# The Reasons for and Impact of the Internationalization of Research and Development: The Case of Indian Multinationals

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Abstract

The aim of this article is to investigate the impact of firm-specific characteristics on the internationalization of R&D, on the one hand, while also analyzing the impact of this process on the innovative performance of the Indian parent companies, on the other hand. It therefore analyzes the factors influencing the likelihood of foreign R&D; and the subsequent impact of foreign R&D on the parent firms' innovativeness. An econometric analysis of Indian firm panel data (period 2003-2012) shows, first, that firm-specific technological advantages are important drivers of foreign R&D investments. Second, technology-seeking foreign R&D positively influences the innovation performance of Indian parent companies.

Keywords: Multinational enterprise, India, R&D, internationalization, technology seeking and exploiting

# The Reasons for and Impact of the Internationalization of Research and Development: The Case of Indian Multinationals

## Introduction

This paper analyses the internationalization of research and development (R&D) by Indian multinational enterprises (MNEs) by looking into the R&D greenfield investments of Indian multinationals over the last decade. It specifically analyses the determinants of foreign R&D investments and the impact of foreign R&D locations on parent company innovativeness.

The traditional literature of the MNE either implicitly or explicitly refers to the technology exploiting motive of foreign direct investment (Hymer, 1976; Dunning, 1981). That is, in order to overcome its liability of foreignness, a MNE and its subsidiary have to possess some firm-specific competitive advantage in order to be able to compete with local (foreign) firms. This firm-specific advantage (Rugman, 1980) or nationality of ownership advantage (Dunning, 1958) has often been associated with a technological competence or asset (Markusen, 2001), which is capable of being transferred and thus exploited in other suitably advantaged locations.

Yet in more recent years, a complementary motive for FDI has been increasingly recognized, in which a MNE is argued to benefit from the international scope of its activities by seeking or sourcing technology-based assets from its foreign-located counterparts. The articulation within the firm of this MNE motive or strategy may be the initially unplanned outcome of the evolution over time of selected subsidiaries (Birkinshaw and Hood, 1998). As these subsidiaries have matured, they have become increasingly capable of local initiatives, entrepreneurship and new business network creation (Birkinshaw, 1997; Forsgren, Holm and Johanson, 2005). This locally competence creating type of FDI has sometimes been termed technology seeking or asset augmenting FDI (Dunning and Narula, 1993; Kuemmerle, 1999; Le Bas and Sierra, 2002).

However, increasingly MNEs –especially from emerging economies- have started seeking out technology from the get-go. Although some (Rugman and Li, 2007) have questioned that multinationals from emerging economies possess (sufficient) ownership advantages to expand successfully abroad, it seems that more and more firms from these emerging markets have gradually accumulated sufficient technological and other capabilities – also known as firm-specific advantages – to do so (van Agtmael 2007, Wells, 1983). As a result, flows of OFDI from emerging markets have increased significantly (Gammeltoft 2008), demanding a closer look as to their characteristics and motivations (Child and Rodriguez, 2005).

There is indeed growing evidence pointing to a ``globalization of innovation" trend. The foreign R&D resources can play one or both of two roles: facilitate local adaptation of the

MNC's products and services and/or enable the creation and acquisition of globally relevant technology for the entire corporation (Feinberg and Gupta, 2004). Various scholars have examined inter alia the characteristics of companies involved in these two types of FDI (Kuemmerle, 1999; Le Bas and Sierra, 2002; Cantwell and Mudambi, 2005; Berry, 2006) and the regional characteristics that attract these different FDI types (Cantwell and Piscitello, 2005; 2007).

Furthermore, so far it has been implicitly assumed that knowledge acquired and created at foreign locations is transferred to a sufficient degree to the companies' headquarters. If this is not the case, it cannot be excluded that technology sourcing gradually leads to substitution of domestic R&D by moving part of a firm's R&D activities to foreign locations.

Although most MNEs come from advanced markets, firms from emerging markets have made remarkable progress on the international investment scene in the last decade. Outward FDI from developing and emerging economies reached $328 billion in 2010, while six developing economies -including China and India- were among the top 20 investors (UNCTAD, 2011). In terms of destination, detailed data shows that sixty percent of the OFDI flows from developing countries went into other developing countries, mostly in the form of greenfield investments (World Bank, 2011). UNCTAD's World Investment Prospects Survey 2011–2013 (WIPS) confirmed that developing economies are becoming important investors, and that this trend is likely to continue in the near future (UNCTAD, 2011).

This article will therefore analyze the specific determinants of the internationalization of R&D investments of Indian firms. Starting point of the analysis is the empirical fact that firms pursue different goals when getting engaged in foreign R&D. Given that firms are driven by different motives for investing abroad in R&D, the aim of this article is to investigate the differences between specific motives with respect to the factors influencing the likelihood of market-seeking versus technology-seeking R&D investment. It will analyze whether these firm-specific advantages do indeed drive these two R&D investments and whether these foreign R&D locations add to the innovativeness of their parent companies. The remainder of the text will frame the article in existing literature while developing hypotheses. The analysis will subsequently focus on the determinants of market-seeking versus technology-seeking investments and their respective impacts on the parent company's innovative intensity.

## Literature and hypothesis development

Innovative effort is traditionally expected to take place mainly in the home country of multinational enterprises (Castellani and Zanfei 2006). This view is consistent with the product life cycle hypothesis first introduced by Vernon (1966), and is further explained by economies of scale associated with R&D efforts; the importance of learning activities, which

are supported by economies of agglomeration; and the importance of access to a rich and growing market to introduce innovations. This concentration of strategic innovative activities in the home country allow an intensified specialization and division of labor in innovation and the utilization of scale economies, and avoids additional costs of transmitting knowledge to the local subsidiary.

Van Den Bulcke and Halsberghe (1985) found that research and development and the technology employed were centrally controlled decisions. Young et al. (1985) confirmed that almost half of the subsidiaries claimed that R&D was decisively influenced by the parent company. In addition, the research and development involved was generally of a modification and adaptation nature, rather than research aimed at development and innovation. Hood and Young (1988) found that 40 per cent of multinational subsidiaries located in the British Isles conducted no activity in either research or development. Even in subsidiaries which undertook research and development, the number of people employed was small. They therefore concluded that research and development was not only centrally controlled but also centrally located. Further evidence for centralization of research and development was shown by Hu (1992), who found that research and development personnel were mostly concentrated in the home nation.

However, De Meyer and Mizushima (1989) noticed that over the years there was a significant change in the attitude of MNEs to research and development. Consistent with increased globalization, more decentralization of research and development decision-making had occurred. Globalization should result in a greater need for local technical support and therefore a greater autonomy. Ghoshal and Bartlett (1986) evaluated the linkage between subsidiary autonomy and innovation, and established that higher levels of local decision-making power facilitated the creation of locally-developed innovations, which subsequently also led to their diffusion throughout the international network. Locate in Scotland (1997) found that in the case of research and development, subsidiaries had at least partial responsibility in 70 per cent and 82 per cent of cases, respectively. This increase in responsibility is consistent with the findings of Papanastassiou and Pearce (1997) who argue that as global competitiveness intensifies, MNEs need to be able to respond to changing consumer demands in all major markets at an ever increasing speed. This also includes increasingly recognizing the distinctive needs of consumers in various worldwide markets. By allowing subsidiaries to become more responsive to these changing needs both the MNE as a whole and the subsidiary will benefit. The MNE can benefit from a wider scope of knowledge, while the subsidiary may profit from the increase in creative roles devolved to the subsidiary. These benefits are unlikely to be gained if the technology inputs remain within the domain of the established technology function of the MNE, however.

This strategy has been labeled as asset exploiting, home base exploiting, competence exploiting or market seeking. Asset exploiting strategies are associated with a view of multinational enterprises as a means to exploit firm-specific advantages in foreign markets

(Dunning, 1981, Markusen, 1995, Barba Navaretti and Venables, 2004). Research and development of the subsidiaries support the exploitation by adapting technologies, products and processes to local needs, consumer tastes, regulation, etc. (Dachs and Ebesberger, 2009).

However, the home base exploiting perspective was challenged in more recent years by the observation that multinational enterprises increasingly generate new research and development outside of their home countries. Such a strategy has been described as asset seeking, host base augmenting, competence creating or technology driven. Asset-seeking strategies are driven by supply factors, such as the availability of skilled researchers, the need to monitor the technological activities of competitors, clients, universities and other research organizations, or the wish to assimilate local knowledge in the host countries. Recent empirical studies on R&D internationalization investigate technology sourcing as a driver of investments in R&D at foreign locations. They demonstrate the relevance of this type of foreign R&D and compare the importance of knowledge-seeking strategies with those reflecting market-seeking motives (Cantwsell, 1995, Florioda, 1997, Frost, 2001).

A substantial amount of research has either implicitly or explicitly considered the nature or characteristics of the firms that engage in technology-seeking FDI. In particular, the question of whether high-productivity (leader) or low-productivity (laggard) firms engage in this type of FDI has featured prominently in this debate. Many of the earlier empirical industry-level studies have suggested that laggards are more likely to engage in technology-seeking FDI, as they stand to gain the most from it (Kogut and Chang, 1991; Hennart and Park, 1993; Neven and Siotis, 1996). This conclusion has also been formalized (Fosfuri and Motta, 1999; Siotis, 1999).

However, more recent microeconomic evidence suggests quite the contrary. Notably, in a study of Japanese investors in the United States, Berry (2006) convincingly demonstrates that leaders are more likely to engage in technology-seeking FDI, a result which is corroborated inter alia by Le Bas and Sierra (2002), Branstetter (2006) and Griffith, Harrison and van Reenen (2006). Berry (2006) explains this finding by arguing that unlike leaders, laggard firms have neither the absorptive capacity nor the intra-firm technology transfer skills necessary to benefit from technology-seeking FDI. Smeets and Bosker (2008) also demonstrate the likelihood of leaders engaging in technology seeking FDI, and provide an empirical illustration of this.

The implication of these more recent and more detailed studies on firm heterogeneity and FDI motives is that leaders, and not laggards, are more likely to engage in technology-seeking FDI. Many authors have since investigated the characteristics of companies involved in technology-exploiting versus technology-seeking foreign investment activities (Kuemmerle, 1999; Le Bas and Sierra, 2002; Cantwell and Mudambi, 2005; Berry, 2006). Generally, both motivations for investment seem to respond differently to subsidiary-level determinants, parent characteristics and location-specific influences.

Hypothesis 1. The likelihood that a firm is engaged in R&D activities in foreign locations is positively related to a firm's specific advantages.

Hypothesis 2. The likelihood that a firm is engaged in technology-seeking R&D activities in foreign locations is more positively related to a firm's specific technological advantages than technology exploiting R&D activities.

Hypothesis 3. The likelihood that a firm is engaged in advanced market R&D activities is more positively related to a firm's specific technological advantages than emerging market R&D activities.

The empirical literature dealing with the influence that foreign R&D exerts on the innovativeness of the parent company is inconclusive. It seems that asset technology seeking and exploiting foreign R&D affect the investing firm's innovativeness differently. Technology seeking thereby seems to have a more positive impact on a firm's innovativeness than technology exploiting investments. An increasingly prominent debate on how in-sourced technologies from different national origins may influence a firm's performance and competiveness has drawn significant attention in the literature, with special focus on the catching-up latecomers in the developing countries (Ahuja & Katila, 2004; Cantwell & Santangelo, 2000; Castellacci & Archibugi, 2008; Dunning & Lundan, 2009; Fu & Gong, 2011; Lahiri, 2010; Li-Ying & Wang, 2012). Firms need to source technology across borders to reap another country's specializations in particular technological fields or qualified scientists and engineers (Desyllas & Hughes, 2008; Lahiri, 2010; Malmberg & Maskell, 2006; Singh, 2008). Foreign technologies are commonly considered as a "building block" for latecomer firms to improve their productivity (Katrak, 1990; Kim, 1980). Basan and Brian (1996) found the return to foreign technology purchase in Indian high-tech firms is estimated to be 166%, while the return to domestic technology investments falls to only 1%.

Moreover, the impact of the parent firm's innovativeness depends on the kind of foreign R&D activity. Iwasa and Odagiri (2004) investigated the impact of R&D activities of the US affiliates of Japanese manufacturing firms and found that only research activities had a positive effect on the patent productivity of parent firms when the affiliates are located in high-tech areas. In contrast, more application oriented development activities had no significant influence on innovation performance.

Not all firms pursuing technology seeking strategies benefit to the same extent from knowledge sourcing. Ambos et al. (2006) showed that firms with a high absorptive capacity gain more than those which are weaker in this respect. Therefore, it is not surprising that technology seeking strategies are most prominent in leading countries and least prevalent in technologically less developed economies (LeBas and Sierra, 2002). It is, however, also hypothesized that this might depend upon the absorptive capacity of the parent firm.

Hypothesis 4. R&D activities in foreign locations positively influence the parent firm's innovation performance.

Hypothesis 5. Technology-seeking R&D activities in foreign locations more positively influence the parent firm's innovation performance than technology exploiting R&D activities.

Hypothesis 6. Advanced market R&D activities more positively influence the parent firm's innovation performance than emerging market R&D activities.

## Data and methodology

We make use of the Financial Times' Crossborder Investment Monitor database to examine which companies performed foreign technology investments. This database covers global cross-border investments since 2003 (up until 2012), drawing on press releases, newspaper reports, information from local and national investment agencies, and information provided by the investing firms themselves. The database includes information on the investing firm and its parent company, the city and country of investment, the sector of investment and the type of activity (R&D, manufacturing, logistics, distribution, retail, …). Additionally, the database provides information about the job creation and the capital investment made.

In this database, we tracked all foreign technology investments made by Indian companies. Technology investments are defined in the database as investmens with industry activity 'Research & Development' (R&D) or 'Design, Development & Testing' (DD&T). Accordingly, we collected information on 194 foreign technology investments, made by 92 different Indian firms (see Table 1). Of these 194 investments, we can classify 144 as Design, Development & Testing projects, and 50 as Research & Development projects. Because we also know in which countries these investments are made, we can classify these investments further in projects performed in advanced markets (AM) and in emerging markets (EM). From the table below, we can observe that most technology investments occur in advanced markets (106 projects versus 88). Additionally, the table shows that Indian companies have a preference to perform both types of technology projects (R&D and DD&T) in advanced markets.

Subsequently, we tried to match the companies from the Crossborder Investment Monitor with firms present in the Prowess database. Prowess is a database of the financial performance. It includes all companies traded on the National Stock Exchange and the Bombay Stock Exchange, thousands of unlisted public limited companies and hundreds of private limited companies. We included the most important companies, i.e., more than 11,000 companies. The Prowess database is built from Annual Reports, quarterly financial statements, Stock Exchange feeds and other reliable sources. However, this match was not

complete, which reduced our sample. Appendix 1 shows that we were able to match 157 technology investments (made by 68 different Indian firms). In the following, we will only discuss this reduced sample, as we can evidently only work with the companies that match the prowess database for performing our regressions in the empirical part.

Table 1: Foreign technology investments by Indian companies

| | Advanced Markets (AM) | Emerging Markets (EM) |
|---|---|---|
| Research & Development (R&D) | 26 | 24 |
| Design, Development & Testing (DT&T) | 80 | 64 |

Source: Financial Times' Crossborder Investment Monitor database

When we take a look at the sectors in which these Indian companies make their foreign technology investments (Table 2), we can observe that most investments are made in the ICT & Electronics industry cluster (64%). Furthermore, we can notice that 10% of all investments are made in the Life Sciences industry cluster. Again, this is not surprising as India is quite competitive in the pharmaceutical industry (Pradhan, 2011). When we distinguish between DD&T and R&D investments, we can see clear differences. The large majority (73%) of DD&T investments are made in the ICT & Electronics industry cluster, while the majority (48%) of R&D investments is made in the Life Sciences industry cluster. DD&T investments are however more oriented towards applied research, which explains why most of their investments are made in sectors where applied science is relatively more important than basic science (ICT, software, electronics, creative industries, industrial sectors,…). R&D investments on the contrary are more oriented towards basic research, which explains why most of their investments are made in the Life sciences industry cluster where basic research is very important. Finally, from Appendix 2 (industry cluster distribution of the population), we can see that our sample is representative.

Table 2: Industry cluster distribution

| | All investments | | DD&T | | R&D | |
|---|---|---|---|---|---|---|
| Cluster | Freq. | Percent | Freq. | Percent | Freq. | Percent |
| Consumer Goods | 1 | 0.64 | 0 | 0 | 1 | 3.45 |
| Creative Industries | 3 | 1.91 | 3 | 2.34 | 0 | 0 |
| Energy | 1 | 0.64 | 1 | 0.78 | 0 | 0 |
| Environmental Technology | 3 | 1.91 | 3 | 2.34 | 0 | 0 |
| Financial Services | 7 | 4.46 | 6 | 4.69 | 1 | 3.45 |
| ICT & Electronics | 101 | 64.33 | 94 | 73.44 | 7 | 24.14 |
| Industrial | 10 | 6.37 | 7 | 5.47 | 3 | 10.34 |
| Life sciences | 15 | 9.55 | 1 | 0.78 | 14 | 48.28 |
| Physical Sciences | 1 | 0.64 | 1 | 0.78 | 0 | 0 |
| Transport Equipment | 12 | 7.64 | 9 | 7.03 | 3 | 10.34 |
| Wood, Apparel & Related Products | 3 | 1.91 | 3 | 2.34 | 0 | 0 |
| Total | 157 | 100 | 128 | 100 | 29 | 100 |

Source: Financial Times' Crossborder Investment Monitor database

After linking the Prowess database with the Crossborder Investment Monitor, we can also compare firms that do not perform foreign technology investments with those firms that go overseas to invest in R&D or DD&T. Table 3 compares these firms in terms of age, assets, number of employees, R&D expenditures and intangible assets. Furthermore, the table also differentiates between firms that make at least 1 technology investment and firms that make at least 1 technology investment in a developed market. All variables in this table are mean values. The table clearly shows that firms that internationalize their technology activities are older and larger in terms of assets or employees. Additionally, we can observe that these firms have on average much higher R&D expenditures and intangible assets. These findings confirm previous literature (e.g. Buckley & Casson, 1998; Carlson, 1979; Caves, 1996). The table also shows that firms that internationalize in advanced markets are relatively younger and smaller than the average firm that internationalizes its technological activities, although these differences are not so large. We can also discern that these firms have higher R&D expenditures and possess more intangible assets. This lends support to the argument that firms which internationalize their technological activities in more advanced

markets need to have more absorptive capacity (which can be measured by R&D expenditures or intangible assets).

Table 3: Comparison between non-investing firms and technology investing firms

| | Age | Assets | Employees | R&D expenditures | Intangible Assets |
|---|---|---|---|---|---|
| Non-investing firms | 20.31 | 2028.82 | 3903.68 | 5.99 | 17.83 |
| R&D/DD&T investing firms | 24.98 | 36571.82 | 15137.59 | 251.43 | 308.68 |
| R&D/DD&T investing firms in AM | 23.79 | 29434.15 | 14840.84 | 319.46 | 347.08 |

Source: Prowess database, Centre for Monitoring Indian Economy; and The Financial Times' Crossborder Investment Monitor database

## Data Results

We ran two sets of regressions to try to analyze the determinants that drive foreign technology investments, on the one hand, and the impact that these investments have on the research and development of these investing firms, on the other hand.

Table 4 lists the results of the logit panel regressions we ran on the drivers of the internationalization of R&D. We compared firms that invested in foreign R&D with firms that dit not. The dependent variable is a dummy variable for foreign R&D in the year of investment. We took up R&D investments, intangible assets, purchases of foreign technology by looking at the foreign exchange spent on royalties and technical know-how, and the import of capital goods. We obviously controlled for size and age.

By means of in-house R&D efforts, firms can become proprietary owners of both product and process innovations (Pugel, 1981). As such, firms that do invest in R&D are more likely to be able to generate ownership specific assets to venture into international markets. We have measured the technological capabilities of Indian firms by taking up not only research and development expenditures that are a reflection of current efforts to develop new processes and/or products, but also intangible assets which are a proxy of assets developed over time on the basis of technological efforts.

Firms can also gain access to technology through technology imports. Imports of capital goods, for instance, would bring them the latest technology embodied within the machinery and equipment. With the help of modern technology, the firm would be able to cater to the needs of the global market more efficiently. Import of designs, drawings, and blueprints

against royalty payments also brings with it technological knowledge that can be used to produce products and services of world standard. Firms may augment these imported technologies with in-house efforts to assimilate the existing technology and then improve it to produce proprietary technological assets (Kumar, 1982).

Table 4: Logit panel model analysis on determinants of foreign R&D investments

| | Model 1<br>All | Model 2<br>R&D | Model 3<br>DD&T | Model 4<br>DM | Model 5<br>EM |
|---|---|---|---|---|---|
| Age | 0.0004 | 0.0004 | 0.0001 | -0.0003 | 0.0002 |
| Intangible assets | 0.0001 | 0.0003** | 0.0001 | 0.0000 | 0.0000 |
| Sales | 0.0000*** | 0.0000 | 0.0000** | 0.0000* | 0.0000*** |
| Goodwill | 0.0000 | -0.005 | 0.0001 | -0.0001 | 0.0001 |
| R&D expenses | 0.0010*** | 0.0012*** | 0.0008*** | 0.0008*** | 0.0007 |
| Import of capital goods (cif) | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 0.0000 |
| Foreign spending on royalties & technological knowhow | -0.0069*** | -0.1472 | -0.0051** | -0.0040* | -0.0181** |
| Constant | -11.575*** | -11.243*** | -12.371*** | -11.446*** | -12.150*** |
| Number of observations | 100,439 | 100,439 | 100,439 | 100,439 | 100,439 |
| Number of companies | 11,209 | 11,209 | 11,209 | 11,209 | 11,209 |
| Wald chi2 | 36.54*** | 30.64*** | 20.67*** | 25.24*** | 23.61*** |

Source: Authors' analysis on the basis of Prowess database, Centre for Monitoring Indian Economy; and The Financial Times' Crossborder Investment Monitor database.

The results clearly indicate the importance of in-house R&D (see Table 4). Model 1 shows that R&D expenditures are an important driver of the internationalization of R&D. The purchase of foreign technology is shown to be a significant break on foreign R&D and clearly serves as a substitute for technology development in foreign locations. The other models corroborate these conclusions, although the size of the impact varies depending on which type of investment and which type of location. For instance, in-house R&D is a more important driver for foreign R&D investments than it is for DD&T. In-house R&D is also an important driver of investments into developed markets, but not so for emerging markets.

Table 5 lists the results of the OLS panel regressions we ran on the impact of foreign R&D investments on in-house R&D in the home country. We again compared firms that invested in foreign R&D with firms that dit not. The dependent variable is R&D expenditure by the home country investing parent company, which we lagged. We took up the number of foreign technology labs, purchases of foreign technology by looking at the foreign exchange spent on royalties and technical know-how, and the import of capital goods. We obviously controlled for size and age. The subsequent models then try to measure the differences between foreign R&D and DD&T labs, and between advanced and emerging economies.

Table 5: OLS panel models on the impact of foreign R&D investments on parent R&D

| | Model 1<br>All | Model 2<br>R&D | Model 3<br>DD&T | Model 4<br>AM | Model 5<br>EM |
|---|---|---|---|---|---|
| Sales | 0.0009*** | 0.0010*** | 0.0009*** | 0.0010*** | 0.0010*** |
| Age | 0.0149** | 0.0142** | 0.0150** | 0.0148** | 0.0148** |
| Import of capital goods (cif) | 0.0294*** | 0.0293*** | 0.0295*** | 0.0289*** | 0.0297*** |
| Foreign spending on royalties & technical knowhow | 0.0777*** | 0.0772*** | 0.0770*** | 0.0770*** | 0.0767*** |
| Number of labs | 92.6749*** | | | | |
| Number of labs in R&D | | 438.4266*** | | | |
| Number of labs in DD&T | | | 80.7802*** | | |
| Number of labs in Advanced Markets | | | | 287.1269*** | |
| Number of labs in Emerging Markets | | | | | 70.2617*** |
| Constant | 3.9000*** | 3.7985*** | 4.0238*** | 3.6735*** | 4.1191*** |
| Number of observations | 100,439 | 100,439 | 100,439 | 100,439 | 100,439 |
| Number of companies | 11,209 | 11,209 | 11,209 | 11,209 | 11,209 |
| Wald chi2 | 8628.06*** | 9140.71*** | 8244.71*** | 9785.27*** | 7898.48*** |

Source: Authors' analysis on the basis of Prowess database, Centre for Monitoring Indian Economy; and The Financial Times' Crossborder Investment Monitor database.

The results clearly indicate that foreign investment in technology have a positive impact on the R&D of the corporate parent in the home country (India). When we split the sample between R&D or DD&T investments, the results also indicate that there is a significant difference between the two. In fact, foreign R&D labs have a significantly bigger positive impact on R&D of the corporate parent than DD&T investments abroad. A similar conclusion can be drawn for investments in advanced versus emerging economies. The results show that the positive impact of investments in technology in advanced markets have a far greater impact than those in emerging markets.

Furthermore, the results also indicate that the purchase and import of technology also has a positive impact on home country R&D. This is in line with existing literature. Some even argue that even if the imported technology is not enhanced, developing country firms can become globally competitive by taking advantage of low technology and managerial costs in their home countries to internationalize abroad (Lall, 1982).

## Conclusions

Our analysis has shown support for the hypotheses put forward. First of all, the analysis confirms that the likelihood that a firm is engaged in R&D activities in foreign locations is positively related to a firm's specific advantages, especially its technological assets. Second, the likelihood that a firm is engaged in technology-seeking R&D activities in foreign locations is more positively related to a firm's specific technological advantages than technology exploiting DD&T activities. This is a good sign, in that technologically more competitive firms invest more in R&D, which will be more capable of taking advantage of any technology development because of its absorptive capacity. Third, the likelihood that a firm is engaged in advanced market R&D activities can again be linked to the firm's specific technological advantages as compared to investments in emerging market R&D activities.

The analysis furthermore indicates that R&D activities in foreign locations positively influence the parent firm's innovative performance. Technology-seeking R&D activities in foreign locations thereby more positively influence the parent firm's research and development than technology exploiting DD&T activities. And, finally, advanced market investments more positively influence the parent firm's innovation performance than emerging market technological activities.

# Appendices

Appendix 1: Matched sample: Foreign technology investments by Indian companies

| | AM | EM |
|---|---|---|
| R&D | 19 | 10 |
| DD&T | 70 | 58 |

Appendix 2: Industry cluster distribution of population

| | All investments | | DD&T | | R&D | |
|---|---|---|---|---|---|---|
| Cluster | Freq. | Percent | Freq. | Percent | Freq. | Percent |
| Consumer Goods | 1 | 0.52 | 0 | 0 | 1 | 2 |
| Creative Industries | 10 | 5.15 | 8 | 5.56 | 2 | 4 |
| Energy | 1 | 0.52 | 1 | 0.69 | 0 | 0 |
| Environmental Technology | 3 | 1.55 | 3 | 2.08 | 0 | 0 |
| Financial Services | 8 | 4.12 | 7 | 4.86 | 1 | 2 |
| ICT | 109 | 56.19 | 101 | 70.14 | 8 | 16 |
| Industrial | 11 | 5.67 | 8 | 5.56 | 3 | 6 |
| Life sciences | 33 | 17.01 | 2 | 1.39 | 31 | 62 |
| Physical Sciences | 1 | 0.52 | 1 | 0.69 | 0 | 0 |
| Professional Services | 1 | 0.52 | 0 | 0 | 1 | 2 |
| Transport Equipment | 12 | 6.19 | 9 | 6.25 | 3 | 6 |
| Wood, Apparel & Related Products | 4 | 2.06 | 4 | 2.78 | 0 | 0 |
| Total | 194 | 100 | 144 | 100 | 50 | 100 |

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