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Drivers and Impacts in the Globalization of Corporate R&D: An Introduction Based on the European Experience

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ABSTRACT

Drivers and Impacts in the Globalization of Corporate R&D: An Introduction Based on the European Experience*

The globalization of R&D activities has continued its growth path as companies are increasingly trying to capture knowledge and market opportunities internationally. The rapid evolution of national economies and the ways to conduct knowledge-intensive businesses has led researchers and analysts to pursue a deeper understanding of the globalization of corporate R&D and the related driving factors and impacts. This introduction to the Special Section: "Globalization and Corporate R&D" forthcoming in *Industrial and Corporate Change* (vol. 20 (2), April 2011) provides an update of trends in the globalization of corporate R&D. It reviews the literature on the main drivers and impacts of the process under investigation, introduces the papers for this Special Section, and offers some concluding remarks.

JEL Classification: F23, O32

Keywords: globalization, R&D, outsourcing, FDI

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1 Introduction

Multinational firms are constantly looking for the most favorable setting for their activities. This has been always true for the supply, production and distribution of goods along what has been called the value chain (see Kaplinsky, 2000; Fujita and Thisse, 2006; Roper *et al*., 2008). However, over the last decades, the international reallocation of the value chain has increasingly shifted towards the 'unbundling' of activities previously vertically integrated and locally concentrated (see Hummels *et al*., 2001; Hanson *et al*., 2005; Helpman, 2006; Rugman *et al*., 2010). This unbundling trend has recently affected R&D and innovation which were previously considered 'core activities' to be retained by companies' headquarters (see Grossman and Helpman, 1991; Florida, 1997; Chung and Yeaple, 2008).

In general, this (accelerating) trend has been favored by different factors, such as (1) the nature of ICT and new technologies which can be split into different stages, characterized by different enabling knowledge (e.g. 'open innovation' in terms of software industry); (2) the increasing importance of R&D cooperation across firms (see Veugelers, 1997; Cassiman and Veugelers, 2002; Piga and Vivarelli, 2004), which renders more likely and profitable the emergence of R&D complementarities between firms and firms' divisions located in different areas of the world; and (3) the increasing availability of skilled labor in emerging economies like Brazil, Russia, India, and China (BRIC's) and EU new member states (see Wood, 1994; Wood and Ridao-Cano, 1999; Meschi and Vivarelli, 2009).

In this context, the amplitude of cross-border / overseas R&D operations has dramatically increased over the last two decades. Indeed, products embody a growing number of technologies and components, and are thus becoming increasingly reliant upon an expanding number of specialized fields of knowledge. Therefore, in order to remain competitive, firms must master innovations across a wide range of technology fields and this often requires tapping into different centres of excellence around the world. Following this perspective, internationalization of R&D activities should be seen as a conscious strategy of knowledge seeking companies trying to profit from such globally dispersed reservoirs of knowledge by establishing R&D activities abroad.

At the European level, the policy interest in the globalization of R&D is fuelled by the underlying fear that moving ('offshoring') R&D operations outside the EU might undermine its efforts to become a competitive, knowledge-based society (*i.e.* the 'hollowing out' effects; see Criscuolo, 2009). This Special Section discusses the drivers and possible impacts of internationalized R&D activities in the light of the current policy debate. In this regard, this introductory chapter aims to provide an overview of the available empirical evidence, thus focusing on trends, main drivers and corresponding impact that globalization may have on of corporate R&D. The three papers that follow then discuss in more detail how the individual rationales for internationalization of R&D efforts differ and how R&D outsourcing may affect the mother firm's performance in terms of productivity and innovation.[1]

[1] This Special Section takes stock of the relevant knowledge and evidence presented in course of the 2nd European Conference on Corporate R&D (CONCORD 2010); March 3rd and 4th, 2010, in Seville / Spain. The event was organized by the European Commission – Joint Research Centre (JRC)'s Institute for Prospective Technological Studies (IPTS) and the Spanish Centre for Development of Industrial Technology (CDTI) under the auspices of the Spanish Presidency of the EU Council and also formed part of the Industrial Research Monitoring Analysis (IRMA) activities of the European Commission's Directorates Joint Research Centre (JRC) and Research (RTD). For further details see the website: http://iri.jrc.ec.europa.eu/concord-2010/index.html.

2 Trends in R&D investments and its internationalization

In general, it is fairly difficult to measure corporate R&D activities and specifically to approximate its internationalization, as this data, first of all, are sensitive data from a firms' perspective and – if available at all – are widely incomplete, hard to compare from one country to another, and appear just after a considerable time lag (see in this regard Dunning and Narula 1996; Serapio and Hayashi. 2004; Dunning and Lundan, 2009).[2] Nevertheless, the main trends in terms of corporate R&D investments as arising from the available sources will briefly be summarized hereafter.

Evidence from recent data, covering the period 2002-2008, suggests that the total (public and private) R&D spending as percentage of GDP has largely stagnated in the EU and in the US, while it has grown in countries like China and Japan (see Table 1). Similarly, the R&D expenditures financed by the private sector have stagnated both in the EU (converged to about 1.2% of GDP) as well as in the US where, however, they are at a much higher level of around 2.0%. In contrast, in China, R&D financed by the business sector has increased significantly (from 0.6% to around 1.0% of GDP) and has accounted for most of the growth of China's total R&D intensity.

Table 1: Trends of R&D Expenditures as % of GDP (2002-2008)

	2002	2003	2004	2005	2006	2007	2008
EU-27	**1.87**	**1.86**	**1.83**	**1.82**	**1.85**	**1.85**	**1.92**
of which business enterprise sector share	1.2	1.18	1.16	1.15	1.17	1.18	1.21
US	**2.6**	**2.6**	**2.53**	**2.56**	**2.59**	**2.65**	**2.77**
of which business enterprise sector share	1.82	1.8	1.76	1.79	1.85	1.91	2.01
Japan	**3.17**	**3.2**	**3.17**	**3.32**	**3.4**	**3.44**	**:**
of which business enterprise sector share	2.36	2.4	2.38	2.54	2.63	2.68	:
China	**1,07**	**1.23**	**1.33**	**1.38**	**1.42**	**1.49**	**1.5**
of which business enterprise sector share	0.6	0.7	0.8	0,9	1.0	1.1	1.0

Source: Elaborations based on data from EUROSTAT (2011)[3], United Nations (2010)[4], and OECD (2010)[5]
Note: Data for Japan's R&D in 2008 are not yet available.

Based on R&D figures of the world's top R&D investors (stemming from their annual reports; see European Commission, 2010a)[6] more recent trends (2007-2009) can be studied. Figure 1 suggests that, though the recent economic and financial crisis has affected R&D investment across the world, companies headquartered in the EU have reduced their R&D activities less than US firms. On the other hand, corporate R&D has kept on growing in the Asian countries. This suggests looking at overall R&D internationalization trends first and then investigating the 'off-shoring of R&D' in detail, with a special emphasis on emerging Asian countries.

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[2] Although there is still a need for better data sources, several efforts to gather systematic data are under way. See Moncada-Paternò-Castello (2010) for a detailed discussion.

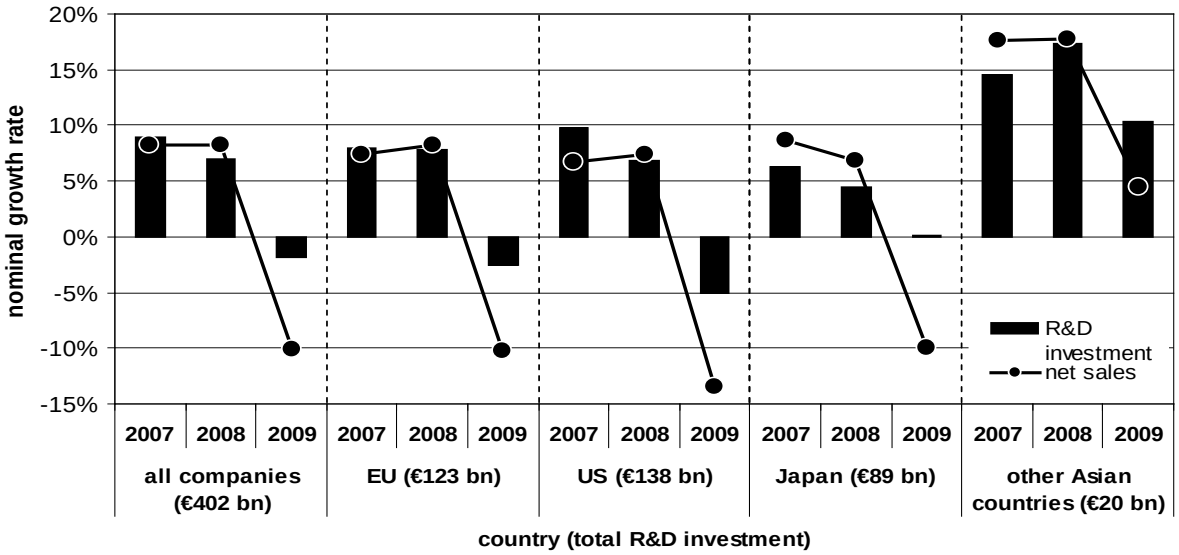
[3] Eurostat – Online Database on Science, Technology & Innovation – (2011) http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

[4] United Nations (2010) - Encyclopaedia of the Nations, Data on Research and Development Expenditure (% of GDP) - World Development Indicators" available online at: http://www.nationsencyclopedia.com/WorldStats/WDI-tech-research-expenditure.html

[5] OECD (2010) Science, Technology and Industry Outlook - ISBN: 9789264084674, 14 Dec 2010

[6] See Moncada-Paterno-Castello *et al.* (2010) for a detailed discussion about differences and complementarities between the data presented in the *EU Industrial R&D Investment Scoreboard* and data on business enterprise expenditure on R&D (BERD) collected by national statistical agencies and published by the OECD and EUROSTAT.

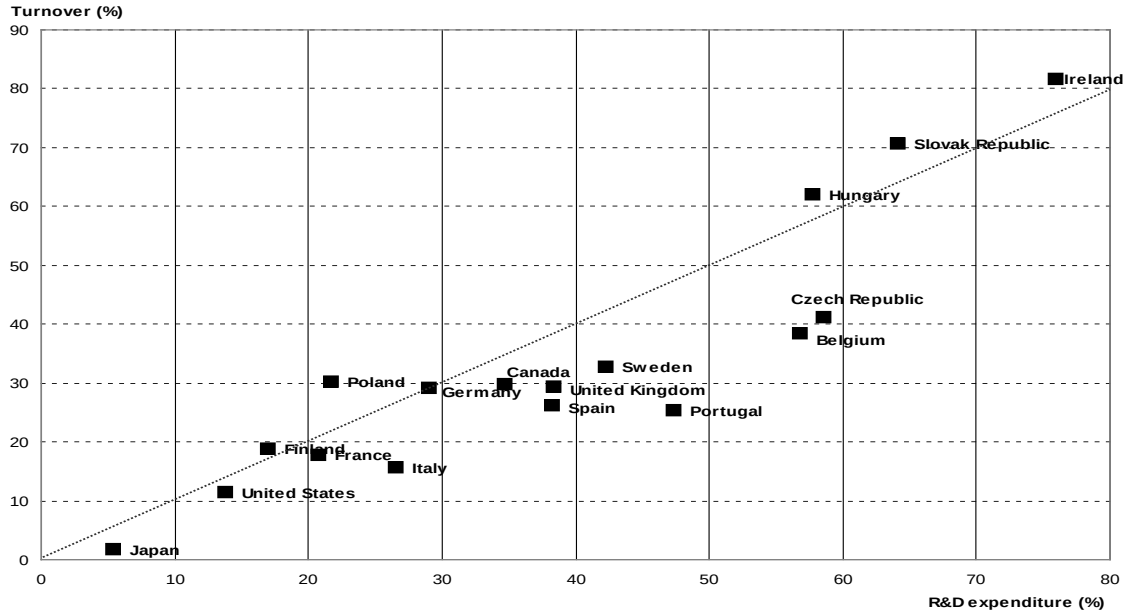
Figure 1: Trends in corporate R&D investment



Source: European Commission (2010): The 2010 EU Industrial R&D Investment Scoreboard.

In this regard, the OECD analyzes the 'R&D expenditures by foreign affiliates of multi-national enterprises in the host market'. Considered in absolute numbers, this indicator measures the amount of R&D being spent in a particular host country by affiliates of foreign multinationals. Comparing patterns of internationalization in R&D with those in production processes, the OECD reports that in most countries the shares of foreign affiliates in total R&D manufacturing expenditure are higher than their shares in total manufacturing turnover, suggesting that R&D is nowadays more internationalized than production (see Figure 2).

Figure 2: Share of total R&D and turnover of affiliates under foreign control, 2006



Source: Elaborations based on OECD (2009) data: Science, Technology and Industry Scoreboard 2009.

The relative importance of R&D expenditures abroad may thus be due less to 'greenfield' R&D investment strategies than to 'brownfield' ones, resulting from a process of mergers and acquisitions (Rodney *et al.* 2009; Smith, 2010). For instance, a study of major French multinationals revealed that in most of the cases the existing foreign R&D department appears to be the result of a takeover (Ministère de l'éducation nationale, 2004). Only in 25% of the cases was the R&D centre created *ex-novo*. There are, however, sectoral differences. In R&D-intensive sectors like ICTs, electronics, chemicals & pharmaceuticals, the option to create an R&D centre from scratch was more frequently chosen than, for example, in machinery & electrical goods (see e.g. Fleetwood and Molleryd, 2009; Takatani *et al*., 2009).

In order to provide a comprehensive picture of the flows and volumes of investments in R&D and related dynamics, it appears to be important to take a closer look at the locations where corporate R&D activities are actually carried out and why and to what extent these are changing. A survey presented by the Economist Intelligence Unit (EIU, 2004) revealed that when managers were asked where they would spend the most on R&D in the next three years, two emerging countries stood out: China and India (39% and 28%, respectively).[7] In fact, China and India are emerging as major competitors to the EU in terms of R&D growth and as locations for R&D activity (see Table 1 and Figure 1). More specifically, an UNCTAD (2005) survey of the largest R&D spenders among multinational enterprises (MNE) revealed that China was the third largest global destination, behind the US and UK; and India was sixth. Out of the 885 R&D-oriented 'greenfield' foreign direct investment (FDI) projects announced in the Asian region, three-quarters (723) were in China and India. The survey also indicated the extent of global R&D off-shoring that went to India: 25% of current foreign location of R&D. Finally, for the following period 2005 – 2009, India was considered an attractive potential R&D location for about 30% of respondents.

In fact, the globalization of business R&D is expected to continue increasing in the years to come. According to a recent global survey of the Economist Intelligence Unit, the proportion of large firms with at least some of their R&D activity taking place overseas was 65% in 2006 and was expected to rise to 84% by 2010 (EIU, 2007). At the same time, it is expected that large enterprises will continue restructuring and rationalizing their global innovation net-works.

According to a recent analysis implemented by the Battelle Institute (2010), based on respondents to a global research community survey, the globalization of R&D will continue in 2011 and beyond as companies are continuously decentralizing their R&D by building new R&D facilities in offshore locations. These changes are mostly being done at the expense of the home organization's R&D infrastructure. Moreover, a few companies in China and India are also starting to globalize their R&D activities.

Looking at the EU, the share of R&D conducted outside the EU has increased slowly but steadily during the last few years. On the basis of a recent survey (European Commission, 2010b), over the period 2005-2012 the surveyed companies expect a reduction of the R&D invested in the EU by ten percentage points (from 78% to 68%). On average, EU-based companies in the survey's sample carry out one quarter of their R&D outside the EU. The largest share of foreign R&D investment is in the US and Canada (around 12%), followed by India (3.1%), China (2.4%), other European countries (2.1%), Japan (1.9%) and the Rest of the World.

[7] US was second (29 %) in this ranking after China, UK fourth (24 %), then Germany, Brazil, and Japan (19 %, 11 % and 10 %, respectively).

3 Driving factors and main impacts of the internationalization of corporate R&D activities

The reasons why firms expand their R&D activities abroad are comprehensively discussed in the literature.[8] They can be grouped into two main categories: (1) the exploitation of assets from the parent firm and (2) the acquisition or improvement of assets by exploiting the advantages of the host country. In the first case, the internationalization of R&D serves to transfer technology to the foreign subsidiaries in which the technological assets developed in the home country are exploited, usually after some adaptation to the characteristics of foreign markets (Bartlett and Ghoshal 1990; Berry and Sakakibara, 2008). In the second case, multinationals make R&D investments abroad in order to acquire resources only available at foreign locations and to augment their stock of knowledge (Florida 1997).

Looking deeper at the drivers of locating corporate R&D activities, Thursby and Thursby (2006) stress four outstanding factors: output market potential, quality of R&D personnel, university collaboration, and intellectual property protection. Further, for companies locating in emerging economies, the growth potential of the local market and the quality of R&D personnel appear to be very important. For companies locating in developed countries, the quality of R&D personnel and intellectual property protection are most vital. Further relevant institutional factors are the public support of R&D activities, the quality of the technological infrastructure, and framework conditions such as macro economic and political stability. Finally, pure proximity to a certain (important) market is commonly seen as crucial when deciding about outsourcing corporate R&D activities. This is why countries with large and affluent markets (such as the US) continue to be a magnet for foreign R&D investment. The logic behind this is that the closer R&D is to the customer, the more customer-tailored the products will be and the larger the share of the market that they will be able to capture.

Turning our attention to a managerial perspective, one way of looking at the internationalization of R&D focuses on the company strategy which in turn characterizes the typology of sites according to the two main company motives for internationalizing as outlined above: either accessing local markets or accessing critical scientific knowledge at a local level (see in this regard e.g. Zedtwitz and Gassmann, 2001). Similarly, Richtnér and Rognes (2008) identified four main forces that may influence R&D activities in terms of location and organization: (1) corporate growth and positioning; (2) knowledge sourcing; (3) R&D management and flexibility, and (4) communication and problem solving. These strategic drivers resemble the more general ones discussed at the beginning of this section.

However, the management attitude to internationalization of R&D depends also on the different phases of an R&D project. In fact, when a company decides to internationalize its R&D it often makes a distinction between *research* activities and *development* activities, with the company's research and development sites not necessarily sharing the same location (see Zedtwitz and Gassmann, 2001; Gulbrandsen and Godoe, 2008).

An alternative model developed in order to illustrate how MNE organize global R&D projects is provided by Chiesa (2000) and Chiesa and Manzini (2009). A distinction is made between different types of R&D units, categories of global R&D structures and the different phases of

[8] See e.g. Kumar (2001) and Narula (2002) for overviews. For discussing the characteristics of several individual motives for internationalizing R&D activities see Hollenstein (2009).

an R&D project: a) The *Centre of excellence* structure where one lab is assigned a global mandate in a certain technology/product/process area in order to increase R&D efficiency by concentrating the needed resources in one location; b) The *supported specialization* structure where the main resources in a technology/product/process area are still concentrated in one location but a number of small units are dispersed worldwide to supply the local markets; c) The *network* structure which consists of a network of dispersed labs in different countries working in the same technology/product/process and where each lab is free to undertake its own R&D initiatives and allocate resources to locally developed projects; and d) The *specialized contributors* where each unit is specialized in one or a few disciplines and contributes by developing a piece of the R&D work with an 'integrator' R&D centre having overall management and control.

Managing these geographically dispersed R&D efforts is especially challenging in technology-intensive ventures that involve complex work, risks, and nonlinear development processes (Thamhain, 2009). In particular, knowledge flows can be shaped either by an: '*Asset-exploiting'* or an '*asset augmenting'* attitude (Narula and Zanfei, 2005; OECD, 2005; Dunning, 2009). If the first attitude dominates the mother firm's management strategy, knowledge tends to flow *from* the parent home's laboratory *to* the foreign-based facilities. If the second attitude dominates, knowledge tends to flow *from* the foreign laboratory *to* the central home laboratory (Audretsch and Feldman, 1996; Hegde and Hicks, 2008).

Other researchers pointed towards sector specifics in this regard, suggesting that the asset-exploiting strategy is one of the most widely implemented strategies in electronics and metals, while asset-augmenting is more prominent among chemicals, pharmaceuticals, mining, food, and materials (e.g. Patel and Vega, 1999). More significantly, there has been a shift from believing that asset-exploiting motives were dominant to acknowledging the role of asset-augmenting motives. Le Bas and Sierra (2002), in a study focusing on patent applications to the European Patent Office, found that - overall - the asset-augmenting strategy was more prevalent. Generally speaking, over the last twenty years, international activities of R&D have been characterized by an increasing trend towards asset-augmenting activities.

However, each of the approaches discussed above has its own economic, organizational and operational implications and none of them can be considered the silver bullet for racing ahead in the science and technology-based competition (Heidenreich et al., 2010).

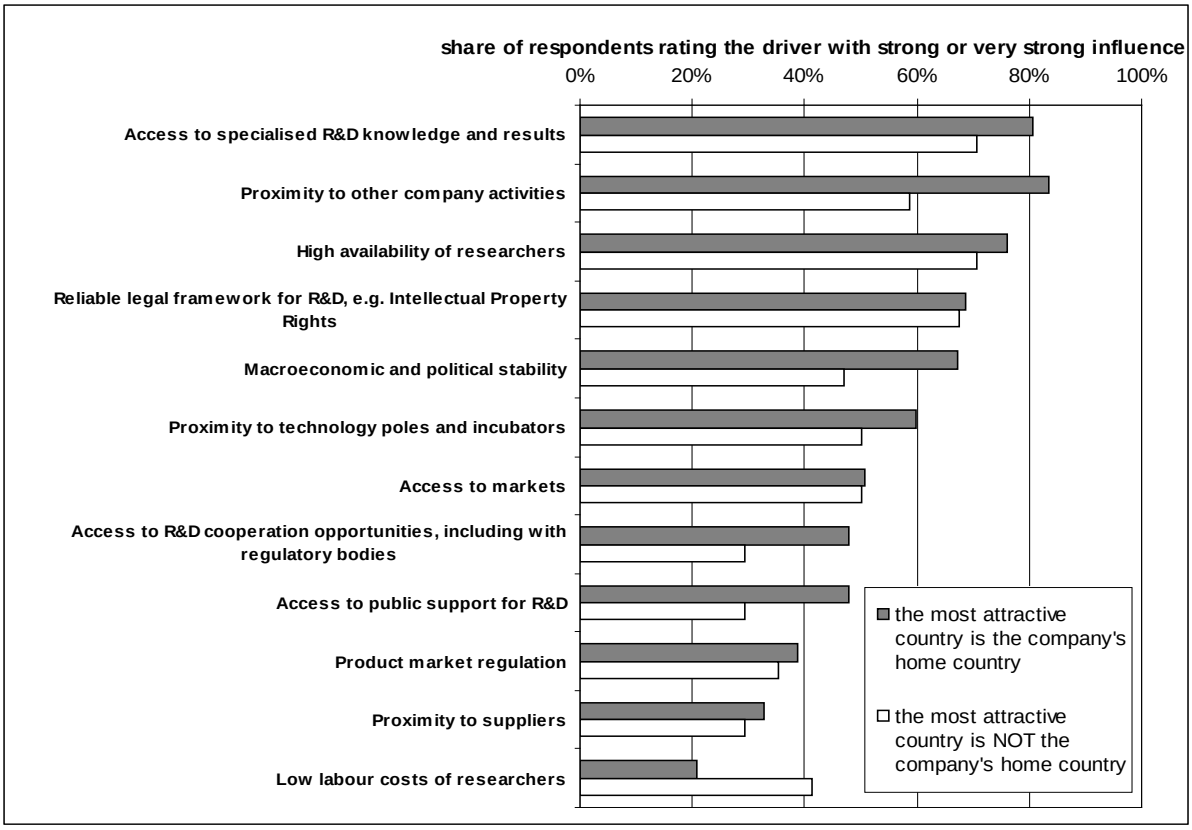
Figure 3 illustrates the key decision factors of EU companies when deciding where to carry out their R&D activities and why (European Commission, 2010b)[9]. As can be seen in this Figure, the determinants of the location of the R&D activities are fairly consistent whether local or international investments are considered. However, the drivers for companies mainly attracted by foreign countries (the white bars in Figure 3) show some peculiarities. On the one hand, the 'asset augmenting' determinants turn out to be dominant: indeed, the access to specialized knowledge, the availability of researchers, and the legal framework rank at the top among the motives of R&D outsourcing. On the other hand, 'asset exploiting' motives – such as the access to market, the cheap labor cost of researchers[10] and the proximity to suppliers – appear to play a secondary role as drivers of R&D location abroad. This evidence from

[9] Figure 3 is based on a survey conducted by the JRC-IPTS of the European Commission in 2009. The figure refers to a random sample of 184 European top-R&D-investors.

[10] It is interesting to note that a number of sources suggest that cheap labor costs of researchers is relatively un-important when deciding to set up or relocate R&D activities in foreign countries (Jones and Teegan, 2003; Papanastassiou, 1997; Voelker and Stead, 1999; Economist, 2004).

European top investors is consistent with the general trend – discussed above – of an R&D globalization increasingly driven by an 'asset augmenting' attitude.

Figure 3: Decisive factors for EU companies when locating their R&D activities



Source: European Commission (2010): The 2009 EU Survey on R&D Investment Business Trends

Turning the attention to the possible impacts of the internationalization of corporate R&D, many aspects in both private and public sphere can be investigated (Dunning and Lundan 2009; Moncada-Paternò-Castello and Voigt, 2010). In this Special Section emphasis will be given to the effects in terms of corporate performance.

In general, internationalization of corporate R&D may bring substantial benefits such as, for instance, higher cost efficiency of the innovation process, leveraged ability to learn about innovation conducted by other companies/institutions, a reduced time length before commercialization and a positive impact on the innovation capacity of the own firm. In fact, the internationalization of R&D activities – involving the setting up of research facilities abroad – not only helps firms to access complementary expertise, but also allows firms to be closer to markets where the fruits of their R&D can be exploited. By the same token, foreign R&D activities may provide access to foreign technologies and therefore can represent a channel for transferring knowledge back to the home country (Miravete and Pernias, 2006).

An interesting approach in this regard is the 'Open Innovation' concept, where a firm finds creative ways to motivate outsiders to supply an ongoing stream of external innovations (West and Gallagher, 2006). The internationalized R&D activities can turn out to be central drivers

for firms' adoption of Open Innovation management tools (Saiyd and Gocaerts, 2009); in fact, companies can gain valuable inputs from geographically disperse R&D labs and personnel (Ebrahim *et al*., 2009).

Another is the so-called 'Smart Specialization' (Foray and Van Ark, 2007; Foray, 2009), where – far from directing resources to the more advanced regional R&D labs – all regions are given a fair chance to compete; in this context, the mother firm would be able to exploit regional strengths wherever they appear to be (Varblane, 2009; Santangelo, 2009).

Therefore, the potentially positive aspects of the internationalization of R&D should not be forgotten nor overshadowed by fears over loss of jobs, innovative capacity and industrial diversification. Foreign R&D activities may provide access to foreign technologies and therefore can represent a channel for transferring knowledge back to the home country. This is referred to in the literature as 'reverse technology transfer' and highlights how the R&D conducted abroad may be seen as a complement rather than a substitute for the R&D carried out at the mother company's labs (OECD, 2005; Griffith *et al.*, 2004).

Table 2 summarizes the possible (favorable and adverse) impacts that R&D globalization may entail both on the host country and the mother firm's country. Of course, which of the listed effects are prevailing is a matter of empirical investigation. The contributed papers in this Special Section aim to shed some light on that.

Table 2: Possible impacts of the internationalisation of corporate R&D

	On host country	On home country
Positive impact	▪ Increased local technical capability ▪ Knowledge & economic spillovers ▪ Better tailored products ▪ Productivity increase ▪ Employment and sale growth	▪ Get access to other sources of expertise and innovation ▪ Enhance access to foreign markets (sales growth) ▪ Results of R&D done abroad may be exploited at home, producing economic benefits ▪ Prolong the life cycle of existing goods/services
Negative impact	▪ Foreign control over domestic R&D resources ▪ Results may be exploited elsewhere; loss of economic benefit ▪ Decrease in R&I impact when/if their links with production get weaker	▪ Loss of technical capability ▪ Hollowing out of industries ▪ Loss of economic benefits if results are exploited only locally ▪ Negative impact on industrial diversification ▪ Loss of jobs in the short-term

Source: Compiled from Sheehan (2004); Fryges, (2004); Harrison *et al.* (2008); Hall *et al*. (2008); Ketokivi and Ali-Yrkko (2009); Cincera and Ravet (2011);

4 This special section

The following three papers of this Special Section belong to the body of literature devoted to the study of the occurrence of the globalization of innovative activities and its possible impact in terms of a company's competitiveness and innovative performance.

In particular, Arvanitis and Hollenstein's paper relates the determinants and the effects of R&D outsourcing at foreign locations. Their analysis is based on three different types of motives fostering R&D internationalization: knowledge-oriented, market-oriented, and resource-oriented. Using data on Swiss manufacturing firms in the years 2002, 2005 and 2008, the study finds that (i) factors related to knowledge-oriented advantages are more important in explaining the likelihood of foreign R&D activities than factors reflecting disadvantages related to home location; (ii) being engaged in foreign R&D activities primarily driven by knowledge-oriented motives is positively correlated to the mother firm's innovative performance; and (iii) foreign R&D activities driven by market-oriented or resource-oriented motives correlate positively with labor productivity. In terms of management and policy implications, these results point out again that an "asset augmenting" attitude is crucial in enhancing a multinational's overall innovative capability. Nevertheless, more traditional 'asset exploiting' motives are still important in increasing parent company's competitiveness. From a policy point of view, these outcomes call for a very cautious and selective approach able to distinguish those sectors and firms mainly driven by knowledge-intensive drivers from those mainly driven by the more conventional determinants of internationalization.

Using a similar approach, Higón and Antolín investigate to what extent firms' internationalization influences the endogenous relation between R&D and productivity.[11] In particular, their paper assesses the contribution of R&D to productivity for a panel of 465 UK companies that differ in their degree of internationalization (domestic, British multinationals and foreign multinationals over the period 2002 to 2006). Results indicate that MNEs are on average more efficient than purely domestic firms as far as the contribution of R&D to productivity is concerned, with the largest difference being at the lower bounds of the distribution. Moreover, British-owned MNEs appear to be superior to foreign multinationals, in terms of the R&D/productivity-estimated elasticity, except for the lower ends, where foreign firms tend to stand out. From a policy and management viewpoint, these outcomes underline the need to jointly consider innovation and globalization strategies at the company level; in fact, those firms which are able to compete globally are also those getting the higher returns from their innovative investments (proxied by R&D expenditures).

Finally, Kampik and Dachs address a similar issue from a different perspective. The authors study empirically the innovative performance of subsidiaries of German multinational companies. Using Community Innovation Survey (CIS) data of more than 2,000 German subsidiaries in 16 European countries, the authors find that innovation output intensity of the average German-owned subsidiary is higher than innovation output intensity of the average domestic firm in all but one country. This result indicates that subsidiaries of German MNEs are highly innovative and contribute with the introduction of new products and processes to economic growth and employment of their host countries. Once again, companies which are able to compete globally reveal an above-the-average innovative performance. This outcome should to be taken into account by managers and policymakers. However, the study reveals

[11] For general overviews of the studies devoted to the R&D-productivity link, see Mairesse and Sassenou, 1991; Hall and Mairesse, 1995; Ortega-Argilés *et al*., 2010.

that individual firm characteristics such as size, the engagement in intramural R&D activity, international market orientation and sectoral affiliation are also significantly associated with a firm's innovative performance.

5 Concluding remarks

The phenomenon of the internationalization of corporate R&D represents a rapid – not accidental but rather accelerating – evolution of the business model adopted by MNEs. Drawing from recent literature and from the papers in this Special Section, it seems that globalized firms tend to do more R&D, innovate more, and get higher returns from doing so than purely domestic firms.

However, it should be highlighted that the occurrence, drivers and impacts of the internationalization of R&D activities highly depend on the assumed typology of firms in terms such as size, sectoral belonging, and financial constraints. From this perspective, the European economy – characterized by the dominant role of SMEs and traditional sectors – may risk playing a minor role in the international arena in comparison with the US and the emerging Asian economies.

Nevertheless, although European firms are lagging behind their US counterparts in terms of their R&D intensity, those that engage in R&D internationalization appear to fully take part in the mainstream trends. For instance, they outsource R&D around the globe, but with the increasing role of China and India as preferred foreign locations. However, the largest foreign R&D investment by the EU-based companies is still concentrated in the US and Canada, followed by India, China, other European countries, Japan, and the Rest of the World.

Moreover, European multinationals move their R&D capacities abroad for reasons that mainly relate to: a) access to specialized R&D knowledge; b) availability of researchers; and c) reliability of the legal framework for R&D, notably Intellectual Property Rights (IPR). This evidence from European companies is consistent with the general trend of an R&D globalization increasingly driven by an 'asset augmenting' motivation.

In this respect policy interest in the globalization of R&D should not be driven by fear that moving R&D operations outside the EU might undermine its efforts to become a knowledge-based society. Rather, it should be influenced by an understanding of the chances arising from foreign R&D as possible complements rather than substitutes. Indeed, the fact that European companies have increased the amplitude of their cross-boarding and overseas R&D operations over the last decades should not be seen as a threat, but rather as an opportunity to move the European technological frontier outwards.

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