Internationalisation of RD: A Review of Drivers, Impacts, and new Lines of Research

Dachs, Bernhard

AIT Austrian Institute of Technology

December 2017

Internationalisation of R&D: A Review of Drivers, Impacts, and new Lines of Research

Preliminary version

Bernhard Dachs[1]

This paper reviews the growing literature on the internationalisation of R&D in the business sector. By internationalisation of R&D, this paper means the fact that firms conduct research and development at locations outside their home countries. The survey focuses on three issues: first, the drivers of the process at the country, the sectoral and the firm level – why firms go abroad with R&D activities. Second, evidence on the effects of the internationalisation of R&D on the host and home countries of multinational firms. So far, there is a consensus in the literature that R&D internationalisation benefits the host countries. Third, the paper discusses some new lines of research on R&D internationalisation related to the role of indirect funding for R&D, R&D internationalisation in services and multinationals from emerging economies.

Key words: Internationalisation, R&D, innovation, foreign-owned firms, outsourcing

[1] AIT Austrian Institute of Technology, Donau-City-Straße 1, 1220 Vienna, Austria, Tel: +43(0)50 550. e-mail: bernhard.dachs@ait.ac.at

1. Introduction

Foreign-owned firms are among the top performers of research and development (R&D) in many countries. In 2013, foreign-owned firms accounted for more than 20% of business R&D in France, Germany, the Netherlands, and Italy; between 30% and 50% in Spain, Poland, and Sweden; and for more than 50% in the United Kingdom, Austria, Belgium, the Czech Republic, Hungary, Slovakia and Ireland (Iversen et al. 2016). Thus, foreign-owned firms have a considerable influence on the technological capabilities of countries, which in turn determine competitiveness to a considerable degree. This makes the internationalisation of R&D a key dimension of science, innovation and technology policy.

This paper reviews the growing literature on R&D internationalisation in the business sector. By internationalisation of R&D, this paper means the fact that firms conduct research and development at locations outside their home countries. The survey focuses on three issues: first, the drivers of the process – why firms go abroad with R&D activities. Second, the effects of the internationalisation of R&D on the host and home countries of multinational firms. Third, I will discuss some new lines of research on R&D internationalisation.

The survey has three important limitations. First, it does not present empirical evidence on R&D internationalisation; readers can refer to recent publications such as Iversen et al. 2016, Dachs, et al. 2014, or OECD 2008a which present this information in detail. Second, the survey will only include the literature on the internationalisation of R&D in firms, and leave internationalisation in higher education or public research centres aside. Third, the literature on foreign direct investment (FDI) and multinational enterprises is only included if it relates to R&D. Internationalisation refers to the internationalisation of business R&D through the remainder of this paper, unless otherwise stated.

The internationalisation of R&D is a relatively young phenomenon, although scientists, knowledge and artefacts have always crossed borders easily in economic history. The early literature regarded internationalisation of R&D as an unlikely phenomenon, because of the strong linkages of large firms to universities and other research organisations in their home countries (Patel and Pavitt, 1991). The oldest literature on the internationalisation of R&D dates back to the end of the 1960s and the beginning of the 1970s (e. g. Dunning 1958; Brash 1966; Safarian 1966). Only few articles and surveys emerged in the 1970s (examples are Creamer 1976; Ronstadt 1977; Lall 1979) and in the 1980s and early 1990s (Behrman and Fischer 1980, Cantwell 1989, Pearce 1992).

Since the year 2000, a growing body of literature provides evidence that the internationalisation of R&D is gaining momentum (OECD 2005; UNCTAD 2005;

Hatzichronoglou 2008; OECD 2008a; OECD 2008b; OECD 2008c; Shapira et al. 2009, OECD 2010, Hall 2010, - Alkemade et al. 2015 and Laurens et al. 2015 see it differently). This literature is accompanied by a number of international comparisons of policies towards R&D internationalisation (CREST Working Group 2007, OECD 2008a, TAFTIE 2009, Schwaag Serger and Wise 2010, OECD 2016a).

2. Search strategy

The paper employs a very simple search strategy: we searched at Google Scholar for three search terms: internationalisation of R&D, offshoring of R&D, and R&D by foreign-owned firms. Existing review articles such as Narula and Zanfrei (2005), Veugelers (2005), Cantwell (2009), Hall (2010), or Santos-Paulino et al. (2014) helped in the selection of these search terms and provided an additional source for identifying relevant research. Google Scholar offers the advantage that it also provides working papers and other articles not yet published in academic journals. The survey mainly considers papers published after the year 2000. The selection of papers is subjective, because due to space constraints not every paper can enter the review. I found it most important to consider papers that can help to identify variables and issues helpful for further empirical research.

3. Drivers of R&D Internationalisation

The benefits and costs associated with the internationalisation of R&D vary between firms, industries, regions or countries. It is therefore important to distinguish between these three levels. I start with a discussion of the drivers at the regional and country level and then go to the sectoral and firm level.

3.1 Drivers at the regional and country level

The potential host country or host region shapes the internationalisation decisions of firms by providing different incentives, as well as different framework conditions to invest in R&D. Drivers at the regional or country level are also important from a policy perspective, because they give room for policy intervention to increase the locational advantages of regions or countries.

A first important driver at regional or country level is economic size, measured by income and market size. Size is an important driver, because high income and high income growth attracts FDI (Ekholm and Midelfart 2004; Blonigen 2005; Jensen 2006; Athukorala and Kohpaiboon 2010; Hall, 2010). The importance of market size points to the relationship between R&D and other MNE activities: R&D investments often follow FDI, and overseas R&D activities are, in most cases, an extension of existing overseas production and marketing activities (Birkinshaw and Hood 1998; Birkinshaw et al. 1998;

Archibugi and Iammarino 1999, De Backer et al. 2016). Moreover, firms may find it easier to cover the cost of R&D in a country with a large market where they expect larger absolute revenues than in a country with a small domestic market, even if wages are considerably lower.

Another important attractor of R&D of MNEs is a skilled workforce and the quality of the education system. In a survey of multinational firms, Thursby and Thursby (2006) find that highly qualified R&D personnel is the most important driver for location decisions in R&D. Tübke et al. (2016) come to a similar conclusion in a recent survey. Ernst (2006) relates the success of India and other Asian countries in attracting R&D of foreign MNEs to their expanding pool of graduates in science and technology. Hedge and Hicks (2008) demonstrate that the innovation activities of overseas US subsidiaries are strongly related to the scientific and engineering capabilities of the host countries.

In turn, skills shortage and a growing demand for engineers and scientists in the home country is often a motive for firms to go abroad with R&D. Kinkel and Maloca (2008) find that capacity bottlenecks are the most frequent reason why German firms move R&D to locations abroad. In the research of Lewin et al. (2009), 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 to Asian countries.

Potential knowledge spillovers between foreign-owned firms and host country organisations are another driver for R&D internationalisation. A discussion of spillovers as an effect of R&D internationalisation is found in the next chapter. Spillovers as a determinant for R&D location decisions point to the importance of the quality of university research as a driver of R&D internationalisation at the country level (Belderbos et al. 2009; Thomson 2013; Siedschlag et al. 2013). Knowledge spillovers may be even more relevant at the regional than at the country level, because spillovers diminish with distance between sender and receiver (Jaffe et al. 1993; Breschi and Lissoni 2001). As a consequence, firms which want to utilize such localised knowledge spillovers have to be present where they occur, and innovative activity tends to cluster locally in industries with a high level of spillovers (Audretsch and Feldman 1996). This effect is related to institutional or technological conditions, such as tacitness of the knowledge base, but also to the existence of specialised local or regional labour markets (see the survey of Breschi and Lissoni 2001).

An example of the importance of spillovers give Siedschlag et al. (2013). They show that agglomeration economies from foreign R&D activities, human capital, proximity to centres of research excellence and the research and innovation capacity of the region are crucial for the R&D location decisions of multinational firms in the European Union. Other

evidence for regional knowledge spillovers by R&D of foreign-owned firms present Castellani and Pieri (2013).

Differences in labour cost between the home country and locations abroad are one of the most important motives for the internationalisation of production (Barba Navaretti and Venables 2004; Brennan et al. 2015). Empirical evidence that differences in the cost of R&D personnel are a major driver for the internationalisation of R&D, however, is weak. Survey results as well as econometric studies see only a modest influence of wage differences in R&D location decisions compared to other factors (Booz Allen Hamilton and INSEAD 2006; Thursby and Thursby 2006; Kinkel and Maloca 2008; Belderbos et al. 2009; Tübke et al. 2017). However, cost differences may become important when firms can choose between two locations that are similar in many other locational factors (Booz Allen Hamilton and INSEAD 2006; Thursby and Thursby 2006; Cincera et al. 2010; Athukorala and Kohpaiboon 2010).

Previous research has also pointed out that geographical proximity between host and home country leads to higher levels of cross-border R&D investments (Guellec and van Pottelsberghe de la Potterie 2001). However, there is also evidence that geographic distance may play smaller role for R&D than for other types of international activity (Dachs and Pyka 2010, Castellani et al. 2013). The distance effect is often explained by additional co-ordination cost, the cost of transferring knowledge over distance, and a loss of economies of scale and scope when R&D becomes more decentralised (von Zedtwitz and Gassmann 2002; Sanna-Randaccio and Veugelers 2007; Gersbach and Schmutzler 2011). In addition, the distance effect may also be explained by cultural, social and institutional factors. The international business literature stresses that foreign-owned firms have to master additional institutional and cultural barriers in their host countries. This disadvantage is known as the 'liability of foreignness' (Zaheer 1995; Eden and Miller 2004) or the 'liability of outsidership' (Johanson and Vahlne 2009). Foreign-owned firms may suffer from a lack of market knowledge and understanding of customer demands, but also a lower degree of embeddedness in informal networks in the host country (Lööf 2009). Disadvantages from the liability of foreignness tend to decrease over time, but may even exist in long-established affiliates with a local management and staff, because the affiliate is embedded in intra-firm networks and have to stick to the rules, norms and standards of the multinational group.

The role of policy for R&D location decisions of MNEs has been investigated by a number of empirical studies (Cantwell and Mudambi 2000; Kumar 2001; Cantwell and Piscitello 2002; Thursby and Thursby 2006; Kinkel and Maloca 2008; De Backer and Hatem 2010; Athukorala and Kohpaiboon 2010). Policy instruments include subsidies for investments or R&D activities, or non-monetary measures such as investment services, match-

making, provision of infrastructure, legal support etc. (OECD 2016a). Fostering intellectual property rights – although not a typical inward investment promotion activity – can also be regarded as an important policy instrument (Branstetter et al. 2006; Thursby and Thursby 2006; Holmes et al. 2016 on China; Schmiele 2013 is more sceptical). Moreover, with the expansion of European and US MNEs into Asia, local content requirements in R&D (mandatory technology transfer, mandatory joint ventures, requirements to perform R&D in the host country) gained some prominence as a policy tool (Walsh 2007, Weiss 2016).

Two findings on the role of policy in R&D internationalisation find a wide consensus in the literature: first, special financial incentives and a positive discrimination of foreign-owned firms in general are not regarded as an appropriate instrument to attract foreign R&D. Athukorala and Kohpaiboon (2010) conclude in their analysis of overseas R&D activities of US firms that 'there is no evidence to suggest that R&D specific incentives have a significant impact on inter-country differences in R&D intensity *(of US firms)* when controlled for other relevant variables'. This does not mean, however, that science, technology and innovation policy has no role in attracting foreign R&D. Measures to improve university education or to foster co-operation between firms and universities can considerably shape the attractiveness of locations by improving the capabilities of the national innovation systems and leveraging R&D efforts of firms. These measures, however, should be open to every firm, domestically or foreign-owned. Siedschlag et al. (2013), for example, show that high public R&D expenditures increase the probability of location of R&D activities by European multinational firms in a particular region.

Second, governments that want to attract R&D of foreign multinational firms should instead focus on the economic fundamentals and provide political stability, good public infrastructure, reasonable tax rates, a stable legal system, and increase the embeddedness of foreign-owned firms in the domestic innovation system (Cantwell and Mudambi 2000; Narula and Guimón 2009; Guimónh 2009; Ascani et al. 2016). This reflects the finding discussed above that the location of R&D often depends on the location of production, sales or other business functions of the firm.

3.2 Drivers at the sectoral level

A second important level for the analysis of drivers is the sector where the firm operates. Empirical studies found huge differences between sectors in terms of R&D internationalisation (OECD 2008; Dachs et al. 2014): R&D internationalisation tends to concentrate in high-technology sectors, such as pharmaceuticals, computers, electronics, machinery, or the automotive industry. However, there is not much literature that would

explain these differences. I will therefore present some thoughts based on the innovation economics literature.

Sectors matter for R&D internationalisation in two ways: on the one hand, R&D intensive sectors have a disproportionate share on global foreign direct investment (Markusen 1995, p. 172; Bellak 2004). Hence, there is already a bias towards R&D-intensive sectors in underlying FDI decisions. On the other hand, sectors matter because R&D intensity and R&D processes differ considerably between sectors (Marsili 2001; Malerba 2005; Castellacci 2007; Peneder 2010). These intersectoral differences shape the R&D behaviour of firms to a considerable degree, including decisions to locate R&D abroad, leading to different degrees of internationalisation at the sectoral level.

A first important determinant at the industry level is the degree of tacitness of the knowledge base of a sector. Tacitness results from the fact that cognitive capabilities and abstract concepts are not easy to articulate explicitly and to transfer between people (Cowan et al. 2000). A knowledge base which is highly tacit and bound to individuals may be an obstacle to internationalisation, because it makes knowledge exchange over distance costly. Tacitness, however, may also be a driver for internationalisation, because firms have to move to the place where this knowledge is available when it cannot be transferred over distance.

Second, sectoral knowledge bases also differ in their degree of cumulativeness, or, in other words, in the degree future innovation success depends on the knowledge which has been built up in the past (Marsili 2001). Cumulativeness is high in chemicals, pharmaceuticals, telecommunications and electronics, but low in mechanical engineering, food, clothing, or civil engineering (Malerba and Orsenigo 1996; Marsili 2001). A high degree of cumulativeness may require a high degree of specialisation in R&D, which gives advantages to centralised R&D. Cumulativeness may also promote R&D centralisation when strong learning effects lead to increasing returns to scale in R&D, or when the R&D process includes economies of scope and effects from cross-fertilisation. Moreover, cumulativeness of the knowledge base may also imply that R&D activities require a certain minimum scale in order to be successful.

Third, sectors also differ in terms of appropriability, the degree to which an innovation can be protected from imitation (Cohen et al. 2000; Cohen 2010). Firms in sectors with a low degree of appropriability, like many service sectors, may be reluctant to internationalise R&D because they have only weak means to prevent involuntary knowledge spillovers.

Fourth, another source for inter-sectoral differences is the firm's network of external relations with suppliers, clients, universities, public administration, etc. (Marsili 2001; Malerba 2002). Some industries, such as biotechnology or pharmaceuticals, have strong

linkages to basic science, and firms in these industries may find it useful to locate R&D close to excellent research universities. Belderbos et al. (2009) show that firms with a strong science orientation prefer to locate R&D in host countries with strengths in academic research. Another very important locational factor for high R&D intensive sectors is the framework for R&D, including intellectual property rights (Tübke et al. 2017). Firms in other sectors, such as the automotive of the electronics industry, are closely connected to suppliers and customers through international production networks. Enterprises in these sectors may be forced to internationalise their R&D to gain market access, in particular have development capabilities in proximity to key clients. Tübke et al. (2017) show that for medium- and low-tech sectors, market access is more important than a reliable framework for R&D. The existence of lead users or other potential co-operation partners may also pose a strong incentive to locate R&D in a particular country.

3.3 Drivers at the firm level

The third relevant level for the explanation of overall patterns of R&D internationalisation is the firm level. Internationalisation paths of two firms can be completely different – even if they operate in the same region and operate in the same industry – when they differ in their firm characteristics (for example, size, internationalisation experience), the costs and benefits that arise for them from internationalisation, and resulting motives and strategies. The interplay of these three factors, together with framework conditions from the country, regional and sectoral level, determines the degree of R&D internationalisation of firms.

Internationalisation decisions in R&D are closely connected with internationalisation decisions in production and the emergence of global value chains (these are discussed in Amador and Chabral 2016; Timmer et al. 2014). This relationship can be explained by two reasons. First, internationalisation in production can be a result of superior, firm-specific assets. Firms internationalise, because they want to exploit these assets at foreign markets via their subsidiaries (Dunning 1973; Markusen 1995; Caves 1996 (1974); Markusen 2002). Dunning (1973; 1981) suggests that firms exploit these assets via FDI and not via exports or licensing because of ownership, location and internalisation advantages associated with this mode of exploitation. Thus, firm heterogeneity leads to self-selection in the internationalisation strategies of firms (Head and Ries 2003; Helpman et al. 2004; Helpman 2006). Only the most productive (and thus innovation intensive) firms expand their operations via FDI, while less productive firms choose to export or serve only domestic markets. However, the relationship also exists in the other direction: globally engaged firms use more innovative inputs and generate more innovative outputs, leading to a higher productivity (Criscuolo et al.

2010). In addition, there is also evidence for a positive relationship between innovation and exports at the firm level (Greenhalgh and Taylor 1990; Lachenmaier and Wößmann 2006; Harris and Li 2009).

Second, there is a mutual relationship between R&D and international expansion because they are both driven by the same determinants. Some firm characteristics that are positively related to R&D intensity also drive internationalisation (Arvanitis and Hollenstein 2006, Cerrato 2009). Dogson and Rothwell (1994), Cohen (1995, 2010), Kleinknecht and Mohnen (2002) or the OECD (2009) have examined the determinants of R&D and innovation in detail. R&D and R&D intensity is, at first, associated with firm size. There are different advantages and disadvantages of small and large firms in the innovation process, leading to a U-shaped relationship between size and R&D (Kleinknecht 1989; Cohen 1995). Regression analysis also finds a significant and positive association between firm size and the internationalisation of R&D (Arvanitis and Hollenstein 2006; Kinkel and Maloca 2008; Schmiele 2012). R&D is also positively related to the internal knowledge and capabilities of the firm (Cohen and Levinthal 1989 and 1990; Teece et al. 1997). These capabilities enable the firm to create new knowledge, but also absorb knowledge from external sources.

Besides firm characteristics, another source of firm heterogeneity in the internationalisation of R&D are the costs of a decentralised organisation of R&D (Sanna-Randaccio and Veugelers 2007; Gersbach and Schmutzler 2011, Belderbos et al. 2013). These costs first comprise the foregone benefits of R&D centralisation, including economies of scale and scope from specialisation and a tighter control over core technologies of the firm. Second, additional costs also arise from higher co-ordination efforts and the cost of transferring knowledge within the MNE. Proximity also facilitates co-ordination of R&D activities with other parts of the firm, such as production and marketing, and mutual learning between these parts. A growing literature discusses the need of firms to co-locate production and R&D to enable mutual learning effects (Ketokivi and Ali-Yrkkö 2009, Defever 2012, Alcacer and Delgado 2016). Loosing such co-location advantages would be a hampering factor for R&D internationalisation. Third, a concentration of R&D activity in the home country is also favoured by various linkages between the firm and the home country innovation system. Patel and Pavitt (1999), Narula (2002), or Belderbos et al. 2013 point out that firms are strongly embedded in and dependent on their home country innovation system. The ties that bind firms to their home country include formal R&D co-operations with domestic universities, but also informal networks that grew from doing business together in the past. Informal networks between firms may also evolve from recruiting staff from the same universities and labour mobility. Removing these linkages by moving R&D abroad would incur

considerable costs on the firms, because they would need to re-install similar linkages with host country organisations.

Finally, firm characteristics and the costs of R&D internationalisation have to be seen alongside the benefits of R&D internationalisation and the resulting strategies of the firms. A first benefit is that R&D can support overseas production. Products and technologies often have to be adapted to consumer preferences, regulation, or environmental conditions of foreign markets in order to facilitate their exploitation in these markets. These adaptations can be done more easily in proximity to potential clients in the host countries. MNEs therefore locate design, engineering and R&D units in main foreign markets to support marketing and production facilities abroad. There are various names for this motive in the literature, including asset-exploiting behaviour (Dunning and Narula 1995), competence-exploiting subsidiary mandates (Cantwell and Mudambi 2005), home-base exploiting strategies (Kuemmerle 1999), or market-driven internationalisation of R&D (von Zedtwitz and Gassmann 2002).

A second benefit and important driver of R&D internationalisation at the firm level is access to knowledge and the creation of new knowledge abroad. This motive is known as the asset-seeking motive (Dunning and Narula 1995), competence-creating subsidiary mandate (Cantwell and Mudambi 2005), home-base augmenting strategy (Kuemmerle 1999), or global R&D strategy (von Zedtwitz and Gassmann 2002) in the literature.

Asset-seeking strategies are driven, on the one hand, by the existence of superior local knowledge and favourable framework conditions for R&D in various host countries. Some types of knowledge are tacit, bound to their local context, and transferable over distance only at high costs (Cowan et al. 2000; Breschi and Lissoni 2001). This knowledge may be found at universities and other research organisations, in clusters, or be available from clients, suppliers or competitors. Various authors describe foreign-owned subsidiaries as ‘surveillance outposts’ or ‘antennas’ (Florida 1997; Almeida 1999) that extensively monitor and assimilate knowledge from local sources. On the other hand, asset-seeking strategies may also be driven by factors related to the nature of various technologies and changing firm strategies. Narula and Zanfei (2005) for example, suggest that the increasing complexity of products is a driver of the internationalisation of R&D. Rising technological complexity increases the knowledge requirements of firms and forces them to search for new knowledge abroad. A similar argument is brought forward by Chesbrough (2003). He points out that many innovative firms have moved to an ‘open innovation’ model where they exploit ideas and knowledge not only provided by internal R&D, but also from a broad range of external sources and actors. In this respect, asset-seeking can be seen as a variant of ‘open innovation’ strategies with a focus on their geographical dimension.

There is evidence that asset-seeking strategies have become more frequent in the recent years, although asset-exploiting strategies still prevail (Narula and Zanfei 2005; Sachwald 2008). Moreover, some authors (for example Criscuolo et al. 2005) stress the fact that the two motives cannot be separated in a number of cases. Firms – intentionally or unintentionally – often follow both strategies simultaneously. Microsoft's efforts to adapt their products to the Chinese language resulted in new knowledge that could also be used in other contexts (Gassmann and Han 2004).

Finally, an important aspect of firm strategy towards R&D internationalisation is the degree of decentralisation. In order to make internationalisation of R&D possible, the head office of the MNE has to allow a higher degree of decentralisation by changing firm organisation and giving a higher degree of autonomy to the subsidiaries (Birkinshaw and Hood 1998; Birkinshaw et al. 1998; Zanfei 2000).

4. Impacts of MNE R&D Activities on Host and Home Countries

The technological and economic characteristics of countries provide different locational advantages and disadvantages for foreign-owned firms to set up R&D and innovation activities. However, R&D activities of MNE affiliates may also influence the innovation systems of their host and home countries to a considerable degree. The literature has identified various potential opportunities and challenges for host and home countries from the internationalisation of R&D and innovation (see Table 1).

Table 1 Potential opportunities and challenges for national innovation systems from the internationalisation of R&D and innovation

	Opportunities	Challenges
Host country	Increases in aggregate R&D and innovation expenditure	Competition with domestically owned firms for resources; crowding-out
	Knowledge diffusion to the host economy	Loss of control over domestic innovation capacity
	Demand for skilled personnel	Separation of R&D and production
	Structural change and agglomeration effects	Less strategic research, less radical innovations, more adapting

Home Country	Improved overall R&D efficiency	Loss of jobs due to relocation
	Reverse technology transfer	'Hollowing out' of domestic R&D and innovation activities
	Market expansion effects	
	Exploitation of foreign knowledge at home	Technology leakage and involuntary knowledge diffusion

Source: Adapted from Sheehan (2004), UNCTAD (2005), Veugelers (2005).

4.1 Impacts of MNE R&D and innovation activities on host countries

I first discuss the perspective of the host country (the two upper cells in Table 1). The presence of MNE affiliates in a country can considerably raise aggregate R&D expenditure of this country over the short and medium term. Multinational firms spend huge amounts on R&D, even compared with aggregate R&D expenditure of countries (OECD 2010, p. 121). A new R&D activity of an MNE may therefore considerably affect aggregate R&D activity of the host country, in particular in small and medium-sized countries. Empirical evidence suggests that small countries benefit most in relative terms, also because they usually exhibit higher degrees of internationalisation in FDI than large countries (Lonmo and Anderson 2003; Costa and Filippov 2008). MNE affiliates – in contrast to domestically owned firms – can access financial means of their parent enterprise abroad; expansion of R&D activity is therefore not limited by a lack of internal resources or incomplete credit markets in the host country. There is also evidence that affiliates of foreign-owned firms perform better in many aspects of innovation behaviour than domestically owned firms (Frenz and Ietto Gillies 2007, Dachs et al. 2008, Sadowski and Sadowski-Rasters 2008, Cozza and Zanfei 2016). This includes, for example, higher levels of innovation output and higher labour productivity, and a higher propensity to co-operate than domestically owned enterprises after controlling for size, sector and innovation input.

A second benefit for the host country is the diffusion of information and knowledge (knowledge spillovers[1]) to host country organisations. Potential receivers of this knowledge are domestic firms, universities, or research centres. The literature gives considerable attention to knowledge diffusion and spillovers by foreign-owned firms (see the surveys by Keller 2004, 2010, Mayer and Sinani 2009, or Hayakawa et al 2010). More recently, the literature also discusses spillovers from R&D between foreign-owned firms and the innovation systems of emerging economies (Qu et al. 2013, Feng 2017).

According to Blomström and Kokko (2003), spillovers are the strongest argument as to why countries should try to attract inward investment. Empirical evidence on the size and the effects of spillovers, however, is mixed. Meta-studies (Görg and Strobl 2001, Görg and Greenaway 2004; Mayer and Sinani 2009; Havránek and Iršová 2010) show no clear relationship between foreign presence and the performance of domestically owned firms. Görg and Strobl (2001) for example indicate that the number of studies that identify positive spillovers roughly equals those identifying no effects or even negative consequences from the presence of foreign-owned firms. In the majority of cases considered by Görg and Greenaway (2004), no significant effect of MNE presence on domestic firm productivity is observed. Veugelers (2005, p 37) finds that it is 'fair to conclude that the results on positive spillovers on host economies are not strong and robust'. Empirical evidence is clearer below the aggregate level. Contributions by Singh (2007), Keller and Yeaple (2009) and by Coe et al. (2009) reveal substantial spillover effects from foreign R&D stocks and the presence of foreign-owned firms at the sectoral level. Marin and Bell (2006) provide a similar result at the firm level.

A main reason for this vagueness of the results, besides measurement issues, is the fact that spillovers from foreign-owned firms to the local economy are bound to specific industry and economy-wide conditions to occur. These factors include a certain level of absorptive capacity (Cohen and Levinthal 1989, 1990; Cantner and Pyka 1998) of domestic organisations; weak instruments of foreign-owned firms to protect proprietary knowledge, which is mostly sector-specific; and the propensity of the transfer channel or type of interaction between foreign-owned firms and domestic organisations (Veugelers and Cassiman 2004).

R&D activities of foreign-owned firms in a particular country may also help to enhance the level and quality of human resources. New R&D labs by MNEs may create additional demand for researchers and give incentives to governments to improve higher education systems. MNEs are attractive employers, because they can offer international career perspectives and pay higher wages than domestically owned enterprises (Lipsey 2002; Bailey and Driffield 2007; Hijzen et al. 2013; Nilsson Hakkala et al. 2014). Moreover, jobs created by foreign-owned firms appear to be more persistent than jobs generated in domestically owned plants (Görg and Strobl 2003).

Finally, foreign-owned firms can also contribute to structural change towards a higher share of technology-intensive firms and to the emergence of clusters in the host country. Structural change is related in two ways to the presence of foreign-owned firms. On the one hand, foreign-owned firms operate predominantly in technology-intensive industries. Market entrance and subsequent growth of the foreign-owned firm will therefore shift the industrial structure of a country towards a higher technology intensity (Blonigen and

Slaughter 2001; Driffield et al. 2009). On the other hand, MNE subsidiaries trigger structural change because their demand for inputs favours the growth of technology-intensive suppliers in the host country. This demand may lead to the emergence of clusters and other agglomerations at the regional level in the host country (Young et al. 1994; Bellandi 2001; Pavlínek 2004). Foreign-owned subsidiaries in clusters often strongly embedded locally, but have also a lot of ties with international partners inside and outside their company group, and can therefore act as bridges for knowledge transfer between domestic organisations and abroad (Birkinshaw and Hood 2000; Lorenzen and Mahnke 2002).

I now turn to potential challenges for host countries that emerge from the presence of foreign-owned firms. One striking aspect in the literature on FDI spillovers is the number of studies that report negative effects (see, for example, Aitken and Harrison 1999; Konings 2001; Castellani and Zanfei 2002; Damijan et al. 2003; Marin and Sasidharan 2010; Damijan et al. 2013, Rojec and Knell, 2015). These negative spillovers are often found in studies on developing and transition economies. Wang (2010), for example, investigates the determinants of R&D investment at the national level for 26 OECD countries from 1996-2006 and finds that foreign technology inflows through trade and FDI had a robust and negative impact on domestic R&D. One explanation for these negative impacts is increased competition in product and factor markets due to foreign presence (Aitken and Harrison 1999; Konings 2001). In the context of R&D, competition for staff (Figini and Görg 1999; Driffield and Taylor 2000) seems to be relevant in particular. Additional demand by MNEs for skilled personnel is beneficial for the host country in the short run when there are unemployed scientists, engineers and technicians and alternative employment opportunities – for example at domestic universities – are scarce. However, it may have negative consequences for the host country when the supply for research personnel is inelastic and foreign-owned firms and domestic organisations compete for qualified staff. In the long run, the effects of the demand by foreign-owned firms on the labour market for R&D staff look more positive. Stronger demand for high-skilled labour due to market entry of foreign-owned firms and structural change may foster academic training and increase the number of graduates in science and technology in the long run. A higher skill intensity in the economy, in turn, may foster locational advantages and further increase the attractiveness of the country for inward investment. Barry (2004) illustrates such a 'virtuous circle' for the case of Ireland.

Fears that a high share of foreign-owned firms on aggregate R&D expenditure may lead to negative effects are also nurtured by more general concerns against MNE presence (see Barba Navaretti and Venables 2004; Jensen 2006; Forsgren 2008 for a summary of this discussion). This is less an academic and more a general policy discussion, so there are only very few academic papers that investigate these issues. These concerns include:

the assumption that the internationalisation of R&D leads to a loss of control over domestic innovation capacity, because decisions on R&D of foreign-owned firms may not be taken by the subsidiaries themselves, but by corporate headquarters abroad; the assumption that R&D activities of MNEs are more 'footloose' than those of domestically owned firms, because they can be easily transferred between countries; the assumption that foreign-owned enterprises act in ways that are not in accordance with the national interest; the assumption that an important motive for R&D internationalisation is rent-seeking in selecting locations. Another concern against foreign ownership is that R&D of foreign-owned firms is associated with a higher degree of adaptation and less basic, strategic research, because MNEs often concentrate strategic, long-term R&D in the home country; rising shares of foreign ownership on aggregate innovation activity may therefore lead to fewer radical innovations than in the case of domestic ownership.

Empirical evidence that supports these concerns is thin. Internationalisation certainly leads to a shift of control from domestic head offices to MNE headquarters abroad. However, domestic policy does not necessarily have a higher ability to influence R&D decisions when enterprises are domestically owned (Dunning and Lundan 2008, p. 249 ff). In addition, it seems that autonomy of MNE subsidiaries over their R&D activities has been rising over time (Dunning and Lundan 2009, chapter 8). The question if foreign ownership is associated with a downsizing of R&D activity has been evaluated both for take-overs as well as for all foreign-owned and domestically owned firms. In the case of take-overs, there are both, examples of downsizing as well as examples of expansion, depending on the complementarity between acquiring and acquired firms and other factors (Cassiman et al. 2005; Bertrand 2009; Bandick et al. 2010; Stiebale and Reize 2011). Studies that compare innovation input and output of domestically owned and foreign-owned firms find no negative effect of foreign ownership after controlling for firm characteristics such as size, sector, or export intensity (Sadowski and Sadowski-Rasters 2006, Dachs et al. 2010).

R&D internationalisation may also be associated with a separation of R&D and production (Pearce 2004; Pearce and Papanastassiou 2009). MNEs have much more choices in the location and organisation of R&D and production than mono-national firms. R&D and production is not necessarily located in the same country, because MNEs may find it useful to develop products in one country and manufacture in another country where conditions for production seem more favourable. As a consequence, policy measures to promote R&D and product development may yield only few jobs and give only a weak stimulus to growth when foreign-owned firms decide to produce abroad. To my knowledge, no empirical study has thoroughly examined the effects from the separation of R&D and production so far. It is, however, plausible that such a leaking-out is stronger in small countries and in countries with a high share of foreign-controlled R&D, and

weaker when foreign-owned firms have a high degree of autonomy and strong mandates in their enterprise groups, because these firms may try to concentrate not only R&D, but also production at their location to maximise influence in their enterprise group.

4.2 Impacts of R&D and innovation activities abroad on the home countries

The internationalisation of R&D has also implications for the home country of the multinational firm. D'Agostino (2015) provides a recent survey of these effects, so this section will be short.

As discussed above, a main reason for firms to go abroad with R&D activities is to get access to knowledge not available in the home country. Hence, a first main benefit for the home countries is the transfer of results from overseas R&D activities which brings new knowledge into the home country. Various studies provide evidence for such reverse knowledge transfers (Fors 1997; Feinberg and Gupta 2004; Todo and Shimizutani 2005; Ambos and Schlegelmilch 2006; Piscitello and Rabbiosi 2006; Narula and Michel 2009; Rabbiosi 2009; AlAzzawi 2011). Reverse knowledge transfers can increase overall technological capacities, help to develop new products and foster growth and employment in the home country. R&D activities abroad can therefore strengthen the growth of the parent company in the home country (Rammer and Schmiele 2008). The size of these benefits depends on the absorptive capacities and other firm characteristics of the parent company (Schmiele 2012), on the degree of complementarity between activities abroad and at home (Arvanitis and Hollenstein 2011), and on the motives for R&D activities abroad. Todo and Shimizutani (2005) demonstrate for Japan that effects of reverse technology transfer on the productivity of firms in the home country is large when foreign-owned affiliates undertake R&D to tap into advanced knowledge abroad. Adaptive R&D however was found to improve productivity in the host country, but did not contribute to enhanced productivity in the home country. Griffith et al. (2004) find that R&D by UK firms in the US have resulted in benefits from reverse technology with the effects being larger in the case of R&D units set up to source technology. Results for Sweden, however (Fors 1997; Braconier et al. 2002) indicate that there have not been significant spillovers to the home country, possibly because much R&D has been of the adaptive type. AlAzzawi (2011) finds that R&D abroad had a positive impact on the home country's level of innovation activity in both developed and newly industrialised countries, but finds productivity benefits for newly industrialised countries only. Moreover, there seems to be a positive relationship between internationalisation and the returns from R&D at home (Criscuolo and Martin 2009; Añón Higón et al. 2011) which may further increase the benefits for the home country.

Potential challenges or costs from the internationalisation of R&D for the home country may arise when firms replace domestic R&D and innovation activities with similar

activities abroad. This type of substitution has become an important topic in international economics (see the survey of Crinò 2009). It may lead to a 'hollowing out' (Criscuolo and Patel 2003) of domestic innovation capacity, a loss of jobs in R&D, and a downward pressure on wages of R&D personnel in the home country. Despite public discussions on the offshoring of R&D and possible consequences for home country innovation systems,[2] empirical results that confirm such 'hollowing out'-effects are rare. The reason for this are complementarities between overseas adaptations and R&D at the home base (D'Agostino and Santangelo 2012). Studies based on patent data give no indication for a substitutive relationship between R&D abroad and home-based R&D activities (D'Agostino et al. 2013). However, data on R&D expenditure of domestic firms abroad is available only for a very small number of countries, which makes a test of the assumption difficult.

5. New directions for research on R&D internationalisation

R&D internationalisation today is a well-established research field within international economics literature, the international business literature and within the economics of innovation and technological change. There is a consensus on the main drivers as well on the impacts of the process. However, some questions remain open, and new questions arise. This is why the final chapter – instead of a summary - points to three fields where more research in needed in the future.

5.1 Tax credits for R&D as policy incentives

There is a consensus in the literature that the best countries can do to attract R&D of foreign-owned firms is to create favourable conditions for doing business and R&D that benefit both, domestic and foreign-owned countries (see Section 3.1). Financial incentives for foreign-owned are not regarded as a suitable instrument to attract these activities.

This consensus has been challenged in recent years by the emergence of tax incentives for R&D. In 2015, this type of incentive is offered by 28 of the 34 OECD countries and a number of non-OECD countries (OECD 2016, chapter 4; Appelt et al. 2016). Bellak and Leibrecht (2016) discuss tax incentives for R&D and their welfare effects in the context of general investment incentives for foreign direct investment.

The effect of R&D tax incentives on location choices of MNEs is still an unexplored topic (Appelt et al. 2016, 19). From the arguments brought forward in the literature, however, it seems that tax credits for R&D are a very appealing instrument for MNEs (Mohnen 2013, Appelt et al. 2016, Bellak and Leibrecht 2016):

- MNEs operate more often in R&D intensive sectors and more perform R&D frequently than single-national firms. Thus, a subsidy that focusses on R&D seems more appealing to MNEs than other non-R&D investment incentives.
- Tax credits for R&D favour large R&D spenders (Mohnen 2013) MNEs may in particular favour fiscal incentives because they offer them opportunities to minimize corporate income taxes single-national firms or smaller firms do not have, for example by shifting R&D costs between countries.
- Large firms have considerably lower application costs in R&D tax credit schemes than in the case of direct R&D funding which usually involves various eligibility checks. This may again favour large R&D spenders, which do not have to administer a large number of single funding applications. Moreover, A number of countries have no upper ceiling for R&D tax credits.
- Income-based tax incentives for R&D (tax breaks for income from trademarks, patents and other forms of intellectual capital) in the form of patent boxes etc. may be particularly appealing for MNEs with multiple R&D locations because it may also provide them with incentives for shifting profits via licence income.

As a consequence, R&D tax incentives may be much more effective than other forms of policy incentives to attract foreign-owned firms. There is some empirical support for these arguments; Dachs (2016) report that foreign-owned firms in Austria – in contrast to domestically owned firms – receive the bulk of their public support for R&D via tax credits. Results by Poti and Spallone (2016) indicate a significant and positive correlation between R&D tax credits and R&D of foreign-owned firms.

5.2 R&D internationalisation in service industries

Services are the 'dark matter' of R&D internationalisation – we know there should be a lot of it, but so far, we cannot see it. Only a limited number of countries (most prominent the USA) provide data on R&D by foreign-owned firms in the services sectors. This data indicates that services account for around a third of total R&D by foreign-owned firms. If we generalize these observations there should be much more R&D by foreign-owned firms than we currently observe in official statistics.

The expansion of services in R&D internationalisation cannot be explained by a single reason. On the one hand, the use of new technologies makes service firms increasingly R&D intensive, like in the case of information and communication services. On the other hand, R&D intensity in services increases because services and parts of the service value chain become increasingly tradable (O'Mahony 2013). As a result, manufacturing firms outsource R&D to specialized suppliers of R&D services. The most prominent example of this development is the pharmaceutical industry (Ramirez 2013) which moves clinical trials and other stages of the R&D process to specialized firms. Moreover, the emergence

of small biotechnology firms has created a new type of divisions of labour between small and large firms in the pharmaceutical industry.

Both developments lead to a higher internationalisation in services, and to more overseas R&D activities in service firms in particular, because of the asset-augmenting and the asset-exploiting motive discussed above. Questions, however, remain about the service-specific drivers and obstacles of service firms, as well as the co-ordination costs and conditions for knowledge-transfer within service firms which may be shaped by different degrees of taciteness compared to manufacturing.

5.3 Multinational firms from emerging economies

Multinational enterprises originating from emerging economies (EMNEs) became important players in foreign direct investment in recent years. According to the 2014 World Investment Report, the share of developing and transition economies on total FDI outflows has climbed from 7% in 1999 to 39% in 2013 (UNCTAD 2014, p. 7). The rise of is not surprising; the international business as well as international economics literature predicts that firms with superior knowledge capital and assets will increasingly turn invest abroad to exploit these assets at international markets. In recent years, expenditures for R&D have increased considerably in emerging economies – most notably in China (OECD 2014), a strong indicator for the build-up of knowledge and superior assets.

Moreover, we can expect that EMNEs – once they have established international production – increasingly move from asset-exploiting to asset-creating strategies in their foreign activities. This means that EMNEs increasingly create and collect knowledge outside their home countries by locating R&D and innovation activities in various host countries. Various authors (Di Minin and Zhang 2010; Di Minin et al. 2012; Giuliani et al. 2014, Crescenzi et al. 206) are observing the first R&D active EMNE subsidiaries in Europe and the US.

The rise of EMNEs creates new questions for research on the internationalisation of R&D. It challanges old views on the global diffusion of knowledge from the most to least developed countries, and raises new questions on the nature of superior assets of EMNEs, given that these firms evolve in more restrained environments than firms in advanced economies (Narula 2012). Moreover, it brings back family and state ownership, two models of governance which have become quite unfamiliar among US and European multinational firms. Family- and state-owned firms may have different cultures of decision-making, and follow different rationales in R&D internationalisation. For example, the rise of EMNEs has created fears of ‘predatory behaviour’ - that state-owned EMNEs will acquire domestic companies, exploit their knowledge and leave. Such concerns,

however, are not new, and have also been raised against MNEs from other countries as well.

Acknowledgements

The author wants to thank the European Commission, DG Research and Innovation, for its financial support of the project "Internationalisation of business investments in R&D and analysis of their economic impact", contract number 30-CE-0677869/00-21/A4/2014, specific contract under the framework contract for the provision of services to the Commission in the fields of research evaluation and research policy analysis, Ref. OJ 2010/S 172-262618.

Notes

1. The concept of spillovers found in the international economics literature differs in some respect from the concept of knowledge flows in the innovation economics literature where knowledge flows are also frequently labelled as spillovers. Spillovers in the context of the international economics literature do not exclusively focus on the transfer of information or knowledge, but also include other non-compensated effects like competition, labour market or agglomeration effects (see Harris and Robinson 2004 for a typology of spillovers). One example is a lower price level in a certain market due to increased competition after market entry of a foreign-owned firm. Another form of spillover not related to knowledge is the threat of market entry by R&D intensive MNEs that may spur R&D activities of domestically owned firms (Aghion et al. 2009).
2. An example is the June 2010 issue of the Journal of Technology Transfer which discusses production offshoring and its effects on US manufacturing R&D in detail.

References

Aghion, P., Blundell, R., Griffith, R., Howitt, P. and S. Prantl (2009), 'The effects of entry on incumbent innovation and productivity', *Review of Economics and Statistics* **91**(1), 20-32.

Aitken, B.J. and A.E. Harrison (1999), 'Do domestic firms benefit from direct foreign investment? Evidence from Venezuela', *American Economic Review* **89**(3), 605-18.

AlAzzawi, S. (2011), 'Multinational corporations and knowledge flows: evidence from patent citations', *Economic Development and Cultural Change,* **59**(3), 649-80.

Alcácer, J. and Delgado, M. (2016). 'Spatial Organization of Firms and Location Choices Through the Value Chain. 'Management Science 62(11): 3213-3234.

Alkemade, F., G. Heimeriks, A. Schoen, L. Villard, and P. Laurens (2015), 'Tracking the

internationalization of multinational corporate inventive activity: national and sectoral characteristics'. *Research Policy* **44**(9): 1763-72.

Almeida, P. (1999), 'Knowledge Sourcing by Foreign Multinationals: Patent Citation Analysis in the U.S. Semiconductor Industry', in J. Cantwell (ed.), *Foreign direct investment and technological change*, Cheltenham: Edward Elgar, 421-31.

Amador, J., and S. Cabral (2016), 'Global Value Chains: A Survey of Drivers and Measures', *Journal of Economic Surveys* **30**(2): 278-301.

Ambos, B. and B.B. Schlegelmilch (2006), 'Learning from foreign subsidiaries: An empirical investigation of headquarters' benefits from reverse knowledge transfers', *International Business Review* **15**(3), 294-312.

Añón Higón, D., Manjón Antolín, M. and J.A. Mañez (2011), 'Multinationals, R&D, and productivity: evidence for UK manufacturing firms', *Industrial and Corporate Change*, **20**(2), 641-59.

Appelt, S., M. Bajgar, C. Criscuolo, and F. Galindo-Rueda. 2016. R&D Tax Incentives: Evidence on design, incidence and impacts. OECD Science, Technology and Industry Policy Papers No. 32, Paris

Archibugi, D. and S. Iammarino (1999), 'The policy implications of the globalisation of innovation', *Research Policy* **28**(2-3), 317-36.

Arvanitis, S. and H. Hollenstein (2006), 'Determinants of Swiss firms' R&D activities at foreign locations: an empirical analysis based on firm-level data', Zurich: Swiss Institute for Business Cycle Research (KOF) Working Paper no. 127.

Arvanitis, S. and H. Hollenstein (2011), 'How do different drivers of R&D investment in foreign locations affect domestic firm performance? An analysis based on Swiss panel micro data', *Industrial and Corporate Change*, **20**(2), 605-40.

Ascani, A., R. Crescenzi, and S. Iammarino (2016), 'Economic Institutions and the Location Strategies of European Multinationals in their Geographic Neighborhood', *Economic Geography*, **92**(4), 401-429.

Athukorala, P.-C., and A. Kohpaiboon (2010), 'Globalization of R&D by US-based multinational enterprises', *Research Policy*, **39**(10), 1335-347.

Audretsch, D. and M. Feldman (1996), 'R&D spillovers and the geography of innovation and production', *American Economic Review* **86**(3), 630-40.

Bailey, D. and N.L. Driffield (2007), 'Industrial policy, FDI and employment: still 'missing a strategy'', *Journal for Industry, Competition and Trade* **7**(3-4), 189-211.

Bandick, R., Görg, H. and P. Karpaty (2010), 'Foreign acquisitions, domestic multinationals, and R&D', Kiel: Kiel Working Papers no. 1651.

Barba Navaretti, G. and A.M. Falzoni (2004), 'Home country effects of foreign direct investment', in G. Barba Navaretti and A.J. Venables (eds), *Multinational firms in the world economy*, Princeton and Oxford: Princeton University Press, pp. 217-39.

Barba Navaretti, G. and A.J. Venables (2004), *Multinational firms in the world economy*, Princeton and Oxford: Princeton University Press.

Barry, F. (2004), 'FDI and the host economy: a case study of Ireland', in G. Barba Navaretti and A.J. Venables (eds), *Multinational firms in the world economy*, Princeton and Oxford: Princeton University Press, pp. 187-215.

Behrman, J.N. and W.A. Fischer (1980), *Overseas R&D Activities of Transnational Companies*, Cambridge, Mass: Oelgesclagert, Gunn & Hein.

Belderbos, R., Leten, B. and S. Suzuki (2009), 'Does excellence in scientific research attract foreign R&D*?*', Maastricht: UNU-Merit Working Paper 2009-066.

Belderbos, R., Leten, B., and S. Suzuki (2013), 'How global is R&D? Firm-level determinants of home-country bias in R&D*', Journal of International Business Studies* **44**(8): 765-86.

Bellak, C. (2004), 'How Domestic and Foreign Firms Differ and Why Does It Matter? ' Journal of Economic Surveys **18(**4): 483-514.

Bellak, C. and M. Leibrecht (2016), 'The Use of Investment Incentives: The Cases of R&D-Related Incentives and International Investment Agreements*', Rethinking Investment Incentives: Trends and Policy Options*, ed. A.T. Tavares-Lehmann, L. Sachs, L. Johnson, and P. Toledano, 63-93. New York, Chichester: Columbia University Press.

Bellandi, M. (2001), 'Local development and embedded large firms', *Entrepreneurship & Regional Development* **13**(3), 189-210.

Bertrand, O. (2009), 'Effects of foreign acquisitions on R&D activity: Evidence from firm-level data for France', *Research Policy* **38**(6), 1021-31.

Birkinshaw, J.M. and N. Hood (1998), 'Multinational subsidiary evolution: capability and charter change in foreign-owned subsidiary companies', *Academy of Management Review* **23**(4), 773-95.

Birkinshaw, J.M. and N. Hood (2000), 'Characteristics of Foreign Subsidiaries in Industry Clusters', *Journal of International Business Studies* **31**(1), 141-54.

Birkinshaw, J.M., Hood, N. and S. Jonsson (1998), 'Building firm-specific advantages in multinational corporations: the role of subsidiary initiative', *Strategic Management Journal* **19**(3), 221-41.

Blomström, M. and A. Kokko (2003), 'The economics of foreign direct investment incentives', Cambridge (Mass.): National Bureau of Economic Research (NBER) Working Paper no. 9489.

Blonigen, B.A. (2005), 'A review of the empirical literature on FDI determinants', Cambridge (Mass.): National Bureau of Economic Research (NBER) Working Paper no. 11299.

Blonigen, B.A. and M.J. Slaughter (2001), 'Foreign-affiliate activity and US skill upgrading', *Review of Economics and Statistics* **83**(2), 362-76.

Booz Allen Hamilton and INSEAD (2006), *Innovation: Is Global the Way Forward?* Paris: INSEAD.

Braconier, H., Henrik, K. and K.H. Midelfart-Knarvik (2002), 'Does FDI work as a channel for R&D spillovers? Evidence based on Swedish Data', Stockholm: The Research Institute of Industrial

Economics Working Paper no 551.

Brash, D.T. (1966), *American Investment in Australian Industry*, Cambridge, Mass: Harvard University Press.

Brennan, L., Ferdows, K., Godsell, J., Golini, R., Keegan, R., Kinkel, S., Srai, J.S., and Taylor, M. (2015), 'Manufacturing in the world: where next? ', *International Journal of Operations & Production Management* **35**(9): 1253-1274.

Breschi, S. and F. Lissoni (2001), 'Knowledge spillovers and local innovation systems: a critical survey', *Industrial and Corporate Change* **10**(4), 975-1005.

Cantner, U. and A. Pyka (1998), 'Absorbing Technological Spillovers: Simulations in an Evolutionary Framework', *Industrial and Corporate Change* **7**(2), 369-397.

Cantwell, J. (2009), 'Innovation and Information Technology in the MNE', in A.M. Rugman (ed.), *The Oxford Handbook of International Business*, Oxford: Oxford University Press, pp. 417-446.

Cantwell, J. and R. Mudambi (2000), 'The location of MNE R&D activity; the role of investment incentives', *Management International Review* **40**(1), 127-48.

Cantwell, J. and R. Mudambi (2005), 'MNE competence-creating subsidiary mandates', *Strategic Management Journal* **26**(12), 1109-128.

Cantwell, J. and L. Piscitello (2002), 'The location of technological activities of MNCs in European regions: The role of spillovers and local competencies', *Journal of International Management* **8**(1), 69-96.

Cassiman, B., Colombo, M.G., Garrone, P. and R. Veugelers (2005), 'The impact of M&A on the R&D process. An empirical analysis of the role of technological- and market-relatedness', *Research Policy* **34**(2), 195-220.

Castellacci, F. (2007), 'Technological regimes and sectoral differences in productivity growth', *Industrial and Corporate Change* **16**(6), 1105-145.

Castellani, D. and A. Zanfei (2002), 'Multinational experience and the creation of linkages with local firms. Evidence from the electronics industry', *Cambridge Journal of Economics* **26**(1), 1-25.

Castellani, D., Jimenez, A. and A. Zanfei (2013). 'How remote are R&D labs? Distance factors and international innovative activities. ' Journal of International Business Studies 44(7): 649-675.

Caves, R. (1996), *Multinational enterprises and economic analysis*, Cambridge: Cambridge University Press.

Cerrato, D. (2009), 'Does innovation lead to global orientation? Empirical evidence from a sample of Italian firms', *European Management Journal* **27**(5), 305-15.

Chesbrough, H.W. (2003), Open innovation: The new imperative for creating and profiting from technology, Boston: Harvard Business School Press.

Cincera, M. Cozza, C. and A. Tübke (2010), 'The main drivers for the internationalization of R&D activities by EU MNEs', Seville: JRC-IPTS Working Papers on Corporate R&D and Innovation no 2010-02.

Coe, D.T., Helpman, E. and A.W. Hoffmaister (2009), 'International R&D spillovers and institutions', *European Economic Review* **53**(7), 723-41.

Cohen, W.M. (1995), 'Empirical studies of innovative activity', in P. Stoneman (ed), *Handbook of innovation and technological change*, Oxford: Blackwell, pp. 182-264.

Cohen, W.M. (2010), 'Fifty years of empirical studies of innovative activity and performance', in B.A. Hall and N. Rosenberg (eds), *Handbook of economics of innovation*, Amsterdam: Elsevier, pp. 129-213.

Cohen, W.M. and D. Levinthal (1989), 'Innovation and learning: the two faces of R&D', *Economic Journal* **99**(September), 569-96.

Cohen, W.M. and D. Levinthal (1990), 'Absorptive capacity: a new perspective on learning and innovation', *Administrative Science Quarterly* **35**(1), 128-52.

Cohen, W.M., Nelson, R.R. and J. Walsh (2000), 'Protecting their intellectual assets: appropriability conditions and why U.S. manufacturing firms patent (or not)', Cambridge (Mass.): National Bureau of Economic Research (NBER) Working Paper no. 7552.

Costa, I. and S. Filippov (2008), 'Foreign-owned subsidiaries: a neglected nexus between foreign direct investment, industrial and innovation policies', *Science and Public Policy* **35**(6), 379-90.

Cowan, R., David, P.A. and D. Foray (2000), 'The explicit economics of knowledge codification and tacitness', *Industrial and Corporate Change* **9**(2), 211-53.

Cozza, C. and Zanfei, A. (2016). 'Firm heterogeneity, absorptive capacity and technical linkages with external parties in Italy. ' The Journal of Technology Transfer 41(4): 872-890.

Creamer, D.B. (1976), Overseas research and development by the US multinationals, New York: The Conference Board.

Crescenzi, R., C. Pietrobelli, and R. Rabellotti (2016), 'Regional strategic assets and the location strategies of emerging countries' multinationals in Europe. ', *European Planning Studies*, **24**(4): 645-667.

CREST Working Group (2007), Internationalisation of R&D – facing the challenge of globalisation: approaches to a proactive International policy in S&T, Brussles: CREST.

Crinò, R. (2009), 'Offshoring, Multinationals and Labor Market: A Review of the Empirical Literature', *Journal of Economic Surveys* **23**(2): 197–249.

Criscuolo, C. and R. Martin (2009), 'Multinationals and U.S. productivity leadership: Evidence from Great Britain', *Review of Economics and Statistics* **91**(2), 263-81.

Criscuolo, C., J. E. Haskel, and M. J. Slaughter (2010), 'Global engagement and the innovation activities of firms', *International Journal of Industrial Organization* **28**(2): 191-202.

Criscuolo, P., Narula, R. and B. Verspagen (2005), 'Role of home and host country innovation systems in R&D internationalisation: a patent citation analysis', *Economics of Innovation and New Technology* **14**(5), 417-33.

Criscuolo, P. and P. Patel (2003), 'Large Firms and internationalisation of R&D: Hollowing out of

National Technological Capacity?', paper presented at the SETI Workshop: Rome.

D'Agostino, L. M. (2015). 'The neglected effects of R&D captive offshoring in emerging countries on the creation of knowledge at home. ' Economia e Politica Industriale 42(1): 61-91.

D'Agostino, L.M., Laursen, K. and G.D. Santangelo (2013), 'The impact of R&D offshoring on the home knowledge production of OECD investing regions', *Journal of Economic Geography* **13**(1), 145-75.

D'Agostino, L. M. and Santangelo, G. D. (2012). 'Do Overseas R&D Laboratories in Emerging Markets Contribute to Home Knowledge Creation? ' Management International Review 52(2): 251-273.

Dachs, B. (2016), Internationalisierung als Motor des Aufholprozesses im österreichischen Innovationssystem. *Wirtschaftspolitische Blätter* **63**(2): 427-46.

Dachs, B., Ebersberger, B., Lööf, H. (2008), 'The Innovative Performance of Foreign-owned Enterprises in Small Open Economies. ' Journal of Technology Transfer **33,** p. 393-406.

Dachs, B., Kampik, F., Peters, B., Rammer, C., Schartinger, D., Schmiele, A. and G. Zahradnik (2010), *Foreign corporate R&D and innovation activities in the European Union.* Background report for the 2010 Competitiveness Report, Brussels: European Commission.

Dachs, B. and A. Pyka (2010), 'What drives the internationalisation of innovation? Evidence from European patent data', *Economics of Innovation and New Technology* **19**(1), 71-86.

Dachs, B., R. Stehrer and G. Zahradnik (eds., 2014), *The Internationalisation of Business R&D*. Cheltenham: Edward Elgar.

Damijan, J.P., Knell, M., Majcen, B. and M. Rojec (2003), 'The role of FDI, R&D accumulation and trade in transferring technology to transition countries: evidence from firm panel data for eight transition countries', *Economic Systems* **27**(2), 189-204.

Damijan, J. P., B. Majcen, M. Knell, and M. Rojec (2013). 'Impact of firm heterogeneity on direct and spillover effects of FDI: Micro-evidence from ten transition countries', *Journal of Comparative Economics*, **41**(3), 895–922.

De Backer, K., and F. Hatem (2010), Attractiveness for Innovation. Location Factors for International Investment, Paris: OECD Publishing.

De Backer, K., Menon, C., Desnoyers-James, I., Moussiegt, L. (2016) Reshoring: Myth or Reality? Paris: OECD Publishing.

Defever, F. (2012). 'The spatial organization of multinational firms': Canadian Journal of Economics 45(2): 672-697.

Di Minin, A., and J. Zhang (2010), 'An Exploratory Study on International R&D Strategies of Chinese Companies in Europe', *Review of Policy Research* **27(**4), 433-55.

Di Minin, A., J. Zhang, and P. Gammeltoft (2012), 'Chinese foreign direct investment in R&D in Europe: A new model of R&D internationalization? ', *European Management Journal* **30(**3), 189-203.

Dogson, M. and R. Rothwell (1994), 'Innovation and the size of the firm', in M. Dogson and R. Rothwell (eds), *The handbook of industrial innovation*, Cheltenham: Edward Elgar, pp. 310-25.

Driffield, N., Love, J.H. and K. Taylor (2009), 'Productivity and labour demand effects of inward and outward foreign direct investment on UK industry', *The Manchester School* **77**(2), 171-203.

Driffield, N.L. and K. Taylor (2000), 'FDI and the labour market: a review of the evidence and policy implications', *Oxford Review of Economic Policy* **16**(3), 90-103.

Dunning, J. (1958), American investment in British manufacturing industry, London: Allen and Unwin.

Dunning, J. (1973), 'The determinants of international production', *Oxford Economic Papers* **25**(3), 289-336.

Dunning, J. (1981), International production and the multinational enterprise, London: Allen and Unwin.

Dunning, J., and S.M. Lundan (2008), *Multinational enterprises and the global economy* (2nd ed.), Cheltenham: Edward Elgar.

Dunning, J. and S.M. Lundan (2009), 'The internationalization of corporate R&D: A review of the evidence and some policy implications for home countries', *Review of Policy Research* **26**(1-2), 13-33.

Dunning, J. and R. Narula (1995), 'The R&D activities of foreign firms in the United States', *International Studies of Management & Organization* **25**(1-2), 39-72.

Economist Intelligence Unit (2004), Scattering the Seeds of Innovation: The Globalization of Research and Development, London: Economist Intelligence Unit.

Eden, L. and S. Miller (2004), 'Distance matters: Liability of foreignness, institutional distance and ownership strategy', in M.A. Hitt, and J.L.C. Cheng (eds), *The evolving theory of the multinational firm.* Advances in International Management, Vol. 16, Amsterdam: Elsevier, pp. 187-221.

Ekholm, K. and K.H. Midelfart (2004), 'Determinants of FDI: the evidence', in G. Barba Navaretti and A.J. Venables (eds), *Multinational firms in the world economy*, Princeton and Oxford: Princeton University Press, pp. 127-50.

Ernst, D. (2006), Innovation offshoring – Asia's emerging role in global innovation networks, Honolulu: East-West Center Report Nr. 10.

Feinberg, S.E. and A.K. Gupta (2004), 'Knowledge spillovers and the assignment of R&D responsibilities to foreign subsidiaries', *Strategic Management Journal* **25**(8-9), 823-45.

Feng, H. L. (2017), 'Does foreign direct investment improve the productivity of domestic firms? Technology spillovers, industry linkages, and firm capabilities', *Research Policy* **46**(1), p. 138-59

Figini, P. and H. Görg (1999), 'Multinational companies and wage inequality in the host country: The case of Ireland', *Review of World Economics* **135**(4), p. 594-612.

Florida, R. (1997), 'The globalization of R&D: Results of a survey of foreign-affiliated R&D

laboratories in the USA', *Research Policy* **26**(1), 85-103.

Fors, G. (1997), 'Utilization of R&D Results in the Home and Foreign Plants of Multinationals', *Journal of Industrial Economics* **45**(3), 341-58.

Forsgren, M. (2008), *Theories of the Multinational Firm*, Cheltenham: Edward Elgar.

Frenz, M. and Ietto-Gillies, G. (2007). 'Does Multinationality Affect the Propensity to Innovate? An Analysis of the Third UK Community Innovation Survey. ' International Review of Applied Economics 21(1): 99-117.

Gassmann, O. and Z. Han (2004), 'Motivations and barriers of foreign R&D activities in China', *R&D Management* **34**(4), 423-37.

Gersbach, H. and A. Schmutzler, (2011), 'Foreign Direct Investment and R&D Offshoring', *Oxford Economic Papers* **63**(1), 134-57.

Gerybadze, A. and G. Reger (1999), 'Globalization of R&D: Recent Changes in the Management of Innovation in Transnational Corporations', *Research Policy* **28**, 251-274.

Giuliani, E., S. Gorgoni, C. Günther, and R. Rabellotti. 2014. 'Emerging versus advanced country MNEs investing in Europe: A typology of subsidiary global–local connections', *International Business Review* **23**(4), 680-91.

Görg, H. and D. Greenaway (2004), 'Much Ado about Nothing? Do Domestic Firms Really Benefit from Foreign Direct Investment?', *The World Bank Research Observer* **19**(2), 171-97.

Görg, H., and E. Strobl (2001), 'Multinational Companies and Productivity Spillovers: A Meta-analysis', *Economic Journal* **111**(November), 723-39.

Görg, H. and E. Strobl (2003), '"Footloose" Multinationals?', *The Manchester School* **71**(1), 1-19.

Greenhalgh, C.A. and P. Taylor (1990), 'Innovation and Export Volumes and Prices: A Disaggregated Study', London: CEPR Discussion Papers 487.

Griffith, R., Redding, S. and H. Simpson (2004), 'Foreign Ownership and Productivity: New Evidence from the Service Sector and the R&D Lab', London: CEP Discussion Paper 649.

Guellec, D. and B. van Pottelsberghe de la Potterie (2001), 'The Internationalisation of Technology Analysed with Patent Data', *Research Policy* **30**(8), 1253-266.

Guimón, J. (2009), 'Government strategies to attract R&D-intensive FDI', *Journal of Technology Transfer* **34**(4), 364-79.

Nilsson Hakkala, K., F. Heyman, and F. Sjöholm (2014), 'Multinational firms, acquisitions and job tasks', *European Economic Review*, **66**(Supplement C), 248-265.

Hall, B. A. (2010), *The internationalization of R&D*, Berkeley: University of California. http://elsa.berkeley.edu/users/bhhall/papers/BHH10_RND_international_August.pdf

Harris, R. and Q.C. Li (2009), 'Exporting, R&D, and absorptive capacity in UK establishments', *Oxford Economic Papers* **61**(1), 74-103.

Harris, R. and C. Robinson (2004), 'Productivity impacts and spillovers from foreign ownership in

the United Kingdom', *National Institute Economic Review* 185(1), 58-75.

Hatzichronoglou, T. (2008), The Location of investment of multinationals linked to innovation, Paris: OECD.

Havránek, T. and Z. Iršová (2010), 'Which Foreigners Are Worth Wooing? A Meta-Analysis of Vertical Spillovers from FDI', Prague: Czech National Bank Working paper 3/2010.

Hayakawa, K., T. Machikita and F. Kimura. (2012), 'Globalization and Productivity: A Survey of Firm-level Analysis', *Journal of Economic Surveys* **26**(2): 332-50.

Head, K. and J. Ries (2003), 'Heterogeneity and the FDI versus Export Decision of Japanese Manufacturers', Cambridge (Mass.): National Bureau of Economic Research (NBER) Working Paper 10052.

Hedge, D. and D. Hicks (2008), 'The maturation of global corporate R&D: Evidence from the activity of U.S. foreign subsidiaries', *Research Policy* **37**(3), 390-406.

Helpman, E. (2006), 'Trade, FDI and the organisation of firms', *Journal of Economic Literature* **44**(3), 589-631.

Helpman, E., Melitz, M.J. and S.R. Yeaple (2004), 'Export versus FDI with heterogeneous firms', *American Economic Review* **94**(1), 300-16.

Hijzen, A., P. S. Martins, T. Schank, and R. Upward (2013), 'Foreign-owned firms around the world: A comparative analysis of wages and employment at the micro-level', *European Economic Review*, **60**(Supplement C), 170-188.

Holmes, R. M., H. Li, M. A. Hitt, K. DeGhetto, and T. Sutton (2016), 'The Effects of Location and MNC Attributes on MNCs' Establishment of Foreign R&D Centers: Evidence from China', *Long Range Planning* **49**(5): 594-613.

Iversen, E., Dachs, B., Poti, B., Patel, P., Cerulli, G., Spallone, R., Zahradnik, G., Knell, M. and F. Lang (2016), Internationalisation of business investments in R&D and analysis of their economic impact (BERD Flows). Final report. Project for the European Commission, DG Research and Innovation.

Jaffe, A.B., Trajtenberg, M. and R. Henderson (1993), 'Geographic localization of knowledge spillovers as evidenced by patent citations', *Quarterly Journal of Economics* 108(3), 577-598.

Jensen, N.M. (2006), *Nation-states and the multinational corporation*, Princeton and Oxford: Princeton University Press.

Johanson, J. and J.-E. Vahlne (2009), 'The Uppsala internationalization process model revisited: From liability of foreignness to liability of outsidership', *Journal of International Business Studies* **40**(9), 1411-431.

Keller, W. (2004), 'International technology diffusion', *Journal of Economic Literature* **42**(3), 752-58.

Keller, W. (2010), 'International trade, foreign direct investment, and technology spillovers', in B.A. Hall and N. Rosenberg (eds), *Handbook of the economics of innovation*, Vol. 2, Amsterdam,

Elsevier, pp. 794-829.

Keller, W. and S.R. Yeaple (2009), 'Multinational enterprises, international trade, and productivity growth: firm-level evidence from the United States', *Review of Economics and Statistics* **91**(4), 821-31.

Ketokivi, M. and J. Ali-Yrkkö (2009), 'Unbundling R&D and manufacturing: postindustrial myth or economic reality?', *Review of Policy Research* **26**(1-2), 35-54.

Kinkel, S. and S. Maloca (2008), FuE-Verlagerungen in Ausland - Ausverkauf deutscher Entwicklungskompetenz?, Karlsruhe: Fraunhofer ISI.

Kleinknecht, A. (1989), 'Firm size and Innovation', *Small Business Economics* **1**(3), 215-22.

Kleinknecht, A. and P. Mohnen (eds)(2002), *Innovation and Firm Performance*. Basingstoke and New York: Palgrave.

Konings, J. (2001), 'The effects of foreign direct investment on domestic firms. Evidence from firm-level panel data in emerging economies', *Economics of Transition* **9**(3), 619-33.

Kuemmerle, W. (1997), 'Building effective R&D capabilities abroad', *Harvard Business Review* 7**5**(2), 61-70.

Kuemmerle, W. (1999), 'Foreign direct investment in industrial research in the pharmaceutical and electronics industries – results from a survey of multinational firms', *Research Policy* **28**(2-3), 179-93.

Kumar, N. (2001), 'Determinants of location of overseas R&D activity of multinational enterprises: the case of US and Japanese corporations', *Research Policy* **30**(1), 159-74.

Lachenmaier, S. and L. Wößmann (2006), 'Does innovation cause exports? Evidence from exogenous innovation impulses and obstacles using German micro data', *Oxford Economic Papers* **58**(2), 317-50.

Lall, S. (1979), 'The international allocation of research activity by US multinationals', *Oxford Bulletin of Economics and Statistics* **41**(4), 313-31.

Laurens, P., C. Le Bas, A. Schoen, L. Villard, and P. Larédo. (2015), 'The rate and motives of the internationalisation of large firm R&D (1994–2005): Towards a turning point? ' *Research Policy* 44(3): 765-76.

Lee, G. (2004). 'How the globalization of R&D competition affects trade and growth', *Japanese Economic Review* **55**(3), 267-85.

Lewin, A.Y., Massini, S. and C. Peeters (2009), 'Why are companies offshoring innovation? The emerging global race for talent', *Journal of International Business Studies* **40**(6), 901-25.

Lipsey, R.E. (2002), Home and host country effects of FDI, Cambridge (Mass.): National Bureau of Economic Research (NBER) Working Paper 9293.

Lonmo, C. and F. Anderson (2003), A comparison of international R&D performance: an analysis of countries that have significantly increased their GERD/GDP ratios during the period 1989-1999, Ottawa: Statistics Canada 88F0006XIE2003001.

Lööf, H. (2009), 'Multinational enterprises and innovation: firm level evidence on spillover via R&D collaboration', *Journal of Evolutionary Economics* **19**(1), 41-71.

Lorenzen, M. and V. Mahnke (2002), Global strategy and the acquisition of local knowledge: how MNCs enter regional knowledge clusters, Copenhagen: DRUID Working Paper 02-08.

Malerba, F. (2002), 'Sectoral Systems of Innovation and Production', *Research Policy* **31**(2), 247-64.

Malerba, F. (2005), 'Sectoral systems of innovation', in J. Fagerberg, D. Mowery and R.R. Nelson (eds), *The Oxford Handbook of Innovation*, Oxford: Oxford University Press, pp. 380-406.

Malerba, F. and L. Orsenigo (1996), 'Schumpeterian patterns of innovation are technology-specific', *Research Policy* **25**(3), 451-78.

Marin, A. and Bell, M. (2006). 'Technology spillovers from Foreign Direct Investment (FDI): the active role of MNC subsidiaries in Argentina in the 1990s. ' The Journal of Development Studies 42(4): 678-697.

Marin, A. and S. Sasidharan (2010), 'Heterogeneous MNC subsidiaries and technological spillovers: Explaining positive and negative effects in India', *Research Policy* **39**(9), 1227–241.

Markusen, J.R. (1995), 'The Boundaries of Multinational Enterprises and the Theory of International Trade', *Journal of Economic Perspectives* **9**(2), 169-89.

Markusen, J.R. (2002), Multinational firms and the theory of international trade, Cambridge [Mass.]: MIT Press.

Marsili, O. (2001), The anatomy and evolution of industries: technological change and industrial dynamics, Cheltenham: Edward Elgar.

Mayer, K.E. and E. Sinani (2009), 'When and Where Does Foreign Direct Investment Generate Positive Spillovers? A Meta-Analysis', *Journal of International Business Studies* **40**(7), 1075-94.

Michailova, S. and Z. Mustaffa (2012), 'Subsidiary knowledge flows in multinational corporations: Research accomplishments, gaps, and opportunities', *Journal of World Business* **47**, 383-396.

Mohnen, P. (2013), 'R&D Tax Incentives', I4G Policy Brief 25. Bristol.

Narula, R. (2002), 'Innovation Systems and "Inertia" in R&D Location: Norwegian Firms and the Role of Systemic Lock-in', *Research Policy* **31**(5), 795-816.

Narula, R. (2012), 'Do we need different frameworks to explain infant MNEs from developing countries? ', *Global Strategy Journal* 2(3): 188-204.

Narula, R., and J. Guimón (2009), 'The contribution of multinational enterprises to the upgrading of national innovation systems in the EU new member states: policy implications'. Paper presented at the OECD Global Forum on International Investment, 7-8 December 2009.

Narula, R. and J. Michel (2009), Reverse knowledge transfer and its implications for European policy, Maastricht: UNU-MERIT Working Paper 2009-035.

Narula, R. and A. Zanfei (2005), 'Globalisation of innovation: the role of multinational enterprises',

in J. Fagerberg, D.C. Movery and R.R. Nelson (eds), *The Oxford Handbook of Innovation*, Oxford: Oxford University Press, pp. 318-48.

O'Mahony, M. (2013), *Internationalisation of service markets and growth: Synthesis*, Birmingham: SERVICEGAP Discussion Paper 52.

OECD (2005), Measuring globalisation: OECD economic globalisation indicators, Paris: OECD.

OECD (2008a), The Internationalisation of business R&D: evidence, impacts and implications, Paris: OECD.

OECD (2008b), Open Innovation in Global Networks, Paris: OECD.

OECD (2008c), Recent trends in the internationalisation of R&D in the enterprise sector, Paris: DSTI/EAS/IND/SWP (2006)1/Final.

OECD (2008d), OECD Science, Technology and Industry Outlook 2008, Paris: OECD.

OECD (2009), Innovation in Firms. A Microeconomic Perspective, Paris: OECD.

OECD (2010), Measuring Globalisation: OECD Economic Globalisation Indicators 2010, Paris: OECD.

OECD (2012), OECD Science, Technology and Industry Outlook 2012, Paris: OECD.

OECD (2014), OECD Science, Technology and Industry Outlook 2014, Paris: OECD.

OECD (2016), OECD Science, Technology and Industry Outlook 2016, Paris: OECD.

OECD (2016a) Attracting international S&T investments by firms, in: OECD (Ed.), *OECD Science, Technology and Innovation Outlook 2016*. OECD, Paris.

Patel, P., Pavitt, K., (1991), 'Large Firms in the Production of the World's Technology: An Important Case of "Non-Globalisation"', *Journal of International Business Studies* **22**, 1-22.

Patel, P. and K. Pavitt (1999), 'Global Corporations and National Systems of Innovation: Who Dominates Whom?', in D. Archibugi, J. Howells, and J. Michie (eds), *Innovation Policy in a Global Economy*, Cambridge: Cambridge University Press, pp. 94-119.

Pavlínek, P. (2004), 'Regional Development Implications of Foreign Direct Investment in Central Europe', *European Urban and Regional Studies* **11**(1), 47-70.

Pearce, R. (1992), 'Factors Influencing the Internationalisation of Research and Development in Multinational Enterprises', in P.J. Buckley and M. Casson (eds), *Multinational Enterprises in the World Economy*, Cheltenham: Edward Elgar, pp. 75-95.

Pearce, R. (2004), National systems of innovation and the international technology strategy of multinationals, Reading: University of Reading Discussion paper 2004-06.

Pearce, R. and M. Papanastassiou (2009), 'Multinationals and National Systems of Innovation: Strategy and Policy Issues', in R. Pearce and M. Papanastassiou (eds), *The Strategic Development of Multinationals Subsidiaries and Innovation* Basingstoke: Macmillan Publishers, pp. 289-307.

Peneder, M. (2010), 'Technological regimes and the variety of innovation behaviour: Creating

integrated taxonomies of firms and sectors', *Research Policy* **39**(3), 323-34.

Piscitello, L. and L. Rabbiosi (2006), How does Knowledge Transfer from Foreign Subsidiaries affect Parent Companies' Innovative Capacity?, Copenhagen: Druid Working Paper No. 06-22.

Poti, B., and R. Spallone (2016) 'Fiscal Incentives and their Impact on Inward BERD. A Case Study', Deliverable for the project 'R&D Internationalisation of business investments in R&D and analysis of their economic impact' on behalf of the European Commission, DG Research and Innovation.

Qu, Z., C. Huang, M. Zhang, and Y. Zhao (2013), R& D offshoring, technology learning and R& D efforts of host country firms in emerging economies. *Research Policy* **42**(2): 502-16.

Rabbiosi, L. (2009), 'The impact of reverse knowledge transfer on the parent company's innovativeness : Which role for organizational mechanisms and subsidiary's characteristics?', in L. Piscitello and G. Santangelo (eds), *Multinationals and local competitiveness*, Milan: Edizioni Franco Angeli, pp. 167-95.

Ramirez, P. (2013), The new modes and geography of pharmaceutical R&D: Implications for policy, Birmingham: SERVICEGAP Discussion Paper 49.

Rammer, C. and A. Schmiele (2008), 'Globalisation of innovation in SMEs: why they go abroad and what they bring back', *Applied Economics Quarterly* **59**(Supplement), 173-206.

Rojec, M., and M. Knell (2015), *Why is there little evidence of knowledge spillovers from foreign direct investment?* Oslo: U-Know project report.

Ronstadt, R.C. (1977), *Research and Development Abroad by U.S. Multinationals*, New York: Praeger Publishers.

Sachwald, F. (2008), 'Location choices within global innovation networks: the case of Europe', *Journal of Technology Transfer* **33**(4), 364-78.

Sadowski, B.M. and G. Sadowski-Rasters (2006), 'On the innovativeness of foreign affiliates: Evidence from companies in The Netherlands', *Research Policy* **35**(3), 447-62.

Safarian, A.E. (1966), *Foreign Ownership of Canadian Industry*, Toronto: McGraw Hill.

Sanna-Randaccio, F. and R. Veugelers (2007), 'Multinational knowledge spillovers with decentralised R&D: a game-theoretic approach', *Journal of International Business Studies* **38**(1), 47-63.

Santos-Paulino, A. U., M. Squicciarini, and P. Fan (2014), 'Foreign Direct Investment, R&D Mobility and the New Economic Geography: A Survey'. *The World Economy*, **37**(12): 1692-1715.

Schmiele, A. (2012), 'Drivers for international innovation activities in developed and emerging countries', *Journal of Technology Transfer* **37**(1), 98-123.

Schmiele, A. (2013), 'Intellectual property infringements due to R&D abroad? A comparative analysis between firms with international and domestic innovation activities', *Research Policy* **42**(8), 1482-1495.

Schwaag Serger, S. and E. Wise (2010), *Internationalization of Research and Innovation – new*

policy developments, Seville: paper presented at the 2010 Concord Conference.

Shapira, P., J. Edler, D. Gagliardi, A. Verbeek, E. Lykogianni, and M. Knell (2009), *Analysis of R&D international funding flows and their impact on the research system in selected Member States*, Brussels: RINDICATE specific assignment 7.

Sheehan, J. (2004), *Globalisation of R&D: Trends, Drivers and Policy Implications*, Den Haag: paper presented at the IST 2004 conference.

Siedschlag, I., D. Smith, C. Turcu, and X. Zhang (2013). 'What determines the location choice of R&D activities by multinational firms? ', *Research Policy* **42**(8), 1420-430.

Singh, J. (2007), 'Asymmetry of Knowledge Spillovers between MNCs and Host Country Firms', *Journal of International Business Studies* **38**(5), 764-86.

Stiebale, J. and F. Reize (2011), 'The impact of FDI through mergers and acquisitions on innovation in target firms', *International Journal of Industrial Organization* **29**(2), 155-67.

TAFTIE (2009), Internationalisation of National Innovation Agencies, Stockholm: TAFTIE.

Teece, D.J. Pisano, G. and A. Shuen (1997), 'Dynamic capabilities and strategic management', *Strategic Management Journal* **18**(7), 509-33.

Thomson, R. (2013), 'National scientific capacity and R&D offshoring'. *Research Policy* 42(2): 517-28.

Thursby, J. and M. Thursby (2006), *Here or There? A Survey of Factors in Multinational R&D Location*, Washington DC: National Academies Press.

Timmer, M.P., A.A. Erumban, B. Los, R. Stehrer and G.J. de Vries, 2014 'Slicing Up Global Value Chains', *Journal of Economic Perspectives* **28**(2): 99-118.

Todo, Y. and S. Shimizutani (2005), Overseas R&D activities by multinational enterprises: evidence from Japanese firm-level data, Tokyo: Hi-Stat Discussion Paper Series no. 05-91, Institute of Economic Research, Hitotsubashi University.

Tübke, A., F. Hervás, N. Grassano, and L. Potters (2017), *The 2016 Survey on R&D Investment Business Trends*. Seville: IPTS.

UNCTAD (2005), World Investment Report 2005: Transnational Corporations and the Internationalization of R&D, New York and Geneva: United Nations.

UNCTAD (2014), World Investment Report 2014: Investing in the SDGs: An Action Plan, New York and Geneva: United Nations.

Verbeek, A., Shapira, P., Edler, J., Gagliardi, D., Lykogianni, E. and M. Knell (2009), *RINDICATE. Analysis of R&D international funding flows and their impact on the research system in selected Member States*, Brussels: Report for the European Commission, DG Research.

Veugelers, R. (2005), *Internationalisation of R&D: Trends, Issues and Implications for S&T policies*, Background report for the OECD Forum on the internationalization of R&D, Paris: OECD.

Veugelers, R. and B. Cassiman (2004), 'Foreign Subsidiaries as a Channel of International

Technology Diffusion: Some Direct Firm Level Evidence from Belgium', *European Economic Review* **48**(2), 455-76.

von Zedtwitz, M. and O. Gassmann (2002), 'Market versus Technology Drive in R&D Internationalization: Four different Patterns of Managing Research and Development', *Research Policy* **31**(4), 569-58.

Walsh, K. A. (2007), 'China R&D: A High-Tech Field of Dreams', *Asia Pacific Business Review* **13**(3), 321–35.

Wang, E.C. (2010), 'Determinants of R&D investment: the extreme-bounds-analysis approach applied to 26 OECD countries', *Research Policy* **39**(1), 103-16.

Weiss, M. (2016) *The role of local content policies in manufacturing and mining in low- and middle-income countries*, Vienna: UNIDO.

Young, S., N. Hood, and E. Peters (1994), 'Multinational enterprises and regional economic development', *Regional Studies* **28**(7), 657-77.

Zaheer, S. (1995), 'Overcoming the Liability of Foreignness', *Academy of Management Journal* **38**(2), 341-64.

Zanfei, A. (2000), 'Transnational Firms and the Changing Organisation of Innovative Activities', *Cambridge Journal of Economics* **24**(5), 515-42.