Expatriates as Leaders of Technology Transfer and FDI: Theory and Evidence from Mexico.

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Abstract

Multinational companies (MNCs) are thought to be key in the spread of technology advances across countries. At the same time, the management literature argues that expatriates are key for information and technology transmission from headquarters to subsidiaries. While economic analysis on expatriates has been scarce, our analysis of Mexican plant-level data reveals that subsidiaries relying on foreign employees indeed engage in more technology transfer than those that do not. To understand why, we extend Hermalin (1998) leadership theory and model MNCs' choice of their subsidiaries CEOs and entry decisions. In the model, MNCs have to choose between the expatriate, who is better at transmitting the value of the project, and the local manager who can deal better with the uncertainty in local conditions. We find that MNCs employing expatriates engage in more technological transfer, and more so in technology intensive industries because expatriates can use their own effort to signal the value of this technology (lead by example), whose value increases with the technological intensity. We also find that MNCs rely less on expatriates when local uncertainty is high due to the expatriate's lack of local knowledge. In terms of entry, we find that the attractiveness for FDI will be lower for locations with high local uncertainty that lack a supply of local managers. Yet, the composition of FDI for these areas will be biased towards multinationals in technology intensive sectors because only firms only those sectors find it profitable to enter. Additional empirical analysis finds a set of robust correlations that are not only consistent with our theory but are difficult to explain with the hypothesis that productivity is the only key factor driving both the use of expatriates and the performance of the firm. The theory thus provides a foundation to understand the nature and the barriers of technology transfer within MNCs and its implications for economic development.

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1 Introduction

Economists and policy makers have increased attention to Multinational companies (MNCs) as key in the spread of technological, managerial and organizational advances across countries. The economics literature has documented that MNCs are more productive, pay higher wages, and are more export oriented than domestic firms (Marksen, 2002, and Harrison and Rodriguez-Claire, 2009). Furthermore, their presence is likely to be associated with inter-industry positive spillovers (Blalock, 2002 and Jacorcik, 2004). Policy makes, in particular those from developing countries, have recently tried to attract MNCs expecting them to be bringing technological advances (UNCTAD, 1994).

Given the perceived importance of MNCs as a driver to technology transfer, the following question arises naturally: How do multinational firms transmit the technology and other useful information to their subsidiaries? Management literature has argued that expatriates are MNC's means of controlling and processing information within MNCs (Egelhoff, 1984 and Gupta and Govindarajan, 1991). However, administrating the development and mobility of expatriate managers has been a major challenge for most MNCs, which has attracted much attention in the management literature (See for example Black et. al, 1999 and Ricks, 1999). Since expatriates tend to lack local knowledge, MNCs are facing a trade off when choosing between expatriates, who know better their firms, and local managers, who know better local conditions.[1]

In contrast to the much attention of practitioners and the management literature on the cost and benefit of expatriates, systematic economic analysis has been scarce. In this paper, we fill this gap by presenting both numbers from Mexican subsidiaries of MNCs and a theoretical framework that analyzes the causes and consequences of MNCs' choice of their subsidiaries CEOs and their entry decisions in foreign markets. This is the first paper to analyze both theoretically and empirically MNCs' choice of foreign employees and its implication on technology transfer and the type and amount of FDI flows developing countries attract.[2]

[1] An illustrative example of this trade off between transmission of technology and local knowledge can be found in the field study by Carrillo and Hinojoza (1999) in which a German autoparts firm has two subsidiaries in Mexico. The high end subsidiary employs a German CEO while the low end subsidiary employs no German.

[2] Tan and Mahoney (2006) analyze empirically the determinants of the choice between expatriates and local

We first document several facts from Mexican data that further motivates us to study the MNCs choice of managers in their subsidiaries. Our analysis of Mexican plant-level data reveals that subsidiaries relying on expatriates behave systematically different from those that do not in terms of their innovative activities, technology transfer and training. Namely, they engage in more knowledge transfer from abroad and innovative activities. After presenting theoretical results outlined in the next paragraph, we provide more concrete evidence of correlates of foreign expatriates and of equilibrium predictions regarding the entry both in terms of the quantity and the composition.

In the theoretical section of the paper, we analyze two aspects of MNCs expansion decision: the choice of their potential subsidiary CEO and their entry decision.[3] That is, whether the Headquarter (HQ) appoints an expatriate or a local CEO in the subsidiary where the company may choose to expand.

We argue that the subsidiary CEO shapes the ability to transfer technology and the costs incurred in the local economy. Similarly to Antràs (2005), we distinguish two parts in the production process of the MNC subsidiary. We call them transfer and execution stage. The transfer stage can capture from the actual transfer of technology to management expertise and processes for the best use of this technology or simply the HQ corporate culture. Its defining characteristic is that it requires information to flow from the HQ to the local environment. The technological and/or organizational edge of MNCs over local producers is one of the drivers of multinationals expansion given that "New technology generation is highly concentrated in a number of advanced industrial countries, taking place in large MNCs" (Chapter 2, Piscitello and Santangelo, 2007). The information relative to the transfer stage is known by the HQ but not in the local economy.[4]

managers. Markusen and Trofimenko (2007) analyze theoretically and empirically the consequence of the use of foreign experts on workers. We will turn below.

[3] Although we use the term CEO for the concept of leader in the theoretical section, the concept can be interpreted as a team of managers or experts. Foreign workers in Mexico are likely to be at managerial positions or experts.

[4] An example are quality controls. These are a core aspect of Japanese firms corporate culture and were an essential component of the successful experience of Mitsubishi Belting in Singapore. As the following quote from the UNCTAD(1994) reflects, it involved information flows from the HQ to the subsidiaries: "Quality-control concepts have been adopted by enterprizes in India, Indonesia, Malaysia, the Philippines, Singapore and Thailand. The diffusion of quality-control methods in Asian developing countries has been accelerated by the presence of a considerable number of Japanese foreign affiliates"

The execution stage of the Multinational subsidiary captures, for example, selling the final product to local customers or buying inputs from local suppliers. It requires information from the local environment, which may include cultural, regulatory and political aspects of the subsidiary location. These are known by local inhabitants but not by the HQ. The key idea of the model is that the appointment of the CEO will determine the extent of information asymmetries between the HQ, the CEO and the workers in the transfer and the execution stages.

The information based theory of leadership of Hermalin (1998) is particularly suited to analyze the choice of MNCs subsidiaries CEOs and its implication on technology transfer.[5] This is so because Hermalin (1998) theory is information based: the leader is defined as someone who induces a voluntary following as a result of having superior information. Further, sending an expatriate the multinational expands the set of strategies to transmit information to the subsidiary, because the expatriate can use his effort in the subsidiary as a signal.[6]

In short, the model predicts first that multinationals employing expatriates engage in more technological transfer, and more so in technology intensive industries. This is so because expatriates, familiar with the technology, can use their own effort to signal the value of this technology, that is, lead by example. This is a cheaper way to communicate information than signaling from headquarters. Therefore, multinationals in technology intensive sectors find it more valuable to hire an expatriate, and the expatriate's leading by example boosts local efforts to adopt the technology. Second, our analysis of the entry decision reveals that the attractiveness for FDI will be

[5]The leadership theory by Benjamin Hermalin has been extended and applied widely. For example, Kobayashi and Suehiro (2005) extend the model to allow for imperfect information available to all the team members to endogenize the emergence of leadership while Majumdar and Mukand (2007) analyze the leader's ability to promote reforms, while Gervais and Goldstein (2007) introduce over confidence of the leader in the analysis. Further, Hermalin's theory has been brought to the experimental lab. Potters et al., 2001, 2005; and Gchter and Renner, 2003 find support for the leading-by-example model. Yet, Meidinger and Villeval (2002) suggest that this is due not to signaling but to reciprocity. Huck and Rey-Biel (2006) introduce the role of conformism among followers and the endogenous determination of who will be the leader.

[6]That is, in Hermalin (1998) parlance, he can lead by example. In Hermalin (1998) the leader has two potential signaling strategies to credibly transmit information. He can either lead by sacrifice (giving a gift) or he can lead by example (exerting effort prior to workers). The first means that in the transfer stage the expatriate CEO and the Headquarter can act as leaders, while the local CEO cannot. The second means that only an expatriate manager, physically present in the subsidiary and acquainted with the technological information, and neither the headquarter nor the local manager can lead by example. That is, although we have not explored the two different forms of leadership in our empirical analysis, Hermalin (1998) allow us to open the black box of technological transfer by focusing on the information transmission mechanisms available to the MNCs. This is something other types of organizational theory cannot allow us to do.

lower for locations with high local uncertainty that lack a supply of local managers. Yet, our model also shows that the composition of FDI that countries in these conditions will receive will be biased towards multinationals in technology intensive sectors. Therefore, developing countries face a quantity-composition trade off when developing a supply of local managers.[7] These increase with the uncertainty over local conditions. Finally, the theory predicts that firms whose transfer-stage is a more important input than the execution stage will find it more valuable to hire an expatriate. Therefore, if exports are more transfer-stage oriented activities, which is likely to be especially true if subsidiaries are exporting their products to the country of their headquarter, we expect that export oriented firms are more likely to rely on expatriates. Similarly we do not expect the same for domestic sales. Although this discussion is not so strongly related to the model as previous two, this is important because this shows that not all the performance measures of plants are positively correlated with expatriates. While the model highlights the benefits from hiring an expatriate it also makes explicit its costs, which differentiates itself from a simple alternative productivity-driven story that more productive firms employ expatriates and at the same time excel in every measure. We take these predictions on expatriates to the data and find consistent results.

We find that Mexican subsidiaries of MNCs hiring foreign employees spend more in technology purchase from abroad, and this is correlation is stronger in industries whose R&D intensity is high in the U.S., a typical headquarter country. Second, we find that Mexican states with higher levels of judicial efficiency (an inverse measure of local inefficiency whose increase will also increase local uncertainty) find more foreign firms, but the composition of the industries of such firms are towards with low R&D intensive industries.[8] In the model this is because for high values of local inefficiency, the technology intensiveness of entering firms decreases as local efficiency since the firms induced to enter are low-tech firms that have more profit with local managers. Finally, we find that the reliance on foreign employees is correlated with export status, but not domestic sales,

[7]This is true if high-technology FDI is more beneficial than low-technology FDI for the same level of activities, which is left to a future investigation.

[8]We use R&D intensity in the U.S. because the technology intensity parameter in the model reflects the one at the headquarter.

which rules out the simple alternative productivity-driven story mentioned above in which more productive firms employ expatriates and at the same time excel both in exports and domestic sales.

This paper is related to several strands of literature. First this paper is related to an emerging international trade literature on MNCs' strategy.[9] Recent papers by Antràs (2003, 2005), Antràs and Helpman (2004) and Feenstra and Hanson (2005) extend the property rights models of Grossman and Hart (1986) and Hart and Moore (1990) to explain the MNCs' organizational choice. A series of papers by Grossman and Helpman (2002, 2004, 2005) analyze this choice using the transaction-cost approach. See Lin and Thomas (2008) comparing the empirical predictions of the two approaches above.[10] Puga and Trefler (2010) extend the model of formal and real authority by Aghion and Tirole (1997) to explain the rise of local innovation in developing countries.[11] Tan and Mahoney (2006) analyze empirically the choice between expatriates and local CEOs using data of Japanese MNCs and relate the findings to agency theory. Our paper differs from the papers above in that we focus on the organizational choice of MNCs in developing countries and its implication on technology transfer and composition of FDI.

This paper is also related to the literature on the entry decision of MNCs.[12] Markusen (1995) and Ramondo (2008) empirical evidence shows that around three quarters of all possible country pairs do not engage in multinational production exchanges. Ramondo (2008) shows that bilateral geographical distance and country size are major components of multinational production costs, preventing them from expanding.[13] Burstein and Monge-Narajnjo (2009) explain the unrealized exchanges through the scarcity of managers in the local economy that makes replication of technology across countries impossible. We complement these studies by providing micro-level facts and by modeling how fixed entry cost affect not only the magnitude of FDI but its composition.[14]

[9]For surveys of this literature, see Helpman (2006) and Antràs and Rossi-Hansberg (2010).

[10]For an earlier study to investigate the role of informational asymmetries and knowledge nonexcludability in determining the choice between direct investment and licensing, see Ethier and Markusen (1996).

[11]Hanson and Xiang (2010) also extend Aghion and Tirole (1997) to analyze the characteristics of U.S. denominations.

[12]For this and next strands of literature, Markusen (2004) is a standard textbook.

[13]She argues that plants face a fixed and exogenous cost to replicate the productivity level of the "source" plant that is country pair specific.

[14]Nocke and Yeaple (2008) analyze theoretically the composition of FDI arising from MNCs' choice of greenfield

For example, our framework allows us to discuss the type of firms and local conditions for which the scarcity of local managers will impede entry and whether local development policies. should give priority to investments in human capital of managers or of blue collar workers.[15]

Finally, we also contribute to the literature of the effect of MNCs. Aitken and Harrison (1999) found that foreign presence is negatively associated with the performance of local firms, while Javorcik (2004) found that foreign plants lead productivity growth of the plants in the supplying industries of those plants. [16]. Branstetter, Fisman and Foley (2006) shows that legal reforms on intellectual property rights in countries where subsidiaries locate induce MNCs to transfer more technology. We are pointing out additional channels through which host countries' conditions or policies could affect technology transfer. Markusen and Trofimenko (2007) is the closest to this paper in the sense that they also focus on foreign employees. They find that plants with foreign experts have experienced increases in wages of domestic workers and on the value added per worker. Our paper is different from Markusen and Trofimenko (2007) in two senses. First we explicitly model the choice of MNCs on using foreign employees in their subsidiaries and confirm the model's predictions. Second, we provide evidence on a direct measure of knowledge transfer: the expenditure on technology transfer from abroad.

The paper is organized as follows: In section 2, we present some features of Mexican subsidiaries of MNCs. In Section 3, we present the model and its predictions. In particular, we model multinationals choice of their subsidiaries CEOs and entry decision. Section 4 discussion summarizes the model predictions and the results that we bring to the data. Section 5 presents data and additional empirical results. Section 6 concludes. Results not derived or proved in the text are found in the appendix.

investment or in cross-border acquisitions, while Kesternich and Schnitzer (2009) analyze both theoretically and empirically find that as political risk increases the foreign ownership share decreases but leverage increases

[15]There are several universities in Mexico, most notably Tecnológico de Monterrey, whose main role is to educate potential managers. Our framework in principle allows us to evaluate the consequences of these institutions, which have implications on education policies.

[16]Recent papers explore mechanisms of spillover effects by analyzing what kind of plants are benefitting more (Blalock and Gertler, 2007 and Miyamoto and Todo, 2008)

Table 1: Technology Transfer of Mexican Subsidiaries of Multinational Firms

	Plants with no foreign employees	Plants with foreign employees	Total
Dummy (1 if $Transfer > 0$)	0.09***	0.21***	0.15
	(0.02)	(0.03)	(0.02)
Total Transfer	1999.43**	5496.73**	3626.08
	(914.36)	(2755.95)	(1370.12)
Log of total Transfer	8.73	8.85	8.81
	(0.60)	(0.34)	(0.30)
Total transfer/Sales (%)	0.20**	0.45**	0.32
	(0.06)	(0.10)	(0.06)
Number	209	182	391

Notes: The table reports summary statistics of amount spent on technology transfer from abroad. The first column is the statistics for plants without any foreign employee, while the second with at least one foreign employee, and the third for all plants pooled together. Standard deviation of the means in parentheses. Expenditure on technology transfer is in nominal thousand pesos (A dollar was 9.5 pesos in the beginning of 2000). Significance of the test of the equality of the mean of the two groups: * 10 percent, ** 5 percent, *** 1 percent.

2 Preliminary Facts

Does the identity of the managers of local subsidiaries, i.e. expatriates or a local managers, matter? We first provide facts that plants with expatriates and without them do indeed differ in terms of their innovative activities, technology transfer from abroad and $R\&D$, and training. We use confidential plant-level data from Mexico.[17] Table 1 presents statistics of expenditure on the acquisition of technology from abroad for Mexican subsidiaries of MNCs in the data. Subsidiaries of MNCs are defined as plants that report its foreign capital ratio more than 33 %.[18] There are 391 such plants in the data. Of 391 subsidiaries, 209 plants report that they have no foreign employees, where as 182 plants report that they have at least one foreign employee. We assume that plants with at least one foreign employee has foreign expatiates as managers.[19] Table 1 shows that plants with at least one foreign employee has a statistically significantly higher likelihood of spending a positive amount in technology transfer from abroad. The amount of the expenditure

[17] We explain the data in Section 5.

[18] The choice of this threshold does not affect the qualitative results in this paper.

[19] As the analysis of German plants in Mexico in Carrillo and Hinojoza (1999) shows, this is a realistic assumption: "The presence of Germans based in Mexico represents less than 1% of total employment. Yet, in their majority they hold managing positions".(translated from the text)

Table 2: R&D Intensity of Mexican Subsidiaries of Multinational Firms

	Plants with no foreign employees	Plants with foreign employees	Total
Dummy (1 if $R\&D > 0$)	0.2	0.16	0.18
	(0.03)	(0.03)	(0.02)
Total $R\&D$	2576.56	5492.13	3930.22
	(914.36)	(2755.95)	(1370.12)
Log of total $R\&D$	7.85*	8.77*	8.23
	(0.33)	(0.37)	(0.25)
Total $R\&D$/Sales (%)	0.18*	0.38*	0.27
	(0.04)	(0.10)	(0.05)
Number	209	182	391

Notes: The table reports summary statistics of R&D variables. The first column is the statistics for plants without any foreign employee, while the second with at least one foreign employee, and the third for all plants pooled together. Standard deviation of the means in parentheses. R&D expenditure is in nominal thousand pesos (A dollar was 9.5 pesos in the beginning of 2000). Significance of the test of the equality of the mean of the two groups: * 10 percent, ** 5 percent, *** 1 percent.

as well as the ratio of the expenditure on total sales are also statistically significantly higher for plants with at least one foreign employee than plants with no foreign employee. The comparison of the log of the expenditure suggests that conditional on spending a positive amount of expenditure, there is no difference of the amount of expenditures between the two types of plants.

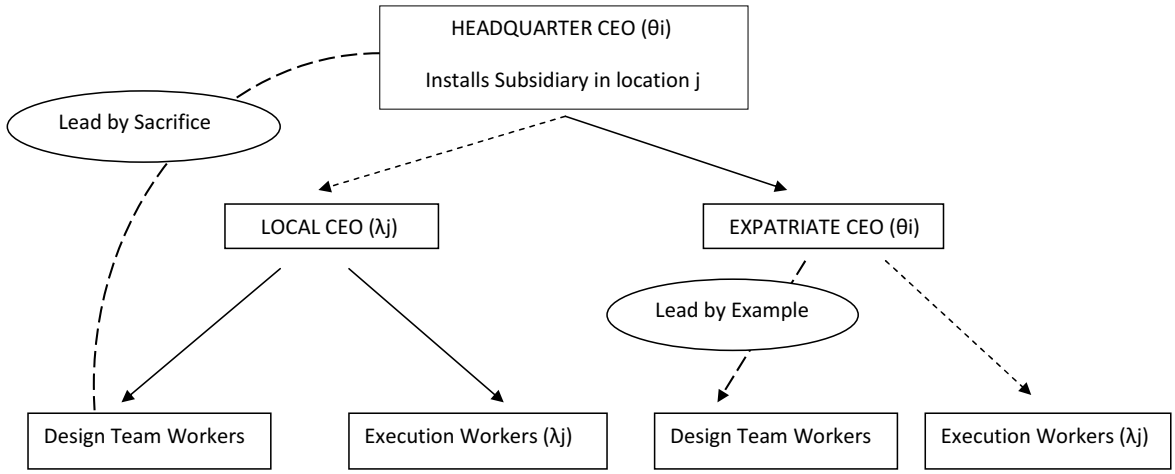
The fact that technology transfer from abroad is higher for plants with expatriates may not be surprising if expatriates are substitute of local $R\&D$. However, plants with expatriates are also spending higher amount of $R\&D$. Table 2 presents summary statistics of $R\&D$ expenditure for Mexican subsidiaries of MNCs. Table 2 shows that there is no statistically significant difference of the likelihood of engaging $R\&D$ between the two types of the plants. However, conditional on engaging $R\&D$, the $R\&D$ expenditure is statistically significantly higher for plants with at least one foreign employee than plants with no foreign employee. These together show that foreign plants with expatriates are engaged in more technology-intensive activities both in terms of technology transfer from abroad and local $R\&D$.

3 A Theory of Multinational Expatriates: Leadership meets Culture

We present an information based leadership theory of multinational expatriates.[20] The model studies whether the Headquarter (HQ) appoints an expatriate or a local CEO in the subsidiary where the company may expand. The key idea of the model is that the appointment of the CEO will determine the extent of information asymmetries between the HQ, the CEO and local workers. In particular, we assume that only the HQ and the subsidiary CEO, if he is an expatriate, are familiar with the technology of the parent company. On the other hand, they ignore local conditions, which are known by local workers and the subsidiary CEO if he is local. Figure 1 summarizes the distribution of information asymmetries as function of the subsidiary CEO. The relative importance of transferring the technology and adapting to local conditions in the profits of the subsidiary as well as the distributional properties of both information sets determines what CEO minimizes the overall negative impact of information asymmetries. Because the expatriate CEO knows the headquarter technology, but the local CEO knows local conditions, multinationals have to choose between who is the best leader, i.e. the expatriate, and who is the best supervisor, i.e. the local manager. This trade off depends on the technological intensity of the subsidiary production and the uncertainty of local conditions. We proceed as follows: The first section describe the assumptions of the model(technology, information structure, contract space and players). The second section presents the multinational's choice of their subsidiaries CEO. The third section presents the entry decision. Proofs and derivations not found in the text are in the model's appendix.

[20]The model is a modified version of the model developed in the theoretical paper "Leadership meets Culture: Multinationals subsidiaries CEOs" by Santacreu-Vasut(2010). Those readers not interested in the details of the theory can go to Section 4, where we discuss the intuitions behind the results we take to the data.

Structure of the game



Note 1: ``LOCAL CEO (λj)" should be read as: the local CEO information set is equal to λj.

Note 2: Design Team Workers information set is empty.

Legend: - - - - - - - Information asymmetry

_____ No information asymmetry

__ __ __ Information transmission

Figure 1: MNCs choice of their subsidiary CEO and information asymmetries along the hierarchy

3.1 Assumptions

3.1.1 Technology

Let V be the total value of the subsidiary production. It is a function of the value generated in a transfer and an execution stage.[21] Namely, V= F(T,X). V is strictly increasing in T and X.[22]

The transfer stage involves team production. There are N_t workers in the transfer team. The CEO is part of the team and exerts effort as well.[23]The effort provided by a member of the team is unobservable and cannot be contracted upon. The transfer value is equal to $T = \sum_{n=1}^{N_t} \theta_i e_n$ where θ_i denotes the value of the technology to be transferred.

The execution stage value is equal to $X = \sum_{n}^{N_x} e_n$. There are N_x workers in the execution stage, distinct from the transfer stage workers. The CEO does not exert effort at this stage.[24]The effort exerted by a given execution worker is observable and contractible upon for all n

3.1.2 Workers Preferences

Workers in the team enjoy utility is $w - d(e)$, where w is a wage and $d(.)$ is an increasing, convex and thrice differentiable function s.t d(0)=0, d'(0)=0. Let $d(e) = \frac{1}{2}e^2$ and normalize reservation utilities U_r of every worker to zero.

Workers in the execution stage enjoy utility: $w - d(e)$ where w is a wage and $d(.)$ is an increasing, convex and thrice differentiable function s.t d(0)=0, d'(0)=0. Let $d_i(e) = \lambda_i e^2$ and normalize reservation utilities U_r of every worker to zero. λ_i reflects the inefficiency of local conditions.

3.2 Information Structure

The distributional properties of θ_i are common knowledge. If the CEO is an expatriate, he knows the realization of θ_i . If the CEO is a local manager he ignores θ_i. Workers ignore the

[21]The execution stage can be interpreted as the relation between the firm and external suppliers.
[22]We will impose further assumptions on F later on.
[23]We can think of them as white collar workers.
[24]We can think of them as blue collar workers.

realization of θ_i. The Headquarter knows the realization of θ_i after deciding whether to rely on an expatriate or a local manager, but before the transfer team members choose their effort.

The distributional properties of λ_i are common knowledge. If the CEO is from the local economy, he knows the realization of λ_i before paying workers. If the CEO is an expatriate from the headquarters, he ignores λ_i. Workers know the realization of λ_i.

3.3 Contract Space

A contract in the transfer team is a set of contingent wages $w_n(T, \hat{\theta})$ for all $n \epsilon N_t$ where $\hat{\theta}$ is the announced value of θ. We restrict attention to renegotiation proof and feasible contracts, that is, such that $\sum_n^{N_t} w_n(, \hat{\theta}) \leq T$. We assume that each worker holds the same beliefs on θ conditional on the announcements. By proposition 1 of Hermalin (1998), this allows us to consider only affine shares contract without loss of generality. We restrict contracts to be equal shares contract. We do so because the transfer value is likely to be nonmonetary or indivisible and so will be equally shared by all the workers involved at that stage. We do discuss the implications of relaxing this assumption for the results we obtain. The headquarter appropriates a fraction η of the transfer value. η can be either exogenous or endogenous. In the former case, it may be so due to some technological property of the production process. In the latter case, the optimal fraction the HQ appropriates is $\eta = \frac{1}{2}$. The local team shares $1 - \eta$ of the transfer value.

The execution stage takes place after the transfer stage. Given T, the CEO is given a positive but negligible bonus as a function of X.

The following table summarizes the parameters and main variables of the model.

3.4 Multinational's Choice of Subsidiary CEO

Conditional on entry, the multinational chooses who to hire as its subsidiary CEO. Given the information structure described above, the multinational faces a trade off between hiring an expatriate, who knows the value of the technology, and hiring a local manager, who is familiar with local conditions. In what follows we start by deriving the advantages of the expatriate in transferring technology. We then derive his disadvantages in dealing with local conditions.

Parameter	Parameter space	Description
θ_i	(θ_h, θ_l)	Value of the project (technology) transfered
p_i	(p_h, p_l)	Probability of high value or low value project
λ_j	(λ_h, λ_l)	Local inefficiency
q_i	(q_h, q_l)	Probability high or low local inefficiency
η	[0,1]	Share of the transfer stage appropriated by Headquarters.[25]
N_t	$[2,+\infty)$	Size of the transfer team
N_x	$[1,+\infty)$	Size of the execution stage workforce
Variable	**Function**	**Description**
V	$V = F(T, X)$	Production output of subsidiary
T	$T = \sum_{n=1}^{N_t} \theta e_n$	Output of the transfer stage
X	$X = \sum_{n}^{N_x} e_n$	Output of the execution stage

Table 3: Parameters and main variables of the model

Finally, we show under what conditions (properties of the technology to be transferred and the extent of local inefficiency and uncertainty) the former outweighs the latter and so an expatriate is hired (and viceversa).

3.4.1 Technology Transfer

Transferring technology to the subsidiary involves both a flow of information from the Headquarter to the local workers and an adoption effort from the local team. In particular, assume that the value of the technology transferred can be high (equal to θ_H), with probability p_H, or low (equal to θ_L) with probability $1 - p_H$. Therefore, the marginal product of effort to adopt the technology is increasing in the value of the technology. As a result of this complementarity and because local workers ignore the technology, workers' effort at this stage will depend on their beliefs about its value. Announcing the value of the technology from the Headquarters will not be credible, as the HQ has incentives to fool workers.[26] Therefore, transmitting information on the value of the technology must be costly to be credible.

The choice of the subsidiary CEO affects the set of available strategies to transfer the technology as follows: The first option is to choose an expatriate CEO. Because the expatriate knows the value of the technology, his presence in the subsidiary means that he can use his own effort to credibly transmit information. That is, in terms of Hermalin(1998) leadership theory, he can *lead*

[26]Please refer to the appendix for the derivation and proof.

by example. Alternatively, the expatriate can make side payments to the members of his team whenever the technology is of high value. This is what Hermalin(1998) calls *lead by sacrifice*. The second option is to hire a local CEO. In this case leading by example is not in the set of available strategies because the subsidiary CEO ignores θ_i. Therefore, the headquarter must make side payments to the members of his team to transmit the information. Hermalin's leadership theory finds a natural application in this setting.

By assumption, the fraction $(1-\eta)$ of team's output is shared evenly among the team members. Consequently the utility of worker j in the transfer team is:

$$\frac{\theta}{\frac{J}{1-\eta}}(e_j + \sum_{m \neq j} e_m) - \frac{1}{2}e_j^2 \tag{1}$$

Let $\theta^E(\mu)$ be the expected value of θ given $p_H = \mu$. The best response of a given workers to $\theta^E(\mu)$ is

$$e^{BR} = \frac{\theta^E(\mu)}{\frac{J}{1-\eta}} \tag{2}$$

Let $r(\mu) = (J-1)e^{BR} = \frac{J-1}{\frac{J}{1-\eta}}\theta^E(\mu)$ be the collective reaction of the workers in the transfer team.

Expatriate CEO: leading by example

Assume that the CEO can exert effort prior to the rest of workers and that this effort is observable but not verifiable. If so, he can signal the value of the technology using his own effort. In principle the expatriate could also lead by sacrifice, but Hermalin(1998) shows that leading by example is superior because it boosts the team total effort (which is optimal given that teams effort free riding problem). The appendix derives the case in which the expatriate leads by sacrifice.

The utility of the CEO is:

$$u(\mu, x, \theta) = \frac{\theta}{\frac{J}{1-\eta}}(x + r(\mu)) - \frac{1}{2}x^2 \tag{3}$$

If $\theta_i = \theta_L$, the CEO chooses

$$x(\theta_L) = \frac{\theta_L}{\frac{J}{1-\eta}} \tag{4}$$

that maximizes $u(0, x(\theta_L), \theta_L)$. In that case, the rest of workers choose $e = \frac{\theta_L}{\frac{J}{1-\eta}}$ and $T_L = (1-\eta)\theta_L^2$.

If $\theta_i = \theta_H$, the CEO chooses

$$x^e(\theta_H) = \frac{\theta_L + \sqrt{2}\sqrt{(J-1)\theta_L(\theta_H - \theta_L)}}{\frac{J}{1-\eta}} \tag{5}$$

such that $u(1, x(\theta_H), \theta_L) = u(0, x(\theta_L), \theta_L)$. In that case the rest of workers choose $e = \frac{\theta_H}{\frac{J}{1-\eta}}$ and

$$T_H = \theta_H^2 \frac{J-1}{\frac{J}{1-\eta}} + \theta_H\left(\frac{\theta_L + \sqrt{2(J-1)\theta_L(\theta_H - \theta_L)}}{\frac{J}{1-\eta}}\right) \tag{6}$$

Result 1: Assume that the transfer team is big enough, namely assume $J > (1 + \frac{2(\theta_H - \theta_L)}{\theta_L})$. *Then, the CEO effort in the transfer stage is higher when he leads by example than when he leads by sacrifice. Furthermore, this difference is increasing in* θ_H.

That is, normalizing $\theta_L = 1$ across firms, those for which the good project has a higher value, for instance in high technology industries, benefit relatively more from the ability of the expatriate to lead by example.

By boosting the CEO's effort, leading by example boosts the team's overall effort, which is optimal and welfare improving given the chronic under provision of effort involved in team production. As discussed in Hermalin (1998), one can improve further effort provision by not imposing equal sharing rule. In particular, because the manager has an extra motive to provide

effort (convince workers), one could decrease the manager's share of the transfer value and increase the rest of the team share. This would be welfare improving and increase total effort as long as the team is big enough.

The expected value of the transfer stage if the CEO is an expatriate and leads by example is equal to:

$$E(T^e|LE) = p_H(\theta_H^2 \frac{(J-1)}{\frac{J}{1-\eta}} + \theta_H(\frac{\theta_L + \sqrt{2(J-1)\theta_L(\theta_H - \theta_L)}}{\frac{J}{1-\eta}})) + (1-p_H)(1-\eta)\theta_L^2 \quad (7)$$

Result 2: The expected value of the transfer stage, $E(T^e|LE)$ when the expatriate leads by example is increasing in θ_H and in p_H. Further, $\frac{\delta E(T^e|LE)}{\delta \theta_H \delta p_H} > 0$

That is, firms that are more likely to have a good project, and whose good project is of higher value generate higher value in the transfer stage. Further, having a potentially high value good project is of more value to firms with higher likelihood of having a good project.

Corollary of result 2: When $\theta_H = \theta_L$ and/or when $p_H = 0$, the value of the transfer stage is identical under an expatriate CEO that leads by example or by sacrifice.

Local CEO: Headquarter leading by sacrifice

If the CEO is a local manager, he ignores the realization of θ_i. Consequently, he cannot lead, neither by sacrifice nor by example, and he behaves as a regular worker in the transfer stage. The headquarter, on the other hand, knows the realization of θ_i. To act as a leader, the only option the HQ has is to lead by sacrifice.[27]

By assumption, the HQ gets ηT of the value of the transfer stage. Let $\Omega(\mu, x, \theta_i)$ be the fraction of profits accrued to the HQ when workers believe that the probability of the good state is equal to μ, the HQ sacrifices x and the true state is θ_i.

[27]This is so because we assume that the HQ CEO does not exert effort in the subsidiary. This assumption can be relaxed. The crucial aspect is that the headquarter are geographically distant from the subsidiary and therefore cannot exert effort prior to the rest of workers in an **observable** manner.

In particular,

$$\Omega(\mu, x, \theta_i) = \eta(1-\eta)(\mu\theta_H + (1-\mu)\theta_L)\theta_i \tag{8}$$

In the least cost separating equilibrium, $x^{HQ}(\theta_L) = 0$ and $x^{HQ}(\theta_H) = \eta(1-\eta)[\theta_H\theta_L - \theta_L^2]$. That is, such that $\Omega(1, x, \theta_L) = \Omega(0, x, \theta_L)$. The expected cost of transmitting information is $p_H x^{HQ}(\theta_H)$.

Result 3: Headquarters expected cost of credibly transmitting the information when they rely on a local manager is increasing in p_h and in θ_H.

Given these

$$E(T^l|HQ) = p_H(1-\eta)\theta_H^2 + (1-p_H)(1-\eta)\theta_L^2 \tag{9}$$

Result 4: The transfer expected value is lower when the subsidiary CEO is local than when he is an expatriate that leads by example.[28]

Result 5: Expected profits obtained in the transfer stage are higher under an expatriate CEO than a local CEO, and this is even more so for firms with high probability of high value technology (with high p_h and high θ_H).

There are two reasons for the first part of this result. First, when an expatriate CEO is relied upon, he can lead by example and has an additional motive to exert higher effort (convince workers that the technology is of high value). Second, an expatriate internalizes the cost of information transmission, given that he is part of the team, a cost that the headquarters has to afford when they rely on a local CEO. The value of relying on an expatriate CEO is increasing in p_h and θ_H because they make the need and cost of credibly transmitting information more acute.

[28] In the appendix we derive the case when the expatriate manager can only lead by sacrifice and compare the cost of transmitting information.

Let LT denote the loss in the transfer stage from relying on a local CEO. LT is equal to

$$LT = p_H\eta(1-\eta)[\theta_H(\underbrace{\frac{\theta_H}{J} - \frac{\theta_L + \sqrt{2(J-1)\theta_L(\theta_H-\theta_L)}}{J}}_{example<0}) - \underbrace{(\theta_H\theta_L - \theta_L^2)}_{sacrifice>0}] \tag{10}$$

.

$LT < 0$ follows from result 5.

3.4.2 Local Conditions

$\lambda_i = \{\lambda_H, \lambda_L\}$ captures the inefficiency of local conditions. It may be high, with probability q_H, or low, with probability $1 - q_H$. This parameter is common to all local workers and captures aspects of the cultural, political and legal local conditions. In particular, we assume that λ_i is the marginal cost of effort of local workers in the execution stage.[29]

If a local manager is relied upon, he knows λ_i and can obtain first best level of effort from workers.[30] On the contrary, if an expatriate is relied upon, he ignores local conditions and can only obtain second best level of effort. We derive the optimal contract in the case in which workers are able to collude against the manager. The appendix includes the optimal contract, a direct revelation mechanism, when workers are unable to collude, that achieves first best.[31] In the appendix we also show that if the expatriate manager offered the contract designed by the local CEO, workers would have incentives to fool him and extract rents from him. In particular, they would work as if local inefficiency was always high, that is $\lambda_i = \lambda_H$.

The expatriate manager will offer a state contingent contract, (w_j^e, e_j^e) for $j = H, L$ in order to maximize expected profits, $E[\prod^e]$, s.t participation and incentive constrains, IR_L, IR_H, IC_L, IC_H.[32]

In particular, he will offer

[29] An alternative interpretation is that λ_i reflects the inefficiency of local suppliers.

[30] The first best contract he offers and its derivation is available in the appendix.

[31] The assumption that collusion is impossible and that the manager relies on the "shot them all mechanism" is unrealistic and uninteresting.

[32] The derivation is included in the appendix superscript.

$$w_H^e = \lambda_H \frac{1}{4[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]^2} \tag{11}$$

and

$$w_L^e = (\lambda_H - \lambda_L)\frac{1}{4[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]^2} + \frac{1}{4\lambda_L} \tag{12}$$

with

$e_L^e = \frac{1}{2\lambda_L}$

$e_H^e = \frac{1}{2[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]}$

Expected output per worker when an expatriate CEO is hired is equal to

$$E[e^e] = q_H(\frac{1}{2[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]}) + (1 - q_H)(\frac{1}{2\lambda_L}) \tag{13}$$

and the difference in expected output between an expatriate and a local CEO is

$$E[e^e] - E[e^l] = q_H(\underbrace{e_H^e - e_H^l}_{<0}) + (1 - q_H)(\underbrace{e_L^e - e_L^l}_{=0}) \tag{14}$$

Result 7: In the execution stage the expatriate secures as much effort from local workers as the local CEO when local inefficiency is low, but less effort when local inefficiency is high.[33] *Therefore, expected output is lower under an expatriate manager.*

Result 8: Higher local uncertainty increases the expected output loss in the execution stage derived from relying on an expatriate CEO(relative to a local CEO)

The expected wage bill when an expatriate is relied upon is equal to

[33] This result is known as "efficiency at the top".

$$E[w^e] = q_H(\lambda_H \frac{1}{4[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]^2}) + (1 - q_H)((\lambda_H - \lambda_L)\frac{1}{4[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]^2} + \frac{1}{4\lambda_L}) \tag{15}$$

and the difference in expected wage between an expatriate and a local CEO is equal to

$$E[w^e] - E[w^l] = q_H(\underbrace{w_H^e - w_H^l}_{<0}) + (1 - q_H)(\underbrace{w_L^e - w_L^l}_{>0}) \tag{16}$$

Result 9: The expatriate CEO pays workers more than the local CEO when inefficiency is low. When inefficiency is high, the expatriate CEO pays workers less than the local CEO.

The expected profit per worker is equal to

$$E[\Pi^e] = q_H(\frac{1}{2[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]} - \lambda_H \frac{1}{4[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]^2}) + (1 - q_H)(\frac{1}{4\lambda_L} - (\lambda_H - \lambda_L)\frac{1}{4[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]^2}) \tag{17}$$

Result 10: Expected profits in the execution stage under an expatriate manager are a decreasing and convex function of q_h and of λ_H.

Result 11: The expected profits in the execution stage under an expatriate manager are lower than under a local manager. The difference is decreasing in λ_H and increasing with local uncertainty. That is, the difference in profits is a U-shaped function of q_H.

Let GE denote the expected gain in the execution stage from relying on a local CEO. GE is equal to

$$GE = N_x[q_h(\underbrace{e_H^l - e_H^e}_{>0} - \underbrace{w_H^l - w_H^e}_{>0}) + (1 - q_h)(\underbrace{e_L^l - e_L^e}_{=0} - \underbrace{w_L^l - w_L^e}_{<0})] \tag{18}$$

$GE > 0$ follows from result 11.

3.4.3 Choice of Subsidiary CEO

As shown before, the expatriate is better at transferring technology but worse at dealing with local conditions. When does the gain in the transfer stage out weight the loss in the execution stage? Assume that expected output from the subsidiary operation is additive in the transfer, T, and the execution stage, X.[34] That is, $V = T + X$ This assumption means that in terms of the total output generated by the subsidiary, these are perfect substitutes.[35]

Result 12: In the transfer stage, an expatriate CEO will outperform a local CEO. In the execution stage, a local CEO will outperform an expatriate

The multinational will choose the CEO, local or expatriate, that maximizes expected profits, which are equal to $E[\Upsilon] = E[V-(1-\eta)T-\sum_{N_x} w_x]$. Let's define $\Psi \equiv E[\Upsilon \mid Local]-E[\Upsilon \mid Expat]$, be the net impact on profits resulting from relying on a local manager rather than an expatriate. Therefore, $\Psi = GE + LT$.

The following graphs plot the profits generated under local and expatriate.

[34]If T and X are imperfect substitutes, $V = \alpha T + (1-\alpha)X$ and we can express Ψ as the weighted sum of the expected gain in the execution stage, GE, and the expected loss in the transfer stage, LT. It is straightforward to see that higher α increases the attractiveness from relying on an expatriate manager.

[35]We can relax this assumption in two plausible ways. First, V may be a weighted sum of T and X, where the weights are a function of the industry or export orientation for example. Second, T and X may be complements. That is, $V = T^{\alpha}X\{1-\alpha$. The formal derivation of how potential complementarities affect multinationals choice is ongoing work. Still, note that if complementary, it may happen that neither the expatriate nor the local CEO generate positive profits and that the multinational decides not to install a subsidiary even if there are no entry costs. That is, the model could generate endogenously barriers to multinational's expansion.

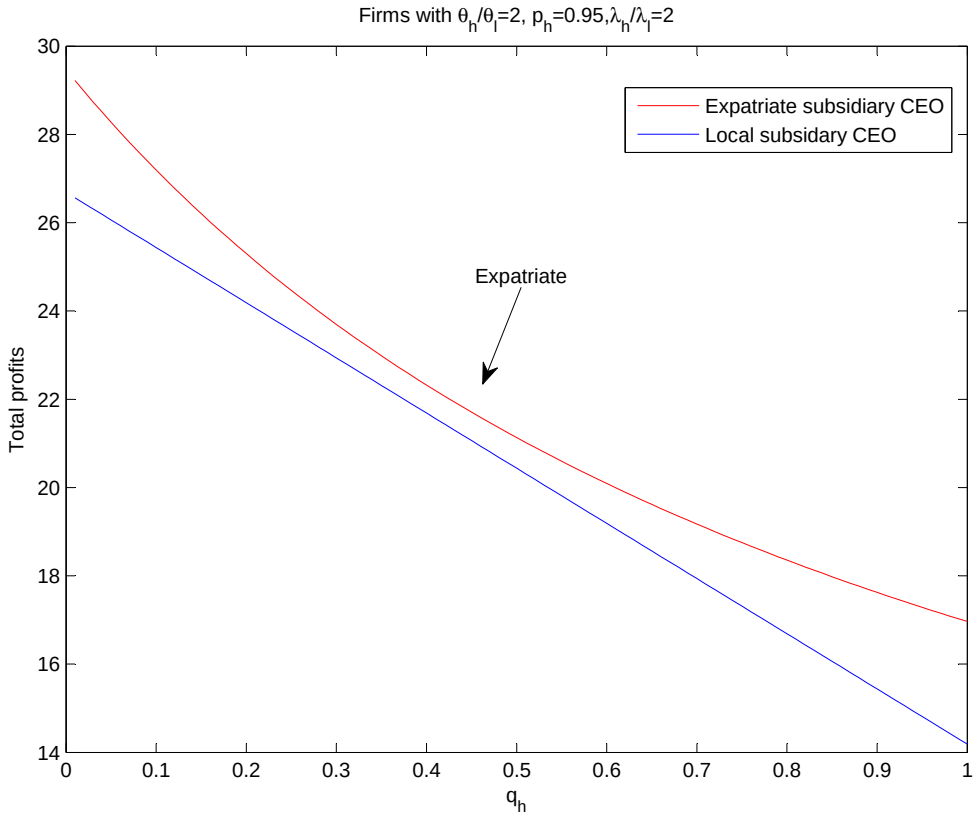


Figure 2: Case I: The expatriate is always preferred

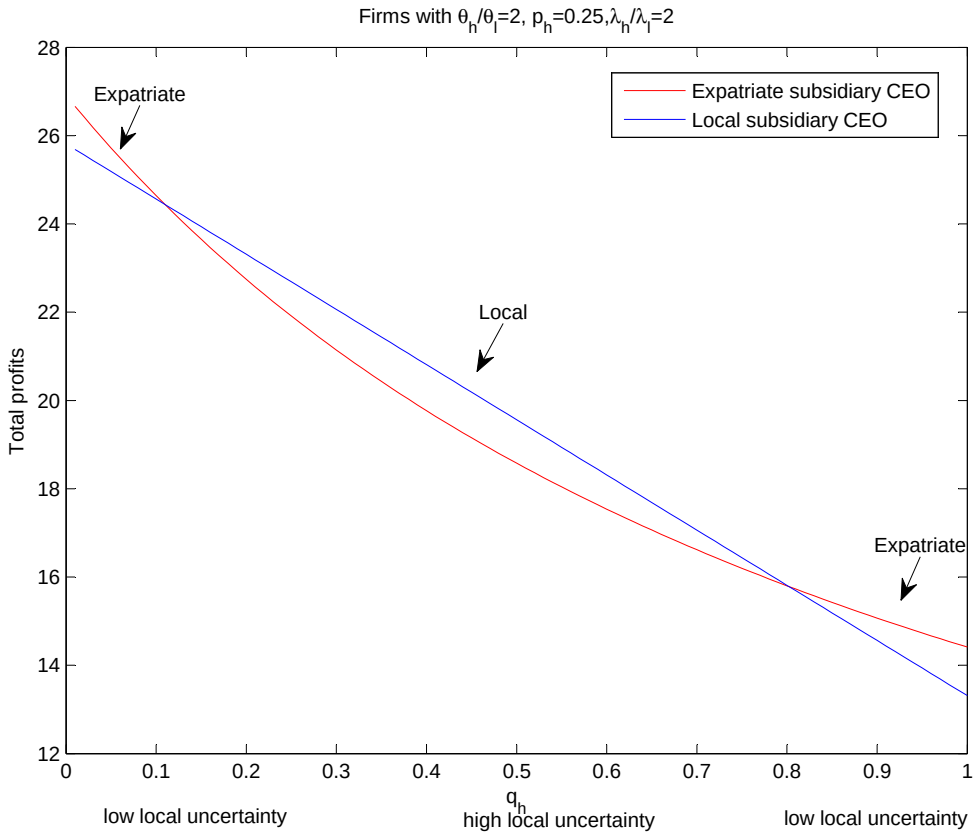


Figure 3: Case II:The expatriate (local) manager is preferred when local uncertainty is low (high)

As figure 2 illustrates, firms with very high value technology, and/or very high likelihood of good project in the transfer stage will always prefer to rely on an expatriate. This is true regardless of the amount of local uncertainty (which is highest when $q_H = 0.5$). The intuition is that for these type of firms the expatriate is very valuable in the transfer stage, overcoming his relatively lower performance as manager in the execution stage. In contrast, as figure 3 illustrates, firms that are not at the cutting edge of their technological sector will choose their subsidiaries manager as a function of local uncertainty. While they will rely on expatriates if uncertainty is low, they will prefer local managers when uncertainty is high.

This analysis allows us to address the following question: Are multinationals relying on expatriates doing so because they are constrained by a shortage of local managers?[36] Empirically, it is hard to distinguish multinationals for which an expatriate is optimal versus those for which a local manager was unavailable. Yet, the model allow us to identify conditions under which the multinational relying on an expatriate was constrained to do so.[37] In particular, let (q^d, q^u) denote the interval of q_H such that a multinational relying on an expatriate is constrained, where q^d and q^u are the roots of $\Psi = 0$. The interval is bigger for firms with lower p_H, lower θ_H and lower λ_H. That is, firms transferring projects to highly unstable economies, specially those with low technological content, would be better off relying on a local manager. If they do not, it must be that they are constrained by a shortage of local managers.

3.5 Entry Decision

In this section we derive the conditions under which the Multinational decides to enter (with an expatriate or with a local manager) and those under which it decides not to enter. To do so, we assume that the multinational faces a positive fixed and exogenous cost of entry, C. We analyze six cases according to the magnitude of the cost of entry. Let's index C from highest to

[36] Alternatively, multinationals may rely on expatriates because they have higher ability not because they need to transfer technology. Although we do not have data to proxy for ability, the case study of German plants in Mexico by Carrillo and Hinojoza (1999) supports our information based story in which German employees are said to be used for the "introduction of new product or process" (translation from Spanish)

[37] We say a multinational is constrained to rely on an expatriate manager when a local manager would have generated higher profit.

lowest such that $C_a > C_b > C_c > C_d > C_e > C_f$ and these thresholds are chosen as the graph shows and we detail later.

This exercise allows us to ask the following relevant and other related questions. What types of projects get implemented in high risk economies? Unstable developing economies are more likely to attract what type of multinationals? Should governments in developing countries invest in high education of future managers or in primary schooling? What are the consequences for the type of FDI they will attract? And for long run development? These questions are broad, and have consequences for the spread of technology across countries and economic development. In answering them, two issues are at hand: The amount of FDI a given country is able to attract and its composition.

Case 1: $C = C_a$ The multinational enters only if it can hire an expatriate and $q_H < q_a$.

Case 2: $C = C_b$ The multinational enters if $q_H < q_b$ and, if available, relies on an expatriate manager.

Case 3: $C = C_c$ The multinational enters if $q_H < q_c^e$ and, if available, relies on an local manager. If $q_{c^e < q_H < q_c^l}$, the multinational enters only if a local manager is available.

Case 4: $C = C_d$ The multinational enters if $q_H < q_d$ and, if available, relies on an local manager.

Case 5: $C = C_e$ The multinational enters if $q_H < q_e^l$ and, if available, relies on an expatriate manager. If $q_{l_c < q_H < q_c^e}$, the multinational enters only if an expatriate manager is available.

Case 6: $C = C_f$ The multinational enters if $q_H < q_f$ and, if available, relies on an expatriate manager.

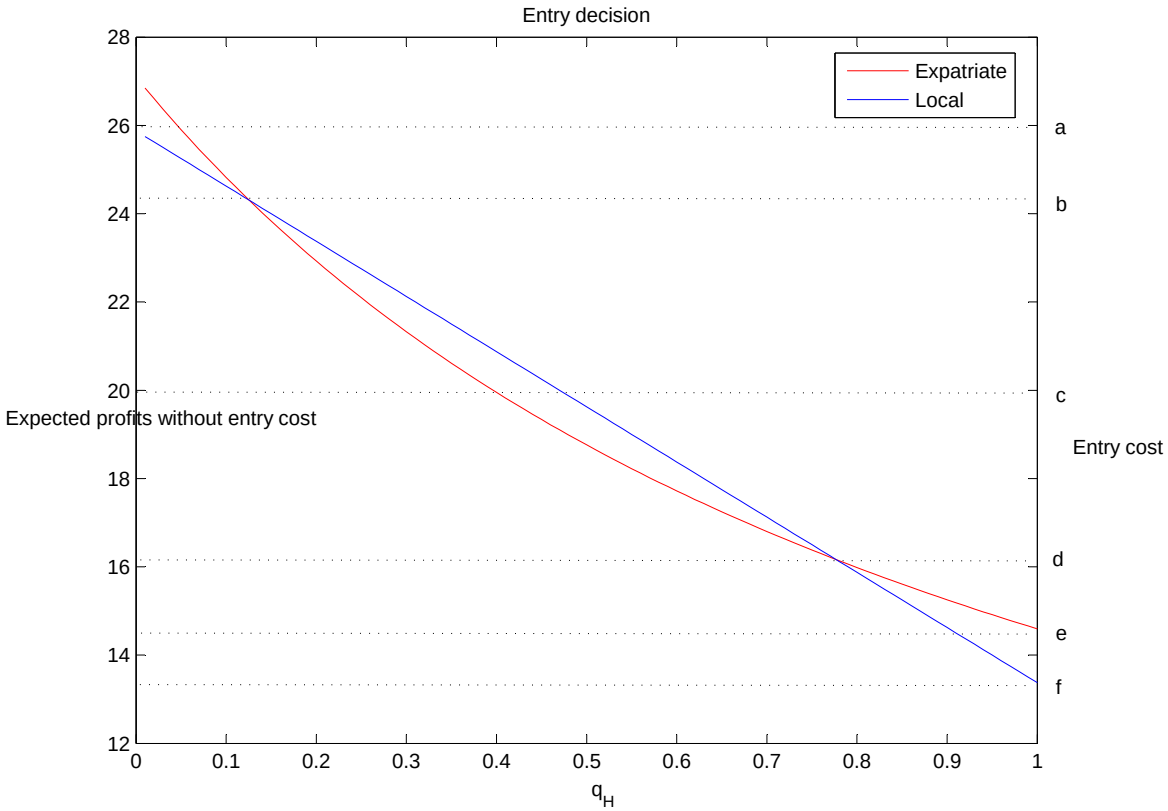


Figure 4: Entry cost, managerial choice and entry decision

Case 3 is particularly interesting. It allows us to understand the consequences for a developing country from lacking a pool of local managers. Multinationals facing a fixed cost of entry that is neither very high nor very low, lacking a pool of local managers will impede entry in countries with high local uncertainty. Under these circumstances, therefore, such countries will attract lower amounts of FDI and its composition will be biased towards firms in the technological edge. That is, with good projects of high value (high θ_H relative to θ_L) and with high probability of being successful (high p_H). The intuition behind this result is that these type of firms, even when facing high local uncertainty will benefit greatly from relying on an expatriate in the transfer stage. Unstable economies that lack a pool of local managers will benefit from this composition bias if spillovers are higher for this type of firm but will attract lower overall FDI levels. Investing in educating local managers will therefore increase the absolute attractiveness of the country but will also affect the composition of FDI. The consequences of this composition-quantity trade-off for economic development are an interesting issue for future exploration. Rather than investing on creating a local pool of managers, a country can invest in primary schooling (equivalent to decrease λ_L). This will represent a shift in the profit function of the multinational both when relying on expatriate and local subsidiaries manager. This shift will increase the absolute attractiveness of the country for a given cost of entry. What are the consequences for the composition of FDI? The answer depends on the degree of local uncertainty and the availability of local managers. If local managers are available, it will bias the composition of FDI towards firms with lower value of good projects (low θ_H). If local managers are not available, it will bias the composition of FDI towards firms with higher value of good projects. Consequently, unstable economies that lack a pool of local managers will benefit more from investing in primary education if their goal is to attract firms at the technological edge.

This section constitutes a first attempt to address issues of composition-quantity trade-off in developing countries FDI educational related policies. Using the model, one can also address the impact of visa policies for expatriates and of measures that directly affect entry cost. SHOULD WE KEEP THE SENTENCE COMING HERE?: Matching the model's predictions with cross

country data on entry, industry composition of FDI flows, local uncertainty and subsidiaries managerial choices is next in our research agenda.

4 Discussion

In this section we summarize and discuss the theoretical results derived from the model that we bring to the data.

Regarding the relation of expatriates and technology transfer the following results are relevant:

Result 1: Assume that the transfer team is big enough, namely assume $J > (1 + \frac{2(\theta_H - \theta_L)}{\theta_L})$. *Then, the CEO effort in the transfer stage is higher when he leads by example than when he leads by sacrifice. Furthermore, this difference is increasing in* θ_H.

Result 2: The expected value of the transfer stage, $E(T^e|LE)$ *when the expatriate leads by example is increasing in* θ_H *and in* p_H. *Further,* $\frac{\delta E(T^e|LE)}{\delta \theta_H \delta p_H} > 0$

Result 3: Headquarters expected cost of credibly transmitting the information when they rely on a local manager is increasing in p_h *and in* θ_H.

Result 4: If the subsidiary CEO is local, the transfer expected value is lower than when the subsidiary CEO is an expatriate that leads by example.[38]

According to these results, multinationals employing expatriates engage in more technological transfer, and more so in technology intensive industries. The mechanism behind this result is as follows. Transferring technology involves sending information about the value of the technology, as well as the effort of a team of local workers, among them the subsidiary CEO, in receiving and making effective the use of this technology. Because the effort of workers in the transfer stage is complementary to how good the technology is, sending information on its value will be costly and more so for firms in technology intensive industries. Expatriates, familiar with the technology, can use their own effort to signal the value of this technology, that is lead by example. This is a cheaper way to communicate information on the value of the technology than signaling giving gift from headquarters, that is lead by sacrifice. This is so because the expatriate internalizes

[38] In the appendix we derive the case when the expatriate manager can only lead by sacrifice and compare the cost of transmitting information.

part of the cost and boost the transfer stage team's overall effort, given that he has an extra motive to exert effort (signaling). Therefore, multinationals in technology intensive sectors find it more valuable to hire an expatriate, and the expatriate's leading by example boosts local efforts to adopt the technology.

Regarding the relation between the local conditions (local inefficiency and local uncertainty) and the reliance on expatriates the following results are relevant:

Result 10: Expected profits in the execution stage under an expatriate manager are a decreasing and convex function of q_h and of λ_H.

Result 11: The expected profits in the execution stage under an expatriate manager are lower than under a local manager. The difference is decreasing in λ_H and increasing with local uncertainty. That is, the difference in profits is a U-shaped function of q_H.

In the model, uncertainty over local conditions, in particular labor costs, is captured by the probability, q_H, that worker's cost of effort is high ($\lambda_i = \lambda_H$).[39] The model results mean that higher uncertainty over local conditions increases the relative value from hiring a local manager, who is familiar with local conditions and so outperforms the expatriate in the execution stage. That is, when q_h is low, increasing it leads to lower reliance on expatriates. When q_h is high, increasing it leads to higher reliance on expatriates. Therefore, the model predicts that subsidiaries in more unstable locations are more likely to rely on local managers. This is more so for firms in non-technological intensive industries, that may be more willing to afford the (lower) cost of not relying on an expatriate in terms of technology transfer. Result 11 also states that locations with lower inefficiency in the bad scenario, that is lower λ_H, will benefit more from having the local manager.

Regarding the analysis of the entry decision we find that the supply of local managers will be most critical for locations with high local instability and average fixed costs of entry. This is because the value of local managers is higher in more unstable locations, as previously discussed.

[39]In particular, uncertainty is maximized when $q_H = 0.5$. An example of such uncertainty is related to political risks or political willingness to undertake reforms. Location with high political risks may be more likely to experience strikes, which increase the cost of effort, for example, making commuting to the workplace more costly for workers. Local managers, familiar with the political, legal and cultural conditions of the location will be better positioned to anticipate these risks than the expatriate.

Therefore, the attractiveness for FDI will be lower for locations with high local uncertainty. Yet, our model allow us to say more than that. In particular, our analysis shows that the composition of FDI to an unstable location that lacks a supply of local managers will be biased towards multinationals in technology intensive sectors. This is so because for these type multinationals it is key to rely on expatriates, and they are willing to afford the costs this involves in the execution stage. Therefore, developing countries face a quantity-composition trade off when developing a supply of local managers.

In addition to the predictions mentioned above, the model bears predictions on the type of firms hiring expatriates with an additional assumption. In particular, result 4 and the following results

Result 7: In the execution stage the expatriate secures as much effort from local workers as the local CEO when local inefficiency is low, but less effort when local inefficiency is high. Therefore, expected output is lower under an expatriate manager.

Result 12: In the transfer stage, an expatriate CEO will outperform a local CEO. In the execution stage, a local CEO will outperform an expatriate

Under the assumption that export oriented firms are more transfer-stage intensive activities while domestic sales oriented firms are more execution intensive activities, the theory predicts that firms hiring expatriates are more likely to be export oriented (while less likely to serve the domestic local market). The mechanism behind this result is that expatriates are particularly valuable for the transfer of technology, while disadvantaged when dealing with local conditions. Consequently, firms whose transfer-stage is a more important input than the execution stage does will find it more valuable to hire an expatriate. Although this discussion here is not directly related to the model as previous ones, this is useful because this shows that not all the performance measures of plants are positively correlated with expatriates. While the model highlights the benefits from hiring an expatriate it also makes explicit its costs, which differentiates itself from a simple alternative productivity-driven story that more productive firms employ expatriates and at the same time excel in every measure.

5 Additional Empirical Results

5.1 Data

The source of information is the *Encuesta Sobre Investigación y Desarrollo de Tecnología* (ESIDET) [Survey on Research and Development of Technology]. This is a confidential survey carried out by the Instituto Nacional de Estadísticas, Geografía (INEGI) [National Institute of Statistics and Geography] of Mexico for the Consejo Nacional de Ciencia y Tecnología (CONACYT) [National Council of Science and Technology]. It has surveys for three sectors: production, education, and government. We will use the data for production, which includes both manufacturing and service sectors. The survey contains information on several aspects of innovative activities: expenditures, human resources and collaborating firms and institutions. It includes information on expenditures for each type of R&D: product R&D and process R&D. We use the 2002 surveys.[40] Each survey elicits information for the previous two years, but for this paper we focus on the cross-sectional variation and report the result for 2000. [41] The key variable is technology transfer, which is defined in the survey as expenses for international technology transfer [egresos por transferencia de tecnología (internacional)] and includes the cost for purchase or licence of patents and other non-patented inventions, revelation of know-how, and technical assistance. One limitation of the data is that we are not able to distinguish between technology transfer from parents and from other firms. However, we think that the variable is mainly consist of technology transfer from the headquarters, as Branstetter, Fisman and Foley (2006) suggest that the mean of royalties paid by affiliates to their headquarters is 0.7 percent (after the patent reform for all the countries), which is actually larger than the mean of the variable in our sample (0.3 percent).

[40] Surveys were done in 1996, 1998, 2002, 2004 and 2006. Teshima (2008) has used the same data to analyze the impact of import competition on different types of innovative activities.

[41] The qualitative results do not change if we use 2001. The advantage of using a panel would be to allow for plant-fixed effects, but the use of expatriates does not change within plants much over a few years, which leaves us little variation within plants.

5.2 Summary Statistics

Table 5 presents summary statistics. We report the mean and the standard deviation of each variable by whether plants have foreign expatriates. Plants with expatriates have larger volumes of total sales and employment. The summary statistics for domestic sales and exports show that plants with expatriates are more export-oriented. They are consistent with the model's prediction that higher productive plants and export-oriented plants are more likely to choose expatriates. We do not find a statistically significant difference of the number of domestic employees. Plants with foreign expatriates have on the average 12 foreign employees.

5.3 Empirical Results

We proceed in the following way. We first investigate whether Mexican subsidiaries of MNCs hiring foreign employees spend more in technology purchase from abroad, and this is correlation is stronger in industries whose R&D intensity is high in the U.S., a typical headquarter country. In the following section, we investigate whether Mexican states with higher levels of judicial efficiency (an inverse measure of local inefficiency whose increase will also increase local uncertainty) find more/less expatriates and foreign firms. We also explore the composition of the industries in terms of R&D intensity. Finally, we examine whether the reliance on foreign employees is correlated with export status, domestic sales and total sales, as a robustness check rather than a direct test of our hypothesis.

5.3.1 Plant-level correlates of expatriates

As we discussed at length in the previous section, the theory predictions that we confirm in the data in this section is that technology transfer is positively correlated with the use of expatriates and more so for technology intensive industries.It is important to note that we are not directly identifying the causality of either the causes or the consequences of MNCs' decision regarding expatriates. The theory predicts correlates of expatriates both as causes and consequences and more importantly the theory also predicts the correlation is stronger for plants or industries with

some characteristics, which is what we would like to examine in the data. [42]

First, we analyze the correlation between expatriates and technology transfer. We run the following regressions.

$$\begin{aligned}(Tech\,Transfer/Sales)_{ij} &= \beta_1 D(Foreign\,Expatriates_{ij}) \\ &+ \beta_2 D(Foreign\,Expatriates_{ij}) * R\&D\,Intensity_j \\ &+ \beta_3 Exporter\,Dummy + \beta_4 Log(Employees_{ij}) + \mu_j + \epsilon_{ij}\end{aligned}$$

where $(TechTransfer/Sales)_{ij}$ is the expenditure on technology transfer from abroad over sales; $D(Foreign\ Expariates_{ij})$ is the dummy variable indicating whether a plant i in industry j has foreign expatriates, and μ_j is a industry fixed effect. We control for the exporter dummy and the log of the number of the employees to control for size and export orientation.[43]

The measure of $R\&D\,Intensity_j$ deserves detailed explanation. This is R&D intensity at the industry level and corresponds to the value of technology for the headquarter. We draw this information from a standard source, the U.S. Federal Trade Commission (FTC) Line of Business Survey from 1974 to 1977. The Line of Business Survey required firms to report separately R&D expenditures by industry, thus providing the most reliable industry-level information on R&D expenditures. The measure has been used in leading studies in international trade, such as Antràs (2003) and Kugler and Verhoogen (2008), for example. We made the concordance between FTC industry classification and Mexican industry classification by verbal industry descriptions.

Table 6 shows the results. We find significant positive effects of expatriates on the intensity of technology transfer even after controlling for size (log employment), exporter-dummy and industry dummies. The results indicate that plants with expatriates have a 0.2-0.3 % higher technology transfer intensity, which is economically very large.[44] This is consistent with the predictions of

[42] We aim to estimate the causal effects of local uncertainty on entry decision and the choice of expatriates using regional variation in such local uncertainty in our future work.

[43] We did not use total sales for independent variables because it appears in the left hand side variable.

[44] Note that the average intensity is 0.3 %.

the theory in that plants that rely more on expatriates are more likely to introduce technology from the parents abroad. Columns (1)-(4) confirm that this is true for both all the industries and for manufacturing industries. Column (5) confirms our prediction that the correlation is stronger for more R&D intensive industries. Furthermore, the coefficient on the expatriate dummy is exactly zero, which indicates that there is no relation between expatriates and technology transfer for a (hypothetical) industry with zero R&D intensity. This is consistent with the information transmission role of expatriates in our theory. These results suggest that foreign expatriates may be a big determinant of the technology transfer from the parent MNCs to their subsidiaries and this relation is stronger for R&D intensive industries.

5.3.2 Regional determinants of expatriates, foreign entry and technology contents of FDI

This section brings the predictions regarding the effect of local inefficiency and uncertainty to the data. We use the data on lawyers' perception about the judicial efficiency in terms of financial contract of each Mexican state collected by ITAM/GMA (1999) as measure of average local inefficiency[45]. Though the ITAM study collected the data focusing on the legal enforcement of financial contracts, it fits our model if we reinterpret the workers in the execution stage in our model as suppliers of intermediate products. The measure captures the mean score along dimensions such as the quality of judges, the adequacy of judicial resources or the efficiency of enforcement of rulings, among others, the measure mainly reflects variations on q_h (the probability that local inefficiency is high) across states rather than variations in λ_h(which would reflect different legislations, for example).[46] In the discussion section we saw that at a high levels of q_h (low level of judicial quality), the dependence on expatriates is decreasing in judicial quality,

[45]This measure has been used by Laeven and Woodruff (2007), who discuss this measure in detail. Briefly the measure is the mean score along several dimensions such as the quality of judges, the adequacy of judicial resources, the efficiency of enforcement of their rulings, the efficiency of the judicial administration, completeness of property registries and the adequacy of local legislation related to contract enforcement. They also make the geographic pattern of the variable in Figure 1of their paper an note that "While there is some pattern of legal institutions improving as we move north in Mexico, Figure 1 makes clear that geography alone does not explain the variation in judicial effectiveness."

[46]Although we cannot distinguish them empirically, the model predicts that locations with lower λ_h should have lower reliance on expatriates.

while at a low levels of q_h, the dependence on expatriates is increasing in judicial quality.

In our analysis, we excluded one outlier state, Aguascalientes, which has by far the best average score (4.59) while the second best state has a score of 3.4. The mean and the standard deviation of the score are 2.78 and 0.56, respectively.

We run the regression of the following form:

$$D(Foreign\ Expariates_{ijs}) = \beta_1 Judicial\ Efficiency_s + (X_{ij}) + \mu_j + \epsilon_{ijs}$$

$Judicial\ Efficiency_s$ is the measure of the Judicial efficiency at state s. Table 7 shows the results of the estimation using Probit. The table reports the marginal effects. For both all the industries and manufacturing, judicial efficiency reduces likelihood on employing foreign employees. One standard deviation (0.56 point) increase in the judicial efficiency is associated with about 8 to 12 percent decrease in the likelihood of employing foreign employees (The mean is 46.5 percent). The results in Table 7 suggest that Mexico lies in the regime with low level of judicial quality (high q_h).

Regarding our predictions on entry, the model predicts that in such regimes(with low levels of judicial quality) there will be more entry of foreign firms associated with an increase in judicial quality. It also predicts in such regimes the foreign plants attracted will be low-tech biased. The reason is that the increase in foreign entry is accompanied with less reliance on expatriates (which we already see in Table 7).

We then run the following regressions to confirm the predictions stated in the previous paragraph:

$$D(Foreign\ Ownership_{ijs}) = \beta_1 Judicial\ Efficiency_s + (X_{ij}) + \mu_j + \epsilon_{ijs}$$

and

$$R\&DIntensity_{js} = \beta_1 Judicial\ Efficiency_s + (X_{ij}) + \epsilon_{ijs}$$

Note that we cannot control for industry effects in the latter regression because $R\&DIntensity$ is defined at the U.S. industry level, allowing variations only at the industry level. Note also that the sample for the foreign ownership equation now includes all the plants, i.e. non-foreign plants from ESIDET.

Table 8 shows the results. The first to fourth columns show the results of the Probit estimation of the effect of uncertainty (judicial efficiency as an inverse measure) on likelihood of foreign ownership, while the fifth and sixth columns show the results of OLS estimation of the effect of same uncertainty on $R\&DIntensity$ defined at the U.S. industry level of the foreign firms that the state attracts. The first to the forth columns suggest that one standard deviation (0.56 point) increase in the judicial efficiency is associated with about 3 to 4 percent increase in the likelihood of the plants in the area being classifies as foreign owned (The mean is 21 percent). The fifth and the sixth columns suggest that one standard deviation (0.56 point) increase in the judicial efficiency is associated with about 1.4 percent decrease on $R\&DIntensity$ (defined at the U.S. industry level) of the foreign firms that the state attracts. This is quantitatively very large because the average $R\&DIntensity$ is 2.8 percent. These results are consistent with the theory that more entry of foreign firms associated with an increase in judicial quality, while attracting low-tech biased foreign firms.

6 Robustness check

Finally, we run regressions of the following form to examine more systematically whether plants with foreign expatriates are more likely to have higher total sales, export sales and domestic sales. We run the following regression:

$$Y_{ij} = \beta_1 D(Foreign\ Expariates_{ij}) + \beta_2 Log(Employees_{ij}) + \mu_j + \epsilon_{ij}$$

Columns (2) and (3) of Table 9 show that both the exporter dummy and exports sales are positively correlated with the use of expatriates, which is consistent with the conjecture that exports are positively correlated with the use of expatriates if exports are more transfer-stage intensive activities. Column (4) shows that domestic sales are not statistically significantly correlated with the use of expatriates, which is not perfectly consistent with the conjecture that domestic sales are negatively correlated with the use of expatriates if domestic sales are more execution-stage intensive activities. It may be the case that expatriates' technology transfer affect also positively the domestic sales which may offset their potential disadvantages in the execution stage. Although the results suggest that exploring the consequences of complementarities between transfer and execution stages is worthwhile, the fact that we do not find positive significant correlation between expatriates and domestic sales allows us to rule out the cases where (a) high productive firms choose to expatriates for reasons unrelated to our model and drives everything or where (b) some other factors are affecting both productivity and choice of expatriates. Finally, Column (1) shows that total sales as a whole is positively correlated with the use of expatriates.

7 Conclusion

In this paper we analyzed multinationals choice of their subsidiaries CEOs and related entry decisions in foreign markets. Namely whether, conditional on entry, they rely on foreign expatriates or local managers. We applied the information based theory of leadership of Hermalin (1998) and find that multinationals using cutting edge technology are more likely to employ foreign expatriates. These are key in fostering technological transfer to the subsidiary, given their ability to lead by exerting effort in the subsidiary. Doing so, they can convince workers of the value of the multinationals technology. In highly unstable economies, nevertheless, the expatriate managers

are unable to provide high incentives to local workers. Multinationals choice of their subsidiary CEO, as we analyze in the data, have important consequences in the local economy.

In particular, Mexican plant level data reveals that plants with higher productivity and higher export orientation are more likely to rely on expatriates. We also show that foreign expatriates are more likely to engage in technology transfer, and more so in R&D intensive industries. The magnitude of these results suggests that foreign expatriates may be a big determinant of the technology transfer from the parent MNCs to their subsidiaries. Further, using data on lawyers' perception about the judicial efficiency of each Mexican state collected by ITAM/GMA (1999) as measure of average local inefficiency we find that judicial efficiency reduces the likelihood on employing expatriates, which suggest that Mexico lies in the regime with low level of judicial quality. Regarding multinationals entry decision, our theory shows that developing countries face a composition-quantity trade-off when deciding to create a pool of local managers. Not doing so they may attract less FDI but its composition will be biased towards firms at the technological cutting edge. In the data we do find more entry of foreign firms associated with an increase in judicial quality, while attracting low-tech biased foreign firms.

A Appendix

A.1 Information Transmission and Incentives to Fool Workers[47]

Recall that a fraction $(1-\eta)$ of team's output is shared evenly among members of the transfer team. Consequently the utility of worker j in the transfer stage is:

$$\frac{\theta}{\frac{J}{1-\eta}}(e_j + \sum_{m \neq j} e_m) - \frac{1}{2}e_j^2 \tag{19}$$

[47]We show that an expatriate CEO has incentives to fool workers. It follows that the HQ has the same incentives.

Let $\theta^E(\mu)$ be the expected value of θ given $p_H = \mu$. The best response of a given workers to $\theta^E(\mu)$ is

$$e^{BR} = \frac{\theta^E(\mu)}{\frac{J}{1-\eta}} \tag{20}$$

Let $r(\mu) = (J-1)e^{BR} = \frac{J-1}{\frac{J}{1-\eta}}\theta^E(\mu)$ be the collective reaction of the workers in the transfer team.

Given $r(\mu)$ the CEO utility is equal to

$$\frac{\theta_i}{\frac{J}{1-\eta}}(e + r(\mu)) - \frac{1}{2}e^2 \tag{21}$$

Regardless of the realization of θ_i, the expatriate CEO utility is increasing in $r(\mu)$. Consequently, he has incentives to fool workers and announce $\hat{\theta} = \theta_H$ regardless of the truth. Anticipating this fact, workers will disregard any announcement from the CEO, and $\theta^E(\mu) = \mu\theta_H + (1-\mu)\theta_L$.[48]

A.2 Expatriate Leads by Sacrifice

To transmit information on the value of the project credibly, the CEO can *lead by sacrifice*. For example, he can spend resources in training workers or give them a gift. Let $\widehat{x}(\theta_i)$ be the amount the manager sacrifices (side payments) as a function of the value of the technology.[49] To minimize the cost of transmitting information, he will only give workers a monetary gift when the true state is θ_H.[50]

If $\theta_i = \theta_L$, the leader makes no sacrifice, $\widehat{x}(\theta_L) = 0$ and workers are certain that $\theta_i = \theta_L$. In

[48] From Hermalin(1998): "Valuable information is not utilized, which is suboptimal relative to a situation in which the leader is induced to announce her information truthfully."

[49] In a dynamic extension of the model that we are working on training will have not only a signaling value but will increase workers human capital next period. Depending on the substitutability or complementarity of manager and workers effort in the transfer team production this will have consequences for the choice of the manager itself. The Mexican data we analyze reveals that firms with foreign workers spend more on general purpose training of workers with above bachelor degree.

[50] This corresponds to the one shot least cost separating equilibrium analyzed in Hermalin(2007).

that case, he and the rest of workers choose $e = \frac{\theta_L}{\frac{J}{1-\eta}}$. $T_L = (1-\eta)\theta_L^2$.

If $\theta_i = \theta_H$, the leader will make a sacrifice to convince workers that the true state is θ_H. In particular, he will choose to give up a gift that would be too costly if the true state was θ_L and workers believed it was θ_H. That is, the CEO will choose

$$\widehat{x}(\theta_H) = \{x|\theta_L(\frac{2(J-1)\theta_L + \theta_L}{2(\frac{J}{1-\eta})^2}) \geq \theta_L(\frac{2(J-1)\theta_H + \theta_L}{2(\frac{J}{1-\eta})^2}) - x\} \tag{22}$$

The CEO will choose the minimum possible sacrifice,

$$\widehat{x}(\theta_H) = \frac{(J-1)\theta_L(\theta_H - \theta_L)}{(\frac{J}{1-\eta})^2} \tag{23}$$

In that case, he and the rest of workers choose $e = \frac{\theta_H}{\frac{J}{1-\eta}}$ and $T_H = \theta_H^2(1-\eta)$.

The expected value of the transfer stage if the CEO is an expatriate and leads by sacrifice is equal to:

$$E(T^e|LS) = (1-\eta)(p_H\theta_H^2 + (1-p_H)\theta_L^2) \tag{24}$$

Assume that the expatriate manager can only lead by sacrifice. Who needs to sacrifice more to convince the local design team on the value of the project, the headquarter or the expatriate manager?

The HQ will sacrifice more than the expatriate CEO if the following condition holds:

$$\eta(1-\eta) > \frac{J-1}{J^2} \tag{25}$$

That is, if what the HQ appropriates out of fooling workers is higher than what the expatriate CEO does then the former needs to sacrifice more than the latter. This is so because he has more incentives to fool workers. If the HQ can choose η, then it will optimally set $\eta* = \frac{1}{2}$ and $x^e(\theta_H) < x^{HQ}(\theta_H)$.[51] That is, it is more costly to transmit information from the HQ than via an expatriate CEO.

The cost of transmitting information from the headquarter is strictly increasing in η for $\eta < \frac{1}{2}$ and strictly decreasing in η for $\eta > \frac{1}{2}$.

A.3 First Best Contract of the Local CEO in the Execution Stage

The local CEO is familiar with the local environment and he is able to offer a contract contingent on the realization of λ_i. In particular, for each worker he chooses (e_{nj}, w_{nj}) to max $e_{nj} - w_{nj}$ s.t $w_{nj} - c(e_{nj}) = 0$ for $j = H, L$. The optimal contract, which achieves first best effort levels, is to offer, for all n, $(w_j^l = \frac{1}{4\lambda_j}, e_j^l = \frac{1}{2\lambda_j})$ for $j = H, L$.[52] That is, when local inefficiency in the local economy is high, the manager offers a low wage and demands a low level of effort. Vice versa when local inefficiency is low.

Ex-ante, total expected output in the execution stage per worker when a local CEO is hired is equal to

$$E[e^l] = q_H(\frac{1}{2\lambda_H}) + (1 - q_H)(\frac{1}{2\lambda_L}) \tag{26}$$

and the expected wage bill and the expected profit per worker is

$$E[w^l] = E[\Pi^l] = q_H(\frac{1}{4\lambda_H}) + (1 - q_H)(\frac{1}{4\lambda_L}). \tag{27}$$

[51] As long as $J > 2$ this condition holds.
[52] The superscript, l, denotes the solution under the local CEO.

Result 6: Expected profits in the execution stage when a local CEO is relied upon are a linear and decreasing function of q_H and λ_H.

Is the "local CEO contract" in the execution stage possible for the expatriate?

Is the first best solution in the execution stage available to the expatriate manager?

Assume the expatriate CEO decides to mimic the local CEO and offers workers two options: (x^l_{nH}, w^l_{nH}) and (x^l_{nL}, w^l_{nL}).

Will a given worker have the incentives to choose (x^l_{nH}, w^l_{nH}) when $\lambda_i = \lambda_H$? If he does so, he gets his reservation utility, that is equal to zero. If he chooses the contract intended for the low-cost scenario, and given that $\lambda_H > \lambda_L$, he gets $u(x^l_{nL}, w^l_{nL}; \lambda_H) = \frac{1}{4\lambda_L} - \frac{\lambda_H}{4\lambda_L^2} < 0$. Clearly, when the marginal cost of effort is high the worker has no incentives to pretend to be in the low cost scenario. The intuition is the following: In the low cost scenario, the worker is given his reservation utility. If in reality he has a higher cost of effort such a contract can only leave him worse off.

Similarly, will a given worker have the incentives to choose (x^l_{nL}, w^l_{nL}) when $\lambda_i = \lambda_L$? In the low cost scenario, the worker has an incentive to fool the manager and pretend to have high cost of effort. This is so because in the high cost scenario, the worker is given his reservation utility. If in reality he has a lower cost of effort such a contract can only leave him better off. In particular, $u(x^l_{nH}, w^l_{nH}; \lambda_L) = \frac{1}{4\lambda_H} - \frac{\lambda_L}{4\lambda_H^2} > 0$.

That is, if the expatriate tries to mimic the local CEO offer, he will invariably obtain low levels of efforts from workers, which will obtain a positive rent when their marginal cost will be low.

A.4 Optimal contract if collusion impossible

If workers are unable to collude with each other, the following direct revelation mechanism is optimal: For all n, $w_n(\hat{\lambda}) = 0$ if $x_n(\hat{\lambda}) \neq \frac{1}{2\hat{\lambda}}$ or $\hat{\lambda}_n \neq \hat{\lambda}_j$ for some $n \neq j$
and $w_n(\hat{\lambda}) = \frac{1}{4\hat{\lambda}}$ if $x_n(\hat{\lambda}) \geq \frac{1}{2\hat{\lambda}}$ and $\hat{\lambda}_n = \hat{\lambda}_j$ for all n,j. Where $\hat{\lambda}_n$ for $n = 1...N_x$ are the simultaneous announcements by the execution workers and $\hat{\lambda}$ is the vector of announcements. Under

such a mechanism, workers incentive compatibility and participation constraints are satisfied in a truth-telling Nash Equilibrium characterized by $e_n = e^*(\lambda_i) = \frac{1}{2\lambda_i}$ for all n. $e^*(\lambda_i)$ denotes the first best level of effort. Given announcements are simultaneous and assuming that there is no communication among execution workers and so, no collusion risk, truth-telling is a focal point.

The CEO is, in principle, able to obtain the first best solution in the execution stage. In such a case, his expected profits are identical as the ones the local CEO obtains. This result is, nevertheless, not robust to collusion risks if workers can communicate. In particular, it follows from the preceding analysis that workers will have incentives to collude and announce $\hat{\lambda} = \lambda_H$ regardless of the true local conditions.

B Proofs and Derivations

B.1 Proof of Result 1

CEO's effort when he leads by example is equal to $x^e(\theta_H) = \frac{\theta_L + \sqrt{2}\sqrt{(J-1)\theta_L(\theta_H - \theta_L)}}{\frac{J}{1-\eta}}$ and when he leads by sacrifice is equal to $\frac{\theta_H}{\frac{J}{1-\eta}}$.[53] For the first part of the result note that the difference, $D = \frac{\theta_L - \theta_H + \sqrt{2}\sqrt{(J-1)\theta_L(\theta_H - \theta_L)}}{\frac{J}{1-\eta}}$ is positive when $J > 1 + \frac{\theta_H - \theta_L}{\theta_L}$ which is satisfied under the assumption $J > (1-\eta)(1 + \frac{2(\theta_H - \theta_L)}{\theta_L})$ For the second part, the sign of the derivative of D with respect to θ_H is equal to the sign of $-1 + \frac{(J-1)\theta_L}{\sqrt{2(J-1)\theta_L(\theta_H - \theta_L)}}$ which is positive when $J > 1 + 2\frac{\theta_H - \theta_L}{\theta_L}$ and so the result follows.

B.2 Proof of Result and Corollary 2

It is straightforward to see that $\frac{\delta E(T^e|LE)}{\delta \theta_H} > 0$ and that $\frac{\delta E(T^e|LE)}{\delta \theta_H \delta p_h} > 0$.

$\frac{\delta E(T^e|LE)}{\delta \theta_H \delta p_h} > 0$ follows from the fact that $\theta_H > \theta_L$ and from result 1.

The corollary of the result follows from the fact that the CEO never leads if $p_h = 0$ and has no incentives to lead if $\theta_H = \theta_L$.

[53] Recall that the CEO leads only when $\theta_i = \theta_H$

B.3 Proof of Result 3

The first part of the result follows from the fact that the headquarter only leads when the project is good.

The second part follows from the fact that $\frac{\delta x^{HQ}}{\delta \theta_H} = \eta(1-\eta)\theta_L > 0$

The intuition is that the higher is the value of the good project, the bigger are the incentives of the headquarter to fool workers. To be credible, then, the HQ needs to sacrifice more.

B.4 Proof of Result 4

We need to show that $E(T^l|HQ) - E(T^e|LE) < 0$, which follows from Result 1. That is from the fact that the subsidiary CEO exerts higher effort than the local CEO in the transfer stage. Namely, $\frac{\theta_L + \sqrt{2(J-1)\theta_L(\theta_H - \theta_L)}}{\frac{J}{1-\eta}} > \frac{\theta_H}{\frac{J}{1-\eta}}$.

B.5 Proof of Result 5

The first part of result 5 follows directly from result 4, $E(T^l|HQ) - E(T^e|LE) < 0$ and the fact that $p_H(\eta(1-\eta)[\theta_H\theta_L - \theta_L^2]) > 0$ which means that $(E(T^l|HQ) - p_H(\eta(1-\eta)[\theta_H\theta_L - \theta_L^2]) - E(T^e|LE)) < 0$. The second part follows from results 2 and 3.

B.6 Proof of Result 6

It follows from

$\frac{\delta E[\Pi^l]}{\delta q_H} < 0$

$\frac{\delta E[\Pi^l]}{\delta \lambda_h} < 0$

B.7 Derivation of contract offered by expatriate in execution stage

$E[\prod^e]$ is equal to

$$q_H(e_H - w_H) + (1 - q_H)(e_L - w_L) \tag{28}$$

and the four constraints are:

$$IC_H : w_H - \lambda_H e_H^2 \geq w_L - \lambda_H e_L^2 \tag{29}$$

$$IC_L : w_L - \lambda_L e_L^2 \geq w_H - \lambda_L e_H^2 \tag{30}$$

$$IR_H : w_H - \lambda_H e_H^2 \geq 0 \tag{31}$$

$$IR_L : w_L - \lambda_L e_L^2 \geq 0 \tag{32}$$

IR_H and IC_L will be binding. Consequently IR_L will be satisfied and slack. Given that it is optimal to set $e_L > e_H$, IC_L will also be satisfied and slack.[54]

IR_H becomes $w_H = \lambda_H e_H^2$ and IC_L becomes $w_L = (\lambda_H - \lambda_L)e_H^2 + \lambda_L e_L^2$

Plugging in the objective function, and maximizing the result in the text follows.

B.8 Proof of Result 7

Note that $e_L^e = \frac{1}{2\lambda_L} = e_L^l$ and that

$e_H^e - e_H^l = \propto (1 - \frac{1}{q_H})(\lambda_H - \lambda_L) < 0$

given that $\lambda_H > \lambda_L$ and that $(1 - \frac{1}{q_H}) < 0$ for $q_h \epsilon (0, 1)$

B.9 Proof of Result 8

First note that $\frac{\delta(E[e^e] - E[e^l])}{\delta q_H} = \frac{e_H^e - e_H^l}{e_H^e} + \varepsilon_{e_H^e, q_H}$, where $\varepsilon_{e_H^e, q_H}$ denotes the elasticity of effort with respect to q_H when local inefficiency is high and the CEO is an expatriate.

Given that $\varepsilon_{e_H^e, q_H} = \frac{\lambda_H - \lambda_L}{\lambda_H - \lambda_L + q_H \lambda_L}$ and $\frac{e_H^e - e_H^l}{e_H^e} = (\frac{1}{q_H} - 1)(1 - \frac{\lambda_L}{\lambda_H})$

and simplifying,

$\frac{\delta(E[e^e] - E[e^l])}{\delta q_H} > 0$ if $q_H > 0.5$ and $\frac{\delta(E[e^e] - E[e^l])}{\delta q_H} < 0$ if $q_H < 0.5$.

Because local uncertainty is maximized when $q_H = 0.5$, the result follows.

[54] If IR_L was binding then IR_H would not be satisfied. If $e_L > e_H$ and IC_H was binding then IC_L would not be satisfied.

B.10 Proof of Result 9

The first part follows from the fact that $w_L^e - w_L^l = (\lambda_H - \lambda_L)\frac{1}{4[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]^2} > 0$

The second part follows because $\frac{\lambda_H}{4[\frac{\lambda_H - \lambda_L}{q_H} + \lambda_L]^2} < \frac{1}{4\lambda_H}$ for $q_H \epsilon (0,1)$

B.11 Proof of Result 10

It follows from $\frac{\delta E[\Pi^e]}{\delta q_H} < 0$, $\frac{\delta^2 E[\Pi^e]}{\delta^2 q_H} > 0$ and $\frac{\delta E[\Pi^e]}{\delta \lambda_H} < 0$, $\frac{\delta^2 E[\Pi^e]}{\delta^2 \lambda_H} > 0$.

B.12 Proof of Result 11

The local manager optimization problem is unconstrained the expatriate faces a constrained optimization problem. Therefore, the expatriate profits must be lower.

B.13 Proof of Result 12

It follows directly from results 5 and 9.

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Table 5: Summary statistics of plant variables in 2000 (ESIDET)

	Plants with no foreign employees	Plants with foreign employees	Total
Total Sales	1528.0	1897.9	1699.7
(in thousand)	(392.6)	(572.5)	(338.6)
Log(Total Sales)	12.68***	13.25***	12.95
	(0.11)	(0.10)	(0.08)
Domestic Sales	1216.0	1003.1	1117.1
(in thousand)	(361.6)	(195.3)	(213.)
Log(Domestic Sales)	12.28**	12.71**	12.48
	(0.14)	(0.14)	(0.10)
Exports	312.0	894.8	582.6
(in thousand)	(154.3)	(398.1)	(202.7)
Exporter Dummy	0.69***	0.82***	0.75
	(0.03)	(0.03)	(0.02)
Exports/Total Sales	0.28*	0.35*	0.31
	(0.03)	(0.03)	(0.02)
Domestic Employees	1246.52	1472.24	1351.32
	(198.51)	(189.81)	(138.06)
Foreign Employees	0.00***	12.82***	5.95
	(0.00)	(2.14)	(1.04)
Number	209	182	391

Notes: The table reports summary statistics of basic plant variables. The first column is the statistics for plants without expatriates, while the second for plants with expatriates, and the third for all plants pooled together. Standard deviation of the means in parentheses. Sales and exports are in million nominal pesos (A dollar was 9.5 pesos in the beginning of 2000). Significance of the test of the equality of the mean of the two groups: * 10 percent, ** 5 percent, *** 1 percent.

Table 6: Regression of the technology transfer on expatriates. ESIDET 2000.

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Technology Transfer: Intensity				
Method	All Industries		Manufacturing Only		
Expatriates Dummy	0.2695**	0.2331*	0.3201***	0.3039***	-0.0000
	(0.1260)	(0.1257)	(0.1071)	(0.1155)	(0.1785)
Expatriates Dummy*					3.7652*
Industry R&D					(2.2291)
Exporter Dummy		0.4104***		0.1913	0.3876**
		(0.1485)		(0.1211)	(0.1710)
Log Employment		-0.0282		-0.0442	-0.0510
		(0.0503)		(0.0573)	(0.0648)
R^2	0.1774	0.1933	0.0318	0.1690	0.2029
N	391	391	297	297	297

Notes: The table reports coefficients on the organizational form (the dummy variable indicating whether plants have foreign employees), its interaction term with U.S. R&D intensity at the industry level, the log of the number of employees and exporter dummy from plant-level regressions of the expenditure on technology transfer from abroad on the combinations of the dummy variable indicating whether a plant has expatriates, its interaction term with the U.S. industry-level R&D intensity, the log of the number of workers, exporter dummy and industry fixed effects. The technology transfer intensities measure is the expenditure divided by total sales. Robust standard errors in parentheses. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 7: Regression of the effect of judicial efficiency form on expatiates. ESIDET 2000.

	(1)	(2)	(3)	(4)	(5)	(6)
Industry	All Industries			Manufacturing		
Dependent Variable	Expatriates Dummy					
Judicial Efficiency	-0.1585**	-0.1899**	-0.2159**	-0.1506*	-0.1926**	-0.1870**
	(0.0732)	(0.0873)	(0.0892)	(0.0804)	(0.0941)	(0.0951)
Exporter Dummy			0.2327***			0.1559*
			(0.0748)			(0.0877)
Log of Employees			0.0763***			0.0934***
			(0.0277)			(0.0320)
Industry Effects	No	Yes	Yes	NO	Yes	Yes
N	392	349	349	297	281	281

Notes: The table reports coefficients (marginal effects) on the judicial efficiency, exporter dummy and the log of the number of workers on the dummy variable indicating whether a plant has foreign employees. Robust standard errors in parentheses. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 8: Regression of the effect of judicial efficiency form on foreign entry and R&D intensity. ESIDET 2000.

	(1)	(2)	(3)	(4)	(5)	(6)
Industry	All Industries		Manufacturing			
Dependent Variable	Foreign Ownership Dummy				R&D Intensity	
	Probit				OLS	
Judicial Efficiency	0.0754***	0.0543*	0.0621**	0.0524*	-0.0246***	-0.0245***
	(0.0292)	(0.0280)	(0.0291)	(0.0265)	(0.0068)	(0.0071)
Exporter Dummy		0.2001***	0.2314***	0.1860***		0.0034
		(0.0238)	(0.0203)	(0.0242)		(0.0066)
Log (Employees)		0.0582***	0.0559***	0.0637***		0.0014
		(0.0086)	(0.0093)	(0.0110)		(0.0019)
r2					0.0445	0.0469
Industry Effects	Yes	Yes	NO	Yes	No	No
N	1687	1687	1393	1393	297	297

Notes: The table reports coefficients (marginal effects) on the judicial efficiency, exporter dummy and log of the number of workers on the dummy variable indicating whether a plant has foreign ownership and on U.S. R&D intensity of the industry that firms belong to. Robust standard errors in parentheses. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 9: Regressions of the total sales, exports and domestic sales on expatriates, ESIDET 2000.

	(1)	(2)	(3)	(4)
Dependent Variable	Log Total Sales	Exporter Dummy	Log Exports	Log Domestic Sales
Expatriates Dummy	0.39***	0.11***	0.50**	0.09
	(0.12)	(0.041)	(0.21)	(0.42)
Log Employment	0.80***		0.91***	0.41*
	(0.07)		(0.12)	(0.22)
R^2	0.59	0.40	0.48	0.33
N	391	391	293	391

Notes: The table reports coefficients on the expatriates dummy from plant-level regressions of the log of sales, exporter dummy, the log of exports and the log of domestic sales on the expatriate dummy and the log employment and industry fixed effects. Robust standard errors in parentheses. Significance: * 10 percent, ** 5 percent, *** 1 percent.