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FDI liberalisation, firm heterogeneity and foreign ownership: German firm decisions in reforming India

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Abstract
The paper investigates the role of firm-level productivity and industry-level R&D for MNEs' choice of undertaking FDI, and the share of ownership in foreign affiliates. Two firm-specific datasets on German MNEs with varying equity stakes in Indian affiliates are used to account for the two-step decision process. The paper also analyses how German firm decisions were affected by the liberalisation of FDI regulations in India. Results show remarkable differences between the selection and the ownership share equation, and also between the pre-reform and post-reform periods. The evidence clearly reveals the trade-offs involved in selective FDI approvals and foreign ownership restrictions.

Keywords: multinational enterprises, liberalisation, selective FDI approval, German FDI, ownership share, Heckman model

JEL classification: F23; L25

1.   Introduction

Attracting foreign direct investment (FDI) is a high priority among governments in developing (and developed) countries. The influx of foreign capital through multinational enterprises is expected to bring in new technology which can dissipate to the local economy and hence boost productivity and growth at the firm and aggregate level. Many developing countries have opened up in order to attract FDI with some success (Agosin and Machado, 2007). The policies of developing countries towards FDI may affect the type or form in addition to the level. This is the issue addressed here in respect of India.

This paper contributes to the substantial literature on FDI in developing countries by studying empirically a (developed country's) firm's decision to locate in India. We focus on two aspects of this choice. First, we model empirically the determinants of the decision to invest in India, compared to a control group of similar firms that did not invest. Second, we investigate the choice of the level of ownership when setting up a foreign affiliate in India. At both levels, we pay particular attention to variables that broadly capture the level of technology that may be transferred to India. Specifically, these are productivity in the parent company and the knowledge intensity (measured as R&D intensity) of the industry in which the parent firm operates. We focus in our analysis also on the importance of FDI liberalisation. India relaxed restrictions on FDI starting from the early 1990s and we investigate whether this had any measurable impact on the 'quality' of FDI as proxied by the two technology variables.

The research questions are important for a number of reasons. First of all, a government may be particularly interested in receiving high-tech investment in order to maximise the spillover and growth effects. At the same time, governments may restrict

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foreign ownership for the host country to appropriate a larger share of FDI-related rents (Asiedu and Esfahani, 2001). Indeed, it has been shown that there are important differences in spillovers from majority and minority owned foreign affiliates of multinationals to the local economy (Blomström and Sjöholm, 1999; Javorcik and Spatareanu, 2008). Javorcik and Spatareanu (2008) in a panel analysis using data for Romanian firms, find that spillovers tend to be higher from partially owned affiliates of multinationals. However, selective approval procedures and ownership restrictions may come at the cost of substantially reducing FDI inflows and limiting the overall potential of local spillovers. A foreign parent company may transfer state-of-the-art technology only to a wholly owned affiliate, rather than to a joint venture (JV), in order to prevent the leakage of technology to the foreign partner (Ramachandran, 1993; Desai et al., 2004). Hence, the decision on investing and the ownership share may ultimately have profound implications for the relationship between inward FDI and growth in the host economy.

The literature on bargaining as well as transaction costs and incomplete contracts offers important theoretical building blocs to analyse FDI-related ownership issues.[1] The first approach typically posits that firms offering more valuable benefits to the host country improve their bargaining position and, thus, tend to have higher ownership shares. On the other hand, foreign ownership tends to be lower when the host country is highly attractive to FDI, for example by offering large local markets. The transaction cost concept of ownership choice takes into account that JVs with local partners may provide benefits to foreign investors relying on local assets and knowledge and, at the same time, give rise to costs if contracts are incomplete and free riding is difficult to prevent.

Arguably, R&D represents an important element with respect to both FDI-related transaction costs and bargaining. Previous literature finds that firms in R&D intensive industries tend to prefer full to shared ownership in order to assure product quality and

prevent leakage of knowledge (Gomes-Casseres, 1989; Javorcik, 2000).[2] Yet, it is from firms in these industries that we may expect the largest beneficial effects to emanate to the local economy. These are knowledge intensive industries which provide a large potential for learning by firms in developing countries.

Apart from industry-level knowledge intensity, another indicator of the knowledge potential of a foreign investor is firm-level productivity. In this respect, Raff et al. (2009) present a theoretical model of the choice a multinational faces between opting for a JV with a local firm or a wholly owned greenfield investment. Their theoretical analysis shows that more productive firms tend to choose higher ownership shares and prefer greenfield investment, as higher productivity (synonymous with higher level of assets in their model) reduces the costs of greenfield investment relative to a JV. Their theoretical proposition is backed up with empirical results using data on ownership choices of Japanese multinationals.

Related to our work, several studies analyse the determinants of the ownership structure of FDI projects by employing dichotomous choice models on wholly owned subsidiaries versus JVs. Gomes-Casseres (1989) shows for some 1500 subsidiaries of about 180 US-based MNEs that this binomial choice depends on the nature of each subsidiary's business, in combination with industry and host-country characteristics.[3] The probability for a JV is lower, for instance, when the US parent is more experienced in the specific industry and more familiar with the host country, when the subsidiary is integrated into intra-MNE trade, and when the subsidiary operates in an R&D intensive industry that is part of the parent company's core business. Likewise, Blomström and Zejan (1991) find that Swedish MNEs with less diversified product lines and more foreign experience opt against minority ownership.[4] Javorcik (2000) focuses on intra-industry differences in R&D and marketing efforts to assess the choice between wholly owned subsidiaries and JVs in

eastern European transition countries. She finds that leading parent companies in terms of technology and marketing prefer wholly owned subsidiaries, though not in low-tech industries.

Asiedu and Esfahani (2001) go beyond the dichotomy between wholly owned subsidiaries and JVs and treat the foreign equity share as a continuous variable. Note however that JVs account for only 14 per cent of their sample of about 2400 subsidiaries of US-based MNEs. Asiedu and Esfahani (2001) complement firm characteristics by industry- and host country-related determinants of foreign equity shares, as we do in the following analysis. Firm characteristics include proxies of the parent firms' assets and more widely used variables such as firm size, production diversity and international experience. Most firm characteristics impact significantly on the equity share, with the notable exception of firm size.

In order to investigate empirically the importance of firm-level productivity and industry-level knowledge intensity for the choice of ownership share we combine two firm-specific datasets on German companies engaged in India as foreign direct investors. The case of German FDI in India is expected to offer relevant insights. Germany is one of the most important home countries for FDI,[5] and plays an important role in India's efforts to attract FDI and, thereby, promote the process of economic catching up. At the same time, India may be second only to China when it comes to concerns about offshoring in the home countries of MNEs. Furthermore, the Indian example is expected to provide interesting lessons as to how firm decisions were affected by less selective approval procedures and relaxed ownership restrictions since the early 1990s.

The structure of the paper is as follows. Section 2 describes the firm-specific data used. We employ two-step Heckman models to assess the impact of firm, industry and location characteristics and present the estimation results in section 3. We find remarkable

differences between the selection and the ownership share equation, and also between the pre-reform and post-reform periods. As argued in section 4, the evidence has important policy implications and clearly reveals the trade-offs involved in selective FDI approvals and foreign ownership restrictions.

2.   Data Issues

To assess the determinants of German company decisions on engaging in India we draw on the detailed information compiled by the Indo-German Chamber of Commerce for almost 800 so-called financial and technical collaborations of German firms with Indian partners (IGCC, 2003). This directory covers subsidiaries of German firms in India, JVs with Indian firms and other collaborations involving the production of goods and services. The snapshot presented in this source relates to the situation as of 2003. The dataset includes JVs that do not fall under the usual FDI definition of involving a minimum of 10 per cent of foreign equity participation. Purely technical collaboration (that is, license) agreements without any financial engagement of the German firm are also listed but are not used in this paper as they do not involve ownership.

It is in several respects that IGCC (2003) offers a particularly rich database. Information related to the type and intensity of the German firms' engagement include: the type of collaboration (financial or purely technical), the year when the collaboration started as well as the founding year of the Indian partner firm, the capital stock of the German subsidiary or Indo-German JV, the German share in paid up capital, annual sales, and employment. In addition, it is clearly identified where exactly in India the German subsidiary or Indo-German JV is located. The focus of German FDI in India was clearly on

the manufacturing sector, accounting for 80-90 per cent of total FDI, while the German engagement in the services sector remained marginal until 2003.[6]

It is important to note that the unit of observation in IGCC (2003) is the subsidiary or JV, rather than the German parent or partner company.[7] Some German companies are actually involved in several FDI projects; prominent examples include major German companies and conglomerates such as Daimler AG, Osram GmbH, Epcos AG, Allianz SE, and Siemens AG. Large FDI projects are the exception. Three quarters of German FDI projects involve subsidiaries or JVs with less than Rs. 60 million of paid up capital in 2003 (slightly more than €1 million at 2003 exchange rates); median employment is slightly below 50 workers and median German equity share is slightly above 50 per cent. Minority shares of up to 25 per cent are clearly the exception (about 10 per cent of all available observations), while almost a third of all FDI projects are wholly German owned subsidiaries. Financial collaboration typically started in the mid-1990s after FDI regulations were relaxed in the course of India's economic reform programme of 1991 (CUTS, 2003).

In order to obtain more information on the German firms engaged in India, we combine IGCC (2003) with company profiles available from the online database of Hoppenstedt, a commercial data provider (http://www.hoppenstedt-hochschuldatenbank.de). This source covers all German companies with more than 20 employees or annual sales of more than €1 million, including most of the parent firms with engagements in India. We use information on the German parent relating to: (major and minor) line(s) of business with NACE industry code(s) (version 1.1), year of foundation, annual sales, number of employees, and number of foreign affiliates. Employment and sales figures for many companies are available online only for the most recent years; to appropriately match the parent firm data with the information on their engagement in India

we refer to earlier hardcopies of Hoppenstedt (2004a, b) for data on employment and sales in, preferably, 2002 (or the closest year available).[8]

Hoppenstedt's company profiles are also used to collect the same set of firm-specific data for a control group of German companies that had not undertaken FDI in India until 2003. The control group is constructed in a way that its overall size as well as its industry structure resembles the size and industry structure of the sample of German FDI cases underlying the subsequent estimations. The selection of companies for the control group is random. We draw the required number n_i of companies for each industry i by dividing the (alphabetically ordered) list of Hoppenstedt profiles for all companies in industry i into $n+1$ subgroups, and drawing the company at the dividing line of two neighbouring subgroups for the control group.

The firm-specific datasets are complemented by two sets of variables. First, we consider some important characteristics of the industry in Germany to which the parent firm belongs.[9] We focus on the R&D intensity of the German industry. On the one hand, developing host countries are typically eager to attract advanced technologies that foreign investors in R&D intensive industries are most likely to possess. On the other hand, firms in R&D intensive industries tend to prefer full ownership to prevent leakage of technological knowledge (Gomes-Casseres, 1989; Javorcik, 2000).[10] Second, we consider state characteristics that may have a say on a state's attractiveness to FDI and which may also be relevant for a firm's choice of ownership share in the foreign affiliate. Our focus here is on openness measures at the state level. In this way, we account for the fact that India's economic reform programme of 1991 has reduced central government control so that policies and institutions at the state level are supposed to matter increasingly in the post-reform era (Singh and Srinivasan, 2006; Kochhar et al., 2006).

The online appendix presents some more details on the database construction, as well as exact definitions of all variables. A more detailed presentation of stylised facts on German FDI projects in India is available in Görg et al. (2008).

3. Methodology and Results

In our empirical analysis we model the investment decision of German firms in India as a two-step problem. First, firms decide whether or not to invest in India. We model this as a zero/one decision depending on firm (i) and industry (j) characteristics,

$$Pr(FDI_i) = \beta_1 X_i + \beta_2 R\&D_j + \beta_3 K/L_j + e_i \qquad (1)$$

This model is estimated using data for the German investors as well as the control group as defined in the previous section. For those firms that do invest in India, we can then also model the choice of ownership share,

$$osh_i = \alpha_1 X_i + \alpha_2 R\&D_j + \lambda_i + v_i \qquad (2)$$

where *osh* is the ownership share chosen by firm *i*.

This model is estimated using the Heckman (1979) two-step procedure. In equation (2), X_i denotes a vector of firm characteristics, and $R\&D_j$ is the industry's R&D expenditure relative to sales. The parameter λ_i captures the probability of firm *i* being observed in this second step (inverted Mills ratio in Heckman's parlance) and v_i is the remaining error term. Equation (1) includes the same set of variables in the selection equation as well as one additional variable to aid identification. The additional variable is a proxy for the sunk costs

of investing abroad, which are assumed to affect the selection but not the choice of ownership. As a proxy for this we use the capital intensity (K/L_j) of the industry of the parent company.[11]

Vector X_i includes size (measured in terms of employment), productivity (measured as labour productivity), age, the number of industries in which the firm is active (as a measure of diversification at the firm level), and number of existing foreign affiliates (as a measure of experience in foreign markets).

Productivity is included as this is highlighted in theoretical and empirical work by Raff et al (2009). In their empirical specification they also control for firm size and age in order to capture observable aspects of firm heterogeneity that may be correlated with productivity. We also add a variable capturing the number of industries in which a parent firm is operating to proxy the level of diversification of the parent. Previous papers hypothesise that more diversified parents are less likely to engage in full ownership, although the empirical evidence in support of this hypothesis is weak (Meyer, 1998; Javorcik, 2000). Arguably, the level of experience abroad may also have implications for the probability of investing in another foreign country as well as the choice of ownership. If they invest at all, firms with no experience may have to cooperate with foreign partners who know about the foreign environment. By contrast, firms with large experience abroad may not have to rely on foreign partners but are familiar with overseas operations and can therefore choose to go on their own. This implies that we would expect a positive correlation between the number of foreign affiliates a firm has, and its presence as an investor in India and its choice of ownership share (see also Gatignon and Anderson, 1988; Blomström and Zejan, 1991).

Note that we interpret statistically significant coefficients as indicating correlations rather than causality. Our data are a cross section and it is therefore difficult to control for

possible endeneity. This may be a problem for the firm-level variables included, in particular productivity and size, as these may be jointly determined with the ownership share, and/or the decision to invest in India. Given the cross-section nature of our data it is difficult to come up with convincing instruments that would allow us to control adequately for this possible endogeneity. However, there is little reason to be concerned about reverse causality running from German FDI in India to parent firm characteristics. As we noted before, most German FDI projects are fairly small, involving less than €1 million of invested capital and no more than 50 local workers. Still, in order to mitigate the problem, we follow Raff et al. (2009) and lag firm size and productivity in equations (1) and (2).

Table 1 presents the estimations of the baseline model. Column (1) shows the selection equation, column (2) the ownership share equation. In terms of the control variables we find that firm size, age, number of foreign affiliates and degree of diversification are statistically significantly correlated with the decision to invest in India (selection equation). Also, the measure of sunk costs matters for selection, as hypothesised we find that firms in industries with higher sunk costs (capital to labour ratio) are less likely to invest in India. For the choice of ownership share, only firm age and degree of diversification are statistically significant, and their signs are opposite to those found in the selection equation.

Discussion focuses on the two main variables of interest, firm-level productivity and industry-level technology (R&D intensity), which reveal remarkable differences between the selection and the ownership share equation. In terms of selection, it is apparent that more productive firms are associated with being more likely to invest in India. This mirrors the result that more productive firms invest abroad which is common in the literature (for example, Helpman et al., 2004; Geishecker et al., 2009). We also find that firms that operate in more research intensive industries are associated with being less likely to invest

in India. Hence, German investment in India is likely to be from low research intensive industries, but it is by highly productive firms within a given industry. The focus on lower-tech industries tends to be in some conflict with the preferences of host countries such as India, but may reflect that firms choose more advanced locations for investing in high-tech lines of business.

In the ownership share equation we find that results are in some sense opposite. Firm-level productivity is no longer statistically significant, but we find that the research intensity of the industry is positively associated with ownership share. In other words, among the firms that invest in India, firms choose a higher ownership share the higher is the research intensity (or knowledge stock) of the industry. This is in line with the theoretical proposition that firms in industries using higher levels of technology attempt to prevent dissipation of that knowledge through opting for whole or majority owned affiliates rather than JVs with foreign partners holding the majority of shares.

In order to check the robustness of the second-stage result to the choice of estimation technique we also estimate equation (2) using a Tobit estimator. This alternative is appropriate as it allows for the censored nature of the data. Results presented in column (3) are similar to those reported before. Firm-level productivity is not statistically significantly associated with ownership share, while higher industry-level research intensity implies a higher ownership share. In what follows, we concentrate on the Heckman estimation, as this also allows us to model the first-step decision.

[Table 1 here]

In order to look at our analysis from a more policy relevant angle, we make use of India's move towards liberalising its FDI regulations starting in 1991 (CUTS, 2003; FICCI, 2005). Amongst other things, this also included easing restrictions on the operations of foreign firms in India. For instance, Balasubramanyam and Mahambare (2003: 46) argue:

'The 1991 reforms marked a major break from the earlier dirigiste regime with its regulation of the spheres of foreign affiliate participation and its modes of operation.' Of course, this deregulation may have had implications for the choice to invest in India and, indeed, for the choice of ownership share by foreign parents. In particular, given that restrictions on the level of ownership by foreign firms were in place and that more technology intensive projects were favoured by the regulator, the choice before 1991 may not reflect economic optimisation but only the effect of such regulation.

In order to investigate this we split our sample into those firms that invested before and after 1991.[12] In the estimation of the selection equation (1) we include the full control group as counterparts for these two samples. The results are reported in columns (1) to (4) of Table 2. Note that the baseline results reported in Table 1 also adequately describe the choice of investment and ownership share for investments by German firms after 1991 (columns 3 and 4). For investments before 1991, which is under the regulation regime, results differ. In that case, the probability of investing in India is positively associated with firm-level productivity as well as the research intensity of the industry. This is likely to reflect the aim of the regulation, namely, to attract investments in high-tech industries. The choice of ownership share, however, is independent of firm productivity or industry research intensity. In other words, for those firms that were allowed to invest in India, knowledge intensity at the industry, or productivity at the firm level, do not affect their choice of ownership share. This seems to suggest that selective FDI approval procedures, together with foreign ownership restrictions, have helped India to attract the desired form of FDI from German investors – an issue to which we return in section 4.

[Table 2 here]

Liberalisation of the investment regime made the country more open to trade and investment. In order to take a different cut at the data we investigate whether the choice of

ownership share differs depending on the degree of openness of the Indian state in which the investment is located. We use two alternative measures of openness; *openness I* relates to the state-level distribution of investments in so-called 100% export-oriented units (EOU) in 1991-2001, relative to the respective state's share in India's population (Observer Research Foundation, 2004). The EOU scheme was introduced in the 1980s to promote Indian exports.[13] More open states have higher values of *openness I*. An alternative measure, *openness II*, comes from Marjit et al. (2007) who classify 15 major Indian states (covering 82 per cent of our sample of German FDI cases) as relatively open or closed. The index ranges from 1 (most open) to 15 (least open) and is based on a systematic assessment of production structures at the state level. States are considered relatively open when production structures correspond relatively well with India's revealed comparative advantages in international trade. Based on these two alternative measures, we classify states as open if openness measure I (II) is above (below) the median, otherwise states are considered closed.

The results are reported in Table 3. In general, these results are in line with our previous results. In more open states (as in the post-liberalisation period), investment decision and ownership share choice are determined by firm-level productivity and industry-level R&D intensity. In particular, less productive firms, and firms in more R&D intensive industries are less likely to invest in open states, while, for firms that invested there, those in R&D intensive industries tend to opt for higher ownership shares, arguably in order to protect their knowledge from dissipating into the local economy. In less open states (or in the pre-liberalisation period) firm and industry characteristics are less important determinants of investment and ownership share choice.

[Table 3 here]

Finally, we attempt to distinguish between 'vertical' and 'horizontal' German FDI projects in India in order to assess whether the type of FDI matters for the role of firm and industry characteristics. Note that theoretical models such as Raff et al. (2009) focus on horizontal FDI. It is thus open to question whether the type of FDI matters for the robustness of coefficients estimated for the full sample. As mentioned in the introduction, FDI involving state-of-the-art technology improves the bargaining position of foreign firms so that foreign ownership tends to increase with R&D intensity. However, this link may weaken if foreign investors are mainly interested in penetrating large local markets, shifting the relative bargaining position towards the government. According to Desai et al. (2004), foreign ownership is likely to be higher for vertical FDI; in this way, firms coordinating integrated production activities across different locations may mitigate conflicts with local partners pursuing competing goals. Likewise, Hennart (1991: 486) argues that 'conflicts between joint venture partners can be expected to arise … when foreign subsidiaries export back to the parent's home market or to third markets.'

The distinction between vertical and horizontal FDI is bound to be tentative. We draw on bilateral exports and imports, as reported by the OECD in its International Trade by Commodities database,[14] assuming that German FDI in India is more likely to be vertical (horizontal) in industries for which Indian-German trade relations – notably Indian exports to Germany – are stronger (weaker).[15] This is obviously an imperfect indicator of vertical and horizontal FDI, but arguably informative as vertical FDI leads to trade between host and home country (Markusen, 2002). One striking difference in results between vertical and horizontal investments is that for the former, industry-level R&D intensity and firm size are positively correlated with the choice of ownership share. This is not the case for horizontal investments. This appears to be in line with the bargaining argument discussed in the introduction. Vertical investments may bring stronger benefits to the host

economy and, thus, firms may be in a better bargaining position and be able to choose to have higher ownership shares.

<center>*[Table 4 here]*</center>

4.   Policy Implications

There are essentially two approaches of drawing on inward FDI in order to boost firm productivity and economic growth and India at times has employed both; on Indian reform and FDI, see Balasubramanyam and Mahambare (2003), as well as Singh and Srinivasan (2006). India adopted the first approach prior to its reform programme in 1991 by selectively targeting FDI inflows and strictly regulating foreign ownership shares. Policymakers aimed at attracting high-tech, R&D intensive FDI projects and luring foreign investors who readily accepted Indian JV partners. R&D intensive FDI was supposed to offer the best way to receive state-of-the-art technology, and JVs were deemed necessary for the Indian partners to learn from foreign investors and imitate superior technological processes, product design and management procedures. India shifted to the second approach in the course of economic reforms starting in the early 1990s, including the gradual dismantling of FDI regulations. By opening up less R&D intensive lines of business to FDI and relaxing foreign ownership restrictions the country provided rather indirect incentives for foreign investor to transfer state-of-the-art technology.[16] Policymakers increasingly let foreign investors decide on the type of FDI projects and ownership shares. In particular, India increasingly accepted that foreign investors tend to prefer retaining ownership control over superior technologies they possess.

Our empirical results clearly reflect the different approaches in the pre- and post-reform era. The observation of R&D intensity positively affecting the selection of German FDI projects prior to 1991, as well as in closed Indian states, is hardly attributable to

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deliberate choices of German investors, but rather to FDI regulations in line with local policymakers' preferences. The same applies to R&D intensity not having had a significant impact on the German ownership share in the pre-reform period and in closed Indian states. The preferences of German investors came to the fore when and where foreign companies were allowed to choose. Less R&D intensive FDI projects were more likely to be undertaken in the post-reform era and in more open Indian states. Furthermore, investors undertaking R&D intensive FDI projects clearly preferred higher ownership shares when having the freedom of choice.

One may be tempted to conclude at this point that policymakers interested in high-tech FDI inflows with local partners being involved in JVs have good reasons to enforce their preferences on foreign investors through selective approval procedures and foreign ownership restrictions. Such a conclusion would miss an important point, however. Constraining the choices of foreign investors comes at a cost. The inspection of our sample of German investments, in combination with the previously reported results, suggests that policymakers face a serious trade-off. The regulatory pre-reform approach ensures that realised FDI projects correspond to the host country's preferences with respect to firm and industry characteristics as well as ownership structure. At the same time, this approach tends to reduce the number of realised FDI projects. Importantly, regulations may discourage the number of preferred projects as much as projects that are discouraged deliberately. In other words, when assessing the policy implications of the pre- and post-reform approaches it has to be taken into account whether (possibly undesired) reform effects on the structure of FDI in India were compensated by positive effects on the absolute number of FDI projects, including projects with the (possibly still) desired characteristics.

Table 5 substantiates this point by classifying the (counts of) FDI projects in our sample according to the R&D intensity of the industry to which the investor belongs in Germany, the timing of FDI projects and their location in different Indian states. Not surprisingly, the overall number of FDI projects soared in the post-reform period – by a factor of 4.5 when comparing 1992-2003 with 1981-1991.[17] The deregulation of low-tech projects accounts for a substantial proportion of the increase in the overall number of FDI projects, but the number of higher-tech projects also multiplied.[18] Indeed, projects in the high R&D category still outnumbered projects in the low R&D category after the latter were liberalised. Put differently, the highly selective pre-reform approach had not only the desired effect of discouraging low-tech projects, but also appears to have substantially reduced the number of preferred projects.

The table also portrays the experience of two groups of selected Indian states. The four states rated 'more open' accounted for 42 per cent of 100% EOU in India in 1991-2001 (Observer Research Foundation, 2004), while their population share was only 26 per cent. Moreover, Marjit et al. (2007) classified all four states as more open than the group of five 'closed' states. Various authors, including Singh and Srinivasan (2006) and Kochhar et al. (2006), have stressed that policies and institutions at the state level matter increasingly since the early 1990s, with economic reforms having reduced central government control and having increased the potential for greater disparities across states. Indeed, the five closed states, accounting for 37 per cent of India's population, hosted very few FDI projects. This applies to all R&D categories in both the pre- and post-reform period. By contrast, the effects of opening-up to world markets on the structure as well as the overall frequency of FDI are evident for the four more open states. The share of low-tech FDI projects clearly increased in these states in the post-reform period (to about one quarter). More strikingly, however, German FDI projects in all R&D categories are concentrated in

the group of more open states to almost the same extent. Specifically, more open states did not lose relative attractiveness for high-tech FDI projects, compared to states that remained less open.

The distribution of vertical FDI, that is, cases where India's export pattern pointed to a relatively strong integration into intra-industry trade with Germany, reveals another trade-off policymakers are facing when pursuing selective FDI regulations in order to direct foreign investors into high-tech projects. As can be seen from Table 5, vertical FDI accounted for two thirds of the increase in the overall number of German FDI projects, comparing the post-reform period with the pre-reform period. It was particularly in industries with low R&D intensity that vertical FDI appears to have received a boost through the reform programme. This suggests that insisting on high-tech FDI has the undesired side-effect of discouraging export-oriented FDI, a type of FDI which policymakers in developing host countries are typically also fond of receiving.

Finally, the bottom part of Table 5 underscores the reform effects on the ownership structure of German FDI projects in India. Full German ownership was a rare exception in the pre-reform era, while accounting for almost 40 per cent of post-reform projects. Policymakers may consider an absolute decline in the number of FDI projects with foreign minority shares, thereby impairing the chances of local JV partners to learn from foreign investors and imitate their superior technology, as a cost of reform arising from giving foreign investors choice of ownership. However, policymakers must weigh this decline against the number of FDI projects with full or majority foreign ownership that were arguably made possible only by the reforms. For instance, comparing the post-reform period with the pre-reform period in the high R&D category, the decline in the number of cases with minority ownership was overcompensated five times by additional projects with full or majority foreign ownership. Once again it appears that imposing the host

government's preferences on foreign investors might come at a considerable cost, by impairing the incentives of foreign investors to undertake FDI that has at least some of the desired characteristics.

[Table 5 here]

5. Summary and Conclusion

We find both firm and industry characteristics related to technology intensity to be relevant when MNEs decide on (i) whether or not to engage with FDI in a host country and (ii) the share of ownership in foreign affiliates. We estimate Heckman models by drawing on two largely unnoticed datasets on German MNEs with varying equity stakes in Indian affiliates and a control group without any FDI in India. In contrast to most previous studies employing dichotomous choice models on wholly owned subsidiaries versus joint ventures, the data used in the present study allows treating the German MNEs' equity shares as a continuous variable. Furthermore, we explicitly account for the effects of India's opening up to world markets in the early 1990s on MNEs' FDI and ownership decisions.

It turns out that more productive German firms are generally more likely to undertake FDI in India, while firm productivity hardly matters for foreign ownership shares. More strikingly, India's reforms clearly affected the role of industry-specific R&D intensity in the two-stage decision process of German MNEs. During the post-reform period, FDI projects in R&D intensive industries were less likely and FDI projects in such industries were associated with higher German equity shares. By contrast, the limited number of pre-reform FDI projects was mainly R&D intensive and minority owned.

Obviously, the bilateral Indo-German setting of the present paper cautions against rash generalisations. The findings for German FDI do not necessarily apply to companies

based elsewhere. The motivations underlying FDI in India may differ from those of FDI in smaller developing countries. Ideally, one might aim at panel analyses covering various host countries and revealing more than just a snapshot of one particular year. However, such data are at present not available.

Keeping these caveats in mind, the present study offers interesting policy conclusions, notably on the trade-offs policymakers are facing when trying to lure FDI of a preferred type. Selective FDI approval procedures, together with foreign ownership restrictions, seem to have helped pre-reform India to attract the desired form of FDI - high-tech projects with foreign minority shares, enabling local joint venture partners to benefit from project-specific spillovers. Nevertheless, host-country governments aiming at growth and productivity enhancing FDI may be well advised to relax foreign ownership restrictions and open up lower-tech industries to FDI, as India has done since the early 1990s. Strict regulations ensuring that still realised FDI projects correspond to the host country's preferences may substantially reduce the number of realised projects – including those with the preferred characteristics.

[1] For informative accounts of the relevant literature, see Hennart (1991), Nakamura and Xie (1998), Asiedu and Esfahani (2001), and Desai et al. (2004).

[2] However, these studies generally proxy industry characteristics using data for the host country, while we use information on the home country industry. Arguably, the characteristics of the home country industry are a better indicator of the technology level used in the industry than those of the host country.

[3] Gatignon and Anderson (1988) draw on the same database, the Harvard Multinational Enterprise Project covering the entry modes of US-based MNEs in 1960-1975. In contrast to Gomes-Casseres (1989), these authors consider the continuum of foreign ownership (5-100 per cent equity). They find, among others, that MNEs with more experience abroad opt for wholly owned subsidiaries; R&D intensity positively affects the first-stage decision to aim at full ownership, while varying degrees of JV partnership are viewed as equivalent in the second stage once full ownership is ruled out.

[4] Blomström and Zejan (1991) address the dichotomy between minority and majority ownership, rather than that of wholly owned subsidiaries versus JVs.

[5] It is only the United States and the United Kingdom whose outward FDI stocks clearly exceeded Germany's outward FDI stocks in 2006 (UNCTAD, 2007).

[6] The German engagement is also concentrated within manufacturing. Mechanical engineering, chemicals, and metal products figure most prominently in terms of the number of FDI projects.

[7] The same applies to the data used by Raff et al. (2007).

[8] While the matching is improved by drawing on Hoppenstedt (2004a; b), this comes at the cost of losing some observations on German parent firms. The reason is that employment and sales thresholds are somewhat higher (35 employees or annual sales of more than € 3.5 million), compared to the online database.

[9] Most industry characteristics can be calculated at the 4-digit NACE level. An important exception is R&D intensity which is reported only at the 2-digit level (Statistisches Bundesamt, 2002a). Note that the German *Warenverzeichnis* (WZ 2003) corresponds with NACE revision 1.1.

[10] Ideally, one would of course refer to R&D intensity at the firm level. However, these data are generally not available; see Marin et al. (2003) for related survey data on German FDI projects in eastern Europe.

[11] This follows the recent literature on firm heterogeneity, sunk costs and foreign investment, such as Helpman et al. (2004). Note that, strictly speaking, identification of the two-step estimation does not hinge on this additional variable. If there were no additional variable in the first step, identification would be solely on the different functional form of the two equations. We also experimented with including K/L in the second step, but the variable always turned out to be statistically insignificant. This strengthens our assumption that it should be excluded from the choice of ownership share equation.

[12] In the online appendix we provide the Tobit equivalent of the model in Table 2, which shows that results obtained using that estimator are similar in nature, especially with regard to the productivity and R&D variables. We also report in that appendix results that use 1995 rather than 1991 as cut-off, taking account of the fact that the reform programme of 1991 marked just the first steps towards the deregulation of FDI. This does not change the results substantially.

[13] See http://www.mumbaicustoms.gov.in/scripts/eou.asp for details on the EOU scheme.

[14] The data are available at:
http://www.oecd.org/document/18/0,3343,en_2649_34235_1906706_1_1_1_1,00.html (accessed: April 2009).

[15] More precisely, we consider Indian exports to Germany over German exports to India in 2002 in SITC categories that correspond to the NACE codes for which our sample contains German FDI cases. The matching of SITC and NACE codes is mostly at the 3-digit NACE level.

[16] Perhaps there was increasing awareness that technology can be transferred in other ways. Parameswaran (2009) finds that technology spillovers associated with trade have contributed to increasing manufacturing productivity.

[17] Note that the pre-reform period covered in the table goes back to the 1950s.

[18] Just 16 R&D intensive cases were observed in 1981-1991.

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Tables

Table 1: Baseline estimation results

	(1) Heckman Selection	(2) Heckman Ownership share	(3) Tobit Ownership share
Firm variables			
ln(productivity)	0.806	-0.008	0.060
	(0.296)***	(0.110)	(0.136)
ln(size)	0.515	0.021	0.076
	(0.055)***	(0.032)	(0.028)***
age	0.137	-0.065	-0.075
	(0.072)*	(0.031)**	(0.042)*
diversification	-0.689	0.226	0.199
	(0.243)***	(0.093)**	(0.123)
# affiliates	0.419	-0.018	0.026
	(0.106)***	(0.044)	(0.050)
Industry variables			
ln(R&D)	-4.072	1.007	0.904
	(0.646)***	(0.305)***	(0.381)**
ln(K/L)	-1.277		
	(0.329)***		
Observations	508		271
Wald test (p-value)	0.000		
Mills ratio (p-value)	0.267		
R-squared			0.09

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include two digit industry dummies.

Table 2: Results for pre- and post-liberalisation investments

	(1) Pre 1991 Heckman Selection	(2) Pre 1991 Heckman Ownership share	(3) Post 1991 Heckman Selection	(4) Post 1991 Heckman Ownership share
Firm variables				
ln(productivity)	0.749	-0.029	0.800	0.118
	(0.318)**	(0.180)	(0.360)**	(0.176)
ln(size)	0.538	-0.010	0.484	0.025
	(0.084)***	(0.078)	(0.058)***	(0.035)
age	0.058	0.027	0.144	-0.072
	(0.113)	(0.074)	(0.075)*	(0.030)**
diversification	-0.832	0.632	-0.608	0.061
	(0.361)**	(0.187)***	(0.255)**	(0.096)
# affiliates	0.379	-0.148	0.448	-0.013
	(0.144)***	(0.085)*	(0.115)***	(0.049)
Industry variables				
ln(R&D)	2.699	-0.054	-4.076	1.045
	(0.767)***	(0.473)	(0.617)***	(0.278)***
ln(K/L)	1.019		-1.240	
	(0.313)***		(0.316)***	
Observations	314		435	
uncensored obs	77		198	
Wald test (p-value)	0.000		0.000	
Mills ratio (p-value)	0.478		0.056	

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include two digit industry dummies.

Table 3: Robustness checks: liberalisation and openness

	(1) Openness Measure I closed Heckman Selection	(2) Openness Measure I closed Heckman Ownership share	(3) Openness Measure I open Heckman Selection	(4) Openness Measure I open Heckman Ownership share	(5) Openness Measure II closed Heckman Selection	(6) Openness Measure II closed Heckman Ownership share	(7) Openness Measure II open Heckman Selection	(8) Openness Measure II open Heckman Ownership share
Firm variables								
ln(productivity)	0.074	-0.116	0.887	-0.041	0.876	0.179	0.679	-0.116
	(0.679)	(1.074)	(0.331)***	(0.124)	(0.369)**	(0.206)	(0.326)**	(0.146)
ln(size)	0.554	-0.009	0.481	0.003	0.541	0.114	0.464	-0.035
	(0.080)***	(0.111)	(0.061)***	(0.039)	(0.070)***	(0.062)*	(0.065)***	(0.048)
age	0.099	-0.044	0.152	-0.082	0.018	-0.113	0.246	-0.064
	(0.096)	(0.055)	(0.082)*	(0.040)**	(0.088)	(0.039)***	(0.088)***	(0.050)
diversification	-0.679	0.313	-0.577	0.201	-0.720	0.126	-0.526	0.315
	(0.328)**	(0.186)*	(0.265)**	(0.114)*	(0.303)**	(0.134)	(0.279)*	(0.137)**
# affiliates	0.486	-0.069	0.424	-0.041	0.361	0.112	0.503	-0.124
	(0.146)***	(0.110)	(0.116)***	(0.061)	(0.133)***	(0.066)*	(0.123)***	(0.073)*
Industry variables								
ln(R&D)	1.098	0.189	-4.517	1.071	0.427	-0.366	-4.692	1.456
	(0.942)	(0.379)	(0.669)***	(0.355)***	(0.431)	(0.289)	(0.821)***	(0.404)***
ln(K/L)	4.331		-2.521		3.518		-2.755	
	(0.480)***		(0.340)***		(0.226)***		(0.421)***	
Observations	325		420		358		314	
uncensored obs	88		183		121		77	
Wald test (p-value)	0.000		0.000		0.000		0.000	
Mills ratio (p-value)	0.360		0.243		0.426		0.478	

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include two digit industry dummies.

Table 4: Results for vertical and horizontal FDI

	(1) vertical Heckman Selection	(2) vertical Heckman Ownership share	(3) horizontal Heckman Selection	(4) horizontal Heckman Ownership share
Firm variables				
ln(productivity)	0.614	0.082	1.587	-0.151
	(0.307)**	(0.130)	(0.827)*	(0.276)
ln(size)	0.479	0.083	0.585	-0.027
	(0.090)***	(0.045)*	(0.078)***	(0.047)
age	-0.001	-0.057	0.209	-0.071
	(0.123)	(0.046)	(0.094)**	(0.044)
diversification	-1.055	0.171	-0.508	0.237
	(0.433)**	(0.139)	(0.311)	(0.134)*
# affiliates	0.545	0.049	0.367	-0.042
	(0.184)***	(0.081)	(0.137)***	(0.053)
Industry variables				
ln(R&D)	-3.902	0.751	-3.359	0.133
	(0.632)***	(0.355)**	(0.843)***	(0.289)
ln(K/L)	-1.025		-1.053	
	(0.233)***		(0.338)***	
Observations	213		295	
uncensored obs	93		144	
Wald test (p-value)	0.000		0.000	
Mills ratio (p-value)	0.425		0.047	

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include two digit industry dummies.

Table 5 – German FDI cases (number) in pre- and post-reform India: Distribution across industries, states and ownership shares

	All industries	High R&D intensity	Medium R&D intensity	Low R&D intensity
			All Indian states	
Pre reform	77	35	35	7
Post reform	194	68	76	50
			Five closed states[a]	
Pre reform	3	1	2	--
Post reform	4	--	2	2
			Four more open states[b]	
Pre reform	59	27	27	5
Post reform	128	46	50	32
			Vertical FDI[c]	
Pre reform	46	22	18	6
Post reform	122	50	35	37
			Full German ownership	
Pre reform	6	3	2	1
Post reform	76	27	32	17
			German majority share[d]	
Pre reform	29	16	12	1
Post reform	97	33	37	27
			German minority share[d]	
Pre reform	42	16	21	5
Post reform	21	8	7	6

[a] Andra Pradesh, Assam, Bihar, Kerala, Uttar Pradesh. – [b] Gujarat, Karnataka, Maharashtra, Tamil Nadu. – [c] Ratio of Indian exports to Germany over German exports in the same industry to India > 0.3. – [d] Minority: less than 50 per cent; majority: 50-99.9 per cent.

Online Appendix

A – More detail on the database construction

IGCC (2003) distinguishes between the location of headquarters and factory location of the firms in India with German participation. Many headquarters are located in Delhi, Mumbai or Bangalore, while factories are located in other states. The factory location is of principal interest, notably in the manufacturing sector, when assessing the distribution of production activities (Head and Mayer, 2004: 971). In various cases, however, there is no separate entry of factory location in the IGCC database. We then assume production to take place at the location of headquarters. We also use the headquarter location in cases for which the database lists several factory locations.

Apart from stand-alone companies, the Hoppenstedt database presents employees and sales for (i) specific firms belonging to a company group or conglomerate ('Konzern') and (ii) the company group as a whole. We use company group data whenever applicable. Option (ii) is preferred since the decision to engage in India is highly likely to be taken at a higher company level. Moreover, option (i) would involve a downward bias for company size when minor segments of the conglomerate provide the legal base for foreign affiliates, while accounting for a small fraction of the conglomerate's employment and sales.

B - Definition and sources of variables

Variable	Definition	Source
German subsidiary or joint venture in India:		
osh	German share in paid up capital, per cent; 2003	IGCC (2003)
age	Year of subsidiary or JV going into operation	IGCC (2003)
Characteristics of German (parent) firm:		
size	Size of the (parent) company, measured by number of employees; in logs; 2002 or closest year available.	Hoppenstedt (online; 2004a, b)
productivity	Labour productivity of the (parent) company, proxied by sales per employee; in logs; 2002 or closest year available.	Hoppenstedt (online; 2004a, b)
# affiliates	Number of foreign affiliates; proxy of (parent) firm's international experience	Hoppenstedt (online)
diversification	Number of industries (4-digit NACE codes) in which the (parent) firm is active; proxy of degree of diversification	Hoppenstedt (online)
Industry characteristics in Germany:		
K/L	Capital intensity, proxied by net assets per employee; 1000 €; in logs; 2002 (2-digit NACE)	Statistisches Bundesamt (2002a, b)
R&D	R&D intensity, measured by R&D expenses in per cent of gross production; in logs; 2002 (2-digit NACE)	Statistisches Bundesamt (2002a)
Location characteristics in Indian states:		
openness I	State's share in 100% export oriented units (EOU) in all India in 1991-2001, relative to the state's population share	Observer Research Foundation (2004)
openness II	Index on regional openness to trade; ranking of states in terms of their exposure to trade, as defined in the source; range from 1 (most open) to 15 (closed)	Marjit et al. (2007)

C – Alternative estimations

C1. Tobit results for estimations in Table 2

Table A1: Results for pre- and post-liberalisation investments

	(1) Pre 1991 Tobit Ownership share	(2) Post 1991 Tobit Ownership share
Firm variables		
ln(productivity)	0.050	0.298
	(0.136)	(0.262)
ln(size)	0.042	0.129
	(0.039)	(0.032)***
age	0.040	-0.076
	(0.074)	(0.044)*
diversification	0.600	-0.057
	(0.182)***	(0.139)
# affiliates	-0.108	0.070
	(0.069)	(0.056)
Industry variables		
ln(R&D)	0.049	0.776
	(0.477)	(0.350)**
Observations	77	198
R squared	0.22	0.14

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include two digit industry dummies.

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C2. Sensitivity of 1991 cut-off

In the regression results in Table A2, we take account of the fact that the reform programme of 1991 marked just the first step towards the deregulation of FDI, with a sequence of further FDI liberalisation in subsequent years (CUTS, 2003; FICCI, 2005). Accordingly, we split the sample into those investing before and after 1995. Results for firms investing after 1995 are identical to those we obtained in Table 2 for firms investing after 1991. For investments before 1995, the only difference to corresponding columns (1) and (2) in Table 2 is that firms are more likely to invest in India if they are in industries with lower research intensities. However, this effect is much smaller than in the selection equation on investments by firms after 1995.

Table A2: Using 1995 instead of 1991 as cut-off

	(1) Pre 1995 Selection	(2) Pre 1995 Ownership share	(3) Post 1995 Selection	(4) Post 1995 Ownership share
Firm variables				
ln(productivity)	0.895	-0.034	0.732	0.035
	(0.369)**	(0.154)	(0.391)*	(0.198)
ln(size)	0.517	-0.004	0.479	0.027
	(0.072)***	(0.058)	(0.063)***	(0.035)
age	0.164	-0.009	0.109	-0.100
	(0.089)*	(0.050)	(0.085)	(0.033)***
diversification	-0.835	0.396	-0.542	0.048
	(0.300)***	(0.145)***	(0.276)**	(0.100)
# affiliates	0.389	-0.052	0.487	-0.022
	(0.126)***	(0.070)	(0.123)***	(0.055)
Industry variables				
ln(R&D)	-2.274	-0.175	-4.223	1.203
	(0.573)***	(0.284)	(0.634)***	(0.298)***
ln(K/L)	-13.076		-1.224	
	0.275)***		(0.325)***	
Observations	361		397	
uncensored obs	124		160	
Wald test (p-value)	0.000		0.000	
Mills ratio (p-value)	0.435		0.097	

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include two digit industry dummies.