Drivers of International R&D to Asian Economies -

Axel Mangelsdorf [2] ***and Anja Schmiele*** [1]

[1]Centre for European Economic Research

[2] Berlin University of Technology

Abstract:

This paper aims to examine the incentives of companies from industrialized countries to conduct R&D in developing Asian economies. By analyzing the relationship between previous international R&D activities in Asia and the sales of innovative products in Asia, we investigate whether companies follow 'knowledge augmenting' or 'knowledge exploiting' strategies. Since our results show a positive relationship between these activities only in developing Asia, we conclude that those firms follow a knowledge exploiting strategy and are attracted by market opportunities. Further, we find that companies require a certain experience before they conduct R&D activities in Asia. The more R&D units a company has outside its home market, the more likely the company is to locate a R&D unit in Asia. However, going to Asia is not just a phenomenon of large multinational companies. The analysis is based on a dataset about the innovation behaviour of German firms, the Mannheim Innovation Panel. We retrieve a sample of about 739 international innovating firms.

1. Introduction

The rapid increase in international R&D since the 1990s has attracted the interest of scientists and policy makers. A number of factors stimulate the internationalization of business R&D and according to Friedman (2006) we even see the beginning of 'the globalization of innovation'. The emergence of world wide information and communication technology (ICT) has to a large extent reduced the cost of communication, and enables a global division of labor in R&D units across the world (Karlsson 2006; UNCTAD 2005).

Although the bulk of cross border R&D units are established between developed countries, international R&D widens its geographical scope to developing countries, especially to East Asia (Edler 2008; von Zedtwitz, Gassmann 2002). According to a UNCTAD survey of foreign controlled R&D affiliates, 85 percent were located in the Triad (U.S., Europe and Japan), while developing Asia accounts for more than 8 percent (UNCTAD 2004). Despite this trend, academic research in this field is mainly concentrated on R&D units in the Triad region while the growing importance of Asian economies for R&D internationalization has been largely neglected (Ambos, Ambos 2009).

Against this backgroud, our paper aims to illuminate the R&D internationalization activities of companies from industrialized countries in Asian economies. Based on a microeconomic dataset of 1300 German companies with international R&D, this research will contribute to the understanding of R&D internationalization in developing Asian economies. In particular, the paper aims to shed light on the underlying strategy, that is, whether companies follow a knowledge augmenting or knowledge sourcing strategy. Since our results show a positive relationship between establishing R&D units in Asia and sales of innovative products in Asia, we conclude that companies with international R&D in Asia follow a knowledge exploiting strategy. Firms with international R&D in Asia establish their whole innovation value chain, i.e. from knowledge creation to manufacturing and selling of innovative products, to developing Asian economies. We reject the counter-hypothesis of knowledge augmenting strategies because we do not find a statistically significant and positive relationship between R&D in Asia and selling of innovative products in other countries.

The remainder of the paper is organized as follows. The following section provides a literature review of the types and strategies of international R&D. The theoretical background is followed by literature on foreign R&D units in section 3. It includes the perspectives from multinational companies (MNCs) in industrialized countries (source countries) and developing Asian countries (host countries). Based on this overview of the literature, the hypotheses concerning our main research questions are developed in section 4. Section 5 provides de-

scriptive analyses of the microeconomic dataset, and in section 6 the results of the multivariate qualitative response (probit) model are presented. We compare our results to past studies in the last section and conclude with an outlook on future empirical research.

2. Theoretical Background

Types of International R&D

Innovation in developing countries is still a new but growing phenomenon. Zedtwitz (2005) has categorized the set up of R&D ventures in these destinations as the "modern" type of research. Figure 1-1 shows the other types of international R&D. As Figure 1-1 shows, Type 1 concerns international R&D activities among industrialized countries, which cover the bulk of international R&D activities. The focus of our paper is represented by Type 2, which corresponds to setting up R&D units in developing countries by companies from advanced countries. Type 3 describes firms from developing countries establishing R&D units in advanced countries in order to catch up with developing countries. Type 4 concerns R&D internationalization activities between developing countries.

Figure 1-1: Types of international R&D

Home Country: Advanced	**Type 2 Modern (e.g. Germany →China)**	**Type 1 Traditional (e.g. Germany → U.S.A.)**
Home Country: Developing	**Type 4 Expansionary (e.g. India →China)**	**Type 3 Catch-up (e.g. India → Germany)**
	Host Country: Developing	Host Country: Advanced

Source: von Zedtwitz (2005)

Strategies to Internationalize R&D

There is an expanding literature studying the underlying strategies of international R&D. Despite some debates on taxonomies, most researchers divide the motives to undertake R&D in foreign countries into two categories: knowledge exploiting and knowledge augmenting (Ambos 2005; Belitz 2006; Kuemmerle 1997).

In the ***knowledge exploiting*** strategy MNCs gain competitive advantage through exploiting their firm specific technological strength in foreign markets. Companies following knowledge exploiting strategy support local production because products are adapted to lo-

cal demand. Within the knowledge exploiting strategy, international R&D laboratories are established close to existing production facilities and markets. The knowledge exploiting strategies constitute the majority of R&D units abroad and their location is influenced by the importance of local markets (Gerybadze, Reger 1999).

In contrast, firms following ***knowledge augmenting*** strategies invest overseas in order to augment the current stock of company specific knowledge. Favorable conditions in the national research system, for instance highly qualified workforce, lead MNCs to invest in 'pockets of knowledge'. Companies use foreign R&D units to develop products for different countries. The number of knowledge augmenting R&D units has recently increased with the development of global innovation networks, but are still a minority compared to knowledge exploiting laboratories (Sachwald 2008).

These two motives described above are consistent with models of MNCs behavior in international trade theory. The models in this stream of literature can be divided into those that include horizontal and vertical multinational companies (see for instance Markusen (1984) for the former and Helpman (1984) for the latter). Horizontal MNCs tend to establish production sites in multiple countries to produce similar goods globally. Vertical MNCs fragment production processes into development and production activities and locate these according to factor price differences in the world economy. If the two types of MNCs are related to the two international R&D strategies, horizontal companies should exploit their home-based knowledge, thus following the knowledge exploiting strategy (Belitz 2006)

3. Literature Overview: Source and Host Countries

Perspective from Source Countries

After we presented types and strategies of R&D internationalization in the last section, we present in this section a literature overview of international R&D activities from a perspective of source countries and host countries. With the help of this literature overview, we aim to gain insights from past studies regarding our main research question, i.e. whether R&D internationalization follows knowledge augmenting or knowledge sourcing strategies. In the first part, we focus on companies from industrialized countries that locate R&D in developing countries. The second part focuses on developments regarding international R&D from a perspective of host countries.

The available empirical literature on the internationalization of R&D can be divided into three types of data: specifically patenting data by foreign affiliates; the geographically distributed R&D expenditure of MNCs; and, survey based evidence on the question of R&D loca-

tion (Dunning, Lundan 2009). In the following section, we briefly discuss all three types of data.

Regarding evidence from patenting activities, data from the United States shows that the share of patents granted to foreign firms in 2003 was 48%, mostly from the Triad. However, since 2003 the share of patents granted to firms from developing countries and especially Asian countries constantly increases. For instance, inventors from China filed only about 100 patent applications in 1990 but have reached more than 1000 since 2003. However, the total share granted patents in the United States from developing countries remains small (UNCTAD 2005). Similar findings are presented by Belderbos (2006) who examines the patent applications of the 186 top R&D spending firms. The patent applications at the European Patent Office show that only 35 out of 186 firms had applications originating from inventions in the developing Asian regions, but the share of patents from those regions for the 186 MNCs accounts for merely 0.7%. However, it was also shown that patent applications from developing Asian economies are steadily increasing. Empirical estimations to explain patent applications by MNCs in developing Asia show a positive impact of the host countries strength of the IPR protection regime but a negative impact of market attractiveness variables.

As for the second type of empirical data - the geographically distributed R&D expenditure of MNCs - collected by UNCTAD (2005) shows also the rising importance of developing countries in international R&D. For instance, by 2004 more than 100 MNCs had set up R&D affiliates in India, and about 700 had set up affiliates in China. In developing countries as a whole, the contribution of foreign affiliates to total R&D expenditure rose from 2% in 1996 to 18% in 2002.

The third source of data on international R&D is obtained through company surveys. Dörrenbächer and Wortmann (1991) investigate the internationalization activities at the end of the 1980s. At that time, the R&D units of German MNCs where entirely located in Europe, the United States and Japan.

More recently, Ambos (2005) studies R&D laboratories set up by 49 German MNCs. This studied showes that the majority of the R&D units are located in industrialized countries, with approximately 14 percent in Asia. The geographical distribution shows that they first set up companies in Europe and the US before moving East. Regarding the motives to internationalize R&D, i.e. knowledge exploiting or augmenting, the survey responses show that German MNCs locate most of their R&D laboratories abroad in order to exploit the existing knowledge of the firm. In contrast, more recent units were set up in order to increase the existing knowledge, for instance by investing in ‘pockets of knowledge’. The study also investigates

whether R&D units are independent or set up along with manufacturing plants. The results show that 79% of those R&D units are physically attached to production sites, but no regional differentiation is indicated.

Belitz (2006) made similar findings by analyzing the R&D behavior of German MNCs. Using surveys from business R&D, the study shows that on the one hand, internationalization of R&D was a consequence of merger and acquisition (M&A) activities with the aim of accessing new markets. These foreign R&D units are mainly engaged in the development of product adaptation activities. On the other hand, foreign R&D is increasingly conducted to augment firm specific knowledge by accessing the infrastructures abroad. As for the locations of R&D units, Europe and the United states are the most important sites, while Asia is the most preferred location for future innovation activities.

Ito and Wagasuki (2007) have analyzed the determinants that lead firms to a knowledge sourcing versus a knowledge exploiting strategy based on information of Japanese affiliates. In their observation they engaged firm and country characteristics and found that exporting favors both strategies, while host country advantages such as strong IPR enforcement and availability of R&D personnel attracts knowledge sourcing strategies.

Kinkel and Maloca (2008) examine R&D offshoring of German companies in the manufacturing sector. Their study shows that larger companies are less reluctant to offshore part of their R&D units abroad compared to smaller companies. As for the target countries to offshore R&D, the companies mention Asia as the preferred region among which China takes the largest stake. Regarding the reasons to offshore, about one quarter of the companies state that they move R&D activities abroad in order to increase the company' knowledge base. In contrast, knowledge exploiting, i.e. to locate R&D units close to customers in order to adapt products to local demands, seems less important. The motives for relocation, however, are not differentiated by region.

The study by Ambos and Ambos (2009) investigate 25 R&D units in non-triad countries by German MNCs. Regarding the strategy of R&D internationalization, only a small number of R&D units conduct knowledge augmenting, and most of the R&D units are attached to manufacturing plants. Preferred locations for the R&D units in non-triad regions are India, probably due to its large market, Singapore and Taiwan due to their highly specialized technological capabilities.

Host Countries

Now we turn our attention to the host countries in developing Asia. The majority of the companies from our sample conduct R&D in China and India. Therefore, our focus remains

on these two countries. Although conventional wisdom suggests that foreign firms are investing in developing Asian countries for its cheap labor, the literature we review suggests that the increased knowledge base in those countries attracts more advanced R&D.

China is seen as a country where foreign R&D units are increasingly able to transform the role from adapting technologies to local environments, to developing technologies themselves. This shift is usually a long process because of the time required to develop human resources. However, there are numerous Chinese students holding American PhDs in the fields of sciences and engineering, and the Chinese government encourages students to return to their home country. Moreover, China is the second largest country in terms of number of researchers and as a consequence, Chinese R&D units are successfully leveraging innovations. For instance, Nokia succeeded the development of new cell phone models that have developed in its Beijing Product Development Center. Moreover, Henkel's engagement in R&D collaboration with Chinese universities suggests that Western companies try to augment their knowledge by setting up R&D units in China.

The situation in India is similar. It is endowed with a large number of English speaking scientists at the university level. Foreign companies bring their business model in order to commercially exploit the science base. For instance, Adobe used the Indian subsidiary to develop new software products. Intel's Indian subsidiary is engaged in complex tasks and filed 63 patents with a workforce of 1500 IT specialist. In the pharmaceutical industry, most foreign major MNCs have foreign R&D units in India (Asakawa, Som 2008).

To sum up, the cases of R&D laboratories in China and India cited above indicate that MNCs conducting R&D in China and India are increasingly involved with leveraging innovations and use the development of the national innovation system to augment the firm specific knowledge.

4. Hypotheses

In the third section we have seen that empirical studies based on company surveys show mixed results regarding firms' R&D strategy in developing Asian economies, whereas case study evidence points to the increasing importance of knowledge augmenting strategies. Our empirical investigation therefore aims to show whether firms with international R&D follow a knowledge augmenting or knowledge exploiting strategy.

Since our survey did not specifically ask firms for the strategy of their R&D units, we use the relationship between the sales of innovative products and establishing R&D units in Asia. That is, companies with knowledge augmenting R&D use the knowledge obtained from for-

eign R&D units in order to introduce innovative products in their headquarters. New products will be technologically advanced and selling activities will take place mainly in developed countries, whereas selling activities in developing countries is not a necessary condition (see section 2). Thus, we propose Hypothesis 1:

Hypothesis 1: Companies that conduct R&D in Asia following a knowledge augmenting strategy sell innovative products in developed countries.

In contrast, companies following a knowledge exploiting strategy use the foreign R&D units abroad in order customize products to local demands. The sales of those adapted products will take place in the local market, but not in other countries. Hence, Hypothesis 2 is:

Hypothesis 2: Companies that conduct international R&D following a knowledge exploiting strategy sell innovative products in Asian countries <u>but not</u> in developed markets.

In table 4-1 we summarize the expected signs of our variables that correspond to the hypotheses stated above.

Table 4-1: Expected relations between international R&D and R&D strategies

	Selling of innovative products in Asia	Selling of innovative products in developed countries
Hypothesis 1: Knowledge augmenting		(+)
Hypothesis 2: Knowledge exploiting	(+)	(-)

Besides these two hypotheses, which represent the focus of our paper, we include a number of variables in our estimation that may influence the likelihood to conduct international R&D. These variables follow the OLI model from Dunning (1981) and have - for the most part - been used to analyze international R&D location decision, for instance in Rammer and Schmiele (2008) and Hollenstein (2005).

We are further interested to understand, whether the likelihood to conduct R&D in developing Asia is influenced by innovation activities in this region. A positive influence suggests that companies establish their complete innovation value chain in developing Asia whereas a negative sign suggests independent R&D laboratories that transfer knowledge to the home base. Therefore, we include innovation activities in developing Asia in our estimation.

Since firms' require absorptive capacity to use the knowledge in host countries, we derive the hypotheses that international R&D is facilitated by internal R&D and continuous R&D activities (Cohen, Levinthal 1989).

Establishing international R&D units in developing countries is associated with a high degree of risk. In order to reduce the risk and to become more acquainted with the business environment, firms can reduce risk by developing experience by exporting to other countries (Rammer, Schmiele 2008). Therefore, we include export intensity to measure this effect, and expect a positive influence.

Empirical research has shown that firms' tend to internationalize R&D first to developed countries before they go to developing countries. Obviously, firms require a certain experience with international R&D in other countries. Therefore, we include a number of variables that measure the experience regarding R&D internationalizing. First, a count variable measures the number of international R&D units in other countries. We expect that the likelihood to establish R&D units in Asia rises with experience, i.e. with the number of R&D units in other countries. Second, we include innovation activities in developed countries as explanatory variable. Firms with successful innovations steaming from R&D units in developed countries are expected to increase the likelihood to establish R&D units in developing Asia.

Moreover, most empirical research investigates the internationalization of R&D activities by large MNCs. Kinkel and Maloka (2008) have shown that the likelihood to offshore R&D activities rises with the number of employees per firm. Therefore, we include company size measured as employees per firm in logarithm in our estimation.

Finally, we control for industry dummies. Based on NACE codes we use categories for low-tech, medium-tech and high-tech manufacturing as well as services which are developed by Legler and Fritsch (2006).

5. Data

In this section, the database, variables and the methods which are used to empirically test the hypotheses are introduced. The explanatory variable is used to address the research question and is applied to the dependent variable, that is, to conduct international R&D in developing Asian economies.

The German Innovation Survey

This paper employs data from the German Innovation Survey, which represents the German contribution to the EU's Community Innovation Survey (CIS). The German Innovation Survey follows the methodological recommendations for CIS surveys and adopts the

standard CIS questions. The German Innovation Survey is conducted by the Centre for European Economic Research (ZEW) in Mannheim, Germany, and called the Mannheim Innovation Panel (MIP). In addition, the MIP contains a significantly larger number of questions compared to the harmonized CIS questionnaire, which allows a much more detailed analysis of relations between firms' innovation activities and their market and innovation environment. The database has a broader sector and size coverage than the CIS standard, including firms with 5 to 9 employees and covering a larger set of service sectors. The usage of the terms in this paper (e.g. "research" and other "innovation activities") follows the definition of the Frascati Manual (OECD 2002).

Dependent and Independent Variables

The paper employs information from two survey waves of the Mannheim Innovation Panel: 2005 and 2006. The sample has been restricted to innovative firms having their headquarters in Germany and in particular to firms that carry out R&D activities abroad in order to be able to compare the effects of the internationalization drivers of different countries.

The information of the dependant variable has been taken from the 2006 survey which has questioned firms about their innovation activities outside Germany. As for the preferred locations, the majority of the firms' in the survey locate their R&D units in Western Europe and North America, however 16% of the firms establish R&D units in developing Asian countries (Figure 5-1). Figure 5-2 shows the locations of international R&D differentiated by countries. Almost half of the firms have or plan to have R&D units in China and almost one third in India.

Figure 5-1: Sample distribution by foreign R&D location

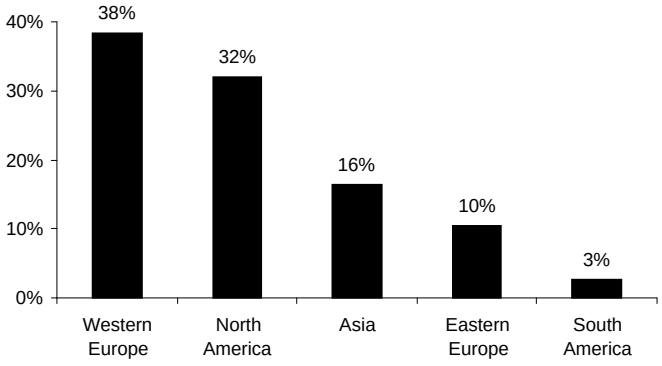
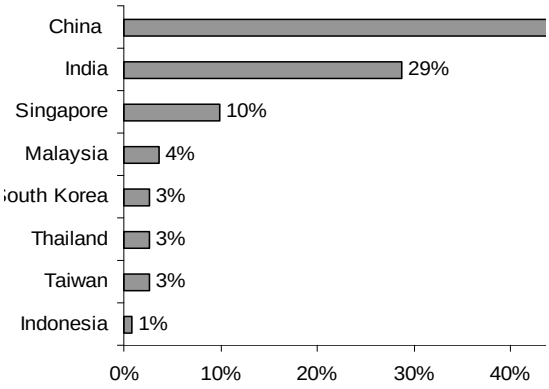


Figure 5-2: R&D units in developing Asia differentiated by countries



The 2005 survey contributes to the variables to test our main hypotheses, selling activities in Asian and developed economies) as well as the control variables described above. Table 5-1 shows the detailed definition of our dependent and independent variables.

Table 5-1: Dependent and Independent Variables

Variable	Indicator
Dependent Variable	
International R&D in developing Asia	1 if a firm plans (in 2006/2007) or already conducts (in 2005) R&D activities in the following countries: China, India, Indonesia, Malaysia, Singapore, South Korea, Taiwan, Thailand; 0 otherwise
Independent Variables	
R&D Strategy	
Selling of innovative products in developing Asia	1 if a firm sells innovative products in developing Asian economies; 0 otherwise
Selling of innovative products in developed countries	1 if a firm sells innovative products in developed economies (North America, Europe); 0 otherwise
Absorptive Capacity	
R&D intensity	Share of R&D expenditure from sales
Continuous inhouse R&D	1 if a firm conducted in-house R&D continuously in 2002-2004; 0 otherwise
Innovation value chain	
Innovation activities in developing Asia	1 if a firm successfully introduced innovations in Asia (construction/ conception of new products, manufacturing of new products, implementation of new processes)
Experience	
Export Intensity	Share of exports from sales
Number of R&D activities in other countries	Number of R&D locations abroad per firm
Innovation activities in developed countries	1 if a firm successfully introduced innovations in developed countries (construction/ conception of new products, manufacturing of new products, implementation of new processes) by 2005; 0 otherwise
Firm Size	
Firm size	Log. No. employees in 2004
Industry Dummies	
Industry Dummy 1	Low-tech manufacturing
Industry Dummy 2	Medium-tech manufacturing
Industry Dummy 3	High-tech manufacturing
Industry Dummy 4	Services

6. Results

The results of our probit model estimation are shown in table 6-1. The estimation results (marginal effects) indicate the impact of a change in the independent variable on the firms'

probability to locate R&D units in developing Asian economies. The model fit - indicated by the pseudo R-square - is 0.39 and therefore satisfactory.

As for our main hypotheses we can confirm hypothesis 2 but reject hypothesis 1. Our results show that firms with international R&D activities in Asia sell innovative products on Asian markets. In contrast, firms selling innovative products in developed countries lower the likelihood to establish R&D units in Asia. Hence, we conclude that firms with international R&D activities in developing Asia follow a knowledge exploiting strategy. This seems in line with the explanation given by Kumar (2001) that foreign R&D in developing countries is generally more adaptive since the competitiveness of those nations is more likely to be a result of MNEs production relocation than domestic innovativeness. Adaptive R&D is naturally more designed to serve the foreign market with existing core technology embodied in domestically altered products.

Moreover, firms with innovation activities in Asia have an increased likelihood for research activities in Asia. Obviously, firms establish their innovation value chain, i.e. from knowledge creation to manufacturing and selling of innovative products, in developing Asian economies.

Among the other variables, we cannot confirm that R&D internationalization in Asia depends on the absorptive capacity of the firm, since the two variables (R&D intensity and continuous R&D) are not significant. However, firms require a certain experience with international R&D. That is, a high number of R&D units outside the home market increase the likelihood to locate R&D in Asian countries. The same accounts for innovation activities in developed countries. Obviously, firms first establish R&D units in developed countries before they move to Asia.

Surprisingly, firm size - measured as employees per firm - does not influence the likelihood to locate R&D in developing Asia. We conclude that R&D internationalization does not only represent an opportunity for large but also small firms who want to profit from the market opportunities.

As for industry dummies, the results show that medium-tech manufacturing firms positively influence the likelihood to locate R&D in Asia (services form the reference category).

Table 6-1: Results of Probit Model

Probit Estimation: Dependent Variable: International R&D in developing Asia		
Variables	**Marginal Effects**	**z-value**
R&D Strategy		
Selling innovative products in developing Asia	0.455*	1.89
Selling innovative products in developed countries	-0.711***	-2.85
Absorptive Capacity		
R&D intensity	0.00189	0.47
Continuous in-house R&D	0.226	1.06
Innovation value chain		
Innovation activities in developing Asia	1.232***	4.21
Experience		
Export Intensity	-0.00391	-0.95
Number of R&D activities in other countries	0.472***	5.24
Innovation activities in developed countries	-0.0748	-0.31
Firm Size		
Firm size	-0.0169	-0.29
Industry Dummies		
Industry Dummy 1	0.228	0.80
Industry Dummy 2	0.666**	2.11
Industry Dummy 3	0.506	1.42
Constant	-2.364***	-6.98
No. of Observations	739	
Pseudo R Square	0.399	

The asterisks represent the levels of significance: ***<0.01, ** <0.05 and * <0.10.

7. Conclusion

In this paper we investigated the international R&D strategies of German companies in developing Asian economies, i.e. whether they follow knowledge augmenting or knowledge sourcing strategies. Since the past empirical and case studies show ambiguous results, we tested for both strategies. We base our hypotheses on the relationship between R&D and sales activities in Asian and developed markets. The results of our probit model confirm that companies with R&D activities in developing Asian countries also sell innovative products in these markets. Since the results do not show a significant relationship between internal R&D activities in Asia and selling activities in developed countries - which would have pointed to knowledge augmenting strategies - we have to reject the hypothesis of knowledge augmenting strategies. Therefore, we conclude that companies with international R&D units in those countries adapt their products to local demand with the purpose of profiting from large consumer markets. Thus, we can confirm hypothesis 2, that companies with international R&D in developing Asian economies predominatly follow 'knowledge exploiting' strategies.

Although we focused our research on international R&D in Asian economies, our findings are for the most part in line with findings in the empirical literature on international R&D that we presented in our overview. First, as Rammer and Schmiele (2008) note, German companies internationalize R&D when they have an innovation based niche market position in the home market and can therefore exploit their unique technology advantage in foreign markets. Second, we draw the same conclusions as Belitz (2006) who finds that international R&D by German companies is adaptive and aims to access new markets. However, our findings contrast with Belderbos (2006), who does not find that market access is the focus of foreign R&D units in developing Asia.

Finally, we can make some suggestions for future research. Our empirical investigation is limited insofar as we focus on Asian developing countries in general and our sample is biased towards R&D in China and India. However, as these countries are different subject to their technological capabilities, future research should investigate in detail the incentives of companies to conduct international R&D activities in specific countries.

Literature

Ambos, B. (2005): Foreign direct investment in industrial research and development: A study of German MNCs. In: Research Policy, 34 (4), pp. 395-410

Ambos, B.; Ambos, T.C. (2009): Location choice, management and performance of international R&D investments in peripheral economies. In: Int.J.Technology Management, 48 (1), pp. 24-41

Asakawa, K.; Som, A. (2008): Internationalization of R&D in China and India: Conventional wisdom versus reality. In: Asia Pacific Journal of Management, 25 (3), pp. 375-394

Belderbos, R. (2006): R&D Activities in East Asia by Japanease European, and US Multinationals, JCER DISCUSSION PAPER No.100. Paper for presentation at the Conference, Japan Center for Economic Research, Tokyo, June 1, 2006.

Belitz, H. (2006): Internationalisation of R&D by Multinationals:The last decade from a German Perspective, Paper Presented at IFSAM VIIIth World Congress Berlin, September 28 - 30.

Cohen, W.M.; Levinthal, D.A. (1989): Innovation and Learning - the 2 Faces of R-And-D. In: Economic Journal, 99 (397), pp. 569-596

Dörrenbächer, C.; Wortmann, M. (1991): The internationalization of Corporate Research and Development. In: Intereconomics, 26 (3)

Dunning, J.H. (1981): Explaining the International Direct-Investment Position of Countries - Towards A Dynamic Or Developmental-Approach. In: Weltwirtschaftliches Archiv-Review of World Economics, 117 (1), pp. 30-64

Dunning, J.H.; Lundan, S.M. (2009): The Internationalization of Corporate R&D: A Review of the Evidence and Some Policy Implications for Home Countries. In: Review of Policy Research, 26 (1-2), pp. 13-33

Edler, J. (2008): Creative internationalization: Widening the perspectives on analysis and policy regarding international R&D activities. In: The Journal of Technology Transfer, 33 (4), pp. 337-352

Friedman, L.T. (2006): The World is flat. The Globalized World in the Twenty-First Century, Penguin Groups (ed.), England.

Gerybadze, A.; Reger, G. (1999): Globalization of R&D: recent changes in the management of innovation in transnational corporations. In: Research Policy, 28 (2-3), pp. 251-274

Helpman, E. (1984): A Simple Theory of International-Trade with Multinational-Corporations. In: Journal of Political Economy, 92 (3), pp. 451-471

Hollenstein, H. (2005): Determinants of international activities: Are SMEs different? In: Small Business Economics, 24 (5), pp. 431-450

Karlsson, M. (2006): The Internationalization of Corporate R&D: Leveraging the Changing Geography of Innovation. *ITPS – Swedish Institute for Growth Policy Studies,* Report Number A2006: 007.

Kinkel, S.; Maloca, S. (2008): FuE Verlagerungen ins Ausland - Ausverkauf deutscher Entwicklungskompetenz? Ausmaß und Teiber von FuE Verlagerungen im Verarbeitenden Gewerbe. Mitteilungen aus der ISI Erhebung zur Modernisierung der Produktion. Nummer 46 April 2008.

Kumar, N. (2001): Determinants of overseas R&D activity of multinational enterprises: the case of US and Japanese corporations, Research Policy, 30, 159-174.

Kuemmerle, W. (1997): Building effective R&D capabilities abroad. In: Harvard Business Review, 75 (March-April), pp. 61-69

Legler, H.; Fritsch, R. (2006): Neuabgrenzung der Wissenswirtschaft -forschungsintensive Industrien und wissensintensive Dienstleistungen (NIW/ISI-Listen 2006).

Markusen, J.R. (1984): Multinationals, Multi-Plant Economies, and the Gains from Trade. In: Journal of International Economics, 16 (3-4), pp. 205-226

OECD (2002): *Frascati Manual 2002*, OECD, Paris.

Rammer, C.; Schmiele, A. (2008): Globalisation of Innovation in SMEs: Why They Go Abroad and What They Bring Back Home. In: Applied Economics Quarterly Supplement 59, 173-206.

Sachwald, F. (2008): Location choices within global innovation networks: the case of Europe. In: Journal of Technology Transfer, 33 (4), pp. 364-378

UNCTAD (2004): The Impact of FDI on Development: Globalization of R&D by Transnational Corporations and Implications for Developing Countries, Note

by the UNCTAD secretariat, December 7.

UNCTAD (2005): World Investment Report (Theme: Transnational Corporation and the Internalization of R&D). United Nations Conference on Trade andbDevelopment, The United Nations, Geneva and New York.

von Zedtwitz, M. (2005): International R&D strategies in companies from developing countries: the case of China. In: Globalization of R&D and Developing Countries. Geneva : UNCTAD, 2006, S. 117-140.

von Zedtwitz, M.; Gassmann, O. (2002): Market Versus Technology Drive in R&D Internationalization: Four Different Patterns of Managing Research and Development. In: Research Policy, 31 (4), pp. 569-88