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Abstract

There is a growing international dispersion of R&D activities by MNEs for the purposes of maintaining and augmenting their knowledge assets. Firms need to tap into alternative knowledge sources , as home countries are rarely able to meet all their technological needs. However, accessing to foreign knowledge implies integration with the host country innovation system that requires considerable time and resources. Although asset-augmenting activities are seen as primarily benefitting the MNE, we argue that home country innovation systems can also benefit from reverse knowledge transfer. Policy makers need to promote these linkages and flows, rather than seeing R&D internationalisation as a threat to the home economy. New knowledge developed abroad by firms can and should be encouraged to be transferred to the rest of the firm and to the local environment of the home country.

Keywords

reverse knowledge transfer, R&D, innovation policy, EU

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Introduction

The internationalisation of R&D is by no means a new phenomenon. The growing intensity and spread of R&D activities by MNEs in a systematic way dates back to the post second-world war period, and reflects – with a lag – how the MNE as a whole has evolved towards complex and interdependent organisational forms to undertake international business. Thus, until the early 1990s, the trend towards more intensive and complex R&D activities abroad was more of an exception, and limited to relatively few large and organisationally sophisticated firms. This has now started to change. Indeed, the growing spread and intensity of R&D is regarded as one of the central and most dynamic elements of the process of globalization, and is now much more commonplace. According to UNCTAD (2005), R&D expenditures of foreign affiliates worldwide more than doubled from 29 billion dollars to 67 billion dollars between 1993 and 2002. Between 1995 and 2003, R&D expenditures of foreign-controlled affiliates increased twice as fast as their turnover (OECD, 2008). It remains the case that much of the R&D undertaken by MNEs abroad tends to be of a relatively low intensity, and primarily aimed at adapting technology developed in their home country for application by their foreign affiliates in response to local conditions and market needs – anecdotal evidence suggest perhaps 70-80% of all overseas R&D expenditures is of such 'asset-exploiting nature'. Nonetheless, it is no longer uncommon that even relatively small MNEs engage in overseas R&D, and it is increasingly common that even resource-constrained or traditionally ethnocentric firms now seek opportunities to engage in 'asset-augmenting' activities, whether on their own, or in collaboration with other actors in the host economy.

Managing and organizing such a complex web of activities represents a managerial challenge to firms, and has been the subject of a growing literature (see e.g., Gassmann and von Zedtwitz, 1999; Cantwell and Janne, 1999; Zanfei, 2000; Foss and Pedersen, 2002; Criscuolo and Narula 2007; Yang et al., 2008). Much less has been said about how governments need to respond to these circumstances, although the dangers of 'hollowing out' of the innovation capacity of home countries has been a matter of some concern even as early as the late 1970s (Lall 1979, Mansfield et al 1979). More recently, R&D internationalization has been seen to be a signal of weakness of the technological competitiveness of the home country, implying that the domestic innovation system does not meet the technological needs of firms in certain industries (Narula and Zanfei, 2004).

In this paper we argue that although asset-augmenting activities is seen as primarily benefitting the MNE, home country innovation systems can also benefit from reverse knowledge transfer. Policy makers need to promote these linkages and flows, rather than seeing R&D internationalisation as a threat to the home economy. New knowledge developed abroad by firms can and should be encouraged to be transferred to the rest of the firm and to the local environment of the home country.

The importance of new knowledge sources for MNEs

Few MNEs can sustain their innovative capabilities by depending exclusively upon the innovation system of their home countries. Firms need access to knowledge abroad, as the home country cannot develop all the technologies needed by the firm. This stems from the fact that innovation systems and technological specialization of nations evolve only very gradually, especially in new sectors (Narula and Zanfei, 2004). Besides, cognitive limits to resources in smaller countries exist that limit the breadth of technological expertise possible. These systems change more slowly than the needs of firms and, as a result, companies must seek to acquire the knowledge they need in foreign locations. MNEs can take advantage of local capacities of host countries in terms of technology stocks, research programmes and trajectories and creative human capital (Pearce et al., 2008). Indeed, despite the economic and technological convergence associated with international production (through imitation and diffusion of knowledge and practices), there are distinct patterns of specialization among countries which MNEs are able to take advantage of, and build interactions with and between their subsidiaries. The kinds of specializations of a specific host location can be explained by the fact that the innovative potential of a region depends on relatively immobile factors, such as the highly skilled workforce, the potential for spillovers, niche markets, research institutions and regulation (Hotz-Hart, 2000). Despite globalization, a perfect convergence cannot be expected between the needs of firms and the technological resources associated with a given location. Therefore, there remains a variety and diversity among locations and an enduring pattern of regional specialization. Thus MNEs – which need access to a variety of technological areas – seek to tap into and integrate their R&D activities with these location-specific assets if they are to sustain their innovative capability.

However, the desire to acquire new knowledge sources has to be tempered with the benefits of centralisation. Ceteris paribus, firms prefer to concentrate their R&D activities at home. In doing so, MNEs benefit from economies of scale for these costly activities, and maintain strategic control of their R&D investments by being close to headquarters. Centralising R&D also decreases the costs of communication and coordination, which are non-trivial (Criscuolo and Narula, 2007). The complexities of innovation and the complexities of building relationships with a large variety of external actors also results in considerable systemic and institutional inertia which makes it hard for firms to easily relocate such activities (Narula, 2002). Firms tend to be risk averse, and the strategic importance of R&D means that firms are hesitant to take risks by relocating their R&D. Thus, the high costs of integration in innovation systems of ‘new’ host countries, compared to the relatively low marginal costs of staying in the innovation system of the country of origin creates an inertia that makes companies hesitant to internationalise their R&D (Narula, 2002).

The embedding of MNEs and the stickiness of knowledge

Despite the advantages of concentrating their R&D activities in a few locations, firms increasingly need to be physically present abroad – whether in response to pressures to adapt their products and services to specific markets, or to access locationally bound foreign knowledge. Although some aspects of knowledge can indeed be acquired without physically establishing abroad, MNEs have greater access to the local knowledge in systems of innovation by doing so (Song and Shin, 2008). *"By going directly to the places with more expertise in a given technological field the firm is able to penetrate at a lower cost such networks."* (Van Pottelsberghe de la Potterie and Guellec, 2001). Knowledge is not always "transportable" and require a physical presence to be more easily accessible (see Criscuolo and Verspagen, 2008, for a review). Even if ideas and innovative solutions are spreading rapidly through space, the tacit knowledge that lead to these ideas cannot be distributed across large distances without moving the people who possess such knowledge (Inkpen, 2008). Tacit knowledge is often better transferred between people through face-to-face contacts or other person-based communication mechanisms, than codified communication (Piscitello and Rabbiosi, 2007). Therefore, as MNEs need to be innovative and acquire constantly new knowledge, they have to be present where this knowledge circulates. Tacit knowledge is much more difficult to exchange or trade, and thus tends to be sticky and geographically less mobile. In industries where the tacit aspect is considerable, *ceteris paribus*, the propensity to geographically concentrate is higher (Iammarino and McCann, 2006) than in sectors where the knowledge being exchanged is codifiable. However, merely establishing a subsidiary in a host country is not sufficient to acquire the knowledge. Foreign companies may be unable to get access to tacit knowledge embedded in the regional interpersonal networks (Singh, 2007). The subsidiary has to create links and relationships with other economic agents, and become part of the economic milieu of the host location, as knowledge is disseminated more quickly and easily when firms are embedded. Embedding a subsdiary is neither instantaneous or costless, because of the effort required to acquire 'membership' of the relevant networks. The effect of interpersonal similarity, also known as *"homophily"* in the literature (which may be defined as a tendency to interact with similar others) facilitates the sharing of knowledge between individuals and within clusters (Makela et al. 2007). Furthermore, firms need to have something to share which other members of the agglomeration need. All these elements imply that MNEs should be present and must invest in these environments to be able to capture knowledge. The company must also communicate its ideas to be accepted by the local scientific community and to obtain the desired information (Porter, 1993). This helps explain why the agglomeration of R&D activities in a few locations changes very slowly.

Of course, not all knowledge flows are intentional. Knowledge 'leaks' unintentionally, for instance when employees move from one firm to another, and these leakages are obviously greater when firms are collocated. The argument in favour of locating in close spatial proximity presumes that firms wish to benefit from and promote knowledge transfers. This is not always the case for two reasons. First, while all firms in principle seek to have positive inflows of knowledge and desire to benefit from unintended spillovers, few firms wish to be the source of unintended knowledge outflows. Although in the case of R&D (compared to sales or manufacturing) there is a greater active interest in seeking spillovers, this tendency will reflect the capabilities of the firm. Alcácer (2006) found that although R&D tends to be more concentrated relative to manufacturing and sales, firms with superior technologies are less keen of being physically proximate to other firms in the same industry (compared to less technologically competitive firms), regardless of the activity. In other words, firms may seek to *avoid* collocation of R&D to minimise leakages of valuable assets.

The importance of spillovers for MNEs

Thus, MNEs that seek to augment their existing competences tend to establish subsidiaries in regions where there are clusters of suppliers, clients, competitors, research institutions, universities or industry associations. As a large literature shows (for a competent review, see Iammarino and Mcann, 2006), firms agglomerate to take advantage of three types of spillovers: intra-industry, inter-industry and external sources of knowledge.

First, intra-industry spillovers are associated with the presence of many technologically active firms in a given sector and concentrated in an agglomeration. This concentration of firms in the same area creates externalities of specialization (as opposed to externalities of diversities due to the concentration of various industries). The companies are in cooperation and competition simultaneously, which can produce stable mechanisms of accumulation of collective knowledge. The competitive advantage of a system is created and maintained through a certain optimal level of rivalry between firms. The spatial concentration of firms can stimulate the intensity of the exchanges and collaboration between agents, thus creating a common attitude towards innovation. In addition, MNEs can monitor technological and competitive environment in a particular place (Doh et al., 2005).

Second, companies can install R&D activities in a location to benefit from inter-industry spillovers (see Jacobs, 1970, 1986). These effects concern the externalities of diversity that promote the creation of new ideas *across* sectors and under the right circumstances create an increase in the scope of research.

Third, the efforts of firms to improve technology are supported by external sources of knowledge, often associated with location-specific knowledge infrastructure that provide quasi-public goods such as public research organisations, universities and industry associations (Asheim and Gertler, 2005). These often tend to be spatially concentrated (Almeida and Kogut, 1997; Saxenian, 1994), and create opportunities for scientific and technological spillovers. However, the work on clusters emphasises that although these opportunities are in principle available to all firms that are part of the spatial agglomeration, having access requires knowledge of informal institutions and time invested in being collocated with these actors, and are not automatically available to all firms (Tallman et al, 2004*)*. A study by Schrader (1991) showed that the frequency of interactions between R&D employees of several firms has a positive impact on the frequency of innovations in these firms. Companies that do not interact with others risk missing opportunities and, as a result, the productivity of their innovation decline. Engineers from Sony, for example, had effectively isolated themselves in the 1990s, in the belief that ideas from outside the company were not good enough. They thus developed products such as cameras which were not compatible with various forms of memory used by clients (Hansen and Birkinshaw, 2007). Firms tend to learn not just from their own experiences and employees, but also from their suppliers, partners, investors, scientists, inventors, customers, competitors and companies that are not necessarily in the same field. This exchange will allow the company to raise or deploy its own knowledge effectively.

The challenges of knowledge transfer

However, acquiring and internalising knowledge derived from interactions with the host location's innovation system is just the first step (see figure 1). Once these new competences are integrated inside the subsidiary, they need to be transferred to the rest of the MNE's operations. Furthermore, this cross-border integration of knowledge may also influence and upgrade the knowledge base of systems of innovation in other locations where the MNEs operations. Indeed, even though home country of the MNE has tended to play a significant (and major) role as a net (and dominant) source of new technological competences for the MNE as a whole, there has been a considerable shift in the relative importance of the home country. That is, conventional knowledge transfer has tended to be from the home country to subsidiaries, with the subsidiaries acting as net exploiters of assets originally developed in the home base. However, a number of studies have highlighted the growing phenomenon of reverse knowledge transfer, with certain subsidiaries transferring knowledge in the reverse direction (Frost, 1998; Håkanson and Nobel, 2001; Criscuolo et al, 2005; Frost and Zhou, 2005; Ambos et al. 2006; Rabbiosi, 2008). There are three possible steps in the reverse transfer of knowledge: from the local environment of the host country to the MNE's subsidiary, from the MNE subsidiary to the parent company, and from the parent company to the local environment of the country of origin[1] (see figure 1).

Figure 1 here

However, achieving successful knowledge transfer remains a challenge, regardless of the direction of knowledge flows. On 97 subsidiaries in 13 Swedish MNEs, most subsidiaries had a very low level of integration of knowledge with the rest of the MNE (Andersson and Forsgren, 2000). Similar results were found in a survey of 255 foreign affiliates of German MNEs (Kutscker and Schurig, 2002). Indeed, although the transfer of knowledge is supposed to be one of the defining attributes of MNEs (Casson, 1979), it is surprising that the *lack* of knowledge transfer between units and individuals appears to be more common than its presence (Forsgren, 2008). In response to the challenges of promoting efficient knowledge transfers as there is a growing geographical spread of MNE's centres of excellence, new R&D organizational structures are being utilised by MNEs that acknowledge that foreign subsidiaries can contribute as much as the home location of the MNE to the creation of new technological assets (e.g. Chiesa, 1996; Gassmann and von Zedtwitz, 1999; von Zedtwitz and Gassmann, 2002; Criscuolo and Narula, 2007). As such, MNEs are moving away from a 'centralised hub' to a multi-hub 'integrated network'.

It is clearly one thing to implement a dispersed R&D structure; it is quite another to achieve successful and efficient coordination, since personnel and management do not always adapt to these new structures readily due to organisational inertia. There are a number of barriers to the internal knowledge diffusion process connected to inter-unit geographical, organizational and technological distance and also to the motivational disposition of both the sender and the receiver units (see Gupta and Govindarajan, 2000; Kogut and Zander, 1993; Szulanski, 1996). Thus if firms want to reap the benefits of a geographically dispersed R&D organization, they must ensure that knowledge generated in different units of the network is transferred to the rest of the organisation and this requires the adoption of intricate and sophisticated mechanisms for the dissemination and integration of both explicit and tacit knowledge. In addition to the problems of

[1] In fact, knowledge transfer may take place through MNE in at least five different forms (e.g. Gupta and Govindarajan 1991; Piscitello and Rabbiosi, 2007): (i) flows from parent company to subsidiaries, (ii) flows from subsidiaries to parent company, (iii) flows from local environment to subsidiary, (iv) flows from subsidiary to local environment, (v) flows to peer subsidiaries. However, in the subject of the reverse knowledge transfer, the three flows mentioned in the text are the most relevant.

transferring tacit knowledge across distances, there is often *technological distance* between subsidiaries, where the recipient subsidiary does not have the needed absorptive capacity to utilise the information being made available. Transfers are more efficient if the receivers of knowledge have appropriate levels of absorptive capacity (Narula, 2003) allowing agents to internalize and use the knowledge made available to them. This means that agents need to properly understand, implement and assess the value of knowledge (Ambos et al., 2006). In addition, other subsidiaries may be reluctant to utilize knowledge developed elsewhere. Many of these individual subsidiaries have often had little experience of cooperating with each other, and in many instances have been engaged in inter-unit rivalry under a centralised hub model. Indeed, in the case of newly acquired operations, they may have been *de jure* competitors (Criscuolo and Narula, 2007). Achieving a harmony of inter-facility division of labour is all the more difficult because of these inter-unit rivalries. MNEs whose subsidiaries have the appropriate skills and show some willingness to absorb and share knowledge are able to achieve better results in the transfer of knowledge (Veugelers and Cassiman, 2004). Thus, the possession of knowledge and practices, and an effective way to manage communications and interactions among subsidiaries, are essential in the process of sharing knowledge (Adenfelt and Lagerström, 2008).

Differences in cognitive knowledge, specialization, language, social norms and identities of individuals also create difficulties in communication (Buckley and Carter, 2004; Welch and Welch, 2008). It is thus essential to increase connectivity within the MNEs in one way or another to improve the internal transfer of knowledge (Makela et al. 2007). In addition, a gap between the vision adopted by management and the beliefs of subsidiaries may result in inconsistencies and conflicts can hinder knowledge transfer. The evidence suggests that while socialization mechanisms help overcome some of these bottlenecks, there remain a number of obstacles in optimising knowledge flows in physically and technologically dispersed R&D facilities (Criscuolo and Narula, 2007).

Indeed, the promotion of reverse knowledge transfer presents remains one of the most vexing features of the modern dispersed and multi-hub R&D MNE structure. According to a recent questionnaire survey involving 35 major Swiss MNEs[2], the transfer of knowledge from parent company to foreign subsidiaries is higher than from foreign subsidiaries to parent company. On a

[2] A questionnaire was sent in May 2008 to the 71 most innovative Swiss firms according to patent applications (see Michel, 2009). In August 2008, 35 firms responded. High-technology industries represent 40 percent of the respondent firms, against 37.1 percent for high-medium technology industries, 11.4 percent for medium-low technology industries and 5.7 percent for low technology industries.

4 point scale, the degree of importance for the conventional knowledge transfer had a mean of 3.11 whereas for reverse knowledge transfer was considerably lower, at 2.22. Further, when asked, "Do your foreign R&D subsidiaries use knowledge from your parent company?" 80 percent responded that it was crucially or very important (with an average of 3.52). When asked: "Do your Swiss units use knowledge from your foreign R&D subsidiaries?", only 48 percent indicate it was as important (with an average of 3.49). These knowledge transfers are associated with countries in which these MNEs have been most embedded. As table 1 shows, the two most important home countries for reverse knowledge transfer are US and Germany, which are also the Switzerland's two most important trade partners, accounting for 29.3 percent of Swiss exports. These two countries also account for 61.2 percent of the foreign patents developed by these firms.

Table 1 here

In general, the survey indicates that in the case of Swiss firms, their R&D centres are interconnected and there is a strong knowledge transfer between subsidiaries and the country of origin. However, the direction of knowledge transfer remains biased towards a conventional flow (figure 1): subsidiaries benefit more of the knowledge created in Switzerland than the other way round. The transfer from foreign subsidiaries to the country of origin is lower than the one from the country of origin to foreign affiliates.

Given that the sharing of knowledge can become a competitive advantage, MNEs must ensure that new insights for the entire organization flow efficiently. According to Yang et al. (2008, p. 5), reverse transfer is much more difficult than conventional transfer because both are based on different transfer logics. While conventional transfer is more of a 'teaching' process, reverse transfer is a 'persuading' process (Yang et al., 2008). Indeed, in conventional knowledge transfer, the subsidiary is often obliged to replicate knowledge from the parent through the use of control mechanisms (Yang et al., 2008). On the other hand, subsidiaries are motivated to transfer knowledge to their parent firm because it could strengthen their strategic position in the whole organization (Gupta and Govindarajan, 2000; Mudambi and Navarra, 2004), and they have to persuade the parent firm that its knowledge can fit the parent's needs (Yang et al, 2008). The study of Swiss MNEs highlights the difficulties of reverse transfer of knowledge. The difficulties of intra-firm reverse knowledge transfer concern firstly the *high specificity* of foreign knowledge, secondly, its relevance to the parent company is not always immediately apparent and thirdly, it may be regarded as inferior to those already available to the parent. The weakness of the transfer is thus not always related to the difficulties inherent in the transfer.

Policy implications

In general, the industrial and technological specialisation of countries changes only very gradually, and – especially in newer, rapidly evolving sectors – much more slowly than the technological needs of firms. As a result, firms must seek either to import and acquire the technology they need from abroad, or venture abroad and seek to internalise aspects of other countries' innovation systems. Thus, in addition to proximity to markets and production units, firms also venture abroad to seek new sources of knowledge, which are associated with the innovation system of the host region. When firms do so, their R&D strategy is about actively tapping into foreign knowledge bases. It is important to emphasise that not many firms engage exclusively in either asset augmenting or asset-exploiting, rather they most often engage in both simultaneously (Criscuolo et al, 2005). When firms engage in R&D in a foreign location to avail themselves of complementary assets that are location-specific (and include those that are firm-specific), they are essentially aiming to explicitly internalise aspects of the systems of innovation of the host location. However, developing and maintaining strong linkages with external networks of local counterparts is expensive and time consuming, and is tempered by a high level of integration with the innovation system in the home location. Such linkages are both formal and informal, and will probably have taken years – if not decades – to create and sustain.

The process of engaging in reverse knowledge transfer efficiently – even by firms which seek to utilize it – is still not fully understood. However, is a growing phenomenon and of considerable importance to MNEs in an interdependent and competitive economic milieu. It is thus essential for policy makers to fine-tune R&D policy, if economic agents are to benefit from this new trend in R&D (Guimón, 2009). It is not only about attracting R&D by foreign firms and promoting their embeddedness, but also about promoting their own national firms to venture abroad, and then to encourage them to share the benefits from their improved competitiveness with their home innovation system. Domestic companies are often the largest contributors to home country R&D activities. For instance, in the EU-15, firms under European control account for 85 per cent of aggregate industrial R&D outlays (OECD, 2008). In Japan, firms under Japanese control account for 97 per cent of the total. In the United States, parent companies perform about 70 per cent of industrial R&D. These companies are now increasingly doing R&D abroad.

Most countries that have been historically inward-looking have also always regarded the need to import technologies as a sign of national weakness, and have – not coincidentally – a tradition of techno-nationalism. That is, they have sought to maintain in-country competences at whatever the cost. This problem is aggravated by the trend towards multi-technologies even in mature industries. The strategy of technological self-sufficiency is particularly untenable in economies that have limited resources (such as small countries). They must either spread their resources thinly across many technological competences or concentrate on a few. It is one thing to propose changing policies that have previously championed self-sufficiency, and quite another to change the attitudes of policy makers and organisations that implement policy. Institutions (in the sense of routines and procedures) create the milieu within which economic activity is undertaken and establishes the ground rules for interaction between the various economic actors. Nonetheless, systems do change, because the costs of supporting inefficient institutions may far outweigh the benefits of change. Systems and institutions are also evolutionary processes which require imitation, experimentation, learning and forgetting, and this most often means that change is gradual, slow and cumbersome.

Some policy makers feel that national champions should not venture abroad, but should seek complementary assets by arms-length mechanisms such as licensing and outsourcing. However, just as there are limits to the firm's use of non-internal sources of knowledge, there are limits to how much countries can rely on such arms-length means. Innovation based largely on improving and modifying external sources of technology acquired through arms-length means is an option only available *as long as there is something to imitate*. As countries approach the technological frontier, there are two problems. First, it may not be possible to buy cutting-edge technologies, since firms that own these technologies are reluctant to license or sell them. The reluctance has to do with the nature of technology (in that a price cannot be put on an unproven knowledge base for which no market exists) and the fact that firms will seek to maximise the rent from their inventions as long as they are in a monopoly position. To sell their new technologies would be to create a competitor. Second, imitation is not possible *at* the frontier, since it is difficult to predict *ex ante* which technology (of several competing nascent technologies) will become paradigmatic. This explains the popularity of strategic technology partnering at and around the frontier, because firms seek to collaborate when it helps to reduce uncertainty and reduce the innovation time span. They therefore seek partners who can improve the probability of 'winning', and these firms are those that have complementary resources to offer (Narula, 2003). As they approach the frontier, countries must have the capacity not just to absorb and imitate technological development created by others, but also the ability to generate inventions of their own. This requires technological capabilities that are non-imitative. In other words, learning-by-doing and learning-by-using have decreasing returns as one approaches the frontier, and in-house learning by asset-augmenting R&D internationalisation is probably the only efficient option.

There are three areas where government policy plays a significant role. First, there are the generic aspects of promoting an efficient innovation system. This concerns investment in R&D whether foreign-owned or domestic (e.g. helping the domestic actors to adopt foreign innovations, attracting foreign talent, promoting collaboration between domestic and foreign players, investing in public research infrastructure, establishing effective intellectual property rights regimes, etc. See Guimón 2009 for a review). Perhaps most importantly, it is the promotion of effective and efficient means by which firms and organizations within an innovation system communicate with each other, and this reflects the balance between the cooperation and rivalry within the milieu. These are 'generic' aspects of a knowledge infrastructure, and are quasi-public goods in that they are potentially available to all firms, and need to evolve to meet the needs of firms. Policies can sustain this reverse technology transfer, for instance, by encouraging the international mobility of skilled manpower or by encouraging the internationalization expansion of public R&D centers and universities. Knowledge transfer may also be encouraged by fostering contacts between research institutions, associations, universities and businesses.

Second, it is important for policy makers to distinguish between asset-exploiting activities and asset-augmenting activities. Asset-exploiting relates to foreign R&D which improve home products in adapting them to local markets. Asset augmenting activities relate to foreign R&D that tap into new sources of knowledge abroad. Augmenting activities have a more innovative function than the exploiting type. Indeed, exploiting activities use initial firm-specific knowledge developed at home in order to adapt products of processes to local conditions. In this context, core activities are concentrated in the home country, and foreign activities enhance the technologies developed at home. Exploring activities develop core innovations in host countries. In this case, a new important source of competitive advantage is the capacity of foreign subsidiaries to create innovations based on host country's technological competences. Domestic R&D activities are thus not the only sources of knowledge that MNEs exploit. They can also access foreign sources of knowledge to complement their R&D activities at home, or to acquire or create new unique intangible assets.

Policy makers also need to distinguish between firms that internationalise as an 'exit' because of the poor fit between the needs of the firm and the knowledge infrastructure, and those that internationalise because they need to augment their existing assets, and those available to them at home. This requires a clearer understanding of the strategies of individual MNEs and their technology portfolios, rather than a one-size-fits-all approach, tailoring their policy tools to specific needs.

Third, policy makers can address means to promote MNEs to actively help them upgrade the home country innovation system through reverse knowledge transfer. Specifically, while Step 1 and Step 2 (see Figure 1) of the reverse knowledge transfer process have a direct bearing on the technological competitiveness of the MNE. Step 3 of the process, on the other hand, has a direct bearing on the quality of the location advantages of the home country, but may have few immediate benefits for the MNE. The system of innovation of home country can profit from the exploring activities. Indeed, this kind of R&D leads to the reverse knowledge transfer.

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Table 1: Location of subsidiaries engaged in reverse knowledge transfer to Switzerland

Countries	Frequency of responses	Percentage
USA	16	28.57
Germany	9	16.07
China	7	12.50
United Kingdom	6	10.71
France	5	8.93
Singapore	3	5.36
Italy	2	3.57
Japan	2	3.57
Austria	1	1.79
Canada	1	1.79
European Union	1	1.79
Finland	1	1.79
Mexico	1	1.79
Sweden	1	1.79
Total	56	100.00

Source : Authors calculations based on a 2008 survey of 35 Swiss multinationals (see Michel, 2009)

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