THE ENTRY OF FIRMS' STANDARD DEVELOPMENT RESOURCES IN FOREIGN COUNTRIES

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ABSTRACT

Standard developing organizations (SDOs) are voluntary inter-firm collaborations with the goal to develop jointly global standards for modular technological systems. This paper proposes to examines the determinants of the decision to locate SDO resources into foreign countries based on country, firm and SDO characteristics. In particular it addresses the question how the presence of the SDO within a country influences the entry choice motives taking firm heterogeneity into account. It builds on three streams of literature: the motivations and characteristics of SDOs, organizational learning and internationalization of R&D. I pan to test the model in the context of cellular telecommunications. The model has important implications on countries and their involvement in standard setting and on firms' strategies contingent on their position and tenure within the SDO.

Keywords: Standard developing organizations, organizational learning, internationalization of R&D, location choice, motives of entry

INTRODUCTION

Standard developing organizations (SDOs) are voluntary inter-firm collaborations with the goal to develop jointly compatibility standards – often on a global base — for modular technological systems. The major rationale for the coordinated technology development is the need for compatibility of components of the technological system from different manufacturers and the economies of scales that can be gained via network externalities (David and Steinmueller, 1994).

While standard-setting via organizations was first studied by economists (Katz and Shapiro, 1986; Farrell and Saloner, 1988), in recent years SDOs gain also attention by management scholars. They have examined topics such as: the factors that drive the decision for a standard (Weiss and Sirbu, 1990); the choice of specific SDOs by firms to get their standard adopted (Lerner and Tirole, 2006); SDOs as information source on future alliance partners (Rosenkopf et al., 2001) and success factors within a given SDO (Leiponen, 2008).

SDOs have a strong presence in information and communications industries with the need to compatible systems. Chiao et al. (2007) identified in their study on different rules within SDOs more than 60 SDOs. Sample members are e.g. the Internet Engineering Task Force (IETF) that standardizes internet protocols, International Telecommunication Union (ITU) that coordinates international telecommunication standards since nearly 150 years and the European Telecommunication Standardisation Institute (ETSI), responsible for standardization for telecommunication in Europe and the originator of the Global System for Mobile Communication standard (GSM).

SDO resources are the delegates in these meetings. They act on behalf of their affiliated firm. SDO activities are the participation in and contribution to the standard development in regular meetings of the SDO via delegates, the SDO resources. SDO activities are part of the R&D function at a rather late stage of research respectively very early stage of development — they are the linking ampersand of R&D.

Though SDOs are becoming increasingly ubiquitous by diffusing into other industries as

utilities, transport and health (EPRI, 2009; ETSI, 2010) and global technical standards have important implications for the respective firms and countries, there is no research done to my knowledge on the internationalization of SDO activities. Internationalization refers to the internationalization of the office location of the delegates, not to the location of the meetings. The purpose of this paper is understand the determinants for a firm's decision to locate SDO resources, i.e. individual delegates, in a foreign country. Entry of a firm's SDO activity is the first appearance of a firm's delegate who is located a given country. It addresses in particular the question, how the presence of the SDO within a country influences the entry choice motives. This study combines the literature of SDOs and the internationalization of R&D activities with its different motives of knowledge and market seeking for location choice (Cantwell, 1989; Granstrand et al., 1993; Kuemmerle, 1999; Cantwell and Mudambi, 2005).

In addition to the importance of SDOs for their own sake, SDOs provide an interesting setting with respect to learning, knowledge flows and adaptations to local requirement: First, the SDO is a locus of external learning with exploitation and exploration simultaneously along the dimensions of the technological and geographic space and across the value chain (March, 1991; Li et al., 2008). Second, delegates to SDOs meet regularly to propose, discuss and decide on technical proposals (Rosenkopf et al., 2001; Leiponen, 2008) — leading to a rather free knowledge flow on a global level, challenging the paradigm of localization of knowledge flows (Jaffe et al., 1993). Third, the fact of a global standard inhibits the adaptation of existing products to local needs — local requirements must be fed into the early stage of standard-setting in order to be considered. These factors lead to unique setting regarding the motives of international R&D.

The paper's contributions to the IB literature is the introduction of SDOs as a new governance form in the IB context and their impact on the internationalization of the according activities. In the next section I review the literature and develop the hypothesis. I finish with a short discussion of next steps and potential conclusions.

THEORY AND HYPOTHESIS DEVELOPMENT

First I review the three streams of literature — SDOs, organizational learning and internationalization of R&D — and then I develop the hypothesis of the model.

Standard developing organizations

The literature on standard setting by committee or organization started about 25 years ago with a strong economic focus based on network externalities of compatibility standards for complex technological systems (Katz and Shapiro, 1986; Besen and Farrell, 1994). Using a simple economic model, Farrell and Saloner (1988) showed that committee-based standard setting can be more efficient than market-based because the market may fail to choose a single standard and economies of scale due to network externalities will be limited.

The economic importance of SDOs extends beyond the industry level, where it is driven by network externalities, to the single firm participating in the SDO[1]. The participation in the SDO has costs and benefits for the participating firm. The costs are two-fold: the direct participation costs via the staffing and travel costs of delegates or hosting of meetings and the potential indirect costs of loosing valuable technological knowledge (Rosenkopf et al., 2001). These costs are balanced by two major advantages (Rosenkopf et al., 2001; Leiponen, 2008; Waguespack and Fleming, 2009): (1) Firms can influence the standard and get their proprietary technological know-how implemented. (2) Firms can gain visibility as legitimate actor within the SDO. The potential risk of loss of technology is mitigated by patent protection and can result in substantial royalty fees for the owner of the intellectual property rights (IPRs). Firms employ different ways to gain and use advantageous IPR positions. Bekkers et al. (2002) study the early development of second generation mobile telecommunications and show how strong IPR positions are reflected in building alliances and finally market share. Firms may leverage their SDO-external relationships in alliances or membership in other SDOs to shape the success in a given SDO (Leiponen, 2008).

SDOs also serve other purposes than standard development. It is an opportunity to learn

[1]Depending on the SDO members can be either individual people or organizations. I study SDOs with firm membership where individual delegates act on behalf of their affiliated organization

about other firms and their capabilities — the SDO can function as a dating market where joint meetings and collaboration leads to future alliances (Rosenkopf et al., 2001) or increases the likelihood of IPO or acquisition for participating start-ups (Waguespack and Fleming, 2009).

While SDOs have attracted attention of management scholars, the IB literature is still more or less silent about standard setting activities in international context despite the importance of global technical standards on the global diffusion of technology and international trade. A recent exception is Dunning and Lundan (2009) who stress the pivotal role of MNCs in the international standard setting process. In summary, while the strong influence of standards and SDOs on industry is widely studied and impact on firm level received more attention, the impact on country or regional level and the interplay with MNCs is rarely addressed. The understanding of this phenomenon gains importance with the diffusion of the organizational form of SDO in other industries.

Organizational learning

March (1991) introduces the distinction between exploitation and exploration in organizational learning. Exploitation is based on the current knowledge base and its refinement and is associated with rather low uncertainty. In contrast exploration targets the unknown which inherently includes a high level of uncertainty. The balance between exploitation and exploration are important for organizations' sustainable innovation performance: exploration allows for novelty, exploitation for stability and efficiency. Tushman and O'Reilly III (1996) coined the term ambidextry, for the balance between exploitation and exploration. The importance of ambidextry for innovation performance was shown in several empirical studies (Katila and Ahuja, 2002; Raisch et al., 2009)

The concept of exploitation and exploration has gained wide traction with the effect that the definitions are used loosely and a variety of different interpretations have occurred. Based on an extensive review of the literature on the different definitions of the concept, Li et al. (2008) develop an unifying framework of exploitation and exploration, extending the dis-

tinction between type and amount of learning as discussed by Gupta et al. (2006) with the goal to reconcile the various interpretations. They distinguish between two domains, where exploitation and exploration can occur: the "function domain" and the "knowledge distance domain". In the "function domain" learning crosses various functions along the value chain as upstream and downstream activities in alliances (Lavie and Rosenkopf, 2006) or the linkage of technological competence and customer competence for product innovation (Danneels, 2002). In SDOs firms with different roles in the value chain participate — providers and users of technology — leading to bi-directional knowledge flow across functions in the value chain with the important input of future market needs. In the case of cellular telecommunication there are for instance three major groups of participants: component suppliers as semiconductor producers, equipment and cellphone vendors and network operators. In the "knowledge distance domain" the distinction is between local and distant search. The knowledge distance domain covers two spaces: the technological/cognitive and spatial/geographic space. Technological distance is for instance one of the dimensions used by Rosenkopf and Nerkar (2001) in their 2 by 2 typology of learning. The geographic dimension plays an important role in the spillover and knowledge flow literature (Saxenian, 1994; Almeida, 1996) and is to a large degree the motivation for R&D internationalization as discussed in the next section. With a large population of participating firms of often more than 50 or 100 firms there is a large variation in the technological capabilities allowing for local and distance search. In addition the development of a global standard attracts members from different regions leading to a high geographic variance. Both allow for local and distant search.

Internationalization of R&D

The focus of the early IB literature was the exploitation of firm and home location advantages in the host country with market-seeking, efficiency and resource seeking motives (Hymer, 1976; Vernon, 1966; Dunning, 1993). In this framework R&D activities in foreign locations were marginal compared to headquarter activities and mainly targeted to adapt existing products to the local market or support manufacturing in the host country.

In the last two decades, a new motive for foreign R&D locations has emerged, the search for new knowledge and competences (Cantwell, 1989; Kuemmerle, 1999; Pearce, 1999). In the literature this new motive for R&D activities is reflected in the distinction between two types of R&D subsidiaries, competence-exploiting (CE) and and competence-creating (CC) (Cantwell and Mudambi, 2005) or home-base exploiting and home-base augmenting (Kuemmerle, 1999).

The early, comprehensive framework of motives by Granstrand et al. (1993) discusses besides motives for centralization of R&D the motives for decentralization with the distinction the demand- and supply-side. Demand-side motives include the adaptation to the tastes of foreign markets, technical support for large manufacturing and potential regulatory requirements. Supply-side motives are the access to scientific and technological knowledge and potential cost advantages. In a similar way Gammeltoft (2006) concludes six drivers: market, production, technology, innovation, efficiency and regulation which can also be grouped into the broad categories of supply- and demand-side. These two broad motives for performing R&D in subsidiaries is the competence-exploiting (CE) and competence-creating (CC) mandate (Archibugi and Iammarino, 2002; Cantwell and Mudambi, 2005; Cantwell and Piscitello, 2005) or home-based exploiting and home-based augmenting (Kuemmerle, 1999). While early studies focused mainly on location characteristics, more recent studies examine the influence of firm heterogeneity on the location decision. The leadership of a firm influences the co-location with competitors. While leaders shy away from strong competitors, laggards are attracted by potent players (Cantwell and Mudambi, 2003; Alcácer and Chung, 2007).

In the literature the two major groups of determinants in the location choice for entry are the country and firm characteristics. The major claims of this study is, that the presence of the SDO in the country mediates the country characteristics with firm heterogeneity moderating the relationship of SDO presence and entry of resources. I proceed following: first, I examine the influence of location characteristics, then the mediating effect of the SDO presence in the country and finally the moderation by firm heterogeneity. In addition I

suggest to control for several country and firm specific attributes guided by previous research.

Location characteristics

Due to the specific setting of SDOs, a knowledge-intensive activity and the need to feed in specific market requirements into this early stage, supply and demand side motives are relevant. On the supply side access to knowledge and trained personnel is important, on the demand side the market and its needs. The early literature of aggregation economies by Marshall (1920) establishes three mechanisms for the externalities due to agglomeration: knowledge spillovers, access to a skilled labor pool and intermediate product markets. While the latter is not applicable for SDO participation as it is a pre-product activity, the former two are relevant.

Knowledge spillovers are geographically constrained, which induces firms to collocate closely to the knowledge sources (Jaffe et al., 1993; Almeida, 1996). Tapping into the local knowledge pool as a determinant of the globalization of R&D is now well established. Pearce (1999) suggests an evolution of R&D labs with greater independence and more important role for the development of MNC competence development by accessing the local knowledge base. Chung and Alcácer (2002) show in their study of FDI entries into US that research-intensive industries are more likely to locate in states with high R&D activities. Shimizutani and Todo (2008) confirm the distinction between CC (basic and applied research) and CE (design and development) subsidiaries for Japanese R&D overseas investment and the motivation to access knowledge.

SDO activities are the link between research and design and the development of a technological standard requires sophisticated technological know-how. Following the logic of prior research that research-related activities are prone to seek for knowledge, I argue that firms have the motivation to locate some of these activities into foreign centers of knowledge and expertise.

Hypothesis 1a: A higher level of technological capabilities of the host country has a positive influence on the entry of a firm's SDO resources.

The importance of the access to a skilled labor pool is confirmed by empirical work on CC activities. Florida (1997) in his survey of R&D labs in US finds that "gain access to scientific and technical talent" is very important for nearly three quarters of the sample. Access to human capital is found to be the central motive for the R&D labs rather than mere monitoring of technological activities or more CE activities as adaptations to the local market. Similarly Kumar (2001) confirms a positive relationship between the availability of engineers and foreign R&D investment in his study of US and Japanese foreign R&D.

While most of the past foreign R&D locations and the research was focused on the triad regions of US, Western Europe and Japan with a highly trained work force, recent trends in R&D globalization see a shift to Asia Pacific (Huggins et al., 2007). A recently emerging topic is the search for scientific and engineering resources in emerging countries due to the vastly increasing numbers of scientific and engineering graduates (Manning et al., 2008) or the global race for talent (Lewin et al., 2009). The need for qualified personnel is confirmed by a recent study by the management consulting firm McKinsey on the core drivers of globalization: managers in North America and Europe ranked R&D/product development as that function where recruitment of talents will be most difficult (McKinsey, 2010).

The SDO activity where experts have to develop, present and defend technological proposals requires sophisticated technological skills. Most of the delegates are either engineers, physicists or trained in related subjects. There is a considerable degree of PhDs among the delegates. Access to talented and trained people is therefore crucial for the success within the SDO. Firms will choose to locate SDO resources close to pools of highly trained resources.

Hypothesis 1b: The level of human resources of the host country has a positive influence on the entry of a firm's SDO resources.

The demand-side motivation for SDO activities is less the direct market-seeking as for sales and marketing activities, but the seeking of market knowledge. von Hippel introduces the concept of lead customers: "Lead users are users whose present strong needs will become general in a marketplace months or years in the future." (von Hippel, 1986, page 791).

Furthermore he posits that lead users derive great benefits for obtaining solutions to their needs. Gertler (1995) studies the importance of the intensity of user-producer-interaction and the closeness between the both parties — in spatial, cultural and organizational dimension — in capital goods industries for the successful development and adaptation of innovations. He argues that the longevity of capital-intensive equipment and its importance for the operations of the customer that an intensive relationship reduces the uncertainty about the needs of the customer and improves the trustworthiness and reliability of the supplier.

The importance of the involvement of customers in the innovation process as a source of competitive advantage is suggested by Zander and Zander (2005) following the "inside track" argument first made by Penrose (1959). It includes among others the access to customer-internal information on future need and exchange of knowledge via joint problem solving. While the first point is largely covered by Hippel's lead user concept, the latter applies in particular to SDOs where firms along the value chain develop jointly new features (innovations) and evolve the standard. Empirically the positive influence of the user-producer relationship is shown in business-to-business industries as mechanical engineering and semiconductor (Urban and Hippel, 1988; Herstatt and von Hippel, 1992).

Technological progress has generally increased the accessibility to resources, knowledge and markets via distance. In particular markets became more accessible due to reduced import barriers and transportation costs and increasing similarity of consumer tastes (e.g. Nachum and Zaheer, 2005). This allows the locational split of CC and CE activities: new products or services can be created wherever the knowledge base is available and from there markets can be accessed. In case of required local responsiveness adaptation can be done locally via CE activities. Underlying this argument however is the assumptions that local adaptation occurs after product creation. This does not apply with the global standard where there is no á posteriori adaptation to local requirements. In order to understand the local market requirements firms need to be locally embedded into the local environment of service providers, suppliers and national standardization bodies or research institutes. The

attention will be higher with a higher lead market size.

Hypothesis 1c: The size of the host country's market has a positive influence on the entry of a firm's SDO resources.

Mediation by SDO presence within a country

The three major motives discussed above have all the motive of knowledge-seeking in common, either technology or market knowledge, via collaboration within the SDO or via hiring in case of resource seeking. Knowledge within the given location is necessary, but not sufficient for the access to knowledge. Mechanisms of local knowledge transfer discussed in the literature are joint research with universities (Alcácer and Chung, 2007; Nomaler and Verspagen, 2008), local suppliers (Dyer, 1996), information sharing via local industrial associations or personal relationships (Saxenian, 1994) and inter-firm job mobility (Almeida and Kogut, 1999; Rosenkopf and Almeida, 2003). The SDO provides all of these mechanisms. In the following I describe in more detail what is happening in the SDO. This is the basis to understand the mediation by the SDO presence and the firm heterogeneity in the next section.

The SDO is the facilitator of external learning and collaboration — either via meeting and joint collaboration projects. First, with the presence of firms from all parts in the value chain and research institutions, collaboration with suppliers, customers and even competitors and research facilities takes place. Second, the SDO with its meeting structure and joint innovation projects provides access to ongoing technological activities within firms. A meeting is an event over several days, where technical proposals are presented, discussed and finally agreed on a status. These proposals are the result of firm-internal research and are at the frontier of current technological knowledge. In case of essential IPRs, patents required for the standard, the technical proposals are translations of the underlying patent into the language of the technological standard and will become part of a specification and the standard. The proposals are also result of an inter-firm negotiation process, where differing views are reconciled and recombined into new revisions until they are either rejected or accepted. Third,

the regular meeting structure creates temporary geographic proximity, a concept introduced and discussed by Torre and Rallet (2005) and Torre (2008). Their major argument is that there is not a permanent need for co-location, but only in specific phases as the negotiation or starting period of an alliance or the experimental phase of a research project. The SDO acts therefore as a global industrial association or a broad pipe of global knowledge flow — based on temporary geographic proximity.

While this explains the importance of SDO presence to facilitate the knowledge transfer from the specific location, it does not explain why permanent co-location is required. Why does temporary geographic proximity not fully substitute for permanent proximity?

Geographic distance is not the only distance which is relevant in inter-organizational collaboration. Nooteboom (2000) introduces the concept of cognitive distance, "the similarities in the way actors perceive, interpret, understand and evaluate the world" (Knoben and Oerlemans, 2006, page 77). It is a rather broad construct that captures differing developing paths of people in different environments. Nooteboom (2007) argues that there is an optimal point of cognitive distance between alliance partners based on the interplay between absorptive capacity, the similarity between partners, and the pool of external, new knowledge available, the distance between them. As firms want to access technological and market knowledge which is potentially distant to their knowledge base they will have rather little absorptive capacity. This can be alleviated by higher cognitive proximity. Though all delegates have access to the same information in meetings independent from their office location, their cognitive lens will be different. For instance, a proposal reflecting rather specific requirements from a location, delegates from the same location will have a better understanding as they encountered these requirements already from different channels — either public media or discussions with colleagues, customers or local or regional conferences.

In addition for joint collaboration permanent co-location facilitates common language and culture that makes the sharing of knowledge and joint problem-solving easier. In a similar direction Peltokorpi et al. (2007) emphasize the importance of a shared context with emerging

relationships in the creation of knowledge and innovation, which is socially constructed.

In summary, while the SDO meetings provide temporary geographic proximity in case of local SDO presence, the need for cognitive proximity and shared context still requires permanent geographic proximity.

I conclude that the country's knowledge source is mediated by the presence of actors in the SDO. Depending on the three different knowledge sources, the specific mediation characteristics of the SDO will vary.

All participating firms in the SDO are technical competent, though the supplier and vendor firms are in most cases those with large R&D organizations and expenditure, where intellectual property rights are created. The access to technological knowledge will be mediated by the participation of all types of firms in the SDO.

Hypothesis 2a: The positive relationship of the country's technological capability on the the entry of a firm's SDO resources is mediated by the participation of the local firms in the SDO — independent of their role in the value chain.

Delegates in SDOs are rare resources (Barney, 1991) as they gain experience with the SDO's working procedure and social capital through repeated participation with presenting proposals and interaction rather than mere physical presence. Social capital is the "the aggregate of resources embedded within, available through, and derived from the network of relationships possessed by an individual or organization" (Inkpen and Tsang, 2005, page 151). The long-term standing of delegates in the SDO is an important asset that improves the work efficiency and effectiveness.

Rosenkopf et al. (2001) posit that the benefits of SDO participation apply to firms and individual participants who have the role of boundary spanners between the SDO and the firm. The repeated interaction among delegates leads to the development of a common language and trust building. Dokko and Rosenkopf (2003) examine the job mobility among SDO delegates and find that the network centrality of the new employer is increasing, while that of the former employee is decreasing. Fleming and Waguespack (2007) point out the

importance of technological prowess and social capital of participating engineers in their study of promotion within the Internet Engineering Task Force (IETF) to work group leaders.

While the pool of general engineering and scientific skills is mainly attractive for pure technical work assignments, firms will be more attracted to SDO delegates and in particular to those who have a long-term experience within the SDO and therefore have gained social capital. The experience in the SDO is the important distinction in the resource-seeking compared to the knowledge-seeking motive. The repeated and in most cases regular participation of most delegates relates to the gain of social capital with the tenure of local firms within the SDO. Engineer and scientist mobility is mainly studied with intra-country or intra-region mobility within a country with the focus of inter-firm knowledge transfer (Almeida and Kogut, 1999; Corredoira and Rosenkopf, 2010), which indicates that most inter-firm mobility takes place within country borders. This leads to the requirement of co-location for the motive of resource-seeking.

Hypothesis 2b: The positive relationship of the country's human resources on the entry of a firm's SDO resources is mediated by the social capital of the local firms in the SDO — independent of their role in the value chain.

One goal of the global standard is to reduce the effort of costly local adaptations and create economies of scale. Therefore technology supplying firms will only take local requirements into account when these are actively taken care of in the SDO. This will normally happen via producer-user-interaction of suppliers and customers. The customers who participate in the SDO can be viewed as lead customers. As the participation in the SDO is costly and customers do not gain the same advantage as suppliers of having their technology implemented into the standard, a major benefit for participating customers is to get their needs taken into account (Gertler, 1995).

Though the specific market needs will be presented in the SDO and are freely accessible independent of the location, there are additional reasons to those discussed above for permanent geographic proximity in case of market knowledge seeking. Buying decisions for new

generation equipment is often made at early stages were real products are not yet finished. The information a customer gains in the SDO about a potential future supplier is therefore a crucial element in the decision process. It's relevance may exceed that of the information firms gain about potential alliance partners (Rosenkopf et al., 2001) as this decision has strong influence on the market position of the customer and potentially about their survival. The opportunity of local co-operation allows a closer and earlier alignment than via the SDO meetings only. The investment in SDO resources by suppliers is also a signal of commitment to the local market compared to an off-the-shelf approach. In many cases a combination of these reasons will affect the decision. I therefore posit that the local market is mediated by the represented market in the SDO via participation of local customers.

Hypothesis 2c: The positive relationship of the country's market size on the entry of a firm's SDO resources is mediated by the participation of the local customers in the SDO

Moderation by firm heterogeneity

Early work on R&D location choice failed to address that the attractive forces of locations may impact various firms differently due to firm heterogeneity. For instance Chung and Alcácer (2002) cover only industry heterogeneity. Later studies (Alcácer, 2006; Alcácer and Chung, 2007; Cantwell and Mudambi, 2003; Feinberg and Gupta, 2004; Song, 2002) show that firm differences play an important role in the assessment of locations by firms. I follow a similar logic, that firm heterogeneity within the SDO influences the motives for entry into foreign countries.

The SDO activities are complementary resources to the technological capabilities of the firm. A primary goal of SDO activities is to get the firm's technological advantages implemented into the standard (Leiponen, 2008). In order to achieve this, a close coordination between the SDO activities and the knowledge creating R&D activities, the technological capabilities, is necessary. This is best facilitated by co-location with the technological capabilities within the organization as the knowledge to be transfered is complex and novel, leading to a high degree of tacitness that requires face-to-face discussions for clarifications

(Kogut and Zander, 1992, 1993). This argument mainly applies to larger firms where research and SDO activity are carried out by different engineers, in smaller firms the same person may patent and participate in SDO activities. These research activities are motivated by tapping into the knowledge of the host country (Chung and Alcácer, 2002; Almeida, 1996). The differential attraction-deterrence effect contingent on the leader or laggard position of a firm in the technological pecking order (Alcácer and Chung, 2007; Cantwell and Mudambi, 2003) may apply to the location decision of the research activity and will be captured by the amount of technological capabilities of the subsidiary. The complementarity between the two activities leads to a moderation of local SDO activities on the technological capabilities of the subsidiary.

Hypothesis 3a: The positive relationship of the local firms' participation on the entry strategy for firms' SDO resources is positively moderated by the firm's local technological capabilities.

The second characteristic in which organizations differ is their tenure within the SDO and the accumulated social capital. The delegates develop SDO specific skills as e.g. drafting and presenting proposals and social capital with other participants as outlined above. It takes a rather long time to develop these skills internally within the organization as it requires repeated interaction within the SDO. This is in particular the case when these capabilities do not exist within the firm or only to a limited degree. Firms with a long tenure in the SDO may prefer to develop new delegates to the SDO internally via internal job rotation. This has the advantage that these employees are familiar with the firm's own technology and internal routines. Therefore newcomers in the SDO will rely more on hiring of external SDO resources. The mobility of engineers between participating firms is studied by Dokko and Rosenkopf (2003), who offer evidence that the new employer gains, while the former employer looses network centrality in the SDO network.

Hypothesis 3b: The positive relationship of the local firms' social capital in the SDO on the entry of a firm's SDO resources is negatively moderated by the focal firm's tenure in the SDO.

Standard development takes place before product development. This implies that during

the work on the first set of the standard only a prospective, not a real customer relationship exists regarding this specific technology. Technology suppliers will seek closeness to important potential future customers to demonstrate their reliability and trustworthiness and influence future buying decisions in a positive way (Gertler, 1995). With the reward of first contracts this situation can change — if a firm receives a contract, the relationship is strengthened, while without a realized user-producer relationship the motive of closeness will fade on both sides. Customers will preferably team up with their now decided suppliers, while suppliers have little benefit in a collaboration as it will not materialize in revenue in near future. SDOs cover complex technologies that are often capital-intensive leading to high switching costs and long-term buyer-supplier relationships. Only a new generation, which goes along with a disruptive technology changes this relationship (Christensen, 1993; Christensen and Bower, 1996) and opens again the door to a future relationship. Entry into a new location driven by market motives are therefore only encouraged when there is either an existing or prospect customer-relationship.

Hypothesis 3c: The positive relationship of the represented market size in the SDO on the entry of a firm's SDO resources is positively moderated by the focal firm's (prospect) user-producer relationship.

Control variables

I suggest to control for country and firm characteristics that influence the location choice decision.

Home and host country

In addition to the three studied major motives the literature sees also support of production, efficiency, and regulation as motives for foreign R&D locations. Support of production does not apply to SDOs as the activity is in a rather early, pre-product stage of the R&D process and production support is more likely to be provided by later stages closer to the product.

Efficiency: Labor cost differentials between home and host country can be a motive for choosing a location (Dunning, 1993). However, as firms face travel costs independent of the delegates' office location and the high stakes of standardization, efficiency mat not play an important role.

Regulatory openness: Despite a large degree of de-regulation in the past two decades, infrastructure industries are still rather regulated. Granstrand et al. (1993) and Gammeltoft (2006) explicitly mention regulatory requirements as one motive for decentralization.

Size: MNCs from different home countries have varying propensity for dispersion of R&D activities. For instance the small European countries as Sweden, the Netherlands and Switzerland expanded very early to overcome the limitations of their small home market and technology base. (Cantwell, 1995).

Geographic distance Geographical distance can play two roles in the SDO context. First, the impact of the distance between the home and the host country. Though geographic distance may matter less than in the past, there is still ongoing evidence of the impact of distance (Nachum and Zaheer, 2005; Asmussen et al., 2009). Related is the debate in the IB community of globalization versus regionalization (Rugman and Verbeke, 2004; Dunning et al., 2007; Rugman and Verbeke, 2007). I therefore control for the home-host-country geographic distance. An alternative explanation of meeting participation is opportunity, i.e. if the meeting venue is close to the delegates office, for instance within the same country. I control for the geographic distance between the delegate's location and the meeting location.

Institutional distance — IPR protection: Prior research suggests that institutional differences between the home and host country impact the choice of MNCs (Xu and Shenkar, 2002). As the industry under study is knowledge intensive with potential concerns of IPR protection, the most important institutional difference is the IPR protection regime. Though this may be less an issue for SDO participation due to the IPR policies and modularity of the technology (Zhao, 2006), it needs to be controlled for.

Cultural distance: Since the seminal work of Hofstede (1980) on cultural differences the

impact of cultural distance on e.g. mergers and acquisitions and entry mode is well acknowledge within the IB literature (Drogendijk and Slangen, 2006; Stahl and Voigt, 2008). Within the SDO context of joint problem-solving cultural distance may spur, rather than hinder entry as the need for the local presence for successful cooperation may be higher.

Firm characteristics

Firm size: Firm size does influence the internationalization as small firms are rather constraint in their resources.

Technological capabilities: Technological capabilities, similar than firm size, has a positive influence on R&D internationalization as shown in many previous studies (Cantwell and Janne, 1999).

Resource dispersion: Entry decisions into foreign market can be seen as a learning process or ongoing search of the firm to increase its performance. The firm learns from past experiences and uses this experience for the next entry decision (Chang, 1996). This positive influence may however have diminishing benefits and may finally have a negative effect. I control for a linear and curvilinear effect of resource dispersion.

Entry mode: The mode of resource deployment, either acquisition, greenfield or adding an activity to an existing subsidiary, plays also a role as established in prior literature. This applies also to SDO activities, which are only a rather small slice within the firm's R&D activities. In case of acquisition the SDO activities will be more a by-product rather than the target of the acquisition. The motives for the acquisition may differ largely from the internationalization motives for SDO participation.

DISCUSSION

I plan to test the hypothesis with data from the development of the second and third generation of cellular telecommunication from 1992 to 2010 by ETSI and its successor since 2000, the Third Generation Partnership Project (3GPP) as focal SDO. Cellular telecommunications is a suitable setting as it is a prime example of a modular system with the need

for the joint standard development. I will use the rosters of the SDO meetings to construct the dependent variable, the entry of SDO resources, by the first appearance of a delegate of a given firm-country combination in a SDO meeting.

The proposed theoretical model with the influence of the SDO on entry decisions has important implications for countries and firms. The major proposition is that the presence of the SDO mediates country factors which can lead to a vicious or virtuous circle for a given country. SDOs are important in systemic, often capital-intensive infrastructure industries as ICT and increasingly energy, health and transport industries — those industries which play a vital role in the development of countries. Gaining a strong position within the SDO can provide important advantages by having the countries requirements accounted for by implementation in the global standard, keeping a high level of knowledge and a potentially fast adaptation of the latest technology. The local participation in the global SDO activities becomes a crucial element in the national innovation system. With the various roles among the value chain the positive impulse can be initiated either on the technological or market level. Firms will adopt different strategies contingent on their position within the SDO characterized by the technological know-how, amount of delegates and tenure in the SDO and accumulated social capital. As a consequence newcomers from emerging countries will take different paths compared to incumbent players of developed countries.

Bibliography

Alcácer, J. (2006). Location choices across the value chain: How activity and capability influence collocation. *Management Science*, 52(10):1457–1471.

Alcácer, J. and Chung, W. (2007). Location strategies and knowledge spillovers. *Management Science*, 53(5):760–776.

Almeida, P. (1996). Knowledge sourcing by foreign multinationals: Patent citation analysis in the U.S. semiconductor industry. *Strategic Management Journal*, 17:155–165.

Almeida, P. and Kogut, B. (1999). Localization of knowledge and the mobility of engineers in regional networks. *Management Science*, 45(7):905 – 917.

Archibugi, D. and Iammarino, S. (2002). The globalization of technological innovation: definition and evidence. *Review of International Political Economy*, 9(1):98–122.

Asmussen, C. G., Pedersen, T., and Dhanaraj, C. (2009). Host-country environment and subsidiary competence: Extending the diamond network model. *Journal of International Business Studies*, 40(1):42 – 57.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1):99.

Bekkers, R., Duysters, G., and Verspagen, B. (2002). Intellectual property rights, strategic technology agreements and market structure the case of GSM. *Research Policy*, 31(7):1141.

Besen, S. M. and Farrell, J. (1994). Choosing how to compete: Strategies and tactics in standardization. *Journal of Economic Perspectives*, 8(2):117–131.

Cantwell, J. (1989). *Technological Innovation and Multinational Corporations*. Basil Blackwell, Oxford.

Cantwell, J. (1995). The globalisation of technology: What remains of the product cycle model? *Cambridge Journal of Economics*, 19(1):155.

Cantwell, J. and Janne, O. (1999). Technological globalisation and innovative centres: the role of corporate technological leadership and locational hierarchy. *Research Policy*, 28(2):119.

Cantwell, J. and Mudambi, R. (2003). On the nature of knowledge creation in mne subsidiaries: an empirical analysis using patent data",. In *paper presented at the DRUID Summer Conference, Copenhagen*.

Cantwell, J. and Mudambi, R. (2005). MNEs competence-creating subsidiary mandates. *Strategic Management Journal*, 26(12):1109–1128.

Cantwell, J. and Piscitello, L. (2005). Recent location of foreign-owned research and development activities by large multinational corporations in the european regions: The role of spillovers and externalities. *Regional Studies*, 39(1):1–16.

Chang, S. J. (1996). An evolutionary perspective on diversification and corporate restructuring: Entry, exit, and economic performance during 1981-89. *Strategic Management Journal*, 17(8):587–611.

Chiao, B., Lerner, J., and Tirole, J. (2007). The rules of standard-setting organizations: an empirical analysis. *RAND Journal of Economics (Blackwell)*, 38(4):905–930.

Christensen, C. M. (1993). The rigid disk drive industry: A history of commercial and technological turbulence. *Business History Review*, 67(4):531.

Christensen, C. M. and Bower, J. L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal*, 17(3):197–218.

Chung, W. and Alcácer, J. (2002). Knowledge seeking and location choice of foreign direct investment in the United States. *Management Science*, 48(12):1534–1554.

Corredoira, R. A. and Rosenkopf, L. (2010). Should auld acquaintance be forgot? the reverse transfer of knowledge through mobility ties. *Strategic Management Journal*, 31(2):159 – 181.

Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal*, 23(12):1095–1121.

David, P. A. and Steinmueller, W. E. (1994). Economics of compatibility standards and competition in telecommunication networks. *Information Economics and Policy*, 6(3-4):217–241.

Dokko, G. and Rosenkopf, L. (2003). Job mobility of technical professionals and firm centrality in wireless standards committees. pages A1–A6.

Drogendijk, R. and Slangen, A. (2006). Hofstede, Schwartz, or managerial perceptions? the effects of different cultural distance measures on establishment mode choices by multinational enterprises. *International Business Review*, 15(4):361 – 380.

Dunning, J. H. (1993). *Multinational Enterprises and the Global Economy*. Addison-Wesley, Wokingham, U.K.

Dunning, J. H., Fujita, M., and Yokova, N. (2007). Some macro-data on the regionalisation/globalisation debate: a comment on the Rugman/Verbeke analysis. *Journal of International Business Studies*, 38(1):177 – 199.

Dunning, J. H. and Lundan, S. M. (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):13–33.

Dyer, J. H. (1996). Specialized supplier networks as a source of competitive advantage: Evidence from the auto industry. *Strategic Management Journal*, 17(4):271–292.

EPRI (2009). Electric Power Research Institute, report to NIST on the Smart Grid interoperability standards roadmap. *(Contract No. SB1341-09-CN-0031—Deliverable 7)*.

ETSI (2010). European Telecommunications Standards Institute, ETSI website. Technical report, www.etsi.org.

Farrell, J. and Saloner, G. (1988). Coordination through committees and markets. *RAND Journal of Economics*, 19(2):235–252.

Feinberg, S. E. and Gupta, A. K. (2004). Knowledge spillovers and the assignment of R&D responsibilities to foreign subsidiaries. *Strategic Management Journal*, 25(8):823–845.

Fleming, L. and Waguespack, D. M. (2007). Brokerage, boundary spanning, and leadership in open innovation communities. *Organization Science*, 18(2):165–180.

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.

Gammeltoft, P. (2006). Internationalisation of R&D: trends, drivers and managerial challenges. *International Journal of Technology & Globalization*, 2(1/2):3.

Gertler, M. S. (1995). 'being there': Proximity, organization, and culture in the development and adoption of advanced.. *Economic Geography*, 71(1):1.

Granstrand, O., Hakanson, L., and Sjolander, S. (1993). Internationalization of R&D a survey of some recent research. *Research Policy*, 22(5-6):413–430.

Gupta, A. K., Smith, K. G., and Shalley, C. E. (2006). The interplay between exploration and exploitation. *Academy of Management Journal*, 49(4):693 – 706.

Herstatt, C. and von Hippel, E. (1992). From experience: Developing new product concepts via the lead user method: A case study in a "low-tech" field. *Journal of Product Innovation Management*, 9(3):213–221. M3: Article.

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values.* Beverly Hills CA: Sage.

Huggins, R., Demirbag, M., and Ratcheva, V. I. (2007). Global knowledge and r&d foreign direct investment flows: Recent patterns in asia pacific, europe, and north america. *International Review of Applied Economics*, 21(3):437–451.

Hymer, S. (1976). *The international operations of national firms : a study of direct foreign investment*. MIT Press, Cambridge, Mass.

Inkpen, A. C. and Tsang, E. W. K. (2005). Social capital, networks, and knowledge transfer. *Academy of Management Review*, 30(1):146–165.

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

Katila, R. and Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45(6):1183 – 1194.

Katz, M. L. and Shapiro, C. (1986). Technology adoption in the presence of network externalities. *Journal of Political Economy*, 94(4):822–841.

Knoben, J. and Oerlemans, L. A. G. (2006). Proximity and inter-organizational collaboration: A literature review. *International Journal of Management Reviews*, 8(2):71–89.

Kogut, B. and Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, 3(3):383–397.

Kogut, B. and Zander, U. (1993). Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of International Business Studies*, 24(4):625–645.

Kuemmerle, W. (1999). The drivers of foreign direct investment into research and development: An empirical investigation. *Journal of International Business Studies*, 30(1):1–24.

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.

Lavie, D. and Rosenkopf, L. (2006). Balancing exploration and exploitation in alliance formation. *Academy of Management Journal*, 49(4):797 – 818.

Leiponen, A. E. (2008). Competing through cooperation: The organization of standard setting in wireless telecommunications. *Management Science*, 54(11):1904–1919.

Lerner, J. and Tirole, J. (2006). A model of forum shopping. *American Economic Review*, 96(4):1091–1113.

Lewin, A. Y., Massini, S., and Peeters, C. (2009). Why are companies offshoring innovation? the emerging global race for talent. *Journal of International Business Studies*, pages 901–925.

Li, Y., Vanhaverbeke, W., and Schoenmakers, W. (2008). Exploration and exploitation in innovation: Reframing the interpretation. *Creativity & Innovation Management*, 17(2):107–126.

Manning, S., Massini, S., and Lewin, A. Y. (2008). A dynamic perspective on next-generation offshoring: The global sourcing of science and engineering talent. *Academy of Management Perspectives*, 22(3):35–54.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1):71–87.

Marshall, A. (1920). *Principles of Economics: An Introductory Volume*. McMillan, London, UK.

McKinsey (2010). Five forces reshaping the global economy: Mckinsey global survey results. *McKinsey Quarterly: The Online Journal of McKinsey & Company*.

Nachum, L. and Zaheer, S. (2005). The persistence of distance? the impact of technology on mne motivations for foreign investment. *Strategic Management Journal*, 26(8):747–767.

Nomaler, O. and Verspagen, B. (2008). Knowledge flows, patent citations and the impact of science on technology. *Economic Systems Research*, 20(4):339 – 366.

Nooteboom, B. (2000). Institutions and forms of co-ordination in innovation systems. *Organization Studies (Walter de Gruyter GmbH & Co.KG.)*, 21(5):915.

Nooteboom, B. (2007). Social capital, institutions and trust. *Review of Social Economy*, 65(1):29–53.

Pearce, R. D. (1999). Decentralised R&D and strategic competitiveness: globalised approaches to generation and use of technology in multinational enterprises MNEs. *Research Policy*, 28(2-3):157–178.

Peltokorpi, Nonaka, and Kodama (2007). NTT DoCoMo's launch of i-mode in the Japanese mobile phone market: A knowledge creation perspective. *Journal of Management Studies*, 44(1):50–72.

Penrose, E. T. (1959). *The theory of the growth of the firm*. Wiley, New York.

Raisch, S., Birkinshaw, J., Probst, G., and Tushman, M. L. (2009). Organizational ambidexterity: Balancing exploitation and exploration for sustained performance. *Organization Science*, 20(4):685–695.

Rosenkopf, L. and Almeida, P. (2003). Overcoming local search through alliances and mobility. *Management Science*, 49(6):751–766.

Rosenkopf, L., Metiu, A., and George, V. P. (2001). From the bottom up? technical committee activity and alliance formation. *Administrative Science Quarterly*, 46(4):748–772.

Rosenkopf, L. and Nerkar, A. (2001). Beyond local search: Boundary-spanning, exploration, and impact in the optical disc industry. *Strategic Management Journal*, 22(4):287.

Rugman, A. M. and Verbeke, A. (2004). A perspective on regional and global strategies of multinational enterprises. *Journal of International Business Studies*, 35(1):3–18.

Rugman, A. M. and Verbeke, A. (2007). Liabilities of regional foreignness and the use of firm-level versus country-level data: a response to dunning et al. (2007). *Journal of International Business Studies*, 38(1):200–205.

Saxenian, A. (1994). *Regional advantage : culture and competition in Silicon Valley and Route 128*. Harvard University Press, Cambridge, Mass.

Shimizutani, S. and Todo, Y. (2008). What determines overseas R&D activities? the case of Japanese multinational firms. *Research Policy*, 37(3):530–544.

Song, J. (2002). Firm capabilities and technology ladders: Sequential foreign direct investments of Japanese electronic firms in East Asia. *Strategic Management Journal*, 23(3):191–210.

Stahl, G. K. and Voigt, A. (2008). Do cultural differences matter in mergers and acquisitions? a tentative model and examination. *Organization Science*, 19(1):160 – 176.

Torre, A. (2008). On the role played by temporary geographical proximity in knowledge transmission. *Regional Studies*, 42(6):869 – 889.

Torre, A. and Rallet, A. (2005). Proximity and localization. *Regional Studies*, 39(1):47 – 59.

Tushman, M. L. and O'Reilly III, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *Calif.Manage.Rev.*, 38(4):8–30.

Urban, G. I. and Hippel, E. V. (1988). Lead user analyses for the development of new industrial products. *Management Science*, 34(5):569–582.

Vernon, R. (1966). International investment and international trade in the product cycle. *Quarterly Journal of Economics*, 80(2):190–207.

von Hippel, E. (1986). Lead users: a source of novel product concepts. *Management Science*, 32(7):791–805.

Waguespack, D. M. and Fleming, L. (2009). Scanning the commons? evidence on the benefits to startups participating in open standards development. *Management Science*, 55(2):210–223.

Weiss, M. B. and Sirbu, M. (1990). Technological choice in voluntary standards committees: an empirical analysis. *Econ. Innov. New Technology*, 1:111–133.

Xu, D. and Shenkar, O. (2002). Institutional distance and the multinational enterprise. *Academy of Management Review*, 27(4):608–618.

Zander, I. and Zander, U. (2005). The inside track: On the important (but neglected) role of customers in the resource-based view of strategy and firm growth. *Journal of Management Studies*, 42(8):1519–1548.

Zhao, M. (2006). Conducting r&d in countries with weak intellectual property rights protection. *Management Science*, 52(8):1185–1199.