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An Integrated Framework of Knowledge Spillovers from FDI

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An Integrated Framework of Knowledge Spillovers from FDI

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Abstract

In this paper we propose that distinguishing different types of Foreign Direct Investment (FDI) in terms of Multinational (MNE) ownership may help to interpret the inconclusive empirical results on knowledge spillover effects from FDI. We frame the relationship between MNE ownership of FDI and knowledge spillovers on three well estbalished microeconomic concepts: spillover channels, tacit knowledge and absorptive capacity. Integrating these aspects in one comprehensive framework, we arrive at a non-linear relationship between MNE ownership and spillovers. We also find that the threat of knowledge spillovers makes that MNEs usually require relatively extreme degrees of ownership over their foreign affiliates. Confronting this with the empirical literature, we show that neglecting these insights has important consequences for estimation and may indeed explain the observed diversity in results.

JEL-Codes: F23, L23, O33

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1 Introduction

Research on knowledge spillovers from Foreign Direct Investment (FDI) has been expanding rapidly over the past few years (cf. Saggi, 2002; Keller, 2004). The majority of such studies are empirical in nature. Remarkably, however, these studies appear to offer little consensus about the existence, magnitude or direction of knowledge spillovers (Görg and Greenaway, 2004; Barba Navaretti and Venables, 2004). These mixed findings are typically attributed to differences in applied methods or measurement issues (Görg and Strobl, 2001).

In this paper we put forward an alternative reason for the lack of empirical consensus, namely the literature's neglect of taking into account differences in ownership structures of FDI ventures. That is, the majority of the theoretical and empirical literature disregards the fact that FDI is in practice composed (of varieties) of minority partnerships, majority partnerships, and (equally shared) joint ventures. In this paper we carefully consider the relationship between types of FDI and knowledge spillovers and verify what this would imply for the empirical assessment of knowledge spillovers from FDI.

The insights we yield are based on three well-established concepts from microeconomic theory on knowledge spillovers in relation to FDI. The first of these concepts is the existence of knowledge spillover channels, for which we argue that different types of FDI involve different (numbers of) channels (Djankov and Hoekman, 2000; Saggi, 2002). Second, we recognize that it is mainly tacit knowledge that is bound to lead to knowledge spillovers (Makhija and Ganesh, 1997; Aydogan and Lyon, 2004). Third, we acknowledge that the absorptive capacity of the (potential) partner firm plays a key role as well (Cohen and Levinthal, 1989; Lane et al., 2001; Grünfeld, 2003). Combining these insights, we conclude that the relationship between knowledge spillovers and FDI ownership is non-linear. Knowledge spillovers from FDI will be low for either low or high levels of integration (e.g. licensing or full ownership), while it is high for intermediate integration modes (e.g. joint ventures). By incorporating this relationship in a partial equilibrium framework governing the investment and entry mode decision of MNEs, it appears that this implies that when knowledge spillovers matter,

firms tend to choose extreme types of ownership. Confronting our findings with the empirical literature on knowledge spillovers and FDI, we conclude that the different findings in the literature may indeed be dependent on measurement issues (Görg and Strobl, 2001), but for a different reason. That is, we argue that it is not so much the measurement of multinational presence, but rather the lack in measurement of different types of FDI that matters. An overview of the empirical literature that takes ownership structures explicitly into account makes clear that making such a distinction indeed matters.

The remainder of this paper is structured as follows. Section 2 discusses some general aspects of knowledge spillovers and establishes its relationship with different types of FDI ownership. In Section 3 we formalize this in a simple partial equilibrium model for the investment and entry mode decision of multinationals. Section 4 confronts standard empirical practice regarding knowledge spillovers with our framework. Section 5 concludes.

2 Knowledge Spillovers and FDI

Previous literature provides a host of possible taxonomies according to which knowledge spillovers can be classified. Distinctions have been made between knowledge versus rent spillovers (Grilliches, 1979), embodied versus disembodied spillovers (Grünfeld, 2003) and active versus passive spillovers (Keller, 2004). For our purposes, however, it is important to make a distinction between knowledge transfer on the one hand, and knowledge spillovers on the other. The main difference is that a knowledge transfer is an intentional transmission of knowledge from one party to another, whereas a knowledge spillover is unintentional. This implies that a knowledge spillover should be thought of as an externality, in contrast to a knowledge transfer. Moreover, a knowledge transfer can be both intra-firm and inter-firm, whereas a knowledge spillover, by definition of being an externality, only occurs between different firms.

Established theories of the Multinational Enterprise (MNE) such as Dunning's (1977) OLI-paradigm or Markusen's (2002) knowledge capital model, all imply that FDI is a channel for

knowledge transfer. For what these theories have in common is the assumption that a firm needs some competitive (knowledge) asset in order to become a MNE. By engaging in FDI, the firm transfers (some of) this knowledge to its foreign affiliate, thus being able to exploit its asset abroad as well.[1] Another approach toward the explanation of MNEs (which is also incorporated in the OLI paradigm) is based on Williamson's (1975) transaction costs economics (Hennart, 1982; Teece, 1983; Beamish and Banks, 1987). This approach posits that in serving foreign markets through trade or licensing agreements, transaction costs arise due to imperfect markets. In the present context, markets fail because they do not allow firms to fully appropriate the knowledge that they exploit through exporting their products or licensing their production. The solution provided by transaction costs economics is to internalize the foreign market, and consequently to become a MNE.

The implication is that if a firm wants to exploit its knowledge abroad as well as prevent it from being appropriated by other firms, it should engage in FDI. Müller and Schnitzer (2006) generalize this insight by proposing a negative relationship between a MNE's degree of integration (i.e. its amount of ownership in a foreign affiliate) and the extent of knowledge spillovers that it generates, the reason being that increased ownership increase the MNE's control over the knowledge (or alternatively, decreases its partner's access to it). But at the same time, the perceived decreased spillover threat due to increased integration will lead the MNE to transfer more of its knowledge abroad, thus increasing the total stock of knowledge present there. This in turn will increase the potential for knowledge to spill over. A paradox then presents itself: Increasing its degree of control over the foreign affiliate will lead the MNE to transfer more of its knowledge abroad, since it perceives a decreased spillover threat. The increased knowledge transfer, however, increases the spillover threat, as it increases the stock of knowledge abroad. A way out of this paradox is by carefully rethinking the relationship between the MNE's integration in the foreign venture and the extent of knowledge spillovers. In what follows, we do so by linking it to three well-established concepts in the literature: knowledge spillover channels, tacit knowledge and absorptive capacity.

Previous literature (Djankov and Hoekman, 2000; Saggi, 2002) suggests three main spillover

channels: demonstration effects, meaning that others observe and imitate the (applied) knowledge; labor turnover, enabling workers employed by the MNE undertaking the FDI to switch jobs and take with them firm-specific knowledge; and vertical linkages, by which the MNE may spill over knowledge or technology to its suppliers (upstream linkages) or its customers (downstream linkages).

Consequently, we should be able to establish a relationship between the MNE's integration decision and spillovers by examining the relevant spillover channels.[2] Consider three types of FDI: Minority FDI (where the MNE has a minority stake in a foreign affiliate, e.g. through licensing), Joint Venture (JV - where the MNE equally shares the foreign affiliate with a foreign partner) and Wholly Owned Subsidiary (WOS - where the MNE has a majority stake in - and in this case is the sole owner of - the affiliate). We first examine the relevance of demonstration effects as a spillover channel. As is apparent from its definition, this channel is only relevant when there exists a partner to demonstrate to (Cheung and Ling, 2004). Hence, demonstration effects only apply to Minority FDI and JVs, but not to a WOS. Second, labor turnover requires employees that have acquired some of the MNE's knowledge to switch jobs. In the case of JV and WOS, it is apparent that local workers are exposed to MNE knowledge which they may exploit elsewhere. But in the case of Minority FDI, transaction costs economics tells us that the MNE is unlikely to transfer (crucial) knowledge abroad, rendering labor turnover irrelevant as a spillover channel in this case (cf. Fosfuri et al., 2001). Third, vertical linkages require the presence of a local network of suppliers and customers in order to transmit knowledge. Since for Minority FDI and JV local partners are involved, it is likely that part of their network will be utilized as well. A WOS, by contrast, has a much less extensive network, at least in the short term, and is therefore unlikely to spill over knowledge in this way (Javorcik and Spatareanu, 2006).

This implies that JVs potentially involve the largest spillover threat, as all spillover channels may be at work in this case, then followed by Minority FDI and WOS. By itself, this would suggest a nonlinear relationship between the MNE's degree of integration and knowledge spillovers, but of course this would be only true if all the spillover channels function for the relevant types of FDI and

if each channel is equally important in transmitting knowledge.

The existence of a nonlinear relationship becomes more likely however, if we also take into account the tacit nature of knowledge. *Tacit knowledge* is knowledge embodied in intangibles (people, routines, experience) and consequently requires communication or face-to-face interaction to spill over (Makhija and Ganesh, 1997; Aydogan and Lyon, 2004). This as opposed to *codified* knowledge, which is embodied in tangibles (books, cd-roms, products) and consequently requires less communication to spill over. Given that it is easier to write contingent contracts on the application and division of codified knowledge (patents, trademarks, copyright), a large part of knowledge spillovers is bound to be tacit (e.g. sharing experiences at the coffee-machine or over lunch). Consequently, the types of FDI that facilitate tacit knowledge spillovers are those that involve intense communication and interaction. The largest spillover threat can thus be expected from JVs, as these involve much more frequent and intensive interaction between partners than Minority FDI and WOS would. Also from this perspective, therefore, a non-linear relationship arises between MNE integration and spillovers.[3]

Finally, we should also consider the firm(s) at the other end of the (spillover) channel, the local partner (or partners). It has been firmly established in the literature that the beneficial effects of knowledge spillovers do not arise unconditionally. A key attribute to be able to receive knowledge is a sufficient degree of *absorptive capacity* (Cohen and Levinthal, 1989; Lane et al., 2001; Grünfeld, 2003). A firm can build up absorptive capacity by investing in R&D or human capital, enhancing the assimilation of outside knowledge and knowledge spillovers. At the same time, however, increasing its own knowledge base may render outside knowledge less useful for a firm, since it is closing the knowledge gap. The absorptive capacity argument provides another building block for the non-linear relationship between MNE integration and FDI. Since there is more interaction between the partners in the JV than in the other types of FDI, as well as the fact that JVs are often established for mutual learning processes (Beamish and Banks, 1987; Makhija and Ganesh, 1997), the extent to which knowledge will be (purposefully) transferred by the MNE to the local partner will be larger as well. Consequently, the MNE is also contributing to its local partner's absorptive capacity in a JV, thus

increasing the potential for knowledge spillovers even further.

Summarizing, when framing the relationship between different types of FDI and knowledge spillovers on the existence of spillover channels, tacit knowledge and absorptive capacity, a non-linear relationship arises. Specifically, we find that equally owned types of FDI (such as JVs) will generally lead to larger spillovers than either minority or majority types of FDI. In the next section we will formalize these insights in a simple partial equilibrium framework to understand the implications for the investment and entry mode decision of MNEs.

3 The model

When faced with the choice of investing abroad, the MNE essentially makes two decisions: It decides whether or not to engage in FDI and (provided that it decides to invest) at what degree of integration (i.e. ownership) to do so. To focus on knowledge spillovers, we assume that the integration decision is only determined by knowledge spillover considerations and, as we will discuss below, follows directly from the investment decision. As a starting point, we consider technological space in the host country in which the MNE is considering to invest. The location of both the MNE and its potential partner firm in technological space is modeled in a Hotelling-like fashion (Hotelling, 1929). Specifically, we assume that the n host country firms are located at equal distances from each other and that their location is fixed along a line. Without loss of generality we normalize the length of this line to 1 so that the distance between two local firms becomes $1/n$.[4] Accordingly, for $n \geq 2$ (an assumption that we will make throughout the paper), the MNE will always locate in between two local firms. Technological distance x is then defined as the distance between the MNE and the local firm that it is closest to, i.e. $0 \leq x \leq 1/2n$. Given that the MNE decides to invest (which it will only if net profits are nonnegative, an issue that we will return to later), the problem it faces is to choose the degree of integration that maximizes profits net of knowledge spillovers.

Denoting the MNE's degree of integration by I we can model the non-linear, concave relationship between knowledge spillovers and I that we derived in the previous section as follows:

$$g(I) = -I^2 + I \tag{1}$$

The degree of integration I, in turn, is determined by the technological distance x between the MNE and its local partner. We argue that the MNE will consider technological proximity to its local partner as a threat and thus increases its degree of integration when its partner is technologically more similar. This view is in line with the theories alluded to in Section 2. It is also in line with Makhija and Ganesh (1997) and Multinelli and Piscitello (1998) who argue that asymmetry in capabilities between JV partners is one of the key motivations to form a JV in the first place. Therefore we specify a negative relationship between integration and technological distance:

$$I = 1 - 2xn \text{ s.t. } 0 \leq x \leq 1/2n \tag{2}$$

Note that this formulation ensures that I is bounded on the domain $[0, 1]$.

To take account of the absorptive capacity of the local partner firm, we split absorptive capacity into two components: absorptive ability and absorption potential. Both of these components are related to the degree of technological similarity between the MNE and its partner: If both firms are technologically very similar, absorptive ability is high because the partner firm is technologically able enough to absorb the MNE's knowledge. However, absorption potential is low in this case, due to the absence of a large technological gap (and thus learning potential) between the MNE and its partner. Conversely, if both firms are technologically very dissimilar, absorptive ability is low because the partner firm does not have the technological requirements to absorb the MNE's knowledge. But now, because of the presence of a large technological gap, absorption potential is high. Both effects combined imply a curvilinear, concave relationship between technological distance and the amount of knowledge spillovers through absorptive capacity $h(x)$:

$$h(x) = x(\frac{1}{n} - ax) \text{ s.t. } a \geq 2 \tag{3}$$

where a is the inverse of absorptive ability and the x in front of the parentheses represents absorption

potential. The inclusion of the term $1/n$ guarantees that $h(x)$ reaches its optimum within the domain of the model.[5] As technological distance x is defined with respect to the local firm that is closest to the MNE, so that $0 \leq x \leq 1/2n$,our discussion of the curvilinearity between S and x implies that $h(x)$ should reach its optimum within this interval. This is indeed guaranteed by the inclusion of the term $1/n$, given the restriction $a \geq 2$.

We are now able to construct a spillover function that depends both on the MNE's degree of integration $g(I)$ and the local partner firms' absorptive capacity $h(x)$:

$$S = F\left[g(I), h(x)\right] \tag{4}$$

For simplicity, we assume that $F(.)$ is a positive additive function in its arguments. Accordingly, using the formulations in (1), (2) and (3), we arrive at the following explicit formulation of the spillover function:[6]

$$S = -x^2(a+1) + \frac{3x}{2n} \tag{5}$$

Of course, the MNE's integration decision is not solely dependent on the amount of spillovers it faces. Therefore, we also introduce a simple profit function. We assume that JV profits (i.e. the profits of both the MNE and its partner firm) are positively related to technological distance x (again in line with the postulated need for asymmetry) and negatively related to the total number of local firms (which represents a market stealing effect):

$$\pi_{JV} = \frac{x}{n} \tag{6}$$

The MNE's share of these profits is proportional to its degree of ownership I, minus some amount of sunk costs c that it has to incur when investing in the host country:

$$\pi_{MNE} = I\left(\frac{x}{n}\right) - c = -2x^2 + \frac{x}{n} - c \tag{7}$$

Note that the MNE profit function becomes a concave function of technological distance and also of the degree of integration (by virtue of (2)). This implies that increased technological distance first

leads to increased MNE profits (at a decreasing rate), then reaches a maximum and thereafter lowers MNE profits (at an increasing rate). This relationship is caused by two opposing effects following from an increase in x. On the one hand, an increase in x induces an increase in π_{JV} (and thus an increase in π_{MNE}) due to an increase in asymmetry between the MNE and its partner. On the other hand, an increase in x also induces a decrease in I and thus lowers MNE's share of π_{JV}. As long as the former effect outweighs the latter, MNE profits will increase.

An important implication from the concavity of MNE profits *and* knowledge spillovers with respect to I is that we obtain potentially *two* MNE participation constraints. Without the presence of knowledge spillovers, the participation constraints could simply be derived from the condition that $\pi_{MNE} \geq 0$. However, since we explicitly allow for knowledge spillovers, this condition becomes $\pi_{MNE} - S \geq 0$. Note that when this condition is satisfied, not only do we know that the MNE will engage in FDI, but we can also immediately derive the degree(s) of integration at which it will do so. We illustrate this graphically by means of Figure 1 below.

<< INSERT FIGURE 1 ABOUT HERE >>

The solid curve in the figure denotes knowledge spillovers S and the dashed curve denotes MNE profits π_{MNE}, both as a function of the degree of integration. The participation constraint is determined at the point where knowledge spillovers are equal to profits. From the figure it follows that there are potentially two participation constraints: a lower constraint $\hat{I}_L$ and an upper constraint $\hat{I}_U$. Formally, we can derive the participation constraints by letting S in (5) equal π_{MNE} in (7). Using (2) to express the derived x values in terms of I, we get

$$\hat{I}_L = 1 - \frac{\Lambda^+}{(a-1)} \; ; \; \hat{I}_U = 1 - \frac{\Lambda^-}{(a-1)} \tag{8}$$

where

$$\Lambda = \frac{1}{2n} \pm \sqrt{\frac{1}{4n^2} + 4c(a-1)} \tag{9}$$

In between these two constraints, knowledge spillovers are larger than MNE profits and the MNE will not invest in the host country. Consequently, only for degrees of integration lower (higher) than $\hat{I}_L$

($\hat{I}_U$) will the MNE invest in the host country. Knowledge spillovers imply that MNEs invest when they can choose extreme levels of ownership. We note that from Figure 1 it may appear that the MNE will always choose for the most extreme degrees of integration (i.e. 0% or 100%), as these maximize net profits. However, in the long run the MNE will only earn normal returns (i.e. net profits will be zero) and the degrees of integration at which the MNE is willing to invest are exactly given by the two participation constraints.

Given that in the present setup both MNE profits as well as spillovers are a concave function of I, the interests of the MNE and its partner (or more generally, the host economy) are aligned from the outset of the model. This is in contrast to a recent model by Müller and Schnitzer (2006), where the government of the host country needs to engage in active policy in order to (partly) align the interests of both parties. One of the reasons for this difference might be that in Müller and Schnitzer (2006) knowledge spillovers are assumed to be linearly declining in ownership, whereas MNE revenue is linearly increasing in ownership. Our framework, by contrast, includes the non-monotonic relationship we derived in the previous section, including an explicit acknowledgement of the absorptive capacity of the host country.

4 The Empirical Literature

As already mentioned in the introduction, there exists a large literature on knowledge spillovers from FDI that largely neglects the fact that there exist different types of FDI in terms of MNE integration. Nonetheless, there is also a fairly recent and rapidly growing strand of empirical research that does acknowledge this fact. In this section we will first briefly consider what our insights imply for the standard empirical practice in the majority of the FDI-spillover studies that disregard differences in MNE integration.[7] Then we will briefly review the empirical literature that does analyze the spillover effects of different types of FDI and comment on its main assumptions and findings.

The empirical estimation function that is often encountered in the FDI-spillover literature has the following generic form:

$$\omega_{it} = F_{it}\beta + \mathbf{X}_{it}\gamma + D_i + D_t + \varepsilon_{it} \tag{10}$$

where i and t index cross-section (firm, sector, region, nation or a combination of these) and time respectively. ω usually is a measure of productivity (either labor productivity or total factor productivity), F is a measure for the presence of FDI (often FDI stock or flows in macroeconomic studies, and FDI output or employment as a share of total output or employment in microeconomic studies), $\mathbf{X}$ is a vector of controls (often including investments in R&D and human capital) and D_i and D_t are cross-section and time dummies. Hence, the general strategy is to explain productivity by all of its known determinants (or alternatively, the determinants for which data are available) and attribute any effect that is left (apart from measurement error) to FDI.

Here we focus on the effect of not distinguishing different types of FDI in models such as (10).[8] According to our discussion in Sections 2 and 3, F is actually given by $F = \sum_{I_{\min}}^{I_{\max}} F_I$ s.t. $I \in [0, 1]$. That is, it is composed of a host of FDI-types that differ from each other in terms of their degree of MNE integration I. It also implies that the estimator β is a vector of dimension $N \times 1$ where $N = I_{\min}, ..., I_{\max}$. Hence accounting for different types of FDI in terms of MNE integration would allow for different estimated spillover effects of each type. Depending on the circumstances in the relevant cross-section i, the curvatures of the spillover and profit functions in Figure 1 could either allow for FDI-types across the entire I-space , or across subsets of I-space. In the latter case, it should be noted that our model implies that there will be an interval $[I_{low}, I_{high}]$ so that $F = \sum_{I_{\min}}^{I_{low}} F_I + \sum_{I_{high}}^{I_{\max}} F_I$, i.e. within this interval FDI will not occur**.** Given the non-linear relationship we specified between spillovers and integration, it also implies that if this interval becomes wider, observed spillovers from FDI become relatively lower and the estimated coefficient vector β will become smaller in magnitude (or insignificant) as well.

From this it follows that not distinguishing between different types of FDI and estimating the model as specified in (10) implies that the estimated coefficient β is a consolidated estimate of all the different β_I corresponding to the different F_I that are present in i at time t. Consequently, the

estimated effect β depends on the types of FDI that are present in e.g. an economy. The composition of F will generally differ across economies i as well as over time t. This implies that the width of the interval $[I_{low}, I_{high}]$ will generally depend on i and t as well. Estimating a low or insignificant β and concluding that there are no spillover effects from FDI is thus unwarranted, as it could very well imply that an economy is "overrepresented" with those types of FDI (minority or majority FDI) that induce few spillovers. We should also stress that the symmetric concave relationship between spillovers and MNE integration in Figure 1 is just an illustration, and the optimum of the function could be both lower or higher, as well as more to the left or right of $I = 0.5$. Again, this may very well depend on both i and t.

All of this implies that the great disparity in empirical results may be indirectly related to differences in (country) samples studied or periods considered, as different places and times will generally lead to different compositions of F. That is, measurement issues may indeed be at the heart of the diverging results in the literature (cf. Görg and Strobl, 2001). Yet the problem is not so much about how to measure multinational presence (e.g. in terms of employment or output), but rather about inappropriately pooling different types of FDI together.[9] The disregard for different types of FDI may indeed go a long way toward explaining the diverse empirical results.[10]

However, a fairly recent and rapidly developing literature has been increasingly taking the differences in MNE integration into account while estimating spillover effects. One of the first to do so were Blomström and Sjöholm (1999). These authors analyze a sample of 13,663 Indonesian manufacturing firms in 1991 and try to establish whether there are different spillover effects between minority and majority owned subsidiaries. They find that both types of FDI lead to spillovers, but that there are no statistical differences between the estimated spillover effects. Dimelis and Louri (2002) analyze a sample of 4,056 Greek manufacturing firms in 1997. Their main finding is that minority owned FDI is more likely to spill over knowledge *vis-à-vis* majority FDI, since the former leads to spillovers at all distinguished levels of productivity whereas the latter only leads to spillovers in high-productivity affiliates. Javorcik (2004) analyzes a panel of approximately 2000 firms in

Lithuania over the period 1996-2000. She explicitly looks at vertical (inter-industry) spillovers as opposed to horizontal (intra-industry) spillovers and finds that shared ownership between the foreign investor and a local firm induces inter-industry spillovers, whereas WOS do not. However, she finds no statistically different effect of minority versus majority FDI. Finally, Javorick and Spatareanu (2006) analyze a panel of 13,129 Romanian firms over the period 1998-2003. They find that shared foreign and domestic ownership induces positive vertical spillovers but negative horizontal spillovers. Moreover, WOS does not induce vertical spillovers, but even larger negative horizontal spillovers.

These findings may seem somewhat contradictive at first sight. However, given that they all investigate the relationship between knowledge spillovers and FDI ownership a bit differently, the results are not directly comparable either. A common finding is that shared ownership between foreign and local investors induces spillovers, whereas fully owned types of FDI do not. The reason that Javorcik (2004) and Javorcik and Spatareanu (2006) do not find differences between minority and majority owned FDI is that they do not make this distinction. The reason that Dimelis and Louri (2002) do not find separate horizontal and vertical spillover effects is again because they do not distinguish these.

Moreover, in terms of our model in Section 3, the results by Blomström and Sjöholm (1999) are particularly interesting. Recall that these authors do find positive spillover effects of minority and majority FDI, but these are not statistically different. This finding corresponds nicely with the intuition and results of our model. It may accordingly be interpreted as a first clue for the non-linear relationship between MNE integration in FDI and knowledge spillovers.

Regarding future empirical work, an additional comment is in order. Instead of analyzing the relationship between FDI ownership and knowledge spillovers (or firm productivity) by using FDI-type dummies for F in (10), as is done in all the studies mentioned above, an alternative and perhaps fruitful strategy is to use the actual degree of ownership (i.e. 0%-100%) as the dependent variable F. A particular advantage of such an approach is that it allows for semiparametric regression analysis. In this case, instead of the linear parametric model in (10), a partial linear model

can be specified:

$$\omega_{it} = g(F_{it}) + \mathbf{X}_{it}\gamma + D_i + D_t + \varepsilon_{it} \tag{11}$$

In this model, FDI ownership F enters the model nonparametrically through $g(\cdot)$. A particular advantage of this type of modeling is that it does not require the specification of a functional form of $g(F_{it})$. Instead, applying a difference-based semiparametric estimator to (11) allows one to first estimate the coefficient vector γ as if the nonparametric component is not present, and subsequently to estimate $g(F_{it})$ nonparametrically conditional on $\hat{\gamma}$ (Yatchew, 1997; 2003). Such an approach is particularly useful when there are no unambiguous *a priori* expectations regarding the functional form of $g(\cdot)$. Since we have posited a concave functional form *vis-à-vis* the negative and positive linear specifications in earlier literature, a semiparametric approach seems warranted.

5 Conclusion

In this paper we forward a theoretical explanation for the many different empirical results regarding the existence, magnitude and direction of knowledge spillovers from FDI. We argue that it is necessary to distinguish between different types of FDI in terms of MNE ownership in order to make sense of these results. Drawing on established theories of the MNE we arrive at a paradox: In order to protect their knowledge from spilling over, MNEs will want to increase their ownership over foreign affiliations, but by doing so, they will also transfer more knowledge to the affiliation, thus increasing the knowledge spillover threat.

By framing the potential for knowledge spillovers of different types of FDI on three well established, microeconomic concepts, we establish a way out of this paradox. Specifically, by linking knowledge spillovers to (i) knowledge spillover channels, (ii) the existence of tacit knowledge and (iii) absorptive capacity, we arrive at the conclusion that there exists a non-linear relationship between different types of FDI and knowledge spillovers, where equally shared types of FDI exhibit the largest

spillover potential and minority and majority owned FDI much less so. We integrated these insights into a partial equilibrium for the investment decision of MNEs, showing that MNEs will typically require relatively extreme degrees of integration under the threat of spillovers, relative to their preferred degree of integration in the absence of spillovers.

Confronting existing empirical practice with our insights, we find that many studies inappropriately pool different types of FDI together, thus only estimating consolidated spillover effects of FDI. We also demonstrate that, accordingly, the empirical results may indirectly depend on the countries and periods of interest. This is caused by the fact that different types of FDI lead to different spillover effects, and different country-period samples in turn host different compositions of FDI-types. Moreover, the empirical results of a study by Blomström and Sjöholm (1999) also give an indication of the validity of the non-linear relationship between MNE-integration and spillovers.

So where do we go from here? First and foremost, we believe that the field is in need of some proper theorizing, since the empirical studies that take the relationship between MNE ownership and spillovers into account are increasing rapidly, but without any theoretical foundation. The point is nicely illustrated by Blomström and Sjöholm (1999) who argue that they have no *a priori* expectation regarding the sign of the relationship between MNE ownership and spillovers since there are multiple forces working in opposite directions. Our framework incorporates (some of) these mechanisms, yielding a first theoretical substantiation of their point. Moreover, as is apparent from the brief discussion of the literature in Section 4, empirical studies analyze the relationship at different levels, and accordingly, different arguments and mechanisms may be at work as well. In this respect, incorporating the insights of this paper in a general equilibrium framework that also takes geography into account would be a valuable research strategy. We are currently developing a New Economic Geography model in which multinationals are allowed to choose differing degrees of ownership over their foreign affiliates, and where knowledge spillovers act both as a benefit as well as a cost for the firms in the model.

From an empirical point of view, the contribution of this paper lies in the fact that it derives a

non-linear relationship between MNE ownership and knowledge spillovers. To our knowledge, such a relationship has not been explicitly tested yet in the empirical literature. Given the fact that the relationship is firmly grounded in well established microeconomic insights, as well as the fact there exists empirical literature that supports the premises on which it is based (Lyles and Salk, 1996; Makhija and Ganesh, 1997; Blomström and Sjöholm, 1999; Lane et al., 2001), we believe that our framework provides interesting possibilities for future empirical work. As mentioned, one particularly interesting aspect that we are currently investigating is semiparametric estimation of the relationship between knowledge spillovers and MNE ownership.

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Notes

[1]This type of FDI has also been coined asset exploiting FDI (Dunning and Narula, 1995; Kuemmerle, 1999). However, in the past few years authors have been arguing - both theoretically as well as empirically - that asset seeking or asset augmentation may also serve as a motive for FDI (Almeida, 1996; Fosfuri and Motta 1999; Siotis, 1999). This still implies the use of FDI as a knowledge transfer channel, but in reverse direction. Our implicit assumption throughout the paper is that FDI is of the asset exploiting type.

[2]Surprisingly, much of the literature on FDI and knowledge spillovers ignores these spillover channels, but rather treats them as a "black box" (Görg and Strobl, 2005).

[3]Lyles and Salk (1996) indeed find evidence of significantly higher knowledge acquisition in 50/50 JVs. Beamish and Banks (1987) and Makhija and Ganesh (1997) point out that international JVs are often aimed at mutual learning, which also implies interaction and knowledge transmission.

[4]We ignore endpoint problems because our focus is on the MNE's location decision between two host firms, and not on modeling competition between host firms.

[5]This formulation also implies that absorptive capacity $h(x)$ decreases as the number of local firms n increase. An intuition for this is that for a given amount of absorptive capacity, for instance in terms of skilled labor present in the host economy, an increase in n will lead to a decrease in absorptive capacity per firm, due to a reallocation of skilled labor over the extended set of local firms.

[6]While adding $g(I)$ and $h(x)$ we scale down the former by $4n^2$. The reason is that we have no *ex ante* motivation to expect a relationship between S and n through I. Indeed, the only reason for $2n$ to appear in (2) is to assure that I is bounded on [0,1]. Hence by dividing $g(x)$ by $4n^2$ we get rid of the unwanted concave transformation on $2n$ in (2).

[7]For some excellent surveys, see Görg and Greenaway (2004) and Barba Navaretti and Venables (2004, Ch.7).

[8]Other problems that we do not discuss here include, but are not restricted to (1) finding the appropriate "other" determinants of productivity, (2) exclusion of other sources of spillovers such as international trade and (3) biases arising from differences in measurement of MNE presence.

[9]This observation is in spirit not unlike that made by Bloningen and Wang (2005) regarding inappropriate pooling of wealthy and poor countries in empirical FDI studies.

[10]The critical reader may object that this would still not explain the negative spillover effects sometimes encountered in the literature (Aitken and Harrison, 1999). However, we explicity did not consider negative spillovers in our model (*cf.* footnote 1). The line of reasoning could nonetheless be extended along similar lines in this case.

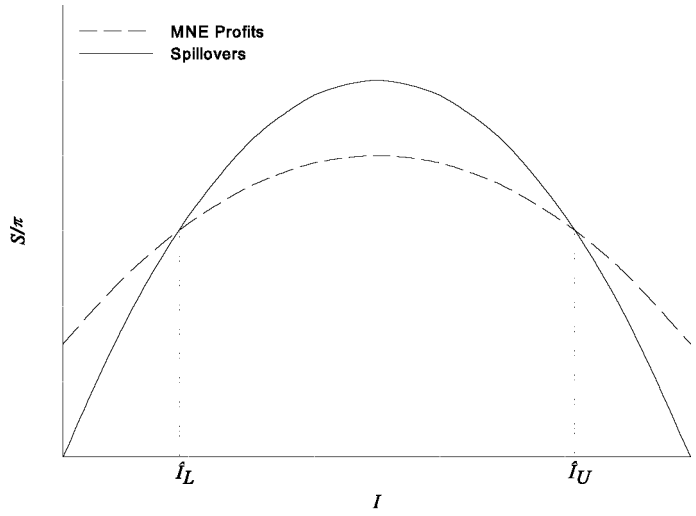

Figure 1: MNE participation constraints