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The internationalisation of R&D: sectoral and geographic patterns of cross-border investments

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ABSTRACT

This paper presents the sectoral and geographic distribution of R&D-related activities, in comparison with manufacturing activities, by analysing data (from the *fDi Markets* database) on the number of cross-border greenfield investment projects. Results show that cross-border R&D investments are concentrated in fewer sectors and countries (of origin and destination) than manufacturing, and they are less sensitive to the obstacles related with the distance between home and host countries. More than the two-thirds of all cross-border investments in R&D-related activities are in ICT/Electronic and Life Sciences/Chemicals sectors, but these sectors differ in their propensity towards R&D and Design, Development and Testing activities. Almost half of the investments is due to multinationals from North America, and over one third from Western Europe, but the two areas show a different sectoral specialization. Considering the areas of destination, Asia is the largest recipient, and specializes in the ICT/Electronics and Industrial Machinery, while Western Europe ranks second and attracts relatively more research investments in Life Sciences/Chemicals, as well as in the Machinery industry.

JEL Codes: F23, O30, L23

Keywords: Internazionalization of R&D, Multinational Firms, Europe, North America, Asia

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Abstract
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[*] The expressed opinions are those of the author and do not necessarily reflect the position of ICE (Italian Trade Promotion Agency).

1. Introduction

The R&D function is traditionally localised in the headquarters of multinational companies (Patel and Pavitt 1991, Gassman and von Zedtwitz 1999, Narula 2002, Belderbos et al. 2010). However, during the past decades, an increasing number of research centres and laboratories have been established in different countries, including several emerging economies (UNCTAD 2005, Narula and Zanfei 2005, Dunning and Lundan 2009, OECD 2011). This process has sometimes given rise to global innovation networks, involving foreign affiliates operating as design, research and development units within both global and local networks, facilitated by the rapid progress and lower costs of information and communication technologies (Ernst, 2002, 2011; Chaminade 2009). Recent surveys suggest that the share on total investments is rather limited, but the trend of decentralising innovative activities is bound to continue along a stable sectoral pattern, with pharmaceuticals, automotive and computer/electronics as the most internationalised industries. While innovation activities are still heavily concentrated in advanced economies, with Intra-EU and EU-US as the most important relationships, some emerging countries, in particular in Asia, also have become important host locations, particularly for US and Japanese firms (INNOGRIPS, 2013).

The geography of R&D-related investments depends on the characteristics of the countries of origin and destination. Sourcing countries may establish R&D units overseas due to a shortage of high skilled personnel or capacity bottlenecks. For example, Lewin et al. (2009), argue that an emerging shortage of high skilled science and engineering talent partially explains the relocation of product development from the United States to other parts of the world, most notably Asian countries. Kinkel and Maloca (2008) find that capacity bottlenecks are the most frequent reason why German firms move R&D to locations abroad. On the other side, while host market size remains the most prominent determinant of the location choice for R&D abroad, knowledge-seeking (access to high-tech of universities and innovative firms) increasingly became another important motive of foreign innovation activities, reflecting primarily the growing complexity of technologies and the higher innovation capacity of many host countries. Efficiency-seeking is instead a relevant motive especially for the less advanced tasks, e.g. engineering/design) (Alcacer and Chung 2007, Basile et al. 2008, Nachum et al. 2008, Hall 2011, Hatem 2011, OECD 2011, Ujjual 2011).

As to the nature and organisation of foreign affiliates, some of them mainly adapt and develop products or processes to the local market needs (asset/competence exploiting affiliates, see Dunning and Narula 1995; Kuemmerle 1999, Gupta and Govindarajan 2000, Cantwell and Mudambi 2005), while others hold a central role in the creation and diffusion of new knowledge (asset augmenting or competence creating). This depends also on sectoral characteristics, as the sources of innovation differ substantially by industry and by technical field (Florida 1997). For example, some industries (like pharmaceutics and biotechnologies) draw heavily from basic science and pure research activity, while in other industrial sectors like ICT, electronics, automotive, industrial machinery innovation is more closely linked to applied activities. Industry characteristics along with the type of innovative function influence therefore the choice of geographical location of the offshored R&D (Hatem 2011, European Commission 2012): the pharmaceutical sector locates mainly upstream R&D activities abroad driven by the availability of scientific infrastructure and skills or by the existence of leading clusters, in order to tap into new technologies and knowledge (supply-related location factors). On the contrary, when it comes to offshore product development and adaptive R&D, market size and institutional regulations may prevail, and R&D-related activities often follow production investments (demand-oriented location factors). Similarly, in the electronic sector upstream R&D is performed in proximity of scientific clusters, while downstream innovative activities are more marked-led. For industrial machinery, localisation depends to a large extent on the country's specialisation in machine production and on market proximity, given the need of interaction with the final users.

Furthermore, distance from the country of origin may be less of a constraint for locating R&D than it is for locating manufacturing activities (Castellani et al. 2012). Due to the growing importance of locating outposts in *clusters* where knowledge is created (Audretsch and Feldmann 1996, Cantwell and Iammarino 2003, UNCTAD 2005, Cantwell and Mudambi 2011, Meyer et al. 2011, OECD 2011), R&D units may need to be established also in countries that are very distant from the parent's company home base, especially when geographic distance is compensated by a certain degree of cultural and institutional proximity. Therefore, the presence of centres of excellence can trigger changes in the geographical distribution of R&D investments, both in the emerging and in the advanced countries, and particularly in industry sectors where a proximity to research centres or skilled personnel is relatively more important.

Against this background, the main aim of this article is to present the sectoral and geographic distribution of R&D-related activities by analysing data on the number of cross-border greenfield investment projects in comparison with manufacturing activities, and to provide some insights on the distribution of investments that are more research-intensive versus others in which applied research and product development represent the main activity.

2. Data on R&D-related investments

We rely on data on cross-border (greenfield) investment projects announced during the period from January 2003 until August 2012, as recorded in the *fDI Markets* database, which is an online database maintained by *fDi Intelligence* - a specialist division of the Financial Times Ltd . *fDi Intelligence* monitors cross-border investments covering all sectors and countries worldwide, relying on media sources and company data, and collects detailed information on investments available since 2003. Data are based on the announcement of the investment and updated daily[1] and, for each one out of the over 140,000 projects, *fDi Markets* reports information on the investment, such as the industry and the main business activity involved in the project, the location where the investment takes place (host country, regions and cities), as well as the name and location of the investing company (home). The database is used as the data source in UNCTAD's World Investment Report, in publications by the Economist Intelligence Unit and in recent academic research (Piscitello and Santangelo, 2010; Amighini et al., 2011; Castellani and Pieri, 2012; Castellani et al. 2012; D'Agostino et al., 2012; Basile et al., 2013;) and policy reports (INNOGRIPS, 2013).
For the purpose of this analysis we referred to the investment projects in R&D-related activities. Such projects are classified either as R&D, when they mainly concern basic or fundamental research, or as "Design, Development and Testing" (DDT), if they are more oriented towards applied research, product development, customisation and testing. Based on the project's description, we first reclassified a number of investment projects. Cross-border projects classified as DDT but containing in the description field the words "R&D", "research and", "research centre" were reclassified as R&D, except if they contained the word "testing". On the contrary, projects which did not mention these words in the description, featuring only development, design and/or testing where reclassified within the DDT group. Accordingly, 970 projects were reclassified as R&D and 51 projects as DDT. Moreover, all intra-US projects were excluded. As a result, our sample consists of 3.980 investments classified as DDT type, and 3.162 falling under the R&D category[2]. As a benchmark, we consider investments in manufacturing activities.

[1] More information at http://www.fdimarkets.com/
[2] It should be noted that the boundaries between these two categories are difficult to set, and that it is often impossible to distinguish clearly between foreign affiliates devoted to basic research vs. applied research (OECD 2011), as confirmed in a recent survey conducted interviewing a number of leading MNCs (Ujjual, 2011).

3. The concentration of R&D-related activities: sectoral and geographic patterns

Table 1 reports the number of projects in R&D-related and in manufacturing activities, broken down by sectors and further aggregated into 7 groups: ICT/Electronics, Transport, Life Sciences and Chemicals, Services, Industrial Machinery, Equipment & Tools, Other sectors. Not surprisingly, investments in these activities are relatively rare: they are slightly more than 5% of all 140,000 projects recorded in *fDi Markets*, whereas the number of investments in manufacturing is four times larger than those in R&D-related activities (7.142 vs. 30.554).

[INSERT TABLE 1]

A striking feature of cross-border investments in R&D- related activities is the high concentration in a few industrial sectors: the Herfindahl concentration index appears to be particularly high in the DDT project type, reaching 0,164 compared to 0,086 in R&D and 0,059 in manufacturing.

Considering the distribution among the different industries, half of R&D-related activities are in the ICT/Electronic sector. This is particularly true for DDT projects, where this group of industries accounts for 61,4% of all the projects. Software projects explain much of this concentration, as 39% of all DDT investments are in fact in the Software industry. This is consistent with the idea that innovative activity in these industries refers mainly to applied research and product development.
Life Sciences and Chemicals is the second most important group of industries. Unlike ICT/Electronics, in Life Sciences and Chemicals R&D investments are more important than DDT. R&D projects in Life Sciences represent 25% of all investments in R&D, and most of them are in the Pharmaceutical (13,6%) and Biotech (5%) industries. On the contrary, firms in Life Sciences are responsible for only 8,3% of all DDT projects. This is consistent with the fact that R&D in these industries is particularly linked with basic science and pure research activities.
The Transport sector ranks third in importance within the R&D investment type, but is second considering DDT investments (382 projects are classified as DDT and 273 as R&D), with the main share held by the Automotive industry (both components and OEM).

R&D-related investments in the Industrial Machinery and in the Services sectors are less frequent, and DDT projects weigh relatively more in both cases. Only about 6% of R&D-related projects are in the Services sectors, although this share has been growing over time, and concerns mainly Business Services performed by affiliates of consulting companies or firms providing R&D, design or testing services to manufacturers on a contractual basis.

It is worth mentioning that the sectoral distribution of R&D-related investments is markedly different than the distribution of cross-border investments in manufacturing activities. About 50% of all manufacturing investments are in "Other sectors", which attract only 17% of R&D and 9,9% of DDT projects. The most important industry in terms of international production is the Automotive Components, where the share of manufacturing investments is 2,5 times larger than the share in R&D-related projects (10,3% vs. 4,1%).

As to the geographical distribution, outward investments (from sourcing countries or areas) feature a stronger degree of concentration than inward investments (towards destination countries or areas), as most R&D-intensive MNCs are headquartered in the advanced economies.

Considering outward investments, the concentration index is slightly higher for projects classified as DDT than for R&D investments (0,231 vs. 0,208), but both are remarkably higher vis-à-vis manufacturing investments (0,097)(Table 2).

For both DDT and R&D activities, almost half of the investments is due to multinationals from North America, and over one third from Western Europe. More specifically, 74,4% of the DDT and 70% of the R&D projects originate from the top five countries, whereas for manufacturing the top five countries account for a more modest 54%. The United States are by far the main sourcing country, accounting for 45% of the DDT cross-border investments and for 43% of the projects classified as R&D. Germany, Japan, United Kingdom and France follow the US, with considerably lower shares (between 5% and 10%) .

[INSERT TABLE 2]

The role of North America as home region is particularly accentuated in the ICT/Electronic industry, as US multinationals are well known world leaders in the Software and in the Semiconductor sectors. As a matter of fact, North American MNCs are responsible for about 45% of outward R&D-related projects, a share which rises to 55,6%-57% for the projects in ICT/Electronics (Table 3).
Western Europe appears instead to be more "specialised" in the Pharmaceutical, Biotechnological and Chemical sectors (43% and 48,9%),where Asia lags behind, as well as for Industrial Machinery (with 49,8% of the DDT projects) due to the presence of important global players in the UK, in Switzerland, Germany and France. Moreover, Western Europe features relatively larger shares in the Transport sector (48,4% of DDT), given the presence of German, French and Italian multinationals, and for Services, where the United Kindom stands out.
Conversely, MNCs originating from the Asian area play a relatively more important role for Transport (22%-32%) and Industrial Machinery (26%), with Japan representing the main source country.

[INSERT TABLE 3]

As mentioned above, geographical concentration of investments by area and country of destination is much less pronounced than in the case of sourcing areas/countries: the top 5 destination countries account for about 50% of R&D-related investment projects and the Herfindahl index is about 0,07, with a concentration of DDT projects slightly higher than for R&D investments (Table 4). For comparison, manufacturing projects of the first 5 destinations account for 39,3% and the Herfindahl index is as low as 0,051.
Considering the areas of destination, Asia is by far the largest recipient. In particular, China (with a share of 17%) ranks first, and India second (14,7%) as destinations for cross-border R&D. The ranking reverses, with India first and China second, for DDT projects, mainly due to India's specialisation in Software and IT services. Notably, the expanding pool of graduates in science and technology helps explain the success of these two countries in attracting R&D-related activities, during the past decade.
The US rank third for both investment types, mainly attracting projects in the Software, pharmaceutical and biotech industries, followed by the UK and by Germany (for DDT projects). Conversely, Germany is placed after Singapore and France for R&D investments .

[INSERT TABLE 4]

Asia appears to be relatively more specialised in hosting projects of the ICT/Electronics sector (51,5% in DDT and 55,6% in R&D), Industrial Machinery (50,7% in R&D) and Services (49%), while Western Europe attracts relatively more research investments in Life Sciences/Chemicals (34,2% in R&D), as well as in the Machinery sector (29,9%). The Middle Eastern area (notably

Israel and the UAE) plays instead a role particularly for R&D in Services, as well as Latin America (Table 5).
It may be noted that Asia and Western Europe appear to be relatively more specialised in attracting investments classified as R&D. This is particularly pronounced for ICT/Electronics, where Asia attracts as much as 55,6% of the R&D projects while, on the opposite, North America hosts only 6,8% . Other areas attract instead relatively more DDT projects, signalling a trend in performing more development-oriented activities than upstream research: for example, North America and Latin America hold both higher shares in DDT investments in the ICT/Electronics and Transport sectors. Moreover, North America holds higher shares in DDT projects for Services and Industrial machinery, while Latin America for Life Sciences/Chemicals.

4. Cross-border investments in R&D-related activities by area of origin and destination

Table 6 shows cross-border investments in DDT and R&D activities by area of origin[3] and destination, including projects in manufacturing activities as a benchmark. Our results show, first of all, that cross-border investments in R&D-related activities are less bound by geographic distance than projects in manufacturing activities. For example, while intra-Europe investments (Western plus Eastern Europe) in manufacturing account for 47,7% of all cross-border investments of MNCs from Western Europe, this share drops to 36,1% in the case of DDT projects and 37,3% for R&D. Conversely, investments of European MNCs in Asia are 25,6% for manufacturing, but 39,7% for R&D type of investments and 36,4% for DDT.
More generally, while 46,3% of manufacturing investments performed by European MNCs are located in distant areas (namely in Asia and the Americas), the same regions attract a much higher share of R&D-related investments (58,7%).

A similar pattern emerges for Asian and North American MNCs. In the case of Asian MNCs, only 29,5% of investments in manufacturing are directed to (Western and Eastern) Europe and (North and Latin) America, while the share of investments in R&D-related activities in the same areas is 45,8% for DDT and 41,9% for R&D. Finally, projects of North American MNCs directed towards geographically distant areas, such as Europe, Asia, Africa and Middle-East, are 75,4% in the case of manufacturing and about 90% for R&D-related (89,9% for DDT and 91,1% for R&D).

[INSERT TABLE 6]

In sum, the evidence is consistent with some recent econometric studies showing that geographic distance between the home and host country may be less of an obstacle for R&D-related projects than it is for manufacturing. In other words, the gravity model, which explains very well bilateral trade and manufacturing FDI flows (De Benedictis and Taglioni, 2011), seems less appropriate for the case of R&D FDI (Castellani et al., 2012). In fact, as knowledge can be transmitted by communication technologies at virtually no costs, in the case of R&D trade costs have a much lower impact than for other activities, while knowledge- and market-seeking factors play a crucial role.

The results are also in line with the idea that cultural and institutional similarities may allow to overcome the obstacles of geographic distance. For example, it can be seen that despite higher geographic distance North American MNCs are more likely than Asian or European companies to invest in Middle East, in particular in Isreael and the UAE. Similarly, the likelihood of European MNCs doing R&D-related investments in Latin America (especially Brazil and Mexico) are similar to that of (the much closer) North American MNCs.

[3] For simplicity we show only the three largest areas of origin: Asia-Pacific, Western Europe and North America

Furthermore, if we look at R&D-related investment patterns by area of origin and destination for each group of sectors[4], we observe not only that distance from the home country does not represent a particular obstacle for establishing innovation-related investments, but that some areas attract relatively more projects in specific sectors, signalling the presence of locational advantages (Tables 7a and 7b.

For example, the share of North American investments in the European area (Western plus Eastern countries) shows a particular concentration in the Transport sector (with 45,5% DDT and 38,4% R&D type of projects) and in Industrial Machinery (34,3% in DDT and 37,8% in R&D). In the case of the automotive industry this may be explained by the existence of a number of clusters with advanced industrial and technical competences. Similarly, in the latter sector the specialisation in machine production represents a key attracting factor, along with market proximity, as innovative activities in this field require close contacts with the users (Hatem 2011).
In the Life Sciences and the Chemical sectors, a relatively high share of North American upstream research activity is located in the Western part of Europe (38%), and the presence in that area of poles of excellence suggests the influence of knowledge-seeking factors and of agglomeration economies in these industries.
North American investments directed to the Asian area record instead a particularly high share in the ICT/Electronics sector (60%, mainly due to the Software industry), notably determined by availability in India and in China of highly specialized human resources. Also European MNCs have set up in Asia almost half of the R&D centres in the ICT/Electronic sector, and a similar share can be seen for Industrial Machinery and Services.
Furthermore, Asia attracts 41% of the European DDT projects in Life Sciences and Chemicals as well as 54% DDT investments from North America, reflecting the strategy of MNCs of advanced countries to be located in final markets in order to develop products for local demand, given the size of the Asian market, or facilitate licensing procedures.

[INSERT TABLE 7a]

[INSERT TABLE 7b]

5. Concluding remarks

Cross-border investments in R&D-related activities represent a small percentage of all international activities of multinational companies, but their magnitude has been increasing over time. In this article we analysed the distribution of cross-border (greenfield) R&D-related investments, in both upstream (R&D) and downstream (DDT) activities, by sectors and geographic areas, using investments in manufacturing activities as a benchmark. Results show that cross-border R&D investments are concentrated in fewer sectors and countries (of origin and destination) than manifacturing, confirming the "spiky nature" of innovation processes (Audretsch and Feldman, 1996; Cantwell and Iammarino, 2003).

More than the two-thirds of all cross-border investments in R&D-related activities are in ICT/Electronic and Life Sciences/Chemicals sectors, but these sectors differ in their propensity towards R&D, more likely in the latter, and Design, Development and Testing activities, more frequent in the former.

Looking at the geographical distribution, the degree of concentration is particularly pronounced in terms of sourcing countries. International R&D-related investments originate mainly from advanced economies where knowledge is accumulated and where several high-tech MNCs are headquartered. The United States play by far the main role, in particular in Software and Electronics, followed by Germany, Japan, France. Conversely, the first two recipient countries of knowledge-intensive investments are China and India, which are considered highly attractive destinations for innovative investments and have outnumbered the United States even in upstream research projects.

Geographic patterns indicate that R&D-related investments are less sensitive to obstacles related with the distance between the home and host countries, which on the contrary remain relevant for manufacturing projects. The uneven distribution of R&D-related investments across host countries seems to reflect the importance of advantages deriving from being located close to research centres or in places where specialised human resources are available, along with location factors linked to market size and proximity to customers.

It follows that the presence of centres of excellence and of high skilled human capital can trigger changes in the geographical distribution of R&D investments, both in the emerging and in the advanced countries. Therefore well designed science, technology and innovation policies at national (and supranational) level, aiming at increasing locational advantages by improving the quality of education and fostering excellent poles of research, can be crucial to attract valuable knowledge-intensive foreign investments.

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Table 1 - Cross-border investment projects in R&D-related activities *(January 2003 - August 2012)*

Sectors	Design, Development and Testing (DDT)		R&D		Manufacturing	
	N. projects	% share	N. projects	% share	N. projects	% share
ICT/Electronics	2443	61.4%	1301	41.1%	3017	9.9%
Software & IT services	1562	39.2%	605	19.1%	78	0.3%
Communications	382	9.6%	311	9.8%	366	1.2%
Semiconductors	310	7.8%	193	6.1%	450	1.5%
Electronic Components	125	3.1%	142	4.5%	1771	5.8%
Business Machines & Equipment	64	1.6%	50	1.6%	352	1.2%
Transport	382	9.6%	273	8.6%	5697	18.6%
Automotive Components	161	4.0%	129	4.1%	3143	10.3%
OEM Automotive	129	3.2%	90	2.8%	1734	5.7%
OEM Non-automotive	18	0.5%	11	0.3%	371	1.2%
Aerospace	58	1.5%	37	1.2%	380	1.2%
Space & Defence	16	0.4%	6	0.2%	69	0.2%
Life Sciences and Chemicals	329	8.3%	802	25.4%	3857	12.6%
Pharmaceuticals	99	2.5%	430	13.6%	775	2.5%
Chemicals	177	4.4%	212	6.7%	2952	9.7%
Biotechnology	53	1.3%	160	5.1%	130	0.4%
Services	228	5.7%	104	3.3%	188	0.6%
Business Services	146	3.7%	71	2.2%	130	0.4%
Healthcare	43	1.1%	17	0.5%	19	0.1%
Financial Services	14	0.4%	14	0.4%	0	0.0%
Transportation	17	0.4%	1	0.0%	7	0.0%
Hotels & Tourism	3	0.1%	1	0.0%	0	0.0%
Real Estate	3	0.1%	0	0.0%	30	0.1%
Leisure & Entertainment	2	0.1%	0	0.0%	2	0.0%
Industrial Machinery, Equipment & Tools	203	5.1%	144	4.6%	2662	8.7%
Other sectors	395	9.9%	538	17.0%	15133	49.5%
Food & Tobacco	62	1.6%	91	2.9%	2391	7.8%
Medical Devices	32	0.8%	89	2.8%	500	1.6%
Consumer Electronics	37	0.9%	70	2.2%	675	2.2%
Plastics	49	1.2%	43	1.4%	1925	6.3%
Coal, Oil and Natural Gas	26	0.7%	34	1.1%	532	1.7%
Consumer Products	13	0.3%	47	1.5%	728	2.4%
Metals	19	0.5%	38	1.2%	2635	8.6%
Engines & Turbines	25	0.6%	29	0.9%	316	1.0%
Alternative/Renewable energy	24	0.6%	17	0.5%	346	1.1%
Rubber	22	0.6%	25	0.8%	688	2.3%
Textiles	29	0.7%	14	0.4%	804	2.6%
Paper, Printing & Packaging	17	0.4%	7	0.2%	833	2.7%
Minerals	26	0.7%	3	0.1%	96	0.3%
Beverages	8	0.2%	13	0.4%	690	2.3%
Building & Construction Materials	2	0.1%	13	0.4%	947	3.1%
Ceramics & Glass	4	0.1%	2	0.1%	549	1.8%
Wood Products	0	0.0%	3	0.1%	419	1.4%
Warehousing & Storage	0	0.0%	0	0.0%	59	0.2%
Total	3980	100%	3162	100%	30554	100%
Herfindahl index	0.164		0.086		0.059	

Source: authors' calculations based on fDi Markets data

Table 2 - Cross-border investment projects in R&D-related activities, by country of origin *(January 2003- August 2012)*

DDT				R&D				Manufacturing			
Rank	Country	N. projects	% share	Rank	Country	N. projects	% share	Rank	Country	N. projects	% share
1	United States	1804	45.3%	1	United States	1351	42.7%	1	United States	5369	17.6%
2	Germany	386	9.7%	2	Germany	287	9.1%	2	Japan	4332	14.2%
3	UK	278	7.0%	3	Japan	253	8.0%	3	Germany	3689	12.1%
4	Japan	274	6.9%	4	France	163	5.2%	4	France	1678	5.5%
5	France	219	5.5%	5	UK	162	5.1%	5	UK	1427	4.7%
6	India	131	3.3%	6	Switzerland	119	3.8%	6	Italy	1055	3.5%
7	Switzerland	114	2.9%	7	China	97	3.1%	7	Switzerland	1031	3.4%
8	Netherlands	84	2.1%	8	South Korea	79	2.5%	8	South Korea	939	3.1%
9	Canada	77	1.9%	9	Netherlands	75	2.4%	9	Netherlands	799	2.6%
10	Sweden	51	1.3%	10	Canada	70	2.2%	10	Taiwan	717	2.3%
11	China	50	1.3%	11	India	65	2.1%	11	Canada	708	2.3%
12	Spain	48	1.2%	12	Sweden	57	1.8%	12	Spain	699	2.3%
13	Finland	46	1.2%	13	Finland	40	1.3%	13	China	635	2.1%
14	South Korea	44	1.1%	14	Italy	38	1.2%	14	Sweden	632	2.1%
15	Denmark	36	0.9%	15	Denmark	38	1.2%	15	India	605	2.0%
16	Taiwan	35	0.9%	16	Taiwan	33	1.0%	16	Austria	605	2.0%
17	Belgium	32	0.8%	17	Ireland	32	1.0%	17	Finland	529	1.7%
18	Italy	31	0.8%	18	Belgium	32	1.0%	18	Denmark	438	1.4%
19	Israel	24	0.6%	19	Spain	22	0.7%	19	Belgium	372	1.2%
20	Ireland	23	0.6%	20	Australia	18	0.6%	20	Malaysia	271	0.9%
	Other countries	193	4.8%		Other countries	131	4.1%		Other countries	4024	13.2%
	Total	3980	100%		Total	3162	100%		Total	30554	100%
	Top 5	2742	74.4%		Top 5	2216	70.1%		Top 5	16495	54.0%
	Top 10	2742	85.9%		Top 10	2335	84.0%		Top 10	17550	68.8%
	Top 15	3642	91.5%		Top 15	2894	91.5%		Top 15	24315	79.6%
	Top 20	3787	95.2%		Top 20	3031	95.9%		Top 20	26530	86.8%
Herfindhal Index			0.231	Herfindahl Index			0.208	Herfindahl Index			0.097

Source: authors' calculations based on fDi Markets data

Table 3- Cross-border investment projects in R&D-related activities, by area of origin *(January 2003- August 2012, percentage share)*

Sectors	Africa	Asia-Pacific	Latin America & Caribbean	Middle East	North America	Rest of Europe	Western Europe	Top 3	Total	Type
ICT/Electronics	0.2%	15.7%	0.7%	0.7%	55.6%	1.2%	25.9%	97.2%	100%	DDT
	0.1%	16.3%	0.4%	0.5%	57.1%	0.2%	25.4%	98.8%	100%	R&D
	0.7%	40.4%	0.5%	0.6%	25.4%	0.9%	31.6%	97.4%	100%	Manuf.
Transport	0.0%	22.0%	0.0%	0.3%	29.3%	0.0%	48.4%	99.7%	100%	DDT
	0.4%	32.2%	0.0%	0.0%	28.6%	0.0%	38.8%	99.6%	100%	R&D
	0.1%	34.3%	0.9%	0.7%	19.2%	2.1%	42.6%	96.1%	100%	Manuf.
Life Sciences and Chemicals	0.0%	8.2%	0.3%	0.9%	40.4%	1.2%	48.9%	97.6%	100%	DDT
	0.1%	13.5%	0.1%	1.2%	41.0%	0.9%	43.1%	97.6%	100%	R&D
	0.7%	23.0%	1.0%	1.8%	24.1%	1.9%	47.4%	94.6%	100%	Manuf.
Services	0.0%	7.0%	0.0%	3.1%	25.4%	0.4%	64.0%	96.5%	100%	DDT
	0.0%	22.1%	0.0%	0.0%	48.1%	0.0%	29.8%	100.0%	100%	R&D
	0.0%	20.7%	0.5%	3.7%	17.0%	4.3%	53.7%	91.5%	100%	Manuf.
Industrial Machinery, Equipment & Tools	0.0%	14.8%	0.0%	0.5%	34.5%	0.5%	49.8%	99.0%	100%	DDT
	0.0%	26.4%	0.0%	0.0%	36.8%	1.4%	35.4%	98.6%	100%	R&D
	0.4%	24.6%	0.5%	0.7%	21.1%	1.7%	50.9%	96.7%	100%	Manuf.
Other sectors	0.5%	13.7%	0.3%	2.8%	38.0%	0.0%	44.8%	96.5%	100%	DDT
	0.2%	20.6%	0.6%	1.5%	31.2%	0.6%	45.4%	97.2%	100%	R&D
	0.9%	25.1%	2.4%	2.1%	17.8%	3.9%	47.8%	90.7%	100%	Manuf.
Total	0.2%	14.9%	0.5%	1.0%	47.3%	0.9%	35.3%	97.4%	100%	DDT
	0.1%	18.3%	0.3%	0.8%	44.9%	0.5%	35.0%	98.3%	100%	R&D
	0.7%	28.0%	1.6%	1.5%	19.9%	2.8%	45.5%	93.4%	100%	Manuf.

Source: authors' calculations based on fDi Markets data

Table 4 - Cross-border investment projects in R&D-related activities, by country of destination *(January 2003 - August 2012)*

DDT				R&D				Manufacturing			
Rank	Country	N. projects	% share	Rank	Country	N. projects	% share	Rank	Country	N. projects	% share
1	India	809	20.3%	1	China	534	16.9%	1	China	4969	16.3%
2	China	511	12.8%	2	India	466	14.7%	2	United States	2776	9.1%
3	United States	316	7.9%	3	United States	249	7.9%	3	India	1879	6.1%
4	UK	261	6.6%	4	UK	187	5.9%	4	Russia	1323	4.3%
5	Germany	140	3.5%	5	Singapore	151	4.8%	5	Brazil	1061	3.5%
6	Singapore	115	2.9%	6	France	126	4.0%	6	Poland	963	3.2%
7	Brazil	99	2.5%	7	Germany	108	3.4%	7	Mexico	959	3.1%
8	Canada	94	2.4%	8	Ireland	106	3.4%	8	Thailand	941	3.1%
9	Spain	91	2.3%	9	Spain	90	2.8%	9	France	872	2.9%
10	France	90	2.3%	10	Canada	83	2.6%	10	UK	834	2.7%
11	Taiwan	72	1.8%	11	Taiwan	71	2.2%	11	Vietnam	831	2.7%
12	Ireland	72	1.8%	12	South Korea	68	2.2%	12	Germany	785	2.6%
13	Mexico	69	1.7%	13	Israel	58	1.8%	13	Hungary	683	2.2%
14	Romania	65	1.6%	14	Brazil	58	1.8%	14	Romania	673	2.2%
15	Australia	64	1.6%	15	Malaysia	53	1.7%	15	Spain	596	2.0%
16	Japan	59	1.5%	16	Japan	50	1.6%	16	Canada	519	1.7%
17	Poland	59	1.5%	17	Russia	50	1.6%	17	Czech Republic	512	1.7%
18	Russia	54	1.4%	18	Poland	47	1.5%	18	Malaysia	448	1.5%
19	Czech Republic	48	1.2%	19	Italy	45	1.4%	19	Indonesia	433	1.4%
20	South Korea	44	1.1%	20	Australia	38	1.2%	20	Slovakia	386	1.3%
	Other countries	848	21.3%		Other countries	524	17%		Other countries	8111	26.5%
	Total	3980	100%		Total	3162	100%		Total	30554	100%
	Top 5	2037	51.2%		Top 5	1587	50.2%		Top 5	12008	39.3%
	Top 10	2526	63.5%		Top 10	1713	66.4%		Top 10	12971	54.3%
	Top 15	2868	72.1%		Top 15	2408	76.2%		Top 15	20145	65.9%
	Top 20	3132	78.7%		Top 20	2638	83.4%		Top 20	22443	73.5%
	Herfindahl Index		0.076		Herfindahl Index		0.071		Herfindahl Index		0.051

Source: authors' calculations based on fDi Markets data

Table 5 - Cross-border investment projects in R&D-related activities, by area of destination *(January 2003 - August 2012, percentage share)*

Sectors	Africa	Asia-Pacific	Latin America & Caribbean	Middle East	North America	Rest of Europe	Western Europe	Top 3	Total	Type
ICT/Electronics	2.3%	51.5%	6.6%	1.8%	7.6%	8.3%	22.0%	81.0%	100%	DDT
	0.8%	55.6%	3.1%	4.1%	6.8%	5.8%	23.8%	86.2%	100%	R&D
	2.8%	52.5%	9.3%	1.8%	6.8%	13.1%	13.8%	73.1%	100%	Manuf.
Transport	0.3%	37.7%	6.5%	1.6%	15.7%	8.9%	29.3%	82.7%	100%	DDT
	2.2%	47.3%	2.6%	1.8%	14.3%	6.6%	25.3%	86.8%	100%	R&D
	3.9%	33.7%	11.1%	1.2%	15.6%	18.7%	15.8%	65.1%	100%	Manuf.
Life Sciences and Chemicals	2.4%	45.9%	7.0%	1.8%	13.4%	3.0%	26.4%	85.7%	100%	DDT
	1.4%	39.4%	4.4%	1.4%	14.3%	5.0%	34.2%	87.9%	100%	R&D
	3.2%	43.0%	7.9%	3.4%	10.4%	8.9%	23.1%	76.6%	100%	Manuf.
Services	3.1%	41.7%	3.5%	3.9%	15.8%	9.2%	22.8%	80.3%	100%	DDT
	1.0%	49.0%	7.7%	12.5%	2.9%	4.8%	22.1%	74.0%	100%	R&D
	9.6%	25.5%	9.0%	8.0%	5.3%	21.3%	21.3%	52.1%	100%	Manuf.
Industrial Machinery, Equipment & Tools	1.5%	44.8%	4.9%	4.9%	12.3%	3.9%	27.6%	84.7%	100%	DDT
	0.0%	50.7%	4.9%	2.1%	9.0%	3.5%	29.9%	89.6%	100%	R&D
	1.7%	42.8%	8.5%	2.5%	10.8%	16.2%	17.5%	71.1%	100%	Manuf.
Other sectors	2.0%	39.0%	7.8%	3.3%	15.2%	4.1%	28.6%	82.8%	100%	DDT
	0.6%	42.6%	4.6%	2.8%	13.6%	5.4%	30.5%	86.6%	100%	R&D
	5.6%	33.3%	10.2%	2.5%	9.9%	19.9%	18.4%	61.7%	100%	Manuf.
Total	2.1%	47.5%	6.5%	2.2%	10.3%	7.3%	24.1%	81.9%	100%	DDT
	1.0%	48.1%	3.9%	3.2%	10.5%	5.4%	27.9%	86.5%	100%	R&D
	4.4%	37.3%	9.8%	2.3%	10.8%	17.3%	18.0%	66.1%	100%	Manuf.

Source: authors' calculations based on fDi Markets data

Tab. 6 - Cross-border investment projects in R&D-related activities, by main areas of origin and of destination
(January 2003 - August 2012, percentage share)

	Area of destination							
Area of origin	Africa	Asia-Pacific	Latin America & Caribbean	Middle East	North America	Rest of Europe	Western Europe	Total
Design, Development and Testing								
North America	1.5%	56.5%	6.4%	2.2%	3.7%	5.8%	23.9%	100%
Western Europe	3.1%	36.4%	6.6%	2.1%	15.7%	10.9%	25.2%	100%
Asia-Pacific	1.7%	47.6%	4.9%	2.2%	18.7%	1.5%	23.4%	100%
R&D								
North America	0.5%	52.1%	4.6%	4.6%	4.4%	4.6%	29.3%	100%
Western Europe	1.8%	39.7%	3.9%	2.3%	15.1%	7.8%	29.5%	100%
Asia-Pacific	0.9%	55.2%	2.1%	1.6%	16.7%	2.9%	20.7%	100%
Manufacturing								
North America	2.5%	37.9%	16.6%	2.3%	7.9%	10.3%	22.5%	100%
Western Europe	4.5%	25.6%	8.4%	1.6%	12.3%	24.7%	23.0%	100%
Asia-Pacific	3.9%	60.2%	6.4%	2.3%	11.1%	7.4%	8.7%	100%

Source: authors' calculations based on fDi Markets data

Tab. 7a - Cross-border investment projects in R&D-related activities, by sectors and areas of origin and of destination *(January 2003 - August 2012, percentage share)*

	Area of destination							
Area of origin	Africa	Asia-Pacific	Latin America & Caribbean	Middle East	North America	Rest of Europe	Western Europe	Total
ICT/Electronics								
Design, Development and Testing								
North America	1,4%	60,3%	5,5%	1,8%	3,5%	6,9%	20,5%	100%
Western Europe	4,7%	34,3%	7,7%	2,2%	11,1%	13,1%	26,9%	100%
Asia-Pacific	1,6%	52,0%	6,3%	1,0%	15,9%	1,8%	21,4%	100%
R&D								
North America	0,3%	59,8%	2,8%	5,7%	4,0%	4,2%	23,3%	100%
Western Europe	1,8%	43,3%	3,0%	2,7%	9,4%	10,0%	29,7%	100%
Asia-Pacific	1,4%	60,8%	3,3%	0,9%	12,3%	4,7%	16,5%	100%
Transport								
Design, Development and Testing								
Western Europe	0,0%	37,3%	7,0%	0,5%	18,9%	14,1%	22,2%	100%
North America	0,9%	37,5%	8,0%	3,6%	4,5%	7,1%	38,4%	100%
Asia-Pacific	0,0%	39,3%	2,4%	1,2%	23,8%	0,0%	33,3%	100%
R&D								
Western Europe	5,7%	44,3%	1,9%	1,9%	9,4%	13,2%	23,6%	100%
North America	0,0%	44,9%	3,8%	3,8%	9,0%	5,1%	33,3%	100%
Asia-Pacific	0,0%	53,4%	2,3%	0,0%	25,0%	0,0%	19,3%	100%
Life Sciences and Chemicals								
Design, Development and Testing								
Western Europe	3,1%	41,0%	4,3%	1,9%	18,6%	5,0%	26,1%	100%
North America	2,3%	54,1%	9,8%	1,5%	3,8%	1,5%	27,1%	100%
Asia-Pacific	0,0%	48,1%	7,4%	3,7%	22,2%	0,0%	18,5%	100%
R&D								
Western Europe	1,7%	32,9%	4,0%	0,9%	22,8%	4,6%	32,9%	100%
North America	1,2%	42,2%	6,1%	1,8%	4,9%	5,8%	38,0%	100%
Asia-Pacific	0,9%	51,9%	0,9%	1,9%	18,5%	2,8%	23,1%	100%

Source: authors' calculations based on fDi Markets data

Tab. 7b - Cross-border investment projects in R&D-related activities, by sectors and areas of origin and of destination *(January 2003 - August 2012, percentage share)*

	Area of destination							
Area of origin	Africa	Asia-Pacific	Latin America & Caribbean	Middle East	North America	Rest of Europe	Western Europe	Total
Services								
Design, Development and Testing								
Western Europe	4,1%	33,6%	3,4%	2,7%	22,6%	13,0%	20,5%	100%
North America	0,0%	56,9%	5,2%	0,0%	3,4%	1,7%	32,8%	100%
Asia-Pacific	0,0%	50,0%	0,0%	25,0%	6,3%	0,0%	18,8%	100%
R&D								
Western Europe	3,2%	45,2%	0,0%	16,1%	3,2%	6,5%	25,8%	100%
North America	0,0%	54,0%	14,0%	6,0%	2,0%	2,0%	22,0%	100%
Asia-Pacific	0,0%	43,5%	4,3%	21,7%	4,3%	8,7%	17,4%	100%
Industrial Machinery, Equipment & Tools								
Design, Development and Testing								
Western Europe	0,0%	45,5%	5,9%	4,0%	15,8%	5,9%	22,8%	100%
North America	1,4%	47,1%	5,7%	7,1%	4,3%	1,4%	32,9%	100%
Asia-Pacific	6,7%	36,7%	0,0%	3,3%	20,0%	3,3%	30,0%	100%
R&D								
Western Europe	0,0%	49,0%	7,8%	0,0%	9,8%	3,9%	29,4%	100%
North America	0,0%	50,9%	5,7%	5,7%	0,0%	3,8%	34,0%	100%
Asia-Pacific	0,0%	52,6%	0,0%	0,0%	21,1%	0,0%	26,3%	100%
Other Sectors								
Design, Development and Testing								
North America	2,7%	42,7%	11,3%	4,0%	4,0%	2,7%	32,7%	100%
Western Europe	1,1%	35,6%	7,3%	2,3%	20,3%	6,2%	27,1%	100%
Asia-Pacific	3,7%	35,2%	1,9%	3,7%	31,5%	1,9%	22,2%	100%
R&D								
North America	0,6%	40,5%	6,5%	5,4%	4,8%	4,8%	37,5%	100%
Western Europe	0,4%	39,8%	5,3%	2,5%	16,8%	7,8%	27,5%	100%
Asia-Pacific	0,9%	52,3%	0,9%	0,0%	18,0%	1,8%	26,1%	100%

Source: authors' calculations based on fDi Markets data

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