

Working Paper Nr. 66

Internationalisation of R&D Activities of Austrian Firms: Strategic Drivers for Spatial Organisation

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ISSN 2218-645X

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Abstract:

R&D activities of firms are becoming increasingly internationally organised, with a growing number of new locations in emerging economies and an increasing number of small and medium-sized enterprises tapping into internationalisation. The aim of this paper is to link international R&D strategies of small and medium-sized enterprises to the spatial organisation of R&D activities. A survey of Austrian firms forms the basis of the analysis. The findings show a clear geographic concentration of foreign R&D activities of Austrian firms in Western and Eastern Europe, especially Germany. However, this general distance decay function is 'distorted' by regions' evolutionary trajectories and their peculiarities, such as cultural and cognitive proximity, and by the scope of R&D envisaged by the firm. The analysis reveals that knowledge-exploiting strategies are more common for activities in emerging economies, whereas knowledge-gaining and learning strategies drive the establishment of activities in countries with an advanced national innovation system. Furthermore, small and medium-sized firms tend to internationalise via international cooperation rather than via the establishment of their own subsidiaries abroad. Plans for future activities show only limited change in this respect.

Keywords: R&D Internationalisation, Firm Strategies, Spatial Organisation, Austria, small and medium-sized enterprises

JEL Classification: L22 - Firm Organization and Market Structure, O32 - Management of Technological Innovation and R&D, R11 - Regional Economic Activity: Growth, Development, Environmental Issues, and Changes

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1 Introduction

It is a widely known and discussed fact that firms internationalise their R&D activities. Firms' R&D networks are growing in space with the highest dynamic in emerging economies. This is due to the phenomenal improvements and significant cost reduction in communication infrastructure (Blinder, 2006; Levy, 2005, Contractor *et al.* 2010) and to governmental policy change, such as the liberalisation of FDI regimes and tighter enforcement of intellectual property rights in many countries (UNCTAD, 2009). Furthermore, firms have started to use external knowledge sourcing more frequently instead of internal R&D organisation due to specific traits of knowledge-intensive activities. This goes along with seeking knowledge and expertise. Geographically and organisationally distant knowledge can be more inspiring (Bierly *et al.*, 2009).

Although these trends are being intensively discussed, the pattern of R&D internationalisation cannot yet be fully explained and existing studies reveal limitations. Firstly, R&D internationalisation is driven by multinational enterprises (MNE). Small and medium-sized enterprises (SME) are expected to follow, but are generally neglected in the international business literature. Massini and Miozzo (2010) as well as Hsuan and Mahnke (2011) call for a correction of the large firm bias. Empirical studies are needed to research whether SMEs adopt innovation offshoring strategies of MNEs or develop their own strategies due to limited resources. Secondly, R&D internationalisation of firms is often explained by the attractiveness of target regions using data gained from national statistics (wage level, share of highly qualified workers, etc.). Strategic motives of firms are rarely taken into account. If strategic drivers are directly identified, they mainly mirror firms' R&D internationalisation in general, but hardly relate to locational or organisational choices at the same time. This leads to the third shortcoming, the one-dimensional (strategy, target countries or organisational mode) view of R&D internationalisation. Moreover, an outlook to future activities related to existing R&D internationalisation patterns is rarely reflected upon.

The aim of this paper is to deal with some current shortcomings in the knowledge of R&D internationalisation and to develop a distinct picture, asking the following questions:

- How are the **three elements** - strategic motives, geographical location and organisational mode - **interlinked**?
- How do traditionally **small and medium-sized firms** from a small and open economy such as Austria internationalise their R&D activities taking a multidimensional view?

The paper links firms' international R&D strategies to the spatial and organisational development of R&D activities. The small and open economy of Austria serves as a case in point. The paper contributes to existing research on the R&D internationalisation process of SMEs. It is attempting to explain their internationalisation pattern using a multidimensional perspective consisting of the interrelation of strategic motives, locational choice and organisational modes. Each location in a firm's R&D network is motivated by different drivers and is organised in a different way.

The analysis is based on a firm survey of SMEs in Austria carried out in 2010. The standardised survey asked about market conditions, current and future R&D activities (including locations), motives for and types of activities performed as well as perceived implications of those activities. The sample is based on innovative enterprises that applied for or received financial innovation support from the Austrian Research Promotion Agency (FFG). The sample gathered was 410 from 5,100 firms approached (the response rate was thus 8%). The survey method gave us the chance to gain information directly on strategic drivers for R&D internationalisation to specific countries instead of relying on secondary data. Moreover, we were able to ask firms about their future plans for development in the next 3-5 years. This responds to the calls by Maskell *et al.* (2007) and Lewin *et al.* (2009) for a more dynamic view of R&D offshoring.

The empirical findings show that half of the Austrian SMEs surveyed - the back bone of the Austrian economy - perform international R&D activities. Firms prefer to work with partners in cooperation. Over 70% of international R&D activities of the Austrian firms surveyed are performed in Western Europe, particularly in Germany, followed by Eastern Europe (14%). Only a few activities are located in North America and Asia. R&D activities abroad follow a clear distance decay function, as R&D needs some sort of spatial and cultural proximity.

The paper is divided into a conceptual and an empirical part. In the conceptual part, the interlinkages of strategic drivers for R&D internationalisation, organisational modes and locational choice are discussed. The main data source and the applied methods are introduced in Section 3. The empirical Section 4 presents evidence from an Austrian firm sample on the interlinkages of the three dimensions. Moreover, it provides an outlook on future dynamics of R&D internationalisation. The conclusion summarises the findings and delivers a more distinct picture of R&D offshoring.

2 Firms' perspective on R&D internationalisation: Conceptual Thoughts

2.1 Strategic motives, locational choice and R&D organisation

MNEs have traditionally been responsible for the increasing internationalisation of R&D. New markets emerge, and 'once a firm realizes it has a capability that could be used to satisfy demand in a foreign country, it will evaluate different options for exploiting this capability.' (Kuemmerle, 1999a:3). Life cycles become shorter, which also affects the stage of new product development (Bayus, 1998, Kaipia *et al.*, 2006). Products and services have become increasingly technology and knowledge-intensive. Firms are obliged to make higher investments combined with quick amortisation. Based on this development, firms are forced to rethink permanently the optimal geographical locations of their R&D activities. The decision-making of firms regarding offshoring is a multidimensional process. It is determined by strategic guidance combined with the attractiveness and potential benefits in host countries, taking into consideration the best organisational form for enabling the achievement of business targets. The three strands – strategic motives, locational choice and R&D organisation – and their interlinkages are analysed from a conceptual perspective in this section.

2.1.1 Strategic Motives

R&D activities are an important and sensitive element from the perspective of firms. Taking a strategic point of view, firms find arguments ranging from those in favour of centrally organised activities close to their headquarters to those favouring completely decentralised R&D activities. Typical **centripetal** forces as drivers for R&D centralisation are:

Control and monitoring: Better control and monitoring opportunities for core competencies through spatial proximity of headquarters and R&D facilities (Ambos and Ambos, 2011).

Efficient coordination: Strong connections to the home country and its comparative advantages lead to efficient coordination and communication (Gammeltoft, 2006; OECD, 2008).

Avoiding high set-up costs: Firms avoid high costs and risk for the establishment of R&D facilities abroad and the integration into the local environment (Narula and Zanfei, 2005). Moreover, at their headquarters location, they can realise economies of scale and scope.

At the same time, R&D processes can easily be geographically decentralised due to modern information and communication technology, codification of knowledge and processes as well as modularisation of production (Gammeltoft, 2006). **Centrifugal** forces as drivers for R&D offshoring are:

- *Market motives:* The aim of firms is to enter and secure markets abroad while exploiting firm-specific knowledge and capabilities in foreign environments (Hymer, 1960; Kuemmerle 1999; Gammeltoft, 2006). However, a global production and commercialisation requires a customisation of products for specific markets (with

respect to climate, technical norms, standards, customer needs). These innovations call for R&D activities conducted directly in the target country, as the innovation process requires feedback loops with customers. Local R&D facilities also contribute to greater acceptance and popularity of brands in foreign markets (Hymer, 1976, Dunning and Narula, 1995; Gammeltoft, 2006, Massini and Miozzo, 2010).

- *Production motives*: R&D activities are located close to manufacturing plants to support engineering units and adapt products to local conditions and resources (Gammeltoft, 2006).
- *Policy motive*: National private and public commitment to R&D are drivers for internationalisation of R&D. The access to infrastructure, the institutional environment, R&D policy support measures (e.g. tax reduction, exemption from customs) and existing legal requirements are examples of policy motives (OECD, 2008, Bielinski, 2010).
- *Cost motive*: The access to less expensive R&D locations is important for firms to optimise their R&D activities (Gammeltoft, 2006). This includes, for example, the reduction of costs, the increasing of the availability of R&D personnel, the reduction of project running time, or conducting R&D on a 24/7 basis.
- *Knowledge and technology motive*: Innovations are more likely to emerge when the knowledge of different players is combined. Hence, there is a need for external knowledge inputs. Firms seek access to new technology, highly qualified science and engineering talents and networks (Florida, 1997; Serapio and Dalton, 1999; Manning *et al.*, 2008). The strategy of firms is to conduct R&D activities abroad to absorb new knowledge and technologies for in-house use. They aim to tap into regional knowledge bases abroad (Cantwell, 1989; Florida, 1997; Kuemmerle, 1999; Manning *et al.* 2008; Lewin *et al.*, 2009; Pearce, 2009; Dunning, 1998; Dunning and Narula, 1995).

The market and production motive corresponds to Kuemmerle's home-based R&D exploitation approach, while the knowledge and technology-related motive mirrors Kuemmerle's home-based augmenting strategy.

Offshoring activities are usually driven by multiple motives (Massini and Miozzo, 2010). However, attention should be paid to the fact that the strategic focus of an R&D location and its evolution is not exclusively directed by the corporate strategy of a firm, but also depends on *external factors*. Frequently referred to as co-evolutionary dynamics, the factors which shape the strategic decisions concerning R&D offshoring are macroeconomic forces, host and home country's offshore policies, industry dynamics and firm-level offshoring capabilities (Manning *et al.* 2008). Kshetri (2007) also identified the institutional factors (regulations, rules and habits) as influencing factors. Castellani und Zanfei (2004) extended the list to include the organisational competence and experience of R&D internationalisation. However, the decision in favour of R&D offshoring is not always a conscious process, but sometimes a "side product" of locational choice for production and distribution sites (Belitz, 2004) or a result of mergers and acquisitions.

The classification summarises the main strategic drivers for the internationalisation of R&D discussed in the management literature. However, firms can have more than one R&D location abroad. Different strategic motives drive firms to specific locations. Although this phenomenon is well known, we often only find a distinction between motives driving firms to advances in

comparison to emerging economies. This view needs a geography perspective in order to differentiate additionally between distant and proximate economies, as knowledge is “sticky” and distance-sensitive.

2.1.2 Locational Choice

Geography is important

Concentrating on the R&D investment dynamics, traditional locations seem to be on their way to losing their attractiveness for R&D investment (Huggins *et al.*, 2007), but looking at the R&D investment stocks, economies with an *advanced national innovation* system such as Western Europe and the NAFTA regions are still leading (Demirbag and Glaister, 2010). *Emerging economies*, such as Eastern Europe, are connected with business uncertainty. Uncertainty increases further in emerging and distant economies such as Asia. In that case, *distance* is not limited to geography, but also includes “psychic distance, defined in terms of factors preventing or disturbing the flow of information between the firm and the target nation, including linguistic, institutional, cultural and political factors” (Ambos and Ambos, 2011: 110). Differences in the new environment need to be learned, which remains an obstacle for firms and causes significant costs (Zaheer and Manrakhan, 2001; Contractor *et al.*, 2010). Accordingly, investment decisions are distance-bounded. Ambos and Ambos (2011) could show negative effects when firms establish a knowledge-sourcing hub in culturally distant economies, taking German MNEs as an example. Although emerging countries experience a high dynamic in R&D, locations in *proximate countries* still count for the highest share of R&D offshoring facilities. Geography is important – firms favour different advantages in advanced vs. emerging national innovation systems and proximate vs. distant economies.

Path dependency and stepwise internationalisation

Internationalisation of R&D in firms does not purely depend on managers’ vision and does not follow current trends automatically. R&D offshoring depends greatly on the path firms have already followed in the past. On the one hand, firms are influenced by past experiences with or without offshoring R&D activities. Moreover, existing markets often require an R&D location, as proximity to existing production activities is necessary. On the other hand, firms are bounded to the geographical evolution of their R&D network and their learning experiences. Researchers realised that path dependency is a “progressive learning-by-doing process” (Lewin *et al.*; 2009: 908). Lewin *et al.* (2009) listed three important reasons emerging in the literature that determine offshore decisions with respect to R&D:

- Behavioural and evolutionary assumptions of firms suggest that rules and routines used by firms lead to the continuation of existing R&D sourcing (mainly internally and close to headquarters), even if environmental dynamics paint a different picture.
- Firms’ past experiences might also influence managers’ perceived choices of opportunities for R&D internationalisation decisions.
- Transaction costs suggest that firms hesitate to change their organisational modes (from internal to external R&D sourcing) or their geographical location. It is risky and costly to experiment with new forms and locations of R&D.

2.1.3 Organisational Modes

Besides strategic motives for specific locational choice, firms have to define the organisational mode of how to internationalise R&D. Organisation of R&D activities means the organisation of knowledge-intensive activities that are not highly standardised and codified. Mudambi and Tallman (2010) demonstrate in their paper why the organisation of R&D is not a make or buy decision, as was conceptually and empirically discussed for production processes. They argue that firms seek organisational structures “that both protect and leverage their strategic knowledge assets, with the final decision often coming down to a choice between different alliance forms” (Mudambi and Tallman 2010:1434). This is due to the special characteristics of knowledge inherent to R&D activities (high value, highly tacit, involving investments in human capital, highly transaction-specific investments, high risk, strategic decisions). Knowledge is difficult to generate and to exchange. It is difficult to protect when partners have the chance to exploit it. These are arguments for in-house R&D activities. But empirical data show that R&D outsourcing is on the rise, with many R&D activities being accomplished through cooperative modes, not markets.

Williamson (1991) already started to introduce a more subtle distinction between hierarchies and markets to defuse the fierce debate on make or buy. His hybrid or so-called cooperative modes have since been extensively researched. Examples of hybrid modes include the exchange of shares with trading partners, a joint ownership arrangement, the issuing of a licence to another firm, long-term contracting (framework agreements), franchising, strategic alliances (Menard 2004). Hybrid modes develop when markets shape up as being unable to allocate adequately the relevant knowledge, resources and capabilities in R&D, whereas in-house R&D would reduce flexibility, create irreversibility and weaken market stimulation (Wang and Nicholas 2007). Reasons for cooperative modes of R&D organisation are labour cost savings, gaining access to talents, increasing business flexibility and the ability to respond quickly to changing markets (Mudambi and Tallman 2010:1434). Firms want to avoid the loss of intellectual property through opportunistic behaviour and the hollowing out of the firm, but to be efficient and effective in R&D they need access to knowledge and high levels of cooperation and coordination. Hybrid modes are more long-term than markets, and rely to a higher degree on trust, reputation and reciprocity (Menard 2005). Meyer (2011) showed for production networks that hybrid modes with its informal character ease cooperation in cross border relations, especially in countries where the institutional setting is weak. Unfortunately, empirical evidence on cooperative cross-border R&D activities is very rare.

2.2 Combining the strategic, organisational and locational perspective to create a distinct view

The leading question in this paper is three-dimensional. How are the three elements - strategic motives, geographical location and organisational mode – interlinked and how can the observed pattern of R&D internationalisation be explained?

2.2.1 Location of R&D and organisational mode

Taking the arguments of the conceptual discussion and tying together the two strands of locational choice and organisational mode in a systematic way delivers the following pattern, shown in Figure 1. While the locational dimension has been divided into two elements, (1) geographical distance and (2) development stage of the national innovation system, the organisational dimension incorporates the three governance modes: hierarchies, cooperation and markets. For emerging economies at distance, the expected entry mode is a hierarchical construction. Location-specific environmental uncertainty (volatile and unpredictable market conditions, policy instability etc.) – as is expected in emerging economies - and behavioural uncertainty (inexperience in business culture and longer reaction time in distant economies, etc.) might have the greatest influence in steering the decisions of firms on hierarchies. In contrast, in advanced and proximate economies, the probability of market relations is high, as uncertainty is low. Firms have control over market action, cognitive proximity is supportive and coordination is eased. For emerging economies in proximity, the picture is less clear. Proximity allows for social control and trust-based governance, but the emerging status requires a certain degree of control. Most likely, cooperation-like relations can combine the elements needed. In advanced but distant economies, control mechanisms can be relaxed. An open-access mode encourages knowledge-seeking activities, but R&D activities at distance require specific control and coordination mechanisms. Again, cooperation might serve this situation best. Due to the specific traits of knowledge-intensive activities discussed before, the share of cooperative R&D is expected to be high.

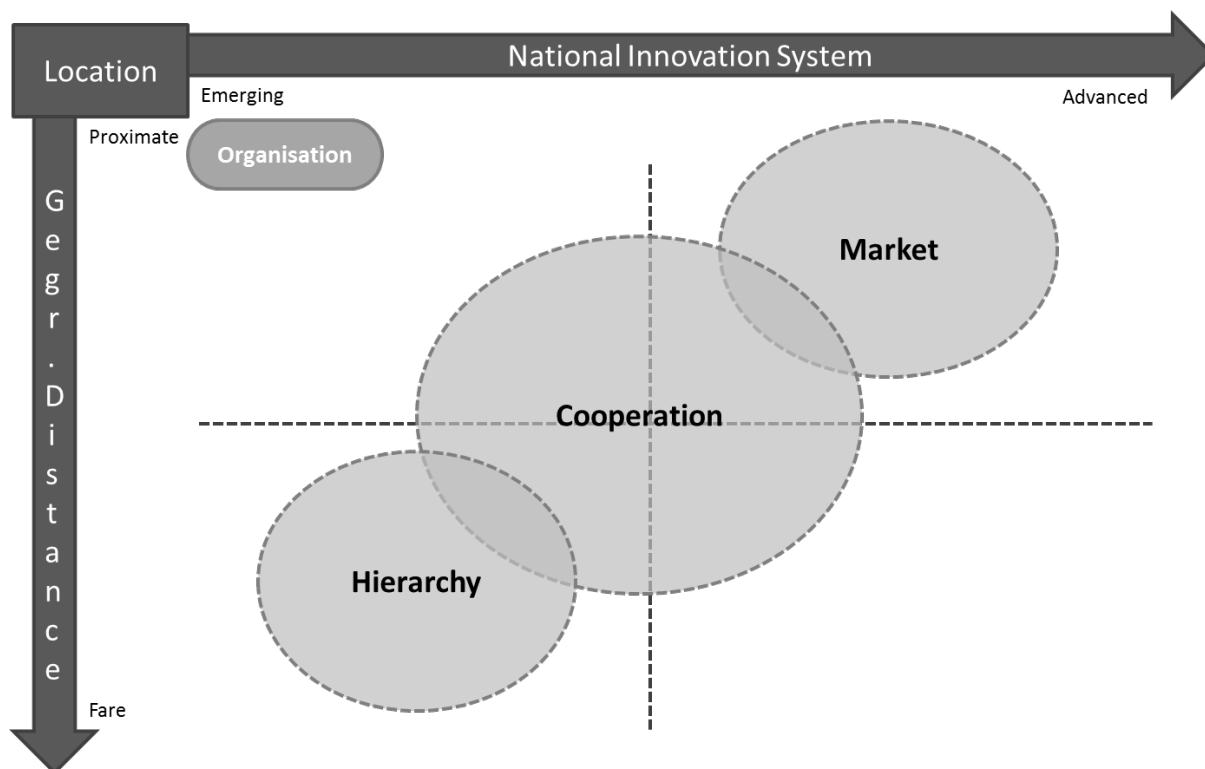


Figure 1: Locational and organisational dimension of R&D activities

Source: own draft

2.2.2 Location of R&D and strategic motives

So far, the literature has mainly focused on motives driving firms to emerging or advanced economies (e.g. Thursby and Thursby 2006), but distance to locations is also important. Advanced economies are not always close and emerging economies are not always distant. We assume that strategic motives and locational choice also reveal a distinct pattern (Figure 2). In advanced and proximate economies, the main driver is knowledge-seeking due to the advanced innovation system and due to cognitive and cultural proximity. At the same time, firms benefit from efficient control and coordination actions in R&D activities. They enjoy a stable policy framework. However, advanced and proximate economies are mainly locations for the first step of R&D internationalisation. This is when path dependency starts, for example routines lead to a continuation of existing R&D sourcing, transaction costs for changing locations are perceived as high, but regional embeddedness of existing activities also leads to continuation. In emerging and proximate economies, production and cost-efficient motives combined with attractive R&D policies are the main drivers. Path dependency is also of lesser importance. Advanced regions at distance are close in cognitive terms, provide mature policy conditions and favour knowledge-augmenting opportunities. However, they offer only limited control and coordination mechanisms. Emerging and distant economies are at cultural and cognitive distance with no path dependency for most of the European firms, but knowledge-exploiting motives (markets, production) and attractive R&D policies are the gravitation points.

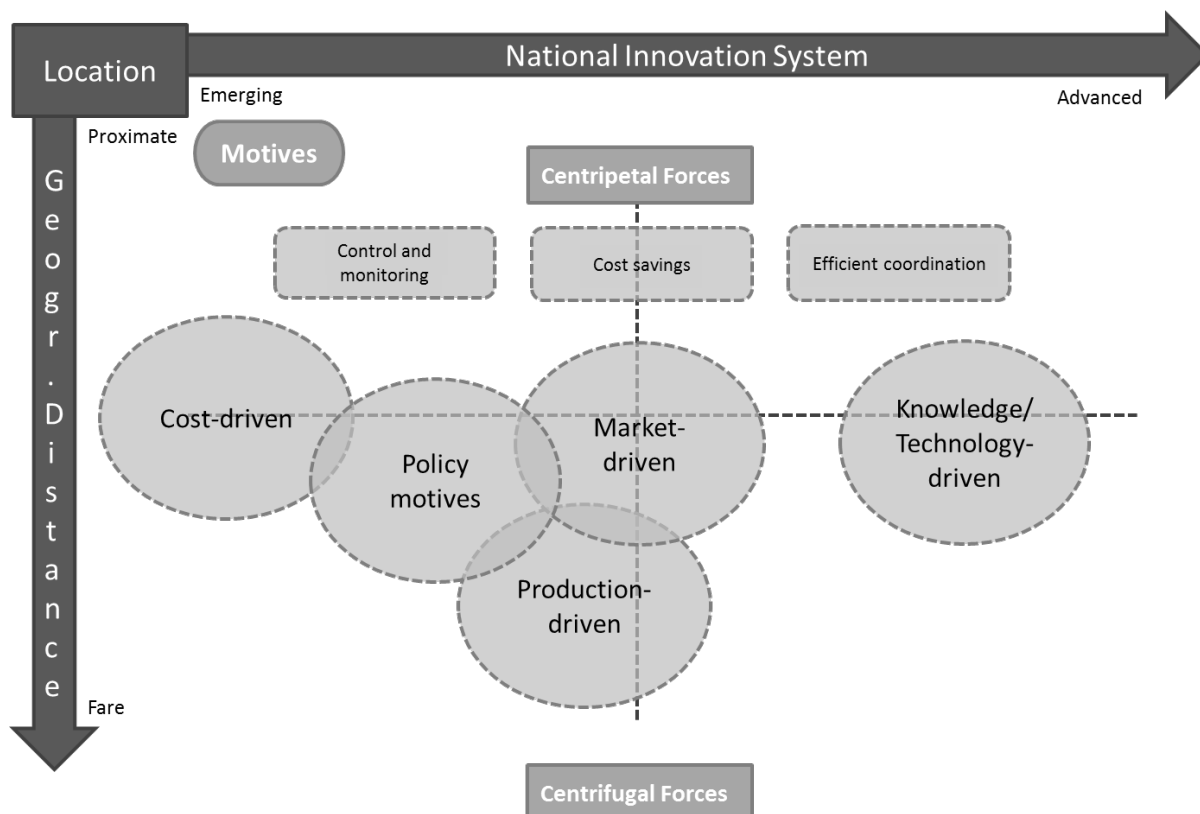


Figure 2: Business and locational perspective on R&D internationalisation

Source: own draft

To access and benefit from knowledge and technology generated abroad, a more open and flexible mode, such as hybrids (cooperation), seems to be more advantageous for firms. For knowledge-exploiting activities, in-house R&D organisation might be profitable to a certain extent.

The picture developed indicates how theoretically existing strands come together in a systematic way to generate a comprehensive explanation for firms' pattern of R&D internationalisation. Strategic motives of firms are interrelated with the organisational choice and the locational decision. Firms seek the optimisation of the three dimensions. In the empirical section, support is delivered, taking the Austrian example to confirm the interrelation of the three strands and the way they shape the observed pattern of R&D activities abroad.

3 Data Sampling and Methods

Data and Methods

The analysis in the following section is based on survey data which was collected in spring and summer 2010 using an electronic questionnaire. The sample consists of all firms that applied for R&D and innovation funding at the Austrian Research Promotion Agency (FFG) from 2005 onwards. All firms within the sample conduct research (incl. basic and applied research) or development activities. The FFG provided a list with names and electronic contact details for about 6,300 firms. After cleaning and (in some cases) supplementing the database, questionnaires were electronically sent to 5,700 firms. About 14% of the email addresses were inactive, hence the actual sample frame was reduced to 5,100 firms. Firms were reminded using first a written (all) and then a telephone (730 firms with more than 10 employees and R&D staff of more than 3 persons according to the FFG database) reminder. As a result, 410 completed questionnaires were received (resulting in an actual response rate of 8%).

The questionnaire consists of six thematic blocs:

- Characteristics of the enterprise (sector, ownership, turnover, employees, access to capital, exports, FDI etc.) and its market environment (number of competitors, information on the type of competition)
- Basic information on R&D activities (R&D personnel, R&D expenditure, type of domestic and foreign R&D)
- Specific questions concerning R&D activities abroad (type of R&D according to location, motives)
- Consequences of the foreign R&D activities
- Obstacles to (more) R&D activities abroad
- Future plans with respect to foreign R&D (according to type and location)

Sample characteristics

About one-third of the enterprises in the sample are small firms with less than 10 employees, 28% have between 10 and 49 employees, 20% between 50 and 249 employees and 19% employ a workforce of 250 or more. The sample mirrors the traditionally high share of SMEs (< 250 employees). Although 19% of firms have more than 250 employees, they are not MNEs, but reflect larger Austrian firms in traditionally strong sectors of the Austrian economy. It is expected that their behaviour is more closely related to the SMEs than to MNEs. Therefore, we do not expect a bias from keeping those firms in the sample. We understand Austrian firms in this sample as SME-like firms.

64% of the firms in the sample are individual enterprises, while the remaining 36% belong to an enterprise group. About a third of these are part of a foreign group, i.e. mainly subsidiaries of German enterprises (43%).

In terms of sector affiliation, slightly more than half of the sample belongs to manufacturing (51%), while 44% of the enterprises offer services¹. A fairly high share of 25% of firms have their main activity in professional, scientific and technical activities (M²) and administrative and support service activities (N). 13% of the firms offer ICT services. The dominating branches within manufacturing are machinery and equipment (C28; 10%) and the manufacture of computer, electronic and optical products (C26; 8%).

Compared to the latest structural business statistics (2008), our sample is biased towards manufacturing and against certain services (construction, retail trade, financial activities etc.). This is a typical situation for R&D activities. Hence, a comparison with the latest R&D survey (2007) shows a certain bias in favour of professional services and against retail/ wholesale trade³.

¹ The remaining 5% stem from sectors such as energy/water supply, construction etc.

² NACE Rev. 2

³ Since the R&D survey 2007 is classified according to NACE Rev. 1.1, a comparison can only be illustrative.

4 R&D Internationalisation of Austrian Firms

SMEs are increasingly following MNEs and internationalising their R&D activities. Austrian firms in general, but also in this particular sample, are predominantly SMEs. SMEs internationalise differently from MNEs due to specific traits. SMEs profit from speed and flexibility, lack of bureaucracy, effective communication and decision-making, close customer ties and the opportunity to niche the market. Rovira Nordman and Tolstoy, (2011) proved for Swedish SMEs that product flexibility can strengthen personal interaction with foreign customers, which in turn enhances technology innovation. But in contrast to MNEs, SMEs have a smaller budget available, have limited access to additional financial resources and only profit partially from economies of scale (EIU, 2011). Therefore, SMEs must develop new strategies and organisational modes to internationalise their R&D activities.

The empirical section is organised as follows. Firstly, the survey findings are presented showing statistics on the R&D locations/partners, organisational modes and strategic motives. Secondly, the three findings are tied together in a network graphic to make patterns visible. Finally, a future outlook is provided on the development of R&D locations/partners abroad.

4.1 Survey Findings of Austrian Firms on Strategic motives, locational choice and R&D organisation

The survey sample for this study is tailored to R&D performers. In Austria, 20% of all firms with more than 9 employees conduct in-house R&D either continuously (12%) or discontinuously (8%) according to the Community Innovation Survey (Figure for 2006-2008; Statistik Austria, 2010). The survey asked firms to indicate their five most important R&D relationships. For each relationship, firms provided information on location, organisational mode and strategic drivers. This enabled us to focus our analysis on the level of R&D relations rather than on the firm level. Firms follow different strategies with different R&D relationships. This fact is taken into account using this approach.

We distinguish between three types of R&D performers: a) **closed and concentrated R&D performers** that only conduct internal R&D domestically, b) **open and concentrated R&D performers** that perform R&D domestically but in an open manner (including R&D cooperation and outsourcing) and c) **international R&D performers** that conduct R&D abroad either internally, externally or in a cooperative way. The three categories mirror an increasing openness and internationalisation from a) to c). While closed and concentrated R&D performers have no R&D activities and no R&D partners abroad, international R&D performers are not limited to R&D performance abroad, but engage in domestic R&D activities in most cases.

Figure 3 indicates the share of R&D performer types according to firm size. Only 13% (n=48) of all R&D firms are organised in a closed and concentrated way. 35% (n=130) are restricted to domestic networks and 51% (n=184) are active on an international level. A comparison according to firm size reveals that SMEs (<250 employees) are less internationally active than large firms, but nevertheless, 46% of firms with less than 9 employees perform R&D activities abroad. The international type is most common regardless of size class. This proves that SMEs

have started to follow MNEs in the internationalisation of R&D activities. It is therefore worth studying where Austrian firms perform their R&D activities and how they organise them.

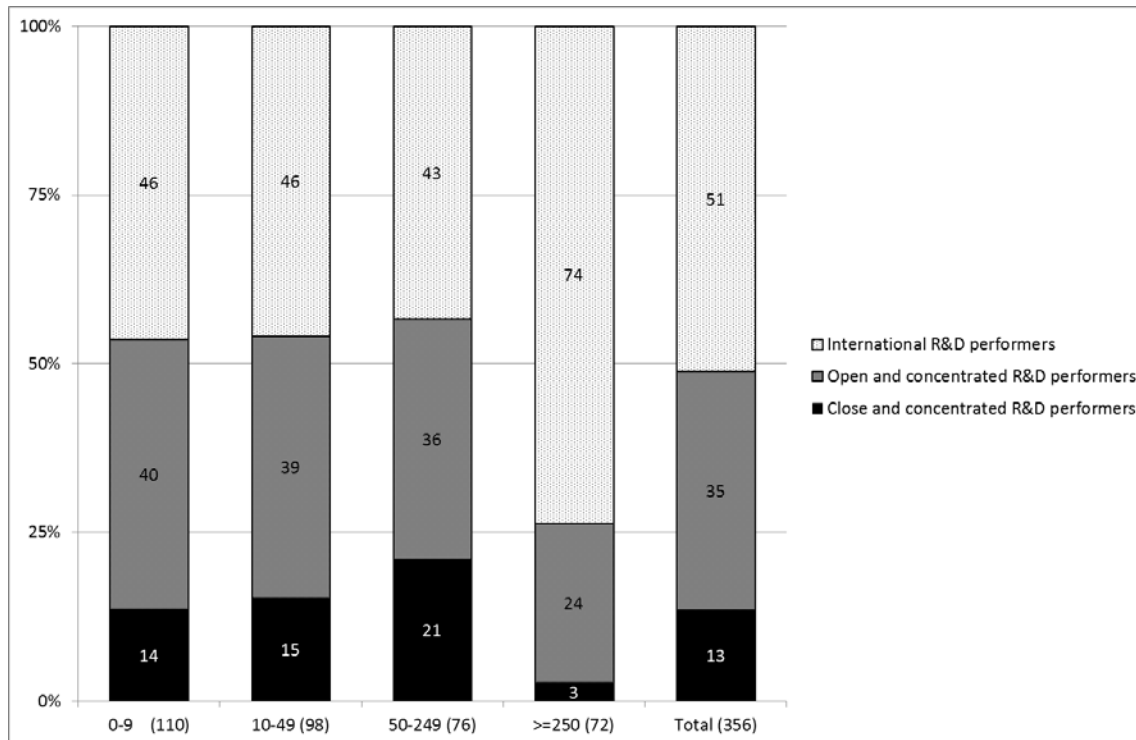


Figure 3: Share of R&D performer types according to firm size (number of employees)

Source: calculations by the authors

In Figure 3 R&D performers were assessed according to their degree of internationalisation measured by the most internationalised R&D relationship among all relations. In Table 1, all relevant R&D relations of Austrian firms are analysed, although one firm can have more than one R&D relationship. The table provides a detailed look at the organisational modes differentiated according to domestic and international R&D. We distinguish between internal R&D (includes all R&D activities that are conducted within the entire enterprise group), external R&D (research that is contracted to external research organisations or enterprises) and cooperative R&D (short or long-term team-building of two or more independent [not capital or legal dependency] enterprises to follow a specific R&D activity). In total, 87% of all R&D performers conduct internal R&D in Austria, 64% have R&D collaboration and 52% outsource R&D. In contrast, internal R&D is the least often pursued activity internationally (16%), while 38% of firms collaborate with foreign partners in R&D and 27% source R&D services from foreign contractors. We can already see how the dominance for organisational modes shifts from internal in domestic R&D to cooperative modes for international R&D activities. Arguments by Mudambi and Tallmann (2010) emphasising a push towards more cooperative R&D can also be confirmed for SMEs. Austrian firms seek cooperative modes to protect and at the same time leverage their knowledge. Moreover, cooperative R&D saves costs for setting up and operating R&D facilities for SMEs, which usually have limited budgets. Another advantage is the flexible and quick reaction to market changes. In general, large firms with 250 employees

or more have a higher share of R&D-active firms over all organisational modes compared to SMEs. A clear size threshold can also be observed for internal R&D. Internal R&D abroad obviously increases constantly with size, while the share of firms with external or cooperative R&D abroad is similar within the SME categories.

Table 1: Organisational mode of R&D activities according to location and firm size

Size	in Austria			International		
	internal R&D	external R&D	R&D cooperation	internal R&D	external R&D	R&D cooperation
0-9	77%	45%	58%	3%	22%	35%
10-49	88%	47%	64%	9%	24%	35%
50-249	95%	51%	57%	20%	20%	32%
>=250	92%	73%	78%	41%	48%	54%
Total	87%	52%	64%	16%	27%	38%

Source: calculations by the authors

In the survey, firms were asked about the locations (country) of their five most important foreign R&D sites, partners and contractors. These were aggregated to country groups. Table 2 underscores the high concentration in Western Europe (EU-15/EFTA) which accounts for 71% of all R&D locations (with Germany alone taking the lion's share of 41%), followed by Eastern Europe (New Member States (NMS) and Central and Eastern Europe (CEE)) with 14%. Hence, we are witnessing a clear distance decay function. This seems to be stronger for R&D collaboration and external R&D, which is reasonable since R&D requires some sort of geographic and cultural proximity. Internal R&D is more spatially dispersed, even though it is still strongly focused on Europe, with 70% of all locations being in Europe. The higher share of internal R&D locations in Asia and North America indicates, on the one hand, the need to set up one's own facilities in places which are far away from headquarters, since direct communication (travelling) is more time-consuming and costly. On the other hand, it reflects different strategic motives for each type of R&D internationalisation (see below).

Table 2: Geographic distribution of international R&D activities

	Internal R&D		External R&D		Cooperative R&D		Total	
	n	%	n	%	n	%	n	%
EU-15/EFTA	49	49%	125	73%	307	76%	481	71%
NMS/CEE	21	21%	21	12%	52	13%	94	14%
Asia	15	15%	8	5%	12	3%	35	5%
NAFTA	12	12%	12	7%	26	6%	50	7%
South/Central America	3	3%	1	1%	2	1%	6	1%
Africa	0		0		1	0%	1	0%
Oceania	1	1%	4	2%	2	1%	7	1%
Turkey/Middle East	0		1	1%	4	1%	5	1%
Total	101	100%	172	100%	406	100%	679	100%

Source: calculations by the authors

Table 3 shows the average number of foreign R&D partners/locations per firm according to firm size. While micro firms have on average only 1 R&D location or partner abroad, firms with 50-249 employees have 1.5 locations/partners on average, and for larger firms this number rises to 3.5. As expected, the number increases with firm size, since larger firms have more internal resources to organise foreign R&D activities. Moreover, Table 3 displays the regional distribution according to firm size (for any organisational mode of international R&D). The concentration on Europe can be observed for SMEs as well as for larger enterprises. Spatial proximity plays a vital role in decisions for R&D locations/partners. Locations/partners in advanced but distant economies such as NAFTA or Oceania are mainly limited to larger and sometimes medium-sized firms. In contrast, locations/partners in emerging and distant economies such as Asia are equally interesting for all firms regardless of size, except micro firms. Comparing SMEs and large firms, they are on equal footing in terms of conducting R&D activities in proximate economies in Western and Eastern Europe and in emerging economies in Asia. Large firms have a clear dominance in setting up R&D activities in advanced and distant economies.

Table 3: Geographic distribution of international R&D according to firm size

	Number of employees				Total
	0-9	10-49	50-249	>=250	
EU-15/EFTA	68%	74%	70%	71%	71%
NMS/CEE	21%	15%	10%	12%	14%
Asia	3%	5%	9%	5%	5%
NAFTA	5%	6%	4%	11%	7%
South/Central America	1%	0%	3%	1%	1%
Africa	1%	0%	0%	0%	0%
Oceania	0%	0%	3%	1%	1%
Turkey/Middle East	1%	0%	1%	0%	1%
Responses*	136	148	115	273	672
Cases	132	110	79	78	399
Average number of R&D locations/R&D partners per firm	1.0	1.3	1.5	3.5	1.7

*number of foreign R&D locations and R&D partners

Source: calculations by the authors

We expect different organisational modes to be associated with different strategic drivers. Figure 4 presents strategic motives and their dominance in different organisational modes. Market/production motives are displayed in white, knowledge-related motives are displayed in grey and cost-related motives are displayed in black. When firms wish to support their production facilities abroad with R&D services on location, they tend to opt for having their own R&D laboratories. R&D cooperation or external R&D becomes less important in this case. Two-thirds of the respondents named supporting the production abroad and the relevance of the host market as the most important reasons when setting up internal R&D facilities. Production requires a customisation of products for specific markets. These innovations call for R&D activities conducted directly in the target country. This is at least partly a reflection of the fact

that R&D centres are often the climax of a stepwise upgrading process of local production sites which gain functions and responsibilities over time. This would also explain why the share of internal R&D in Asia and North America is relatively high (compared to other external and cooperative R&D): these are major markets that already host production sites which – due to distance – can only partly be supported by R&D facilities (and staff) at the headquarters location. Knowledge-augmenting strategies are most likely to be realised in international R&D cooperation or external relations: expertise of the partner and the combination of supplementary knowledge are by far the most important reasons for these types of foreign R&D activities. The open and flexible modes of cooperation and contracts in particular support the generation and back flow of knowledge to the firms.

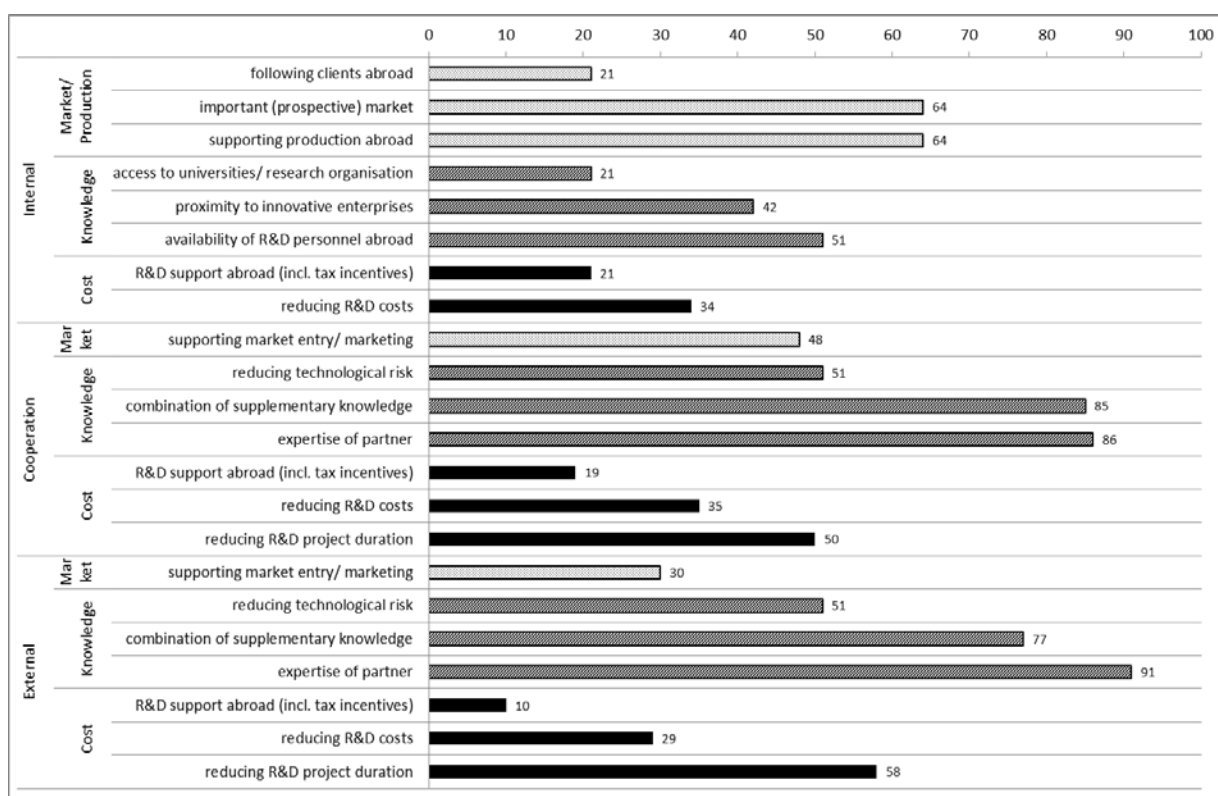


Figure 4: Share of firms assessing the following motives as important/very important for international R&D

Source: calculations by the authors

4.2 Internal R&D on The international level

Strategic motives drive the locational choices as well as the organisational modes. A specific spatial pattern occurs when matching location and strategic motives. This exercise is conducted separately for internal and external/cooperative R&D at the international level.

For internal R&D abroad, our sample encompasses 53 firms that have R&D facilities abroad and that shared the information on the location of these facilities. In total, these 53 firms operate 101 R&D facilities abroad (ranging from 1 to 5⁴ sites per enterprise). As mentioned above, two-thirds of all internal R&D locations are concentrated in Europe (one-fifth in Germany) (Table 4).

Table 4 Number of foreign R&D sites according to region

	Freq.	Percent
EU (old)/EFTA	49	49%
- Germany	22	22%
NMS/CEE	21	21%
Asia	15	15%
NAFTA/ Oceania	13	13%
- US	10	10%
ROW	3	3%
Total	101	100%

Source: calculations by the authors

For about 90 R&D sites, the respondents answered questions about individual motives (min. 87; max. 91). The network diagram in Figure 5 shows the distribution of motives according to (aggregated) location, which allows for a distinct characterisation of each location. These selected locations have the following stereotype-like characteristics according to the development of the innovation system and locational distance: (1) EU-12/EFTA: advanced and proximate, (2) NME/CEE: emerging and proximate, (3) Asia: emerging and distant, (4) NAFTA/Oceania: advanced and distant. In Figure 5, the continuous line indicates proximate economies and the dashed line distant economies. Furthermore, the black line characterises advanced national innovation systems, and the grey line emerging national innovation systems.

An analysis of strategic drivers for R&D sites in advanced/emerging and proximate/distant innovation systems revealed the following pattern: In general, the most important drivers of internal R&D abroad over all countries are important prospective markets. The internationalisation of internal R&D of Austrian firms to advanced and proximate locations within EU-12/EFTA is mainly driven by the availability of R&D personal (quality issue), by the proximity to innovative enterprises and by excellent market perspectives. Furthermore, the access to universities and research organisations is important, although it is not the most important motive. In short, access to knowledge and markets mainly drives Austrian firms to advanced and proximate economies. Locations within NAFTA/Oceania (also advanced innovation system, but distant) are mainly accessed through internal R&D because support of production abroad is necessary. While knowledge-augmenting is a driver towards countries with an excellent innovation system in proximity, it is not necessarily a driver when countries are distant. Classic knowledge-exploiting motives (according to Kuemmerle, 1999) drive Austrian firms to set up internal R&D in advanced and distant economies. Strategic motives to enter locations within the NMS/CEE are again the support of existing production facilities and the

⁴ The questionnaire asked about the max. 5 most important R&D sites

exploitation of new markets, but also the reduction of R&D costs. Locations in Asia are mainly driven by market perspectives, reduction of R&D costs and the support of production facilities. Policy-related motives (e.g. tax incentives) are of minor relevance for decision-making.

In a more general way, we conclude that in *advanced economies* (EU-12/EFTA, NAFTA/Oceania), knowledge-augmenting is the most important driver, albeit distance-sensitive as indicated by the low scores for North America and Australia. In *emerging economies* (NMS/CEE, Asia), cost reduction takes the first place. Moreover, market arguments such as the importance and growth potential also favour these locations. Production in *distant locations* (NAFTA/Oceania, Asia) requires local R&D support teams. Remote places are far more difficult to serve from headquarters in Europe.

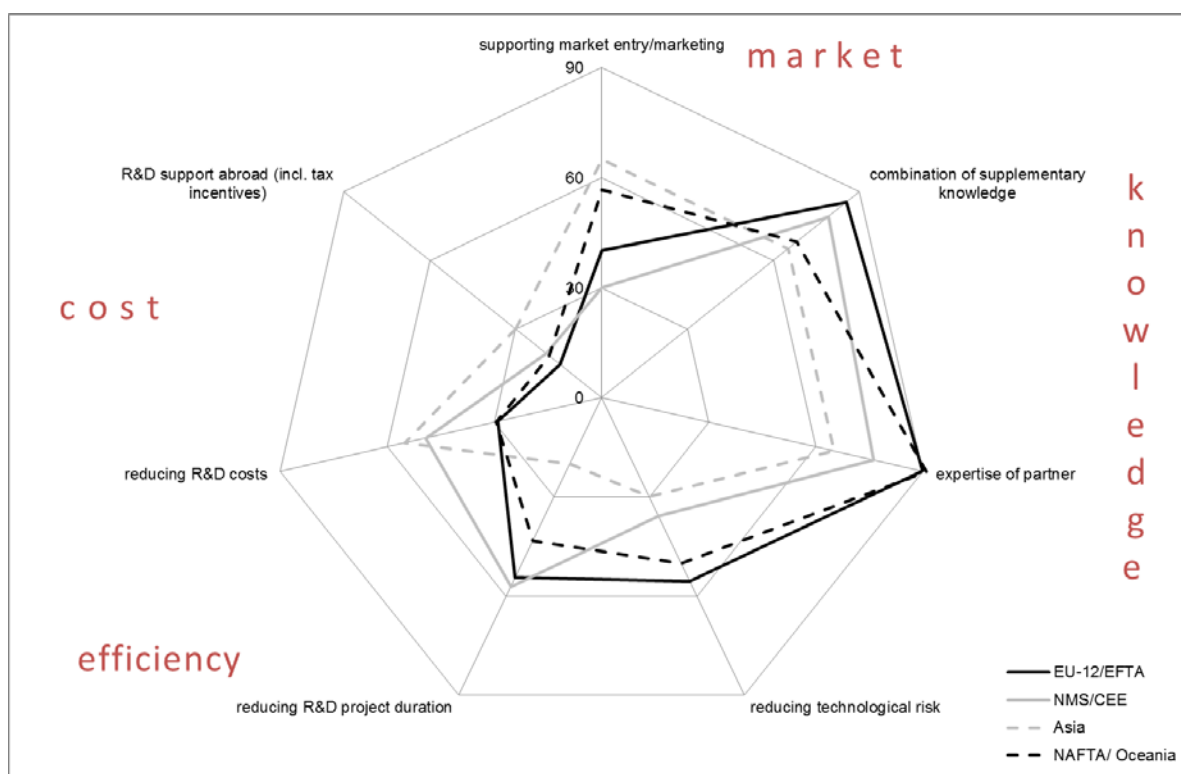


Figure 5: Share of internal R&D sites for which the following motives are (very) important according to region

Note: black/grey line: advanced/ emerging innovation system; continuous/dashed line: proximate/distant locations

Source: calculations by the authors

4.3 Cooperative and external R&D on The international level

In a second step, we analyse the motives according to location for a combined sample of cooperative and external R&D. In total, the sample includes 161 enterprises with 572 R&D

relationships abroad, either cooperative or external; ranging from 1 to 10⁵ partners per enterprise. These external R&D ties with foreign partners are even more concentrated in Europe than foreign internal R&D sites (Table 5). This will at least partly be due to the participation in EU-sponsored research projects of the European Framework Programme, which are open for research organisations and enterprises alike.

Table 5: Number of foreign R&D sites according to region

	Freq.	Percent
EU (old)/EFTA	427	75%
- Germany	254	44%
NMS/CEE	72	13%
Asia	20	4%
NAFTA/ Oceania	44	8%
- US	33	6%
ROW	9	2%
Total	572	100%

Source: calculations by the authors

For about 550 R&D partners, the respondents indicated individual motives for collaboration/contracting (min. 550; max. 556). Figure 6 presents that knowledge factors (expertise of partners, reducing technological risk, supplementing knowledge) are dominant in Western Europe (EU-12/EFTA) and North America, and partly in NMS/CEE. In comparison to internal R&D, knowledge-augmenting is not only realised in proximate economies, but also in *distant economies*. Cost aspects favour R&D outsourcing and cooperation in *emerging economies* such as Asia and Eastern Europe. Market arguments are stronger motives for collaboration with *remote partners* in Asia and North America/Oceania. Efficiency gains are mainly expected through working with *partners in proximity* (Western and Eastern Europe) due to better control and coordination mechanisms.

⁵ The questionnaire asked about the max. 5 most important R&D cooperation partners and the max. 5 most important R&D contractors.

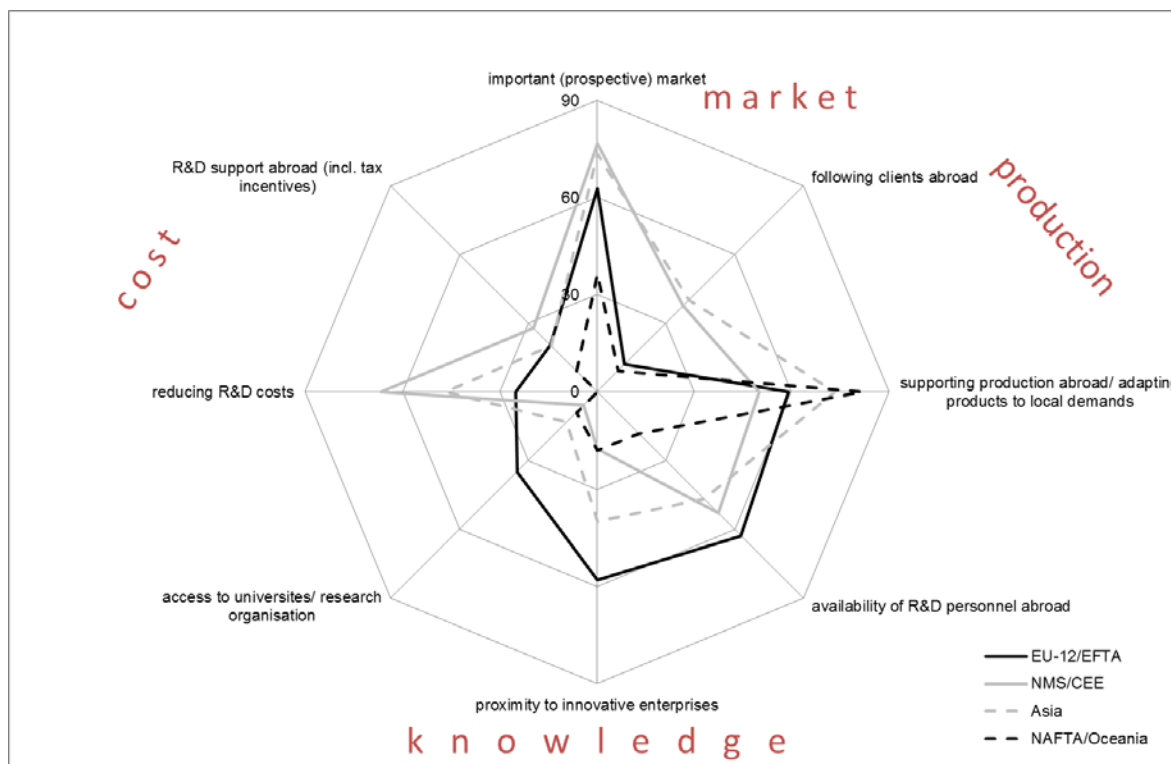


Figure 6: Share of external/cooperative R&D partners for which the following motives are (very) important according to region

Note: black/grey line: advanced/ emerging innovation system; continuous/dashed line: proximate/distant locations

Source: calculations by the authors

We were able to reveal a specific pattern of strategic drivers that determine the location as well as the organisational choice of international R&D activities of Austrian firms. As expected from the theoretical discussion, the main driver for R&D activities in economies with an advanced national innovation system (such as Western Europe or North America) is knowledge-augmenting. This is true for cooperative and external R&D, but only to some extent for internal R&D. The open mode of cooperation promises greater knowledge gains and better complementation of knowledge. In contrast, the reduction of R&D costs are mainly realised in emerging economies such as Eastern Europe or Asia. This is true for all kinds of R&D organisation – internal, cooperative and external. If firms wish to access prospective markets to benefit from economic growth, they seem to prefer their own R&D locations. In that case, R&D internationalisation follows a stepwise approach. In proximate economies, firms obviously start with market observation and supply from headquarters before they set up their own R&D facilities. In distant economies, firms have no opportunity to observe R&D development from the headquarters location - they use cooperative and external R&D. Later, they switch to a continuous presence of R&D activities. This is especially true if firms operate production plants in distant economies that require R&D support. Control and coordination of market and production favours internal R&D, especially in remote areas. Firms generally start with less risky activities in proximate countries and if successful, they gradually expand to more risky

and distant economies (Ambos and Ambos, 2011). In the case of Austria, Germany is the most important location for R&D internationalisation. These R&D locations/partners still exist. Especially for SMEs, scarce financial resources and limited management experience need to be developed before going to new locations. Cognitive and cultural proximity ease coordination. Knowledge can be supplemented in an efficient way. This research confirms findings presented by the OECD (2008), but contributes detailed insight as to which strategic drivers influence location choice and organisational mode.

4.4 Future R&D locations

Austrian firms were also asked to provide information on their plans to increase or newly generate internal R&D activities abroad in the next 3 to 5 years. The figures show strong inertia of existing patterns (Table 6). We made a distinction here between firms with experience in already existing internal R&D activities abroad and those without. Firms which currently do not have internal R&D abroad tend to focus on Europe (especially Western Europe), whereas firms that already run their own R&D facilities abroad have a higher likelihood of setting up R&D sites in Asia. This can be seen as a clear indication that the internationalisation of R&D is a gradual process in which firms start in regions which are in geographic and/or cultural proximity. Setting up facilities further away (with a more uncertain legal and cultural environment) requires experience. This development obviously depends on size. Larger firms with (more) internal R&D sites abroad have better knowledge and resource endowment to afford the establishment of further locations in Asia than, for example, micro firms or small firms.

Table 6: Planned destinations for internal R&D

	all		Firms with internal R&D abroad		Firms without internal R&D abroad	
	n	%	n	%	n	%
EU-12/EFTA	77	49	29	45	48	53
NMS/CEE	39	25	14	22	25	27
Asia	21	13	16	25	5	5
NAFTA	11	7	4	6	7	8
ROW	8	5	2	4	6	6

Source: calculations by the authors

5 Conclusion

This article focuses on the R&D internationalisation of SMEs. In many countries, SMEs are the backbone of the national economy. Some studies already hint at the fact that SMEs have started to discover new innovation markets abroad (Economist Intelligence Unit 2011). SMEs, in comparison to MNEs, have different circumstances for the internationalisation process. They have limited financial resources, limited experience abroad and restricted management capabilities. On the other hand, they profit from speed and flexibility, lack of bureaucracy, effective communication and decision-making, close customer ties and the opportunity to niche the market. Therefore, SMEs could have their specific strategies and methods of R&D internationalisation. The purpose of this research is to extend research on the internationalisation of business R&D while looking into strategic drivers, locational choice and organisational forms of SMEs. In the conceptual part, the interlinkages of strategic drivers for R&D internationalisation, organisational modes and locational choices are discussed. The empirical part delivers evidence from Austria.

About half of the Austrian firms surveyed perform international R&D activities. SMEs are rapidly following MNEs in R&D internationalisation. If Austrian firms perform international R&D, they prefer an external or cooperative form of R&D organisation over the establishment of internal R&D. This is due to the limited financial resources, but also due to the traits of knowledge that allow firms to benefit from more open-access modes (high value, highly tacit, highly transaction-specific investments, etc.). Over 70% of international R&D activities are located in Western Europe, particularly in Germany, followed by Eastern Europe (14%). Only a few activities could be identified in North America and Asia. R&D activities abroad follow a clear distance decay function, as R&D needs some sort of spatial and cultural proximity. Nevertheless, internal R&D activities are more spatially dispersed than cooperative or external R&D activities. There are two reasons for this. Firstly, if locations are spatially distant, uncertainty and transaction costs increase and firms prefer hierarchical structures. Secondly, internationalisation is a stepwise process. SMEs start to perform R&D activities in countries within spatial proximity. If they collect sufficient experience on the learning curve, they step forward to more distant economies in terms of space and culture. Locations in distant, but advanced economies (such as NAFTA/Oceania) are already being accessed by larger firms, but less often by small firms. Distant and emerging economies, such as in Asia, are of equal interest for SMEs. Distinct strategic drivers and choice of R&D locations are related to internal and cooperative/external R&D activities.

Internal R&D activities: If Austrian firms intend to gain new innovation markets regardless of where they are in the world, they opt for an internal R&D organisation, as this is long-term-oriented. If firms plan to improve their R&D performance, they prefer to set up R&D facilities in countries with an advanced national innovation system in spatial proximity (Western Europe). If SMEs wish to reduce costs, they prefer emerging economies such as Eastern Europe and sometimes Asia. Internal R&D is also a preferred organisational mode if firms wish to support existing production facilities in distant locations. This is also the main motive for them to go to the US.

Cooperative/external R&D activities: Cooperative or external R&D is the preferred organisational form if Austrian firms wish to source knowledge from advanced economies. This method is used to augment knowledge from overseas as well as in Western Europe. In contrast, companies' own R&D facilities are not an alternative if SMEs wish to tap into knowledge in distant economies such as the US. The open and flexible mode is most suitable if firms absorb new knowledge. Cost reduction is realised in Asia or Eastern Europe. Firms targeting the combination of supplementary knowledge and increased efficiency (e.g. project running time) prefer specific locations in spatial proximity in Eastern or Western Europe.

Policy-related motives (e.g. tax incentives, innovation support programmes) are not strategic drivers for the internationalisation process of SMEs.

A future outlook shows that Western Europe will remain the most important location for internal R&D of Austrian firms in the next 3-5 years. New facilities and expansions will mainly be concentrated in Eastern and Western Europe. Only firms with existing internal R&D abroad plan to set up R&D in Asia. Future activities will be guided by path dependency characterised by strong experience in Western Europe and a stepwise internationalisation and learning process. An interesting continuation of this kind of research would be a longitudinal study to observe temporal changes and developments.

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