestic production, this corresponds to the share of foreign production in total production being $0.065/(1 + 0.065) \times 100 = 6.1\%$

[31]We restrict our attention to $\mu \leq 0.6$ since this range covers most realistic values of foreign output shares.

to the amount of foreign output relative to domestic output (valued at their respective prices). In order to ease the discussion, in table 3, we also present the results of table 2 as changes over increments of 0.1 for μ. For example, results in table 3 show that the increase in μ from 0.1 to 0.2 corresponds to a tripling of the foreign output level. This increase in FDI also creates a 1.25 percentage point increase in the average growth rate of the financially well-developed countries, a 0.88 percentage point increase in the average growth rate of the financially medium developed countries, and a 0.61 percentage point increase in the average growth rate of the financially poorly developed countries. That is, for the same amount of increase in the share of FDI, the additional growth rates made possible in financially well developed countries are almost double those made possible in financially poorly developed countries.

These numbers may appear to be quite high and one might wonder if the 1.25 percentage point increase for developed economies is an overestimate. There are a couple of things to keep in mind. First, note that we have assumed $A_f/\phi A_d = 2$ in these exercises. For financially developed economies, the actual gap between domestic and foreign producers is likely to be much lower and thus the estimate might be too high. Secondly, as μ increases, it is possible that new MNEs entering a domestic market might be of lower productivity than the first entrants. This could also potentially further reduce the productivity gap between domestic and foreign firms. Nevertheless, the differences in growth rates particularly between the medium level and the low level groups is still significantly different.

Another interesting result that emerges from table 3 is that the change in the growth rates are higher when initial FDI participation is greater. For example, as μ increases from 0.1 to 0.2, the additional growth for a country with poorly developed financial markets is 0.61% while going from 0.3 to 0.4 leads to an additional growth rate of 1.25%. Of course, one might wonder what actually happens to foreign output shares (which are a corollary of changes in μ but are easier to interpret). We already have seen that the movement from 0.1 to 0.2 leads to an output share increase from 6.1% to 13.4% of GDP. From the fourth column in table 2, it is easy to see that as μ moves from 0.3 to 0.4, foreign output share goes from 20.4% to 27%.[32] Thus, the increase in output share is slightly lower in the second case, while the

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[32]In column 4 of table 2 relative output at $\mu = 0.3$ is 0.257. This means that the foreign output share is $0.257/1.257 = 0.204$. Similarly for $\mu = 0.4$, we have $0.369/1.369 = 0.269$.

increase in growth rate is higher.

The fact that growth rates go up when the share of foreign output increases is easy to understand in a scale-effect driven model such as ours. More productive foreign firms raise the scale of the economy and thus increase the number of varieties which raises the growth rate. The non-linearity is less transparent. One possible explanation is given by the indirect horizontal spillover this increased share of foreign firms creates. As the share of foreign firms increase, while the share of domestic firms decreases, the ones that remain in the latter group benefit from the increased number of varieties and thus also have a higher level of technology, and this further adds to the growth rate.

Moving on to table 4, we obtain similar qualitative results when the increase in the extent of foreign presence is captured through an increase in the relative productivity, $A^f/(\phi A^d)$. These results, combined with the ones from the earlier table, suggest that regardless of the *source* of the increase in the extent of foreign presence in the local economy, for the same magnitude of increase in foreign presence, the additional growth effects generated in the local economy are higher for the financially well developed countries than those generated in the financially medium developed countries, and these are higher than those generated in the financially poorly developed countries. However, an important difference is that the additional growth rates generated by improvements in the relative productivity of the foreign firm are quantitatively much lower than those discussed previously for the case of an increase in the share of FDI (higher μ). For example, 15% increase in the relative productivity of the foreign firms increases the growth rate of the financially well developed countries by 0.03 percentage points, the growth rate of the financially medium developed countries by 0.02 percentage points, and the growth rate of the financially poorly developed countries by 0.01 percentage points. The higher relative productivity of the foreign firm corresponds to a only 4.2% increase in the total value of foreign production, $p_f Y_f$, and thus only a marginal increase in the share of foreign production in total production. These results hold qualitatively across alternative μ assumptions.

Obviously, one would be led to wonder why the effects are so dissimilar. An obvious resolution lies in the way that the two alternative scenarios work. Irrespective of the productivity advantage that foreign firms enjoy, an increase in μ ensures a higher share of total expenditures will be devoted to the output

produced by foreign firms. The fact that $A_f > A_d$ ensures that this shift translates into a scale effect. Thus, the exercise in altering μ, simply answers the question—given realistic productivity differences between domestic firms and foreign firms—what would a higher share of multinational production mean for the economy at various levels of financial development? On the other hand, for any given μ, changes in A_f relative to A_d have effects that are slightly more "indirect" in the following sense. An increase in A_f/A_d will reduce the relative price of the foreign good and thus will create a substitution away from the domestic good towards the foreign good. Thus, while the relative price goes down, the relative quantity goes up. With the elasticity of substitution being more than 1, we know that the overall effect is to increase $p_f Y_f$ relative to $p_d Y_d$. However, as the numbers in table 4 indicate, the changes are small, and thus the overall growth effect, not surprisingly, will be small. One possibility is that the choice of $\rho = 0.2$, which implies an elasticity of substitution of 1.25, has an important bearing on these magnitudes. In the next subsection, which deals with the sensitivity of our results, we explore the implications of varying this parameter.

An alternative way is to compare the elasticities of changes in growth due to changes in the parameters of the foreign production firm. For example, instead of restricting ourselves to specific increases in μ or A_f/A_d (which may not be strictly comparable), we could compare the subsequent simultaneous increases in the share of MNE output in total GDP and the associated increase in the growth rate. To fix ideas, consider row 1 of both tables 3 and 4. In the case of countries with poorly developed financial markets, following an increase in μ from 0.1 to 0.2, we see that the rate of growth of GDP increases by 0.61% while the share of MNE output in total GDP increases by 7.3% (from 6.1% to 13.4%). Dividing the former by the latter produces a value of 0.08. This is equivalent to saying that for every 1% increase in the share of MNE output in GDP, the growth rate of the economy rises by 0.08%. Now consider instead an increase in A_f/A_d. Begining from the benchmark (row 1 of 2), a 15% increase in A_f/A_d, as we have already seen, raises the growth rate for poorly financially developed countries by 0.01%. At the same time the share of output in GDP increases from 6.1% to 6.28%—a 0.18% increase in its share. Here the elasticity is 0.05. This suggests that following an increase in A_f/A_d, every 1% increase in the MNE share of output is associated with a 0.05% increase in the growth rate Thus, the elasticity

measures of the effects of changes in μ and A_f/A_d are much less disparate. We can also revisit the comparison between countries with well developed financial markets and countries with poorly developed financial markets. In the case of the former, the elasticity measures yield values of 0.17 and 0.16 following increases in μ and A_f/A_d respectively. Like our earlier findings, we still see that an increase in MNE share of output is associated with higher rates of economic growth for financially well developed economies.

Thus far, we have considered two alternative scenarios with qualitatively similar but quantitatively distinct outcomes. This leads to the next question—which one is more likely to hold in practice? The first scenario where μ increases seems to be more applicable to a "cross-section" analysis. With two countries beginning at the same MNE share (of GDP) but different levels of financial market development, it tells us what happens to the growth rate if the MNE share of GDP increases further. Alternatively, going down column (3) of table 2—we can ask what happens to the growth rate for different MNE shares for the same level of financial development. These are also the kind of questions that growth regressions often seek to answer. The second scenario, where A_f increases relative to A_d, addresses a slightly different issue. It provides a framework to understand what happens as some firms shift to using a more productive technology. This for instance, would be applicable when domestic firms are acquired by multinational enterprises, which then bring their superior technology to these firms. Obviously, this also reflects greater MNE "participation," however, it does not take an increase in output share as a given but as an endogenous outcome of this change. Thus, both scenarios have their respective contributions.

3.1.2   Sensitivity Analysis

Next we examine how the results change with the other parameters or "local conditions." We focus on changes in relative skill endowments across countries (varying H/L), the effects of alternative productivity gaps, changes in the cost of doing business (ϕ), and finally, varying the elasticity of substitution (by varying ρ).

Changes in Labor Endowments: The above exercise kept the relative labor endowments constant

across the three groups of countries in order to observe the differences solely on account of financial market development differences and changes in the share and/or productivity of foreign firms. The three groups however also differ in their relative labor endowments, as shown in the lower panel of table 1. When allowing for different labor endowments, table 5 shows that the growth effects of higher FDI in the countries with well developed financial markets are three times more than the ones with the poor developed financial markets. Tables 6 and 7 present, respectively, the results when we allow for the relative labor endowments to differ among the three groups together with changes in the share of foreign firms, and with changes in the productivity of foreign firms.

When we compare table 5 to table 2, we see that the actual growth rates for countries with medium and poorly developed financial markets are now even lower. Indeed, the growth rate of the countries with low levels of financial market development is now only 0.91% compared to 1.42% earlier. Thus, the introduction of human capital variations across groups exacerbates differences in growth rates.

The incremental effects of changes in μ can be inferred by comparing tables 3 and 6. The differences in the additional growth rates are also much higher once one allows for human capital differences. When μ increases from 0.1 to 0.2, the countries with medium level of financial development see their growth increase by 0.70%, while countries with low level of financial development see their growth increase by 0.43%.

When focusing on productivity gaps, we also find that growth rate differences become larger. Comparing the results in tables 4 and 7, one observes that when $\mu = 0.2$, for example, the additional growth rate generated is 0.06 (table 4) for the financially medium developed countries. When the labor endowments of these countries decrease to the actual level, the additional growth rate decreases to 0.05 (table 7). These results imply that the 0.01 percentage points additional growth was due to the higher quality labor endowments. However, like before, productivity gaps themselves have growth effects that are of much smaller magnitude than changes in μ.

Overall, these results suggest that countries with more skill-intensive labor endowments benefit more in terms of growth effects from FDI, which is consistent with the empirical studies such as Borensztein et al. (1998).

Alternative Measures of Relative Productivity: So far in the analysis, in setting the parameters regarding the relative productivity of the foreign and domestic firms, $A_f/\phi A_d$, we made use of the information from macro level studies showing that the relative productivity difference between the industrialized and developing countries is approximately 2. Micro level studies provide further information regarding the productivity differences between foreign owned and domestic owned firms and, as we discussed above, a wide range of micro estimates are available. We report results in table 8 panels A and B starting with the lowest value from the micro evidence, namely 1.15 (taken from Aitken and Harrison (1999)) and allow for increments of approximately 15% in this value.

Panel A shows the additional growth rates observed in the three groups of countries when the technology gap among the foreign and domestic firms change for different values of μ. The results for the benchmark case ($\mu = 0.1$) suggest that increments of 15% increases in the technology gap between the foreign and domestic firms creates additional growth rates of 0.020 percentage points in the financially well developed countries, 0.010 percentage points in the financially medium developed countries, and 0.006 percentage points in the financially poorly developed countries. If the technology gap measure increases by 100%, to 2.3, one has to look at the cumulative of the additional growth values reported in Panel A. For the financially well developed countries, this doubling of the relative productivity measure creates an additional 0.1 percentage point growth, while creating around 0.05 percentage point growth in the financially medium developed, and around 0.03 percentage point growth in the financially poorly developed countries. Panel B alternatively looks into the additional growth rates due to increased foreign presence measured through changes in μ, rather than through changes in the technology gap. The same results prevail, where the additional growth rates are almost triple for the financially well developed countries than for the financially poorly developed countries.

Changes in the Cost of Doing Business: While the relative productivity between foreign and domestic firms can change due to the changes in the foreign and the domestic firms' gross productivity, an alternative source of change could be alterations in the cost of doing business, ϕ. The effects of a reduction of the cost of doing business in our model are similar to those of a relative increase in the productivity to foreign firms just described. Note that although the interpretation is symmetric,

the policy implications are different. One suggests that the authorities should improve the business environment to benefit more from FDI; the other that attracting more productive foreign firms relative to domestic firms, everything else being equal, implies higher growth rates.

Changes in the Elasticity of Substitution: Table 9 compares the growth rates in the high, medium and low financially developed economies for $\rho = -0.2$ in the upper panel and $\rho = 0.2$ in the lower panel. In particular, when the elasticity of substitution is greater than 1 ($\rho > 0$), for the same value of μ, we observe much higher growth rates. Further increases in μ (i.e., a greater MNE presence), while leading to increases in the growth rate for $\rho = 0.2$, actually *reduces* growth rates when $\rho = -0.2$, despite increasing MNE share in output. Thus, clearly, the elasticity of substitution in the aggregator plays a key role in our numerical exercises. These results suggest one must be cautious when talking of attracting "FDI that is complementary to local production." Such complementarity is useful when one talks of final and intermediate industry relationships. However, it does not necessarily raise the growth rates when domestic and foreign producers supply complementary final goods.

Finally, we consider the extent to which a change in the growth rate following an increase in the overall productivity gap ($A_f/\phi A_d$) is affected by the choice of the elasticity of substitution parameter. As earlier, we consider the implications of a 15% increase in the overall productivity gap. Figures 1 and 2 show the non-monotonic relationship between ρ and the additional growth rates created by increased FDI for the financially developed economies. Figure 1 depicts the relationship when $\rho > 0$, i.e., the elasticity of substitution is greater than 1. Figure 2 depicts the relationship when the elasticity of substitution is less than 1 ($\rho < 0$).[33] We also consider the effects for various values of μ. Beginning with figure 1, we see that as Y_f and Y_d become more substitutable (ρ increases), the additional growth generated actually *declines.* This is true for all values of μ considered here. This might initially seem counter-intuitive. However, note that when the elasticity of substitution is very high, combined with the fact that Y_f already uses technology that is twice as productive and μ is fixed, optimal allocation would cause domestic output to have already been substituted by foreign output as much as possible. Thus,

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[33]The case where $\rho = 1$ is the Cobb Douglas case discussed in the next section. For values of ρ in the neighborhood of 1, there is a sharp discontinuity, and hence we do not include $\rho = 1$ in these diagrams.

further increases in A_f create only limited additional substitution possibilities and hence the additional growth effects are small.

In the situation where the two products are more complementary (i.e., $\rho < 0$), we see again that increases in the elasticity of substitution (i.e., as the absolute value of ρ falls) leads to lower additional growth rates. However, note that the effects are actually even smaller here. The overall impression one can draw is that the introduction of a more advanced technology by the MNE while raising the growth rate, seems to be less effective when a) $\rho < 0$ and b) the products become more substitutable. The figures furthermore show that these results remain unchanged across alternative initial values of foreign presence in the market, i.e., for alternative values of μ.[34]

3.2 Cobb Douglas production function

This section discusses the results for the Cobb Douglas production function. As seen in table 10, column (1), there are large differences in growth rates across groups only due to differences in the level of development of the financial markets. Next, we consider the effect of increasing A_f by 25% as shown in table 10, column (2). Comparing columns (1) and (2) shows very little change in growth rates. The growth rates are slightly higher for the high and medium financially developed countries (i.e., 2.49 vs. 2.52; 3.61 vs. 3.65). Thus, it seems that the marginal effect of raising A_f is very small. This was true for the CES case and carries over here as well. With foreign firms producing only 5% of the total output, it would be unreasonable to expect improvements in their productivity to have large measurable effects on the growth rate of the economy.

In column (3), we allow human capital ratios to vary across country groups. Everything else is as in column (1). Comparing to column (1), we see that the growth rates for medium and low financially developed countries decrease, whereas the rates for the high financially developed country are the same since the ratio for the latter is unchanged. In column (3), the countries with high levels of financial development grow twice as fast as the countries with low levels of financial development. In Column

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[34]The figures and table 9 use benchmark parameters. In particular, the ratio of skilled to unskilled human capital is constant across groups.

(4) we again increase A_f by 25%, except that now human capital ratios vary across the three groups. Again as in the case of comparing column (1) and column (2), the differences between (3) and (4) are negligible.

In column (5), we decrease the share of the domestic firm in total output to 75% (i.e. $\eta = 0.75$) thus taking the share of the foreign firms up to 25%. This probably represents an upper bound in terms of foreign ownership. Everything else is as in column (3). Growth rates are *lower* for all the levels of financial development but the qualitative results are the same. Low financially developed countries grow at less than one third of the speed of high financially developed countries. Column (6) repeats the same exercise with the exogenous increase in productivity of MNE. The growth rates are higher again, though more so than the previous cases, where the increase was negligible. These findings are parallel to the findings reported for the CES case, where the magnitude of effects are much larger when the implicit share of foreign production is higher in the domestic economy. The bottom line is that the role of financial markets is extremely important in realizing the growth effects of higher FDI.

4   Conclusions

Although there is a widespread belief among policymakers that FDI generates positive productivity externalities for host countries, the empirical evidence fails to confirm this belief. In the particular case of developing countries, both the micro and macro empirical literatures consistently finds either no effect of FDI on host countries firms productivity and/or aggregate growth or negative effects. The theoretical models of FDI, on the other hand, imply that FDI is beneficial for the host country's development.

In this paper, we try to bridge this gap between the theoretical and the empirical literatures. The model rests on a mechanism that emphasizes the role of local financial markets in enabling FDI to promote growth through the creation of backward linkages. When financial markets are developed enough, the host country benefits from the backward linkages between the foreign and domestic firms with positive spillovers to the rest of the economy.

Our calibration exercises show that an increase in FDI leads to higher growth rates in financially

developed countries compared to those observed in financially poorly-developed ones. Moreover, the calibration section highlights the importance of local conditions (absorptive capacities) for the effect of FDI on economic growth. We find larger growth effects when goods produced by domestic firms and MNEs are substitutes rather than complements. Policymakers should be cautious when implementing policies aimed at attracting FDI that is complementary to local production. Desired complementarities are those between final and intermediate industry sectors; not necessarily between domestic and foreign final good produces. Finally, by varying the relative skill ratios—while assuming that MNEs use skilled labor more intensively—our results highlight the critical role of human capital in allowing growth benefits from FDI to materialize.

Some caveats are in order. We have focussed on only one kind of spillover. There are likely to be additional spillovers and technology transfers. Besides, our results are based on a model that takes FDI as given. The decision of a firm to outsource or invest abroad (and the potential to generate linkages) may depend on the conditions of the country and on the characteristics of the firm.[35]

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[35]See Antras and Helpman (2004).

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A Modelling Financial Markets

We present a bare-bones model of imperfect financial markets using the costly state verification approach. The model is adapted from King and Levine (1993b).[36] As in their model, we assume individuals have equal financial wealth which is a claim on profits of a diversified portfolio of firms engaged in innovative activity. Some individuals do have the ability to manage innovation, but this does not lead them to accumulate different levels of wealth from the rest of individuals in the economy. These potential entrepreneurs have the ability to successfully manage a project with probability ψ. These abilities are unobservable to both the entrepreneur and the financial intermediary. However, the actual capability of such an individual to manage a project can be ascertained at a cost, F.[37] The main two differences are the following. First, consistent with our model, upfront investments require capital instead of labor. The second difference is related to our assumption regarding the structure of verification costs. We assume these costs to be proportional to the set up costs for any project. The main advantage of this approach is that it allows us to retain the balanced growth properties of the model while allowing in principle to make total verification costs decreasing in the level of overall technology and hence in the level of development.[38] Therefore, one could argue that our setup automatically relates more efficient financial markets to higher levels of development.[39]

We depart from the main text in that now innovation and imitation projects are potentially risky and there is a probability ψ of the project being run successfully. Which potential entrepreneur will manage a project successfully is unknown both to the entrepreneur and the intermediary. The intermediary can spend an amount F to reduce the uncertainty regarding the project's outcome. Further, we postulate the following structure on F,

$$F = fr\frac{a}{n^\theta}. \tag{40}$$

Therefore, since setup costs require $\frac{a}{n^\theta}$ units of K, then the cost of verification simply is proportional to total setup costs and f represents that factor of proportionality. While not necessary for our model, it seems intuitive that f should be less than 1—verification costs are likely to be lower than setup costs.

If the value of a successful project is q, with a competitive intermediation sector, in equilibrium we must have $\psi q = F$.[40] The value of a successful project is simply the present discounted value of profits (v) minus the set up costs (η). Therefore, the above condition can be rewritten as, $\psi(v - \eta) = F$. Further, from our model we had setup costs for each blueprint to be $\frac{ra}{n^\theta}$,

$$\Rightarrow \psi\left(v - \frac{ra}{n^\theta}\right) = F. \tag{41}$$

The standard arbitrage condition from equation (20) continues to hold,

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[36]See Aghion, Howitt and Mayer-Foulkes (2005) for an alternative modelling strategy for imperfect financial markets in an endogenous growth model. In their model, entrepreneurs can pay an upfront cost and defraud the lenders. Incentive compatibility constraints and arbitrage conditions then leads to an upper bound on how much is actually invested in new innovations which is lower than the optimal investment amount. The gap between the two is an inverse function of the degree of creditor protection. Their model seems more suited to "quality ladder" Schumpeterian models, whereas the King and Levine structure is more easily incorporated into a product variety setup such as ours.

[37]Obviously entrepreneurs cannot evaluate themselves and credibly communicate the results to others.

[38]Indeed King and Levine (1993b, 518) suggest this modification as a potentially useful extension of their model.

[39]The objective of our paper, as mentioned, is not to model the relation between financial markets and development but instead the role of financial markets in allowing an economy to reap the benefits of potential FDI spillovers.

[40]Of course in the background we assume that for an intermediary it is better to do this evaluation rather than simply lending the money and not incurring the verification cost.

$$\frac{\pi}{v} + \frac{\dot{v}}{v} = r. \tag{42}$$

Substituting equation (40) in equation (41), we continue to get as in the main model $\frac{\dot{v}}{v} = -\theta\frac{\dot{n}}{n}$. We can combine this with the previous equation to get, $\frac{\pi}{v} - \theta\frac{\dot{n}}{n} = r$. In our model the per intermediate firm operating profit was (see equation (19)), $\pi_i = \frac{(1-\alpha)}{n}[\lambda p_d Y_d + \lambda p_f Y_f]$. Noting that $v = \frac{f}{\xi}r\frac{a}{n^\theta} + \frac{ra}{n^\theta}$, and using $\tilde{Y}_i = Y_i/n^{1-\theta}$, we can obtain an expression for the growth rate similar to the one derived in the main text,

$$g = \frac{\dot{n}}{n} = \frac{\lambda}{\theta}\frac{(1-\tau)(1-\alpha)}{ra\left(\frac{f}{\psi}+1\right)}\left[\lambda p_d\tilde{Y}_d + \lambda p_d\tilde{Y}_f\right] - \frac{r}{\theta}.$$

Of course, what was earlier represented in the main text by i can now be substituted by $r\left(\frac{f}{\psi}+1\right)$. In practice, $\frac{f}{\psi}$ is likely to be unobservable across countries. Therefore, in the numerical exercises, when we use the spread, theoretically, we are measuring $r\frac{f}{\psi}$. Thus, a higher spread has the same effect as a higher verification cost. Further, for every unique f, given r and ψ, there is a unique value of the spread. Therefore, using the spread between lending and borrowing rates serves as a convenient proxy for verification costs.

B   Solving the Model with a CES Aggregator

As mentioned in the text, we begin with six equations,

$$p_d = \frac{A_d^{-1}\beta_d^{-\beta_d}\gamma_d^{-\gamma d}}{\lambda^\lambda}\left(\frac{\delta^{-\delta}(1-\delta)^{-(1-\delta)}}{\alpha}\right)^\lambda \tilde{w}_u^{\beta_d+\delta\lambda}\tilde{w}_s^{\gamma_d+(1-\delta)\lambda}, \tag{43}$$

$$p_f = \frac{\phi A_f^{-1}\beta_f^{-\beta_f}\gamma_f^{-\gamma_f}}{\lambda^\lambda}\left(\frac{\delta^{-\delta}(1-\delta)^{-(1-\delta)}}{\alpha}\right)^\lambda \tilde{w}_u^{\beta_f+\delta\lambda}\tilde{w}_s^{\gamma_f+(1-\delta)\lambda}, \tag{44}$$

$$\frac{p_f}{p_d} = \mu\left[\frac{\tilde{Y}_d}{\tilde{Y}_f}\right]^{1-\rho}, \tag{45}$$

$$p_d = \left(1 - \mu^\varepsilon p_f^{1-\varepsilon}\right) \Rightarrow p_d = p_d(p_f), \tag{46}$$

$$\frac{(\beta_d + \delta\alpha\lambda)p_d\tilde{Y}_d}{\tilde{w}_u} + \frac{(\beta_f + \delta\alpha\lambda)p_f\tilde{Y}_f}{\tilde{w}_u} = L, \tag{47}$$

$$\frac{(\gamma_d + (1-\delta)\alpha\lambda)p_d\tilde{Y}_d}{\tilde{w}_s} + \frac{(\gamma_f + (1-\delta)\alpha\lambda)p_f\tilde{Y}_f}{\tilde{w}_s} = H. \tag{48}$$

Also, recall that the growth rate of varieties is pinned down by equation (26),

$$\frac{\dot{n}}{n} = \frac{(1-\alpha)\lambda}{\theta ia}\left[p_d\tilde{Y}_d + p_f\tilde{Y}_f\right] - \frac{r}{\theta}. \tag{49}$$

We next list the steps involved in arriving at a solution for this setup:

1) First of all note that we can use equations (43) and (44) to express efficiency wages as a function of the prices of foreign and domestic goods,

$$\tilde{w}_u = A_{du} \Delta A_{fu} p_d^{\frac{(\gamma_f + (1-\delta)\lambda)}{(\gamma_f - \gamma_d)}} p_f^{\frac{-(\gamma_d + (1-\delta)\lambda)}{(\gamma_f - \gamma_d)}} , \tag{50}$$

$$\tilde{w}_s = A_{ds} \Delta A_{fs} p_d^{\frac{-(\beta_f + \delta\lambda)}{(\gamma_f - \gamma_d)}} p_f^{\frac{\beta_d + \delta\lambda}{(\gamma_f - \gamma_d)}} . \tag{51}$$

From these two equations we get,

$$\frac{p_d}{p_f} = \frac{A_d^{-1} \beta_d^{-\beta_d} \gamma_d^{-\gamma d}}{\phi A_f^{-1} \beta_f^{-\beta_f} \gamma_{fs}^{-\gamma_f}} \left(\frac{\tilde{w}_u}{\tilde{w}_s} \right)^{\gamma_f - \gamma_d} ,$$

$$\frac{p_d}{p_f} = \frac{\Lambda_f}{\Lambda_d} \left(\frac{\tilde{w}_u}{\tilde{w}_s} \right)^{\gamma_f - \gamma_d} . \tag{52}$$

where $\Lambda_d = \left(A_d \beta_d^{\beta_d} \gamma_d^{\gamma d} \right), \Lambda_f = \left(A_f \beta_f^{\beta_f} \gamma_f^{\gamma_f} \right) / \phi$. Dividing equation (47) by (48),

$$\Rightarrow \frac{(\beta_d + \delta\alpha\lambda) + (\beta_f + \delta\alpha\lambda) \frac{p_f \tilde{Y}_f}{p_d \tilde{Y}_d}}{(\gamma_d + (1-\delta)\alpha\lambda) + (\gamma_f + (1-\delta)\alpha\lambda) \frac{p_f \tilde{Y}_f}{p_d \tilde{Y}_d}} = \frac{\tilde{w}_u L}{\tilde{w}_s H} . \tag{53}$$

Note that the cost minimization equation (45) can be rewritten as,

$$\left[\frac{1}{\mu} \frac{p_f}{p_d} \right]^{\frac{-1}{1-\rho}} = \frac{\tilde{Y}_f}{\tilde{Y}_d} . \tag{54}$$

Substituting this into equation (53),

$$\frac{(\beta_d + \delta\alpha\lambda) + (\beta_f + \delta\alpha\lambda) \left(\frac{p_f}{p_d} \right)^{1 - \frac{1}{1-\rho}} \left[\frac{1}{\mu} \right]^{\frac{-1}{1-\rho}}}{(\gamma_d + (1-\delta)\alpha\lambda) + (\gamma_f + (1-\delta)\alpha\lambda) \left(\frac{p_f}{p_d} \right)^{1 - \frac{1}{1-\rho}} \left[\frac{1}{\mu} \right]^{\frac{-1}{1-\rho}}} = \frac{\tilde{w}_u L}{\tilde{w}_s H} .$$

Further using equation (52),

$$\frac{(\beta_d + \delta\alpha\lambda) + (\beta_f + \delta\alpha\lambda) \left(\frac{p_f}{p_d} \right)^{1 - \frac{1}{1-\rho}} \left[\frac{1}{\mu} \right]^{\frac{-1}{1-\rho}}}{(\gamma_d + (1-\delta)\alpha\lambda) + (\gamma_f + (1-\delta)\alpha\lambda) \left(\frac{p_f}{p_d} \right)^{1 - \frac{1}{1-\rho}} \left[\frac{1}{\mu} \right]^{\frac{-1}{1-\rho}}} = \left(\frac{\Lambda_d}{\Lambda_f} \frac{p_d}{p_f} \right)^{\frac{1}{\gamma_f - \gamma_d}} \frac{L}{H} .$$

Finally using equation (5), $\left(1 - \mu^\varepsilon p_f^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}} = p_d$, we can rewrite the expression above to obtain,

$$\Rightarrow \frac{(\beta_d + \delta\alpha\lambda) + (\beta_f + \delta\alpha\lambda)\left(\frac{p_f}{\left(1-\mu^\varepsilon p_f^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}}\right)^{1-\frac{1}{1-\rho}}\left[\frac{1}{\mu}\right]^{\frac{-1}{1-\rho}}}{(\gamma_d + (1-\delta)\alpha\lambda) + (\gamma_f + (1-\delta)\alpha\lambda)\left(\frac{p_f}{\left(1-\mu^\varepsilon p_f^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}}\right)^{1-\frac{1}{1-\rho}}\left[\frac{1}{\mu}\right]^{\frac{-1}{1-\rho}}} = \left(\frac{1}{\Lambda}\frac{\left(1-\mu^\varepsilon p_f^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}}{p_f}\right)^{\frac{1}{\gamma_f-\gamma_d}}\frac{L}{H}$$

Thus solving for $p_f = p_f^*$, where $*$ denotes the solved value.

2) Given p_f, we can again use $p_d^* = \left(1 - \mu^\varepsilon p_f^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}$ to back out p_d.

3) Since we now have both p_d^* and p_f^*, we can also derive the efficiency wages and the relative outputs. To derive the efficiency wages, we can substitute prices into equations (50) and (51), as to rewrite them such that we have $\tilde{w}_u^* = \tilde{w}_u^*(p_d, p_f)$ and $\tilde{w}_s^* = \tilde{w}_s^*(p_d, p_f)$. More explicitly, after some tedious rearrangements, we get,

$$\tilde{w}_u^* = A_{du}\Delta A_{fu}\,(p_d^*)^{\frac{\left(\gamma_f+(1-\delta)\lambda\right)}{\left(\gamma_f-\gamma_d\right)}}\,(p_f^*)^{\frac{-\left(\gamma_d+(1-\delta)\lambda\right)}{\left(\gamma_f-\gamma_d\right)}}, \tag{55}$$

$$\tilde{w}_s^* = A_{ds}\Delta A_{fs}\,(p_d^*)^{\frac{-\left(\beta_f+\delta\lambda\right)}{\left(\gamma_f-\gamma_d\right)}}\,(p_f^*)^{\frac{\beta_d+\delta\lambda}{\left(\gamma_f-\gamma_d\right)}}, \tag{56}$$

where,

$$A_{du} = \left(A_d\beta_d^{\beta_d}\gamma_d^{\gamma d}\right)^{\frac{\left(\gamma_f+(1-\delta)\lambda\right)}{\left(\gamma_f-\gamma_d\right)}}; \quad A_{fu} = \left(\frac{A_f\beta_f^{\beta_f}\gamma_f^{\gamma_f}}{\phi}\right)^{\frac{-\left(\gamma_d+(1-\delta)\lambda\right)}{\left(\gamma_f-\gamma_d\right)}};$$

$$A_{ds} = \left(A_d\beta_d^{\beta_d}\gamma_d^{\gamma d}\right)^{\frac{-\left(\beta_f+\delta\lambda\right)}{\left(\gamma_f-\gamma_d\right)}}; \quad A_{fs} = \left(\frac{A_f\beta_f^{\beta_f}\gamma_f^{\gamma_f}}{\phi}\right)^{\frac{\beta_d+\delta\lambda}{\left(\gamma_f-\gamma_d\right)}};$$

$$\Delta = \left(\frac{\delta^{-\delta}(1-\delta)^{-(1-\delta)}}{\alpha}\right)^{-\lambda}.$$

This allows us also to derive the relative wages,

$$\frac{\tilde{w}_u}{\tilde{w}_s} = \left(\frac{\Lambda_d}{\Lambda_f}\frac{p_d^*}{p_f^*}\right)^{\frac{1}{\gamma_f-\gamma_d}}.$$

From equation (54), we obtain a value for relative outputs,

$$\Rightarrow \frac{\tilde{Y}_f}{\tilde{Y}_d} = \left[\frac{1}{\mu}\frac{p_f^*}{p_d^*}\right]^{\frac{-1}{1-\rho}}. \tag{57}$$

4) We can write $\tilde{Y}_f = Y\left(\tilde{Y}_d\right)$.

5) Taking the unskilled labor market equation (47),

$$(\beta_d + \delta\alpha\lambda)\,p_d^*\tilde{Y}_d + (\beta_f + \delta\alpha\lambda)\,p_f^*\tilde{Y}_f = \tilde{w}_u^*L,$$

6) We can now substitute this into equation (57) and get $\tilde{Y}_f^*$.

7) Thus, we can now derive the growth rate from equation (49):

$$\frac{\dot{n}}{n} = \frac{(1-\alpha)\lambda}{\theta ia}\left[p_d^*\tilde{Y}_d^* + p_f^*\tilde{Y}_f^*\right] - \frac{r}{\theta}.$$

C   Solving for the Cobb Douglas Case

Similar to the CES case, we begin with an analogous set of six equations,

$$p_d = \frac{A_d^{-1}\beta_d^{-\beta_d}\gamma_d^{-\gamma d}}{\lambda^\lambda}\left(\frac{\delta^{-\delta}(1-\delta)^{-(1-\delta)}}{\alpha}\right)^\lambda \tilde{w}_u^{\beta_d+\delta\lambda}\tilde{w}_s^{\gamma_d+(1-\delta)\lambda}, \tag{58}$$

$$p_f = \frac{\phi(\tau)A_f^{-1}\beta_f^{-\beta_f}\gamma_f^{-\gamma_f}}{\lambda^\lambda}\left(\frac{\delta^{-\delta}(1-\delta)^{-(1-\delta)}}{\alpha}\right)^\lambda \tilde{w}_u^{\beta_f+\delta\lambda}\tilde{w}_s^{\gamma_f+(1-\delta)\lambda}, \tag{59}$$

$$\frac{p_d}{p_f} = \frac{\eta}{1-\eta}\frac{\tilde{Y}_f}{\tilde{Y}_d}, \tag{60}$$

$$p_d = \eta\,(1-\eta)^{\frac{(1-\eta)}{\eta}}\,p_f^{\frac{-(1-\eta)}{\eta}}, \tag{61}$$

$$\frac{(\beta_d + \delta\alpha\lambda)\,p_d\tilde{Y}_d}{\tilde{w}_u} + \frac{(\beta_f + \delta\alpha\lambda)\,p_f\tilde{Y}_f}{\tilde{w}_u} = L, \tag{62}$$

$$\frac{(\gamma_d + (1-\delta)\alpha\lambda)\,p_d\tilde{Y}_d}{\tilde{w}_s} + \frac{(\gamma_f + (1-\delta)\alpha\lambda)\,p_f\tilde{Y}_f}{\tilde{w}_s} = H. \tag{63}$$

We have six equations and six unknowns. Substituting (60) into equations (62) and (63), we obtain,

$$\left(\frac{\eta\,(\beta_d + \delta\alpha\lambda) + (\beta_f + \delta\alpha\lambda)}{(1-\eta)}\right)p_f\tilde{Y}_f = \tilde{w}_u L, \tag{64}$$

$$\left(\frac{\eta\,(\gamma_d + (1-\delta)\alpha\lambda) + (1-\eta)\,(\gamma_f + (1-\delta)\alpha\lambda)}{(1-\eta)}\right)p_f\tilde{Y}_f = \tilde{w}_s H. \tag{65}$$

Therefore, we can derive the wage premium in this setup,

$$\Rightarrow \frac{\tilde{w}_s}{\tilde{w}_u} = \frac{\eta\,(\gamma_d + (1-\delta)\alpha\lambda) + (1-\eta)\,(\gamma_f + (1-\delta)\alpha\lambda)}{\eta\,(\beta_d + \delta\alpha\lambda) + (1-\eta)\,(\beta_f + \delta\alpha\lambda)}\frac{L}{H}. \tag{66}$$

At the same time note that the growth equation,

$$\frac{(1-\alpha)\lambda}{ia}\left[p_d\tilde{Y}_d + p_f\tilde{Y}_f\right] - \theta\frac{\dot{n}}{n} = r \Rightarrow \left(\frac{(1-\alpha)\lambda}{ia\,(1-\eta)}\right)p_f\tilde{Y}_f - \theta\frac{\dot{n}}{n} = r. \tag{67}$$

To solve for the endogenous rate of growth of varieties we simply need to figure out $p_f\tilde{Y}_f$. This in

turn requires us to figure out either $\tilde{w}_s H$, (equation (65)), or $\tilde{w}_u L$, (equation (64))[41]. If we proceed with the former, we have,

$$\left(\frac{(1-\alpha)\lambda}{ia}\right)\left(\frac{\tilde{w}_s H}{\eta(\gamma_d + (1-\delta)\alpha\lambda) + (1-\eta)(\gamma_f + (1-\delta)\alpha\lambda)}\right) - \theta\frac{\dot{n}}{n} = r. \tag{68}$$

Similarly, to solve for $\tilde{w}_s$ and $\tilde{w}_u$, equations (58) and (59) can be rewritten such that we have, $\tilde{w}_u = \tilde{w}_u(p_d, p_f)$ and $\tilde{w}_s = \tilde{w}_s(p_d, p_f)$. More explicitly, after some tedious rearrangements, we get,

$$\tilde{w}_u = A_{du}\Delta A_{fu} p_d^{\frac{(\gamma_f + (1-\delta)\lambda)}{(\gamma_f - \gamma_d)}} p_f^{\frac{-(\gamma_d + (1-\delta)\lambda)}{(\gamma_f - \gamma_d)}}, \tag{69}$$

$$\tilde{w}_s = A_{ds}\Delta A_{fs} p_d^{\frac{-(\beta_f + \delta\lambda)}{(\gamma_f - \gamma_d)}} p_f^{\frac{\beta_d + \delta\lambda}{(\gamma_f - \gamma_d)}}. \tag{70}$$

Note that these are exactly the same as the corresponding CES equations (55) and (56). We can use these expressions for efficiency wages and substitute them into equation (66) and write prices as a function of L/H. Again this involves some tedious algebra but ultimately gives us

$$\frac{p_f}{p_d} = \frac{\phi A_d \beta_d^{\beta_d}\gamma_d^{\gamma_d}}{A_f \beta_f^{\beta_f}\gamma_f^{\gamma_f}}\left(\frac{\eta(\gamma_d + (1-\delta)\alpha\lambda) + (1-\eta)(\gamma_f + (1-\delta)\alpha\lambda)}{\eta(\beta_d + \delta\alpha\lambda) + (1-\eta)(\beta_f + \delta\alpha\lambda)}\frac{L}{H}\right)^{\gamma_f - \gamma_d}. \tag{71}$$

Therefore, we have the relative prices completely in terms of exogenous variables. As expected, the prices are inversely related to the relative TFP's of the sectors. Further as long as $\gamma_f > \gamma_d$ (share of H is greater in the foreign sector), a decrease in the L/H ratio leads to a decrease in relative prices. As human capital becomes relatively more abundant, the sector that uses this factor more intensively benefits more from the lower cost and therefore charges a lower price. Finally we can use equation (61) in conjunction with (71) to solve explicitly for p_f and p_d. Once we have these two solutions, we can substitute them back into equations (69) and (70) and derive the explicit values for $\tilde{w}_u$ and $\tilde{w}_s$. All of this involves another round of tedious algebra, and we get the following solutions,

$$p_f = \Upsilon\left(\frac{\Lambda_d}{\Lambda_f}\right)^{\eta}\left(\Phi\frac{L}{H}\right)^{\eta(\gamma_f - \gamma_d)}, \tag{72}$$

$$p_d = \Upsilon\left(\frac{\Lambda_d}{\Lambda_f}\right)^{-(1-\eta)}\left(\Phi\frac{L}{H}\right)^{-(\gamma_f - \gamma_d)(1-\eta)}, \tag{73}$$

$$\tilde{w}_u = \Delta\Upsilon\Lambda_d^{\eta}\Lambda_f^{1-\eta}\left(\Phi^{-1}\frac{H}{L}\right)^{\Psi_\gamma}, \tag{74}$$

$$\tilde{w}_s = \Delta\Upsilon\Lambda_d^{\eta}\Lambda_f^{1-\eta}\left(\Phi\frac{L}{H}\right)^{\Psi_\beta}, \tag{75}$$

where $\Upsilon = \eta^{\eta}(1-\eta)^{(1-\eta)}$; $\Lambda_d = \left(A_d\beta_d^{\beta_d}\gamma_d^{\gamma_d}\right)$; $\Lambda_f = \left(A_f\beta_f^{\beta_f}\gamma_f^{\gamma_f}\right)/\phi$; $\Psi_\beta = \eta(\beta_d + \delta\lambda) + (1-\eta)(\beta_f + \delta\lambda)$; $\Phi = \frac{\eta(\gamma_d + (1-\delta)\alpha\lambda) + (1-\eta)(\gamma_f + (1-\delta)\alpha\lambda)}{\eta(\beta_d + \delta\alpha\lambda) + (1-\eta)(\beta_f + \delta\alpha\lambda)}$; $\Psi_\gamma = \eta(\gamma_d + (1-\delta)\lambda) + (1-\eta)(\gamma_f + (1-\delta)\lambda)$; (note that $\Psi_\beta +$

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[41]Given the symmetric nature of Cobb Douglas production functions, ultimately it does not matter which one we proceed with.

$\Psi_\gamma = 1)$.

To derive the growth rate, we substitute $\tilde{w}_s H = \Delta \Upsilon \Lambda_d^\eta \Lambda_f^{1-\eta} (\Phi L)^{\Psi_\beta} H^{\Psi_\gamma}$ into equation (68) to derive $\frac{\dot{n}}{n}$.

D   Domestic and Foreign Production as Perfect Substitutes

For this section, note that both firms have to sell the products at the same price and thus we ignore the aggregator. As mentioned in the main text, we normalize this price to 1. Therefore, $Y = Y_d + Y_f$. Working through the model and solving it the same way as in the Cobb Douglas case, we have the total value of output produced by MNEs as,

$$\tilde{Y}_f = \frac{(\beta_d + \lambda \delta \alpha) \tilde{w}_s H - (\gamma_d + \lambda (1 - \delta) \alpha) \tilde{w}_u L}{(1 - \lambda + \alpha \lambda)(\beta_d - \beta_f)}, \tag{76}$$

and the following expression for the domestic production,

$$\tilde{Y}_d = \frac{(\gamma_f + \alpha \lambda (1 - \delta)) \tilde{w}_u L - (\beta_f + \lambda \delta \alpha) \tilde{w}_s H}{(1 - \lambda + \alpha \lambda)(\beta_d - \beta_f)}, \tag{77}$$

where the equilibrium factor prices (which can be derived using cost functions and labor market clearing conditions like before) are given by,

$$\tilde{w}_u = \left(\frac{\delta^\delta (1 - \delta)^{(1-\delta)}}{\alpha}\right)^\lambda \left(\frac{1}{\left(A_d \beta_d^{\beta_d} \gamma_d^{\gamma_d} \lambda^\lambda\right)}\right)^{\frac{\gamma_f + (1-\delta)\lambda}{\gamma_d - \gamma_f}} \left(\frac{A_f \beta_f^{\beta_f} \gamma_f^{\gamma_f} \lambda^\lambda}{\phi}\right)^{\frac{(\gamma_d + (1-\delta)\lambda)}{\gamma_d - \gamma_f}}, \tag{78}$$

$$\tilde{w}_s = \left(\frac{\delta^\delta (1 - \delta)^{(1-\delta)}}{\alpha}\right)^\lambda \left(A_d \beta_d^{\beta_d} \gamma_d^{\gamma_d} \lambda^\lambda\right)^{\frac{(\beta_f + \delta\lambda)}{\gamma_d - \gamma_f}} \left(\frac{\phi}{A_f \beta_f^{\beta_f} \gamma_f^{\gamma_f} \lambda^\lambda}\right)^{\frac{\beta_d + \delta\lambda}{\gamma_d - \gamma_f}}. \tag{79}$$

While we do not go into the details, observe that for both $\tilde{Y}_f$ and $\tilde{Y}_d$ to be positive, the parameters must satisfy certain conditions. Summing the two equations, (76) and (77), and using the fact that $(\gamma_f - \gamma_d) = (\beta_d - \beta_f)$, we can rewrite total final good production in the economy as,

$$\tilde{Y}_d + \tilde{Y}_f = \frac{(\gamma_f - \gamma_d) \tilde{w}_u L + (\beta_d - \beta_f) \tilde{w}_s H}{(1 - \lambda + \alpha \lambda)(\beta_d - \beta_f)} = \frac{\tilde{w}_u L + \tilde{w}_s H}{(1 - \lambda + \alpha \lambda)}. \tag{80}$$

Substituting equation (80) into the arbitrage condition (26) gives us the equilibrium growth rate for varieties,

$$\frac{\dot{n}}{n} = \frac{\lambda}{\theta} \frac{(1 - \alpha)}{ia} \left[\frac{(\tilde{w}_u L + \tilde{w}_s H)}{(1 - \lambda + \alpha \lambda)}\right] - \frac{r}{\theta}. \tag{81}$$

Improvements in the level of financial market development continue to have clear positive effects on the growth rate. How does a change in A_f (or ϕ) affect the growth rate of the economy? In order to perform this exercise, we need to solve for the effect of changes in A_f on $\tilde{w}_u$ and $\tilde{w}_s$. Looking at the reduced form factor price equations, an increase in A_f raises the skilled wage per efficiency unit and reduces the unskilled wage per efficiency unit as long as multinationals use skills more intensively, that is $\gamma_f > \gamma_d$. This is because an improvement in the technology of the skill intensive sector raises the demand for skills more than it raises the demand for raw labor. As a result, this creates an upward pressure on skilled labor wages. This creates an excess supply of unskilled labor since domestic firms use

this kind of labor relatively intensively. As a result, skilled labor wages rise and unskilled labor wages fall. This suggests that the overall effect on growth can be ambiguous. Moreover, the effect of changes in A_f depends also upon the relative stocks of L and H in the economy. If the increase in skilled labor wage bill, more than compensates the reduction in unskilled labor wage bill then the growth rate of the economy will go up. Thus, even the skill intensive nature of FDI is not sufficient to ensure that more FDI leads to higher growth rates in the economy. If it does raise the growth rate then clearly both sectors experience increases in growth rates. This would then be the case of a beneficial spillover effect. On the other hand, if the increase in skilled wages does not compensate for the reduction in unskilled wages, then the growth rates will diminish. In this case, FDI would have a negative impact in the economy.[42] Of course the opposite happens if A_d increases.

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[42]Rodriguez-Clare (1996) and Markusen and Venables (1999) also get ambiguous results in terms of the effects of multinationals in the domestic economy stemming from reduction in the demand for local inputs due, for example, to the fact that foreign firms may import intermediate inputs.

Table 1: Parameters

Benchmark Parameters		

Common parameters for three groups		
$\alpha = 0.91$	$r = 0.05$	$\phi = 1$

Production Function Parameters		
$\beta^d = 0.34$	$\beta^f = 0.27$	$\gamma = 0.5$
$\gamma^d = 0.33$	$\gamma^f = 0.40$	$A^f/A^d = 2$
$\mu = 0.1$	$\rho = 0.2$	

Group Specific Parameters		
	Financial Dev.	L/H
High (rich)	0.045	5
Medium (middle)	0.085	5
Low (poor)	0.145	5

Robustness Parameters		

Production Function Parameters		
$\rho = 0.2$	$\mu = 0.2$	$A^f/A^d = 2$

Group Specific Parameters	
	L/H
High (rich)	5
Medium (middle)	9
Low (poor)	12

Notes: We group countries based on their financial market development levels, using the interest rate spreads. The average spread for the low financially developed (poor) countries, medium financially developed (middle income) countries and the high financially developed (rich) countries between 2000 and 2003 are 14.5%, 8.5%, and 4.5%, respectively. In the benchmark case, all countries have the same ratio of unskilled to skilled labor equal to 5. In the sensitivity analysis, we set the ratio of unskilled labor to skilled labor equal to 12 for the poor countries, 9 for the middle income countries, and 5 for the rich countries (taken from Duffy et al. (2004)).

Table 2: Benchmark Results

μ	Growth Rate High Financial Development	Growth Rate Medium Financial Development	Growth Rate Low Financial Development	Relative Output (Y^f/Y^d)
0.1	3.10	2.13	1.42	0.065
0.2	4.35	3.01	2.03	0.155
0.3	6.17	4.29	2.92	0.257
0.4	8.74	6.10	4.17	0.369
0.5	12.25	8.57	5.88	0.487
0.6	16.97	11.89	8.18	0.612

Notes: See table 1 for the parameter values. Growth rates are in percent. Relative outputs are valued at their respective price. The relative labor endowments are constant at the level of rich (high financial development) countries and $\rho = 0.2$.

Table 3: Increasing Foreign Presence, Changing μ

$\Delta\mu$	Δ Growth High Financial Development	Δ Growth Medium Financial Development	Δ Growth Low Financial Development	Δ Relative Output $\Delta(Y^f/Y^d)$	Percent Change in Y^f
0.1 to 0.2	1.25	0.88	0.61	0.09	203.2
0.2 to 0.3	1.83	1.29	0.89	0.10	114.1
0.3 to 0.4	2.56	1.80	1.25	0.11	84.8
0.4 to 0.5	3.51	2.47	1.71	0.12	69.6
0.5 to 0.6	4.72	3.32	2.30	0.12	59.9

Notes: See table 1 for the parameter values. All changes are in percentage points unless reported otherwise. Relative outputs are valued at their respective price. The relative labor endowments are constant at the level of rich (high financial development) countries and $\rho = 0.2$.

Table 4: Increasing Foreign Presence via Increasing MNE Productivity: $A^f/A^d \uparrow$ by 15%

μ	Δ Growth High Financial Development	Δ Growth Medium Financial Development	Δ Growth Low Financial Development	Δ Relative Output $\Delta(Y^f/Y^d)$	Percent Change in Y^f
0.1	0.03	0.02	0.01	0.002	4.2
0.2	0.09	0.06	0.04	0.006	5.0
0.3	0.19	0.13	0.09	0.009	5.8
0.4	0.35	0.24	0.17	0.013	6.6
0.5	0.59	0.41	0.29	0.017	7.2
0.6	0.94	0.66	0.46	0.022	7.8

Notes: See table 1 for the parameter values. All changes are in percentage points unless reported otherwise. Relative outputs are valued at their respective price. The relative labor endowments are constant at the level of rich (high financial development) countries and $\rho = 0.2$. A 15% increase in A_f/A_d implies that this ratio increases in value from 2 to 2.3.

Table 5: L/H Varies by Group

μ	Growth Rate High Financial Development	Growth Rate Medium Financial Development	Growth Rate Low Financial Development	Relative Output High	Relative Output Medium	Relative Output Low
0.1	3.10	1.68	0.97	0.065	0.065	0.064
0.2	4.35	2.38	1.40	0.155	0.153	0.153
0.3	6.17	3.40	2.02	0.257	0.255	0.253
0.4	8.74	4.84	2.90	0.369	0.365	0.363
0.5	12.25	6.79	4.09	0.487	0.482	0.480

Notes: See table 1 for the parameter values. Growth rates are in percent. Relative outputs are valued at their respective price. The relative labor endowments change together with financial development as high, medium and low; $\rho = 0.2$.

Table 6: Increasing Foreign Presence (Changing μ) and L/H varies by Group

$\Delta\mu$	Δ Growth High	Δ Growth Medium	Δ Growth Low	Δ Y^f/Y^d High	Δ Y^f/Y^d Medium	Δ Y^f/Y^d Low	% Δ Y^f High	% Δ Y^f Medium	% Δ Y^f Low
0.1 to 0.2	1.25	0.70	0.43	0.09	0.09	0.09	203.2	202.5	202.2
0.2 to 0.3	1.83	1.02	0.62	0.10	0.10	0.10	114.1	113.6	113.4
0.3 to 0.4	2.56	1.43	0.87	0.11	0.19	0.11	84.8	84.4	84.2
0.4 to 0.5	3.51	1.96	1.19	0.12	0.12	0.12	69.6	69.2	69.1

Notes: See table 1 for the parameter values. All changes are in percentage points unless reported otherwise. Relative outputs are valued at their respective price. The relative labor endowments change together with financial development as high, medium, low; and $\rho = 0.2$.

Table 7: Increasing Foreign Activity via Increasing MNE Productivity ($A_f/A_d \uparrow$ by 15%), and L/H varies by Group

μ	Δ Growth High	Δ Growth Medium	Δ Growth Low	Δ Y^f/Y^d High	Δ Y^f/Y^d Medium	Δ Y^f/Y^d Low	% Δ Y^f High	% Δ Y^f Medium	% Δ Y^f Low
0.1	0.03	0.02	0.01	0.002	0.002	0.002	4.23	4.23	4.22
0.2	0.09	0.05	0.03	0.006	0.005	0.005	5.04	5.03	5.02
0.3	0.19	0.10	0.06	0.009	0.009	0.009	5.83	5.81	5.80
0.4	0.35	0.19	0.12	0.013	0.013	0.013	6.56	6.56	6.52
0.5	0.59	0.33	0.20	0.017	0.017	0.017	7.21	7.19	7.18

Notes: See table 1 for the parameter values. All changes are in percentage points unless reported otherwise. Relative outputs are valued at their respective price. The relative labor endowments change together with financial development as high, medium, low; and $\rho = 0.2$.

Table 8: Increasing Foreign Productivity and Presence for Different Relative Productivity Levels

Panel A: Increasing Foreign Productivity
Effect of Increases in A_f/A_d for different values of μ

A^f/A^d	Δ Growth High $\mu = 0.1$	Δ Growth Medium $\mu = 0.1$	Δ Growth Low $\mu = 0.1$	Δ Growth High $\mu = 0.2$	Δ Growth Medium $\mu = 0.2$	Δ Growth Low $\mu = 0.2$	Δ Growth High $\mu = 0.3$	Δ Growth Medium $\mu = 0.3$	Δ Growth Low $\mu = 0.3$
1.15 to 1.32	0.02	0.010	0.006	0.05	0.03	0.02	0.11	0.06	0.04
1.52	0.02	0.003	0.002	0.05	0.01	0.00	0.11	0.02	0.01
1.75	0.02	0.002	0.001	0.06	0.01	0.00	0.12	0.01	0.01
2.0	0.02	0.011	0.006	0.06	0.03	0.02	0.12	0.07	0.04
2.3	0.02	0.011	0.007	0.06	0.03	0.02	0.13	0.07	0.05
2.6	0.02	0.010	0.006	0.06	0.03	0.02	0.12	0.07	0.04

Panel B: Increasing Foreign Presence
Effect of Increases in μ for different values of A_f/A_d

A^f/A^d	Δ Growth High $\Delta\mu$ 0.1 to 0.2	Δ Growth Medium $\Delta\mu$ 0.1 to 0.2	Δ Growth Low $\Delta\mu$ 0.1 to 0.2	Δ Growth High $\Delta\mu$ 0.2 to 0.3	Δ Growth Medium $\Delta\mu$ 0.2 to 0.3	Δ Growth Low $\Delta\mu$ 0.2 to 0.3	Δ Growth High $\Delta\mu$ 0.3 to 0.4	Δ Growth Medium $\Delta\mu$ 0.3 to 0.4	Δ Growth Low $\Delta\mu$ 0.3 to 0.4
1.15	1.05	0.59	0.36	1.49	0.83	0.51	2.03	1.14	0.69
1.32	1.09	0.61	0.38	1.56	0.88	0.54	2.15	1.20	0.73
1.52	1.14	0.64	0.39	1.65	0.92	0.56	2.28	1.27	0.78
1.75	1.20	0.67	0.41	1.74	0.97	0.59	2.42	1.35	0.83
2.00	1.25	0.70	0.43	1.83	1.02	0.62	2.56	1.43	0.87
2.30	1.31	0.73	0.45	1.93	1.08	0.66	2.72	1.52	0.93
2.60	1.36	0.76	0.47	2.02	1.13	0.69	2.87	1.60	0.98

Notes: See table 1 for the parameter values. All changes are in percentage points unless reported otherwise. The relative labor endowments change together with financial development as high, medium, low; and $\rho = 0.2$.

Table 9: MNEs and Local Firms: Substitutes or Complements

μ	Growth Rate High Financial Development	Growth Rate Medium Financial Development	Growth Rate Low Financial Development	Y^f/Y^d
	$\rho = -0.2$ (complements)			
0.1	1.03	0.67	0.42	0.13
0.2	0.54	0.33	0.18	0.24
	$\rho = 0.2$ (substitutes)			
0.1	3.10	2.13	1.42	0.06
0.2	4.35	3.01	2.03	0.16

Notes: See table 1 for the parameter values. Growth rates are in percent. Relative outputs are valued at their respective price. The relative labor endowments are constant at the level of rich (high financial development) countries.

Table 10: Growth Rates For The Cobb Douglas Case

	(1) Same L/H $A^f = 2A^d$ $1 - \eta = 0.05$	(2) Same L/H $A^f = 2.5A^d$ $1 - \eta = 0.05$	(3) Diff. L/H $A^f = 2A^d$ $1 - \eta = 0.05$	(4) Diff. L/H $A^f = 2.5A^d$ $1 - \eta = 0.05$	(5) Diff. L/H $A^f = 2A^d$ $1 - \eta = 0.25$	(6) Diff. L/H $A^f = 2.5A^d$ $1 - \eta = 0.25$
Low	1.67	1.69	1.16	1.17	0.85	0.91
Medium	2.49	2.52	1.98	2.01	1.49	1.59
High	3.61	3.65	3.61	3.65	2.78	2.94

Notes: $(1 - \eta)$ is the MNE output share when using the Cobb Douglas function. All values are in percentage points. $\phi = 1$ in all columns. In (1) -(2) the relative endowments are the same (at the level of high financial development countries) for all group of countries. In (3) - (6) the relative labor endowments change together with financial development as high, medium, and low
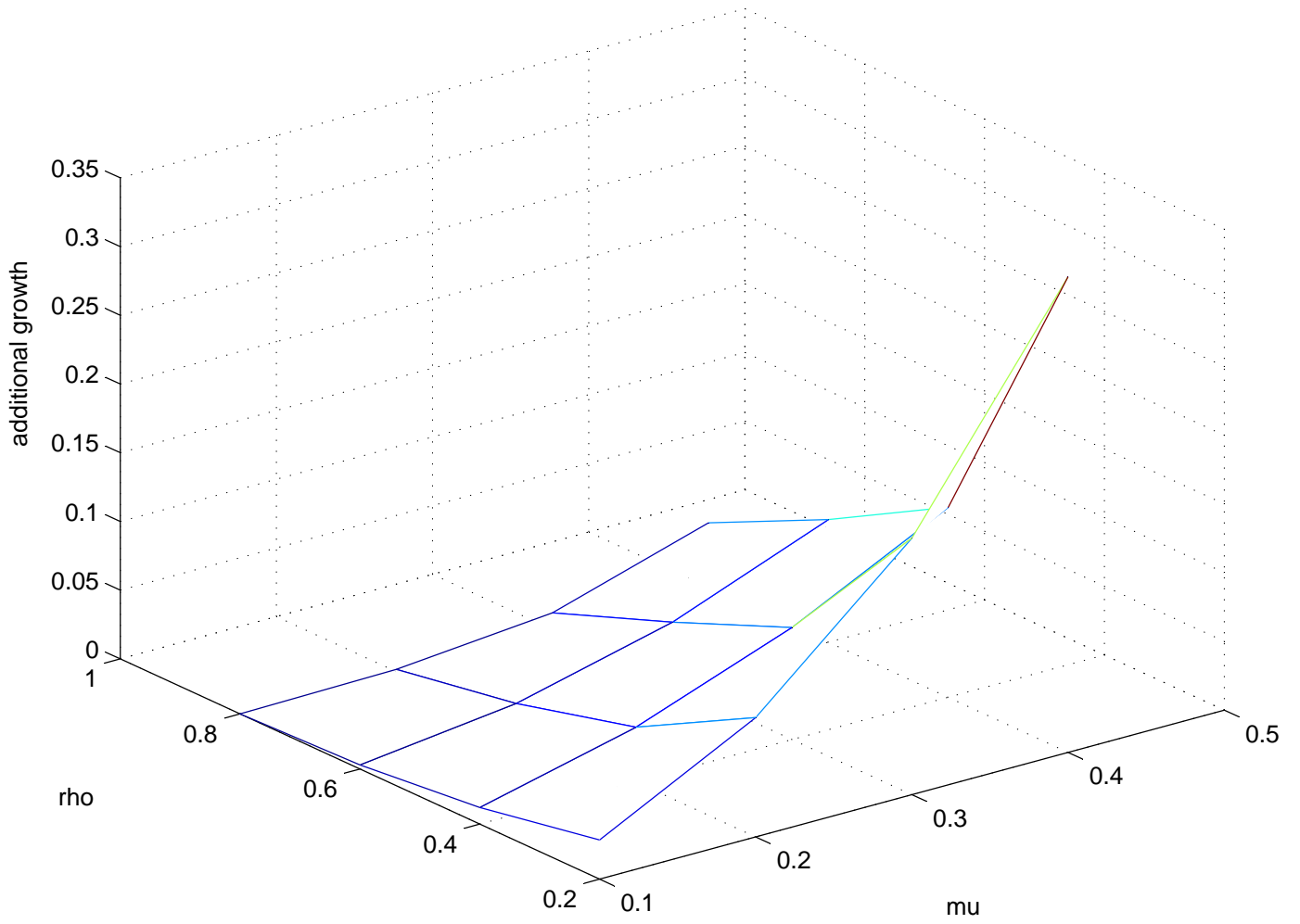
Figure 1: Financially well-developed, positive rho

Figure 2: Financially well-developed, negative rho