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The Impact of Innovation Off-shoring on the Effectiveness of Organizational Innovation

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Abstract

We analyze the effects of off-shoring of innovation activities on the ability of firms to successfully introduce organizational innovation. Using consecutive waves of the German part of the Community Innovation Survey, we find at the most general level an inverted u-shape, implying a threshold value for innovation off-shoring beyond which the impact on organizational innovation becomes negative. This effect however, depends on the firm?s strategic focus on R&D, the degree to which a firm is engaged in on-shore R&D collaborations, and the geographical dispersion of off-shore innovation activities.

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1 Introduction

International relocation of firm operations has become an increasingly important topic in management practice and has evolved from an exotic niche strategy to standard management decisions (Rilla and Squicchiarini, 2011). While initially primarily simple production steps have been relocated in order to save costs, today also more and more complex knowledge-intensive processes such as innovation activities are moved to other countries. Off-shoring activities have been steadily moving up the value chain (Bardhan and Jaffee 2005) and although innovation off-shoring is still a limited phenomenon (Cusmano et al. 2009) it is increasing in importance (Nieto and Rodríguez 2011). Instead of cost saving a decisive motive has become the access to new knowledge sources outside the realm of the domestic system or network of innovation (Maskell et al. 2007, Bardhan and Jaffee, 2005). Further drivers for off-shoring include the need to adapt innovation to the specific conditions of foreign markets (Granstrand et al., 1993; Hollenstein, 2008; Kuemmerle, 1997).

At the same time, however, off-shoring of knowledge-intensive firm processes can cause adverse long-run effects because of the implied increase in managerial complexity (Bartlett and Ghoshal, 2002).

Despite the increasing importance of innovation off-shoring the focus in the literature was on the related phenomenon of innovation outsourcing (e.g. Cassiman and Veugelers, 2002) which differs from innovation off-shoring by the fact that the latter relates to relocating innovation activities outside the organizational boundaries of the firm while off-shored innovation takes place inside these boundaries but at off-shored locations (Lewin et al., 2009). Therefore, while several papers have analyzed the impacts of innovation outsourcing on firm performance in general or innovative capabilities, little is known about the effects of innovation off-shoring.

In this paper we build on complexity theory (Simon 1962, 1996, 2002) and argue that innovation off-shoring has an inverse u-shaped relationship with the performance effects of organizational innovation, where organizational innovation is the visible counterpart of firms' adaption capability vis-à-vis changing environmental conditions. From an evolutionary perspective, organizational innovation is central because it is a fundamental determinant of long-term competitiveness (Windrum et al., 2008).

We also investigate several moderating factors. In particular, we show that the relationship between innovation off-shoring and organizational innovation is contingent on the firm's strategic focus on R&D, the degree to which a firm is engaged in on-shore R&D collaborations, the geographical dispersion of off-shored innovation, and firm size.

By providing proof of an inverted u-relationship of innovation off-shoring on success of organizational innovation we extend the related discussions on the long-run effects of innovation outsourcing (Howells, 2006; Howells et al., 2008; Fifarek et al., 2008; Bettis et al., 1992; Barthélemy and Quélin, 2006; DeSarbo et al., 2005, Grimpe and Kaiser, 2010) and of general outsourcing (Görzig and Stephan, 2002; Bengtsson and von Hartman, 2005; Lacity and Willcocks, 1998; Gianelle and Tattara, 2007) to off-shoring innovation. In addition, we stress the role of moderating factors providing important practical advice for the strategic management of geographical dispersed innovation processes.

2 Theory

Current theorizing about the benefits and downsides of innovation relocation has focused primarily on innovation outsourcing. The perspective that has been adopted was primarily that of the resource based view (RBV) with its emphasis on capabilities and transaction cost economics (TCE) or a combination of those two.[1]

We start with a short survey of some arguments made in the RBV-related literature. Several authors highlighted the importance of tapping into new knowledge sources (Maskell et al., 2007; Bardhan and Jaffee, 2005; Barthélemy and Quélin, 2006; DeSarbo et al., 2005). Innovation outsourcing serves as a means to access external knowledge that can be recombined with existing in-house knowledge, potentially generating gains from complementarity (Cassiman and Veugelers, 2006).

With respect to potentially detrimental effects, it has been argued that internal resources may be weakened by excessive use of external knowledge (Grimpe and Kaiser, 2010) and that a firm's integrative capabilities may be hampered (Helfat and Raubitschek, 2000; Grimpe and Kaiser, 2010). In addition, a strong focus on external knowledge sourcing in innovation processes could reduce the absorptive capacities of the organization (see Cohen and Levinthal, 1990) and may consume too much management attention (Ocasio, 1997; Grimpe and Kaiser, 2010).

TCE instead seeks to determine the optimal boundaries of the firm and basically argues that firms have to trade-off the costs of using the market for and the costs of using internal coordination principles such as hierarchy or network coordination (Williamson, 1985, 2008). A firm should therefore outsource activities when the costs of market procurement are lower than the costs of internal production.

While both theories can actually be used to argue for positive, negative or inverted u-shape relationships between innovation relocation and firm performance, we will build on complexity theory (Simon, 1996, 2002) as the departure of our theorizing instead.

Expectations of both the RBV and the TCE view on performance effects of outsourcing are highly dependent on implicit assumptions about the dominance of either benefits or costs. As an example, Maskell et al. (2007) claims that firms should keep control of their core competences, because agency problems could be disastrous if firms loose control over their core processes. While this argument is certainly important and well accepted, it implicitly assumes that undesired leakage of competences dominate potentially positive effects of outsourcing at least as concerns core processes. Grimpe

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[1] Some contributions have also focused on network approaches.

and Kaiser (2010) on the contrary argue for an inverse u-shape by implicitly assuming that the costs of outsourcing are low relatively to the benefits when the level of outsourcing is moderate, but costs are high relatively to benefits when outsourcing becomes excessive. Thus, obviously the predictions obtained from TCE and RBV will depend on these assumptions about the relative size of costs and benefits. While both theories provide a valuable analytic framework, predictions about the relationship to performance can only be made when we make additional assumptions about relative strength of opposing effects.

In this study, we employ complexity theory (Simon, 1962, 1996, 2002) as a conceptual framework to derive hypotheses about the relationship between innovation relocation and firm performance without the need for assumptions about costs or benefits.

While complexity theory has been used in many branches of the management literature e.g. the study of interfirm relationships (see Argyres 1999, Sturgeon, 2002) it is relatively new in the field of off-shoring activities. Because of this and because of the fact that complexity theory derives from evolutionary biology rendering many of its concepts remote from intuitive economic and management thinking, we will make an effort to relate complexity theory back to interpretative counterparts in both TCE and RBV. We will see that many insights gained from the three approaches, will coincide or are related to each other.

Before we proceed with the delineation of the hypotheses we first introduce some basic concepts in complexity theory and show how this theory relates to the RBV and TCE.

2.1 Elements of complexity theory

Complexity theory (Simon 1996, 2002, see also Simon 1962) provides design principles for complex systems. Its key-concept is the nearly decomposable system (ND-system). ND-systems are defined as multi-level hierarchies of systems, subsystems, subsubsystems etc., with the important characteristic that each system or subsystem itself consists of *nearly independent* subsystems that are linked by standard interfaces (Baldwin and Clark 1997).[2] The main postulation of complexity theory is that such systems are more able to adapt to environmental turbulence and will ultimately dominate non-ND-systems in terms of performance (Simon 2002; for simulation results see for example Frenken et al. 1999, Rivkin and Siggelkow 2007, Ethiraj and Levinthal 2004).

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[2] In fact, this concept is closely linked to the term modularization that has been studied extensively in the management literature (Koen and Mendritzki 2012, for e review see Campagnolo and Camuffo 2007).

This postulation rests on two arguments. First, in the case of dependent (non-ND-systems) the current level of performance does not provide accurate information about the evolutionary advantage of a given change. An intended change at one locus of the system might have unintended consequences at another. If unintended consequences occur with a time lag, the immediate performance effects of a change will provide distorted information about the long-run performance effect and will eventually lead systems to evolve in wrong directions. ND systems, however, will receive unbiased information from their current performance level because a change made to one subsystem will be confined to that subsystem and will not call forth unintended effects.[3]

Second, suppose a system consists of two – the number is generic – subsystems which are linked by some sort of interdependence. The optimum state of the complete system can only be found, when both subsystems are jointly optimized. If there is no interdependence, the global optimum of the whole system can be found by optimizing each subsystem individually, which is quite generally much easier task.

Since non-ND-systems receive distorted performance information and cannot subdivide complex tasks, such systems will find it much harder to adapt in turbulent environments. The visible counterpart of adaption to changes in an organization's environment is the introduction of organizational innovations. Therefore we should expect that firm organized as ND-systems will be more successful in introducing organizational innovation.[4]

There are two ways in which a system might be non-ND. Either, it has been decomposed too much or too little. In the first case, processes that belong together are torn apart, inhibiting for example recombination of knowledge assets that share commonalities (Hedlund 1999). In the second case, systems that do not necessarily belong together are within the same subsystem implying that management complexity is greater than it ought to be.

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3 Indeed it has been demonstrated that the time from the emergence of the first life-forms was only sufficient to bring forth complicated organisms such as those observed today, if the life-forms are ND (Simon, 1996).

4 We deliberately leave out the task of explaining how nearly decomposable multinational corporations in fact will look like in practice, because this is not really our concern and has been done already in the literature. E.g. using the highly related concept of near recomposibility, Hedlund (1999) names properties such as common language, rewards to composition or productive diversity. In fact, the N-form organization (Hedlund 1994) is a very detailed set of organizational principles that follow from ideas of complexity theory.

2.2 Linking Complexity Theory to RBV and TCE

The term independence used in complexity theory is strongly linked to two key concepts of externalities and agency problems central to TCE (Windrum et al. 2008). Both will imply dependence between subsystems, because determining the optimal state of the whole system will only be possible by joint optimization over all systems, subsystems, subsubsystems, etc.

While this parallel between complexity theory and TCE has been made explicit by Windrum et al. (2008) for the case of outsourcing, it may also be relevant in the case of off-shoring. This is because also agreements within the boundaries of a firm are generally incomplete. Fama (1980) makes this point prominently by arguing that firms are a nexus of contracts between different parties. While this view certainly neglects other aspects of internal organization (among them hierarchy, trust, or network-coordination), it highlights the importance of contract-related problems of effective organization also inside firms. Thus, opportunistic behavior is not only relevant for market-mediated transactions but can also be observed inside the firm. Even if less severe, all the problems identified by transaction-costs economics (Williamson, 1985, 2008) should not be neglected inside the firms' boundaries.

With respect to RBV and the closely linked capabilities approach, complexity theory implies that firms which are ND find it much easier to successfully introduce organizational innovation and are able to adapt better to changing environments. Obviously, the state of being ND has therefore a capabilities interpretation. It is closely linked to combinative (Kogut and Zander 1992) and integrative capabilities (Aoki 1986; Henderson e al. 1994) because it means that firms recognize and respect existing interdependencies, while they need to be able to create effective interfaces between subsystems. At the same time, ND has a resource-interpretation. The latter can be seen when reexamining the property of a resource, which, according to Barney (1991), is scarce, inimitable, and valuable. We argue that that being ND shares all those characteristics. First, because environmental turbulence continuously changes the parameters that determine whether a given organizational set-up is ND, at any point in time a considerable share of firms while have adopted organizational structures that are at least temporarily non-ND, leading to scarcity of this property. Furthermore, the ND-characteristic is clearly valuable, because it allows firms to perform adaptation tasks much more accurately. It is also inimitable, because being ND is completely contingent on the current, localized organizational settings in that particular firm. Even if a competitor is able to observe this characteristic and to completely understand its mechanics – we stress that this is unlikely – this knowledge will be relatively useless for him because it is highly specific to its context.

2.3 Derivation of the Hypotheses

2.3.1 The general relationship

We argue for an inverse u-shape between off-shoring and organizational innovation. At the core of our argument is the following reasoning: By definition, off-shoring increases geographical dispersion of the innovation process, implying that processes which have been integrated before are now decomposed.

As complexity theory has highlighted, the impacts on the ability to introduce organizational innovation will depend on the question of whether this decomposition results in the creation of an ND-system, i.e. whether the individual subsystems are roughly independent of each other.

Based on this theory it is relatively straightforward to conjecture that both too little and too much decomposition will result in non-ND-systems, because either systems are linked together that are actually independent or systems are torn apart that actually belong together. Hedlund (1999) for example using an argument about knowledge recombination states that the opportunity created by organizational turbulence "will mostly not be fruitfully addressed by further decomposition." The most important word in this phrase obviously is "further" it indicates that excessive decomposition might be problematic (while some may be desirable).

This makes a strong point for an inverted u-shape-relationship between off-shoring and organizational innovation: on the one hand, because decomposing an ND-system will reduce complexity, the management architecture becomes easier and organizational innovations can be introduced more easily. As a concrete example, suppose two distinct innovation activities are roughly independent: they can be decomposed. This will among other things mean that the units in which the activities are located become smaller, and individual behavior becomes better observable. This will reduce agency problems because monitoring becomes more effective. In turn management will be more able to achieve comparable outcomes with much simpler management architecture.

On the other hand, 'over off-shoring' – a term that we borrow from Grimpe and Kaiser's (2010) 'over-outsourcing' – will result in non-ND-systems making attempts to introduce organizational innovations less fertile.

> *H1: The degree of innovation off-shoring has an effect on the effectiveness of organizational innovation that follows an inverted u-shape.*

Having established a general expectation about the relationship between off-shoring innovation and the ability to successfully introduce organization innovation, we now turn to potentially moderating factors.

2.3.2 Moderating factors

Geographical dispersion and the size of the firm:

In H1 we focused on the overall degree of innovation off-shoring on organizational innovation and inferred from this to the degree of decomposition. While this is a valid perspective the degree of decomposition also depends on the way the off-shored innovation activities are scattered over different countries. If e.g. a company has off-shored, a given share of its innovation, the process would be considered less decomposed, if all activities were located at a single off-shore location compared to a situation when off-shoring activities are scattered all over the world.

In addition to geographical dispersion of off-shoring, firm size is supposed to be another important moderating factor since the size of an organization affects the opportunities for decomposing activities into separate subsystems. Considering the effects of size is also important because the predictions of the RBV/capabilities approach and complexity theory about off-shoring impacts on organizational innovation differ when differences in firm size and the organizations' ability to deal with geographical dispersion are considered.

A common argument in the RBV/capability literature suggests that larger companies are better able to cope with the organizational tensions from multi-site production because they possess superior management capabilities (e.g. Herstad et al. 2012). According to this, they it is easier for them to decompose any given processes into smaller but independent subprocesses.

Employing complexity theory, one may draw a different conclusion: Suppose there are two companies, the first one being twice as large as the second. If both companies consist of subsystems each of the same size, the second company will consist of N subsystems and the first of 2N subsystems. If management decided to decompose one these subsystems, the smaller firm has to make sure that this new subsystem is independent of the other N systems. The management in the large company, however, must seek to create the new subsystem in a way that it is independent of 2N subsystems, obviously a much more complex task.

In essence this means that while, the capabilities approach tends to highlight superior management techniques in larger companies, the complexity approach highlights the greater flexibility and the easier and more transparent organizational set-up of smaller firms. While we have a strong inclination to the prediction based on complexity theory, because it delineates the greater abilities to deal with geographical dispersion as a result of its reasoning, rather than to simply posit it, we still present both hypotheses as competing ones:

> *H2a (capability approach): Large companies find it easier to deal with geographical dispersion of their R&D processes.*

> *H2b (complexity theory): Small companies find it easier to deal with dispersion of their R&D processes.*

The role of on-shore innovation networks:

Another important moderating variable can be delineated from the fact that innovation is increasingly performed in open networks (Chesbrough, 2003). As one of the intellectual predecessors of the open innovation paradigm, the innovation systems approach (Lundvall, 1992; Nelson, 1990; Edquist, 1997) posits that the innovation capability of actors (e.g. a firm) is not only determined by inherent capabilities but is also by the way that all actors within a system of innovation interact, because knowledge is created by individuals who interact with each other and within and beyond the boundaries of an enterprise (Nonaka and Toyama, 2005). Most importantly, the innovation system perspectives highlights that not only internal resources but also external links to other innovation-relevant actors are important sources of innovative capability as well. Though off-shoring may increase the external links of a firm, it can also weaken a firm's network because established links may be broken up when approaching new suppliers or customers. At the same time it is not easy to establish the same links abroad because organizational routines tailored to this task are usually too specific to transfer (Ebersberger and Herstad, 2011, Schmidt, 2010) since such routines often build on social capital and trust among partners (Laursen et al., 2012). Herstad et al. (2012) argue that the mediators that could facilitate the establishment of new contacts in off-shore locations are either not present or difficult to access for outsiders. The net effect of off-shoring on network embeddedness will therefore be negative. Because of the critical importance of the network links for the technological innovation ability and the positive complementarity between technological and organizational innovation, weakening onsite R&D networks should also imply a lower ability for organizational innovation.

H3: The effect of off-shoring R&D on the ability to introduce organizational innovation is negative for firms that are more strongly involved in domestic R&D collaborations.

Strategic Focus on R&D:

We argued that ‘over off-shoring’ will cause the emergence of non-ND systems e.g. by creating additional externalities or agency problems. Strategy research highlights that this might be particularly virulent when knowledge-intensive or processes related to core competences are concerned (Prahalad and Hamel, 1990). Therefore it is often argued that firms should keep tight control over their core competences (Maskell et al., 2007) because otherwise the consequences of opportunistic behavior may be disastrous.

This is in line with complexity theory since activities relating to core competences are non-ND with respect to the strategic management process. However, as strategic management processes tend to be located at the onshore site, off-shoring may result in a decomposition of operational activities relating to core competences and strategic management, together forming a non-ND system. This will result in reduced effectiveness of organizational innovation, just as the strategic management literature posits.

The argument that innovation activities should remain under tight control is contingent on the postulation that innovation activities are of strategic importance and thus form an ND-relationship with strategic management processes. But some firms might not consider their innovation activities relating to their core competences, making the argument much weaker, for example for low-tech firms that derive their competitive advantages from sources distinct from internal R&D.

H4: The effect of off-shoring internal R&D on the ability to introduce organizational innovation is negative for highly R&D-intensive firms and positive for less R&D-intensive firms.

3 Dataset and Identification Strategy

3.1 Dataset construction

The data used to test our hypotheses is taken from the Mannheim Innovation Panel (MIP). The MIP is an annual survey of innovation activities of German enterprises. The MIP is the German contribution to the bi-annual Community Innovation Surveys (CIS) of the European Commission and fully complies with the methodological standards of the CIS. The MIP is based on a stratified random sample of enterprises located in Germany with 5 or more employees that have their main economic activity in mining, manufacturing, other industry, wholesale trade, transportation and storage, information and communication services, financial and insurance activities, and other business-oriented services. More details on the MIP can be found in Peters and Rammer (2013).

For this paper we use information from three survey waves, 2006, 2007 and 2009. The 2006 wave collected detailed information on firms' innovation off-shoring activities. Each firm reported the type of off-shored innovation activity (distinguishing five types: R&D, design, production of new products, introduction of new process technology, marketing and sales of new products), the share of off-shored activities in the firm's total innovation activities for each type, and the countries where off-shored innovation activities take place. Date on innovation off-shoring refers to activities performed during 2003 and 2005. The 2009 wave contains information on organizational innovation and the effects these innovations had on firm performance. In line with the recommendations in the Oslo Manual (OECD and Eurostat, 2005), three types of organizational innovation are distinguished: new business practices for organizing procedures, new methods of organizing work responsibilities and decision making, and new methods of organizing external relations with other firms or public institutions. Five types of performance effects of organizational innovations are covered: reduce time to respond to customer or supplier needs, improve ability to develop new products or processes, improve quality of goods or services, reduce costs per unit output, and improve communication or information sharing within the firm or with other enterprises or institutions. Data on organizational innovations refers to 2006-2008, i.e. the three years following the period for which off-shoring activities were reported. The 2007 wave is used to construct various control variables for a firm's propensity to introduce organizational innovations and its ability to yield certain performance effects fromw these innovations.

Note that in what follows we restrict our sample to firms with headquarters in Germany for all three years. That means that we exclude firms which are subsidiaries of multinational companies with headquarters outside Germany. These firms represent 6 percent of the sample. The approach guarantees a clear meaning of the terms ‘on-site’ and ‘off-site’. Additionally, we exclude all firms with no innovation expenditures in 2006, because for them the question of off-shoring innovation is meaningless.

We end up with a sample of 447 firms that have responded in all three MIP waves and had headquarters in Germany. Due to item non-response, the net sample of firms used for model estimations is between 258 and 271.

3.2 Core variables and methods

The dependent variables capture the firms’ responses on the impact of organizational innovation on reaction times, development capabilities, quality, production costs, and communication flows, based on a 4-point Likert scale taking the values none, minor, medium, and large. While this measure displays some degree of subjectivity, the alternative of using the questions whether certain organizational innovations had been introduced would have fallen short off the intention of this paper. In fact, off-shoring innovation almost surely requires organizational innovations accommodating for the changes in the R&D process, but the decisive is whether the decision to off-shore affects future success with these innovations.

The key explaining variables are the shares of off-shored innovation falling into the three categories internal R&D, construction and design of new products, services or processes, as well as downstream activities that captures investment, production, and selling activities. Observe that from the last two categories construction and design as well as downstream activities are certainly both part of a holistic innovation process but are in that order increasingly remote from the actual research and development processes. With respect to several of the arguments made above (e.g. strategic control of R&D) it is crucially important to be very precise about what types of R&D we refer to when we talk about the effects of off-shoring.

Hypothesis H1 basically makes a postulation about the effect of R&D off-shoring on the success with organizational innovation (in this case an inverted u-shape). In order to test this we run a regression of the organizational innovation success on the shares of off-shored R&D and its square. We do that by categories of off-shored R&D. Due to restrictions in space we construct a summary measure of organization innovation success as the sum of all six dimensions. Because in this and the following cases the explained variable is an ordered discrete response variable we use the ordered Probit model. However, different specifications, such as plain linear regression or Tobit with corresponding limits, do not change anything substantial about the results.

H2 shifts the attention away from the share of off-shored R&D and analyses inasmuch the geographical dispersion of the off-shored R&D has an impact on the ability to successfully introduce organizational innovation. While higher shares of off-shored R&D may be indicative of high geographical dispersion of the R&D process this is not necessarily so. For example, a firm with headquarter in country A that moves all its R&D activities (including internal R&D, construction and design, and downstream activities) to country B does not have a dispersed R&D process. In order to measure geographical dispersion we use the destination countries provided in the survey. To be precise, respondents were asked to provide by category of off-shored R&D activity whereto the activities were relocated. E.g. for internal R&D the answer could have been US and Canada, for construction and design US and China, and for downstream activities US, China and Canada. In that case, we constructed a variable that measures the share of destinations that for internal R&D at which also construction and design as well as downstream activities can be found. In the example case, this measure would be 50%, because internal R&D is conducted in two locations (length of this country set is two) but only for one location (the US) all activities are found. We allow the effect of this variable to be moderated by the indicator variable for whether the company is small (<500 employees) or larger (>=500 employees). Therefore, we do not only include the plain effect of the relative geographical dispersion measure but also the interaction with the size indicator. The reason for not using the a continuous size measure such as number of employees because we think that that the argument made is more of a categorial type, because large companies at a certain level of size and multinationality radically change their organizational structures rather than evolving on grey-scales. Therefore, we think a dichotomous indicator captures better what we would like to measure. Note, in any case, that using a continuous measure does not fundamentally change the results.

H3 and H4 return to the impact of the share of off-shored R&D. Like in H2 the focus lies in interaction effects. H3 postulates that stronger involvement in on-shore R&D collaborations tends to produce less favorable outcomes when R&D is off-shored. We measure the strength of this involvement by the sum of different types of collaboration partners, where companies could choose from companies in the same group, customers, suppliers, competitors, consultancies, universities, and public research institutions. So this variable is at lowest zero (when the company had not onsite collaborations) and seven (when it had active collaborations with all types of partners).

In H4 the moderation variable is the R&D-intensity. Thus additional to the plain effect we include the interaction of off-shored R&D and the R&D-intensity as measured by R&D expenditures divided by turnover.

Observe that in H1-H3 we do not distinguish by dimension of effect concerning organizational innovation, because the results for the compound summary measure and the single dimensions are relatively similar. In H4, however, there is a marked difference. That is why we report the results for each effect separately.

3.3 Confounding Factors

We will now discuss important confounding factors that need to be controlled for in our regressions. In order to potentially confound results, such a factor should be correlated both with the off-shoring decision as well as with the ability to introduce organizational innovations.

Despite some other control variables that we will include we think that in particular size, group- or holding-structure, export activities, past experience with off-shoring activities, market structure in the home-country, access to relevant knowledge sources and collaboration opportunities at home and in the target country are of importance, and overall R&D activities.

Size: Size is one of the most important factors with respect to offshoring activities reflected in robust results that primarily large firms tend to off-shore (Bardhan and Jaffee, 2005). This may be due to scale advantages that allow firms to incur the fixed costs that are caused by the establishment of off-shored R&D facilities and innovation activities. At the same time it is well known that the propensity to innovate is gradually increases with size of the firm, where it has been claimed already by Schumpeter (1943) that larger firms are more innovative because of a greater ability to spread costs and reap profits of innovation as well as improved funding opportunities. We thus expect size as measured by employees to be positive in the regressions of organizational innovation.

Group structure: The argument about size is closely related to the prevalent group-or holding structure. Different organizational structures are supporting or hampering organizational innovation. As regards geographical dispersion of enterprise activities, subsidiary management is likewise an important influencing factor, in particular as regards the degree of independence, flows of capital, knowledge and products between the parent and the subsidiary (Birkinshaw, 1998; Bartlett and Ghoshal, 2002) and influences in particular inbound off-shoring activities of enterprises. At the same organization of the firm also impact on the ability to introduce organizational innovations. Based on complexity theory we believe that firms that belong to a group are much more accustomed to management of multisite processes and therefore may find it c.p. easier to introduce organizational innovations. Note that this argument is different from the size argument because it makes a statement about organization and not size. In any case, we believe that the dummy equaling unity of the company belongs to a group is positive.

Export activities and past experience with off-shoring: Export activities increase the likelihood of off-shoring activities because of the increasing need to adapt products to local markets and to interact closely with the customers (von Hippel, 1988, 2006; Kuemmerle, 1999; Gassmann and von Zedtwitz, 1999). Past experience in with off-shoring will also lead to higher off-shoring activities in the present not only because of sunk costs and path dependence but also because of management learning. At the same time export activities and past innovation off-shoring might also impact organizational learning (Macharzina et al., 2001; Gassmann and von Zedtwitz, 1999) and thus stimulate organizational innovation. This is because export activities are rarely organized as completely remote selling activities abroad but need close interactions with foreign customers. Therefore, export activities often imply an increased geographical dispersion of the value chain that might be problematic for the companies raising the need for organizational innovations. With respect to management learning Pavitt (2004) has highlighted that companies become increasingly better in handling geographical dispersion. Therefore, a straightforward reasoning is that prior experience and related capabilities managing a multisite value chain should clearly be impact positively on the ability to introduce organizational innovation. We therefore think that the dummy of whether the firm already had off-shoring activities should be positive. The impact of the export intensity is less clear, because more important export activities do not only reflect learning but also are indicative of relatively (possibly over-) decomposed processes.

Other control variables, which we will not discuss in detail here, include market share of the company, the expenditures on R&D, the share of material costs in total costs as a measure of capital intensity, a dummy for a location in eastern Germany where industrial structures and management practices are still today quite different from the western part of the country, and sector dummies based on the OECD classification of technology levels (OECD, 2007), which have been widely applied in the literature.

4 Results

4.1 Descriptive results

In Table 1 we find the summary statistics for the main variables used throughout this paper. We provide this table as a reference for the reader. Yet, more interesting is the analysis of the sample with respect to the characteristics of the off-shoring firms.

Table 1: Descriptive Statistics

Variable	Data type	Survey year	Mean	Std. Dev.	Min	Max
OI: General	Summed Likert scale	2009	5.18	5.10	0.00	15.00
OI: Reaction time	Likert scale	2009	1.14	1.21	0.00	3.00
OI: Development capability	Likert scale	2009	0.95	1.11	0.00	3.00
OI: Quality	Likert scale	2009	1.14	1.22	0.00	3.00
OI: Production costs	Likert scale	2009	0.84	1.03	0.00	3.00
OI: Communication	Likert scale	2009	1.12	1.17	0.00	3.00
Market share (%)	Continuous	2007	22.29	26.40	0.00	100.00
Share material costs (%)	Continuous	2006	53.93	23.41	0.09	100.00
Employees	Count	2006	2260.88	22164.00	0.00	475000.00
Export intensity	Continuous	2006	0.20	0.26	0.00	1.00
R&D intensity	Continuous	2006	0.04	0.14	0.00	2.08
Eastern Germany	Dummy	2006	0.37	0.48	0.00	1.00
Group member	Dummy	2006	0.44	0.50	0.00	1.00
Share off-shored R&D (%)	Continuous	2006	2.07	8.77	0.00	75.00
Share off-shored construction & design (%)	Continuous	2006	2.04	8.15	0.00	75.00
Share off-shored downstream activities (%)	Continuous	2006	4.04	8.84	0.00	75.00
# types domestic R&D partners	Count	2009	0.98	1.51	0.00	7.00
Relative geographical dispersion (%)	Continuous	2006	95.93	19.77	0.00	100.00
Off-shoring in 2005	Dummy	2006	0.25	0.43	0.00	1.00
High-tech manufacturing	Dummy	2006	0.10	0.30	0.00	1.00
Medium-high-tech manufacturing	Dummy	2006	0.17	0.38	0.00	1.00
Medium-low-tech manufacturing	Dummy	2006	0.16	0.37	0.00	1.00
Low-tech manufacturing	Dummy	2006	0.20	0.40	0.00	1.00

In this context, we computed a general measure of innovation related off-shoring as the mean value of the share of off-shored internal R&D, construction and design activities, and selling activities. We analyze this variable with respect to the presence of internal R&D and size (Table 2) and with respect to the sector (Table 3), where we use the OECD-technology-level classification, as mentioned before.

Not surprisingly, we find that the propensity to off-shore innovation-related activities is a lot higher for firms with internal R&D. Less than half of the R&D performers have not performed off-shored some parts of their innovation-related activities. This shows how much off-shoring of knowledge-intensive processes has become common, being in line with the claims that that this niche-topic has transformed into a quite common management practice. However, most firms still conduct the majority of R&D at onshore sites. Only about 13% of R&D performers have relocated more than 10% of their innovation activities. Virtually none has conducted more than 50% non-domestically. While, of course, the propensity to off-shore is much lower for firms without internal R&D, the interesting observation is that still almost 7% in this group had relocated some innovation-related activities. This also shows that, internal R&D, even if an important driver, is not a necessary condition for off-shoring innovation-related activities. In particular, non-R&D construction and design as well as innovation-related selling/investment/production activities are found to be off-shored even if R&D is absent.

Concerning the size of the companies, we find that larger firms (more than 500 employees) are more likely to off-shore than smaller ones. In fact, about 20% of the small and medium sized companies have off-shored some innovation-related activities while it was 45% for the bigger companies. But this still shows that innovation-related off-shoring is, though more common for larger firms, not exclusively an issue for them.

Table 2: Off-shored Innovation for R&D and non-R&D performers and by size

Share off-shored innovation	With internal R&D	No internal R&D	Total
0%	49.46	78.48	59.73
0-5%	25.45	13.92	21.03
5%-10%	12.54	5.06	10.07
10%-25%	9.68	2.53	6.94
25%-50%	2.51	0.00	1.79
>50%	0.36	0.63	0.45
Share off-shored innovation	**500+ employees**	**<500 employees**	**Total**
0%	43.28	62.63	59.73
0-5%	19.40	21.32	21.03
5%-10%	10.45	10.00	10.07
10%-25%	19.40	4.74	6.94
25%-50%	7.46	0.79	1.79
>50%	0.00	0.53	0.45

With respect to the technology level of the sectors we find a consistent picture. The higher the technology level, the higher is also the propensity to off-shore innovation related activities. Yet, there is an interesting innovation: although knowledge-intensive services have (in line with the general picture) a higher propensity to off-shore R&D than other services, it is lower than even for low-tech-manufacturing (88% non-off-shorers vs. 81%). This holds even though the R&D-intensity is much higher in knowledge-intensive services compared to e.g. low-tech manufacturing thus there seems to be also a divide between services and manufacturing. We will test in the multivariate regression models whether this observation concerning the propensity to off-shore has any bearings for the effects off-shoring on organizational innovation.

Table 3: Innovation Off-shoring by Technology Classification

Sector	0%	0-5%	5%-10%	10%-25%	25%-50%	>50%
High-tech	38.64	27.27	18.18	11.36	4.55	0.00
Medium-high-tech	38.89	26.39	20.83	8.33	4.17	1.39
Medium-low-tech	53.95	27.93	9.21	7.89	1.32	0.00
Low-tech	60.64	23.40	8.51	7.45	0.00	0.00
Knowledge-intensive services	77.60	13.60	4.80	3.20	0.80	0.00
Other services	75.00	8.33	2.78	8.33	2.78	2.78

4.2 Investigation of the hypotheses

In H1 we hypothesized that firms experience an inverted u-shape relationship, basically firms should try to create ND-processes. This means that firms that do not decompose decomposable processes (too little R&D offshoring) show lower ability to introduce organizational innovation, while the same adverse effects should hold for firms that do too much R&D offshoring.

We test this hypothesis by regressing the share of off-shored innovation and its square on the success with organizational innovation. We differentiate between different types of R&D. Namely: share of off-shored internal R&D, the share of off-shored construction and design, and the share of off-shored downstream activities, among them selling of new products.

Table 4: Innovation Off-shoring and Organizational Innovation (squared Effects)

	(1) OI: General	(2) OI: General	(3) OI: General
Share off-shored internal R&D	0.0675 (1.08)		
(Share off-shored internal R&D)^2	-0.00262 (-1.28)		
Share off-shored construction & design		0.0508** (2.15)	
(Share off-shored construction & design)^2		-0.000751* (-1.85)	
Share off-shored downstream activities			0.0639** (2.27)
(Share off-shored downstream activities)^2			-0.00177** (-1.98)
Market share	0.354 (1.33)	0.388 (1.40)	0.387 (1.41)
Share material costs	0.240 (0.74)	0.0431 (0.13)	0.172 (0.51)
Employees	0.0000283 (0.45)	-0.0000343 (-1.24)	-0.00000429 (-0.15)
(Employees)^2	-2.99e-11 (-0.12)	1.76e-10 (1.16)	4.13e-11 (0.26)
Export intensity	0.101 (0.31)	0.0462 (0.14)	0.267 (0.73)
R&D intensity	0.259 (0.42)	-0.0724 (-0.12)	0.0731 (0.13)
Eastern Germany	0.271* (1.80)	0.259* (1.66)	0.200 (1.29)
Group member	0.244* (1.66)	0.369** (2.47)	0.340** (2.30)
Off-shoring in 2005	0.502*** (2.60)	0.554*** (2.78)	0.502*** (2.60)
FuE-Aufwendungen	-0.00433 (-0.77)		
Medium-high-tech manufacturing	0.00811 (0.03)	0.140 (0.47)	0.0817 (0.28)
Medium-low-tech manufacturing	0.0681 (0.24)	0.332 (1.11)	0.293 (1.01)
Low-tech manufacturing	-0.0537 (-0.19)	0.0898 (0.30)	0.0719 (0.25)
Knowledge-intensive services	0.408 (1.43)	0.569* (1.90)	0.599** (2.03)
Other services	0.160 (0.41)	0.348 (0.89)	0.446 (1.16)
Observations	277	261	261

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The results are summarized in Table 4 in equations (1)-(3), which differ by the type of R&D activity. What we indeed see is that for both construction and design activities as well as downstream activities the linear term is positive while the squared term has a negative sign. This corroborates the inverse u-shape for these two types of R&D. For internal R&D, both terms have the expected sign, but the linear term is not significant, eventually not giving a clear evidence of an inverse u-shape for core R&D activities.[5]

We briefly discuss also the confounding factors here. What we see is that unlike expected, size does not have a detectable influence on organizational innovation. The same seems to be true for export activities, with the exception of Model 1, where we find a weakly significant positive impact. This might be indicative that learning effects and the implied additional decomposition actually off-set each other. Clearly positive, on the contrary is the dummy for the presence of past off-shoring activities which clearly gives a strong indication of the existence of management learning effects as hypothesized by Pavitt (2004). Significantly positive is also the dummy for the group membership, which we interpreted as a proxy experience with multisite processes that non-group firms do not possess. The results with respect to these variables remain relatively stable in all subsequent regressions. Therefore, we will not repeatedly discuss these results in what is to follow.

Having established an inverted u-shape of off-shoring and organizational innovation, an interesting follow up question is where the optimal point lies and how many firms are above or below that threshold. The results can be found Table 5:[6]

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5 If we run the regressions (not presented) by type of effect of organizational innovation we find a significant inverted u-shape for reaction times, production costs, and communication flows. All effects (both linear and squared) are insignificant for development capabilities and quality. This supports the view that also for internal R&D the relationship is quadratic but not for all effect-dimensions.

6 The optimal value follows easily directly from differentiation yielding the formula $optval = -\beta_l / \left(2\beta_{sq}\right)$, where the β denote the coefficient on the linear and the squared R&D variable.

Table 5: Threshold values for Innovation Off-shoring by Type

	Optimal value (%)	z-val.	Larger values total (%)	Larger values off-shorers (%)
Share off-shored internal R&D	12.79 ***	4.22	4.33	38.19
Share off-shored construction & design	33.83 ***	4.38	0.66	4.87
Share off-shored downstream activities	15.9 ***	3.98	7.97	19.89

Again the results show that all optimal values (also the one for internal R&D) are significantly different from zero. Also we see that while the thresholds are relatively low for internal R&D and downstream activities, they are larger for construction and design. This suggests that from the point of view of organizational integration it might be easier for firms to off-shore construction and design rather than internal R&D and downstream activities. A second interesting observation is that the majority of firms (over 95%) stay below this threshold, if we consider all firms (including the non-off-shorers). Thus for a large majority the critical threshold is not yet reached. While this seems to corroborate Pavitt's (2004) view that firms are relatively efficient to handle their degrees of off-shoring, the picture is a little bit different when we focus on the share of firms above the respective thresholds among the off-shorers. While the figures are with 6.89% still quite low in the case of construction and design, they are larger for downstream activities (19.61%) and massive for internal R&D (almost 40%). This means that, if firms off-shore internal R&D, a large share goes beyond the threshold. These companies run the risk of experiencing problems organizational integration. It might also be an explanation why we have seen strong tendency to backshore certain core activities following the enthusiasm about off-shoring (Kinkel and Maloca, 2009).

Turning to the question of possible moderators we have suggested in H2a and H2b that size of the company might play an important role. It is the usual conception in the literature that larger companies should be more able to effectively deal with a geographical dispersion of their R&D processes because they have had greater experience with internally dispersed production. On the other hand, larger companies already have to manage a considerably higher degree of organizational complexity, often leading to communicational or organizational interfaces inside the company that are sluggish or inflexible. Therefore, smaller companies might find it easier to effectively deal with any given degree of R&D geographical dispersion than larger companies.

In order to analyze this issue more in depth, we have generated a measure of geographical dispersion that gives the share of country destinations where not all three types of R&D are located (see Section 0). If we believe that larger companies can more easily handle geographical dispersion (H2a), we would expect that the effect of our measure is positive for larger companies and negative for smaller companies. If we believe in the conflicting hypothesis (H2b), the effects should be vice versa.

In fact, what we do find in Model 1 in Table 6 is that the coefficient on moderation effect with an indicator for large companies is negative, while the main effect is insignificant. This implies that larger firms suffer more severely from increasing geographical dispersion of their R&D process. This clearly gives more evidence of H2b instead of the conflicting hypothesis H2a.

In addition to size, we have hypothesized in H3 that off-shoring R&D might generate problems for firms that are intensely involved in local collaboration activities. This is because R&D has become collaborative and open process taking place in networks. Off-shoring then implies that local network participation might be weakened, because attention to them could be reduced.

In any case, if this is true, we would expect a negative coefficient on the interaction between share of off-shored R&D and the number of different types of local R&D collaboration partners. In Table 6 we analyze this effect by our three types of R&D activities internal R&D, construction and design as well as downstream investment. We find the effect corroborated for internal R&D and construction and design. The coefficient for downstream R&D related investment has the predicted negative sign but fails to reach the significance level. Therefore, we confirm H3 for internal R&D and construction and design.

By noting that from internal R&D over construction and design to downstream investment the degree of remoteness from core technology development increases this is also an intuitive observation: because the argument of open collaborative technology development should be more compelling for core R&D activities in comparison to more remote downstream investment activities.

Table 6: Innovation Off-shoring and Organizational Innovation (Cooperation and geographical dispersion)

	(1) OI: General	(2) OI: General	(3) OI: General	(4) OI: General
Relative geographical dispersion	0.00693 (1.22)			
Large company	1.852** (2.47)			
(Relative modularization)*(Large company)	-0.0216*** (-2.82)			
# types domestic R&D partners		0.199*** (3.30)	0.177*** (3.04)	0.182*** (2.82)
(Share off-shored R&D)*(# types domestic R&D partners)		-0.0315** (-2.28)		
(Share off-shored construction and design)*(# types domestic R&D partners)			-0.0104* (-1.86)	
(Share off-shored downstream activities)*(# types domestic R&D partners)				-0.00651 (-0.97)
Market share	0.324 (1.16)	0.227 (0.79)	0.263 (0.91)	0.264 (0.92)
Share material costs	0.0334 (0.10)	0.0931 (0.27)	0.0753 (0.22)	0.0850 (0.25)
Employees	-0.0000400 (-1.00)	-0.0000315 (-1.08)	-0.0000275 (-0.93)	-0.0000174 (-0.58)
(Employees)^2	2.48e-10 (1.14)	2.94e-10* (1.68)	1.81e-10 (1.10)	1.16e-10 (0.72)
Export intensity	0.223 (0.60)	0.0626 (0.17)	0.0360 (0.10)	0.104 (0.28)
R&D intensity	0.293 (0.46)	0.367 (0.55)	0.0309 (0.05)	0.00302 (0.00)
Eastern Germany	0.211 (1.34)	0.227 (1.43)	0.236 (1.49)	0.213 (1.34)
Group member	0.415*** (2.60)	0.311** (1.97)	0.329** (2.06)	0.309* (1.94)
Share off-shored R&D	-0.0307* (-1.72)	0.0281 (0.93)	-0.0221 (-1.26)	-0.0280 (-1.62)
Share off-shored construction & design	0.0226* (1.83)	0.0347** (2.36)	0.0401** (2.32)	0.0205 (1.61)
Share off-shored downstream activities	-0.00178 (-0.14)	-0.00171 (-0.13)	0.00105 (0.08)	0.00820 (0.60)
Off-shoring in 2005	0.543*** (2.62)	0.550*** (2.67)	0.547*** (2.66)	0.555*** (2.69)
Medium-high-tech manufacturing	0.196 (0.65)	0.0290 (0.10)	0.0870 (0.28)	0.0222 (0.07)

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Finally, following the strategy literature that off-shoring might be particularly problematic for the ability to introduce organizational innovations effectively, if there is a strong strategic focus on R&D. For these companies R&D is clearly of greater strategic importance and off-shoring it will imply a loss of control over certain strategic processes, which is generally assumed to be detrimental. Differentiating by effects of organizational innovation we find in Table 7 that the corresponding negative interaction of share of off-shored internal R&D can only be observed for effects of organizational innovation on development but not for the other effects, among them costs or reaction times. This is an interesting observation, because it highlights that the negative effects of off-shoring in R&D in R&D-intensive firms relate to the core processes themselves. That means that the negative effects are organizationally localized in the sense that off-shoring R&D negatively impacts on organizational adaptability of the development processes themselves but not necessarily on the broader organizational adaptability of the firm. In any case, we would least for this special focus corroborate H4.

Table 7: Innovation Off-shoring and Organizational Innovation (R&D Intensity)

	(1) OI: Reaction time	(2) OI: Development capability	(3) OI: Quality	(4) OI: Production costs	(5) OI: Communication
Share off-shored R&D	-0.0122	-0.00813	-0.0210	-0.00854	-0.0193
	(-0.63)	(-0.41)	(-1.08)	(-0.43)	(-0.98)
(Share off-shored R&D)*(R&D intensity)	-0.0369	-0.111*	-0.0268	-0.0664	-0.0334
	(-0.88)	(-1.81)	(-0.63)	(-0.72)	(-0.79)
Market share	0.304	0.341	0.279	0.317	0.198
	(1.04)	(1.15)	(0.97)	(1.09)	(0.69)
Share material costs	0.0963	-0.161	-0.0848	-0.144	-0.00134
	(0.27)	(-0.44)	(-0.24)	(-0.41)	(-0.00)
Employees	-0.0000273	-0.0000300	-0.0000263	-0.0000236	-0.0000219
	(-0.88)	(-1.01)	(-0.78)	(-0.77)	(-0.73)
(Employees)^2	1.50e-10	2.36e-10	1.52e-10	1.38e-10	1.16e-10
	(0.88)	(1.22)	(0.83)	(0.82)	(0.71)
Export intensity	0.165	0.283	0.288	0.337	0.280
	(0.43)	(0.73)	(0.74)	(0.88)	(0.73)
R&D intensity	0.656	3.252**	0.384	0.127	0.812
	(0.80)	(2.06)	(0.47)	(0.15)	(1.00)
Eastern Germany	0.219	0.283*	0.219	0.291*	0.258
	(1.34)	(1.68)	(1.34)	(1.78)	(1.59)
Group member	0.286*	0.473***	0.289*	0.282*	0.279*
	(1.78)	(2.90)	(1.80)	(1.74)	(1.75)
Share off-shored construction & design	0.0111	0.0224*	0.0194	0.00646	0.0302**
	(0.87)	(1.78)	(1.46)	(0.50)	(2.36)
Share off-shored downstream activities	0.00472	0.00309	-0.00535	0.000668	-0.00159
	(0.36)	(0.24)	(-0.40)	(0.05)	(-0.12)
Off-shoring in 2005	0.493**	0.507**	0.527**	0.647***	0.468**
	(2.32)	(2.39)	(2.47)	(3.03)	(2.22)
High-tech manufacturing	-0.332	-0.220	-0.310	-0.472	-0.623
	(-0.82)	(-0.53)	(-0.77)	(-1.18)	(-1.52)
Medium-high-tech manufacturing	-0.181	-0.257	-0.435	-0.306	-0.356
	(-0.50)	(-0.69)	(-1.19)	(-0.85)	(-0.98)
Medium-low-tech manufacturing	-0.147	-0.178	-0.167	-0.185	-0.223
	(-0.42)	(-0.50)	(-0.47)	(-0.54)	(-0.63)
Low-tech manufacturing	-0.362	-0.321	-0.385	-0.533	-0.248
	(-1.08)	(-0.94)	(-1.14)	(-1.60)	(-0.74)
Knowledge-intensive services	0.299	0.213	0.294	-0.281	0.0582
	(0.87)	(0.61)	(0.86)	(-0.83)	(0.17)
Observations	258	258	258	258	258

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5 Discussion and conclusion

The empirical results from the previous section deliver several interesting starting points for further discussion, that have implications both for major strands in the management literatures as well as direct managerial implications.

Cost of off-shoring and back-shoring

While the off-shoring literature has often been relatively enthusiastic about the associated benefits, the cost side has often been ignored or only marginally touched. Our analysis is more encompassing, because we identify positive as well as negative effects of off-shoring. We show that there is an optimal threshold for the off-shoring of innovation related activities, beyond which the costs in terms of organizational adaptability exceed the benefits. Over off-shoring in R&D narrows the companies' ability to react, which is in a world with ever shorter innovation cycles a clear disadvantage. In addition, we showed that there are important contingencies determining the associated costs. Dimensions that we analyzed were the R&D-network involvement and the reliance on internal R&D. We found that the stronger the focus on R&D or the more strongly integrated the firm is in on-shore R&D networks, the more the ability to create appropriately decomposed organizational structures decreases.

From a theoretical perspective, the strong emphasis on the benefits in the previous literature certainly stems from the central role that agency problems have played as motivator of costs in the analysis of outsourcing activities. For off-shoring these opportunism-related costs may indeed be weaker, because the activities still take place within the boundary of the firm. However, our theoretical approach highlighted that a premature dismissal of the importance of the cost side neglects the fact that off-shoring, in particular over-off-shoring increases management complexity. Our results with respect to local knowledge networks and R&D-intensity indicate that this complexity issue may be tightly linked to the management of the knowledge generation processes. In terms of the knowledge perspective of the firm (Kogut and Zander 1992, in particular Grant 1996)) as an outflow of the RBV literature, the central argument would be that (excessive) off-shoring might weaken the knowledge-integration function of firms. Obviously these network and R&D-intensity-related contingencies also provide valuable information for managerial decision making because they identify important cost determinants.

The trade-off between benefits and costs also provides a candidate explanatory framework also for the wave back-shoring activities that has been witnessed during the last years. There is a small but emergent literature on this topic, which however mainly investigated this phenomenon for production activities of companies, identifying problems in flexibility and delivering ability as well as quality problems as major motives for back-shoring (Kinkel and Maloca 2009). As highlighted, the reasons for the back-shoring of innovation activities may be quite different from the back-shoring motives of manufacturing activities and relate much more to the role of functioning and manageability of the knowledge generation processes. To the degree that we expect that innovation back-shoring will become more important these results have important implications for future works analyzing such processes.

From the perspective of managerial implications, we suggest if companies engage in innovation off-shoring activities the management should in particular monitor closely reaction times, communication flows and production costs, as well as the effectiveness of their development processes as measure of success of organizational innovation. They should do this in order to identify the optimal share of off-shored R&D negative effects, and thus to avoid associated costs that will eventually cause the company to back-shore.

The diversity of off-shoring motives and activities

The literature on internationalization (comprising both outsourcing and off-shoring) has highlighted considerable diversity the motives. With respect to motives common distinctions are between market-driven, technology-driven and knowledge-driven internationalization motives for R&D activities (e.g. von Zedtwitz and Gassmann 2002, Kuemmerle 1999, Patel and Vega 1999). Paralleling the diversity in motives, our data focused in different innovation types, where our results convey important differences in the effects (see for example the results on impacts of on-shore R&D networks and their interaction with internal R&D, construction and design, and downstream activities). In confirmatory regressions (not presented to due to restrictions in space) we were able to show that also the general effects are not identical for each dimension of organizational innovation. The inverted u-shape for example of off-shoring of internal R&D was visible for some types of organizational innovation but not for others. It therefore seems highly important to analyze the effects of off-shoring differentiated by type of innovation, with which different motives are associated.

Size and organizational structure

A dominant pattern in the literature is that larger firms have both higher propensities to off-shore as higher shares of off-shored activities. In many cases, this has led to the assumption that off-shoring is primarily a large-company phenomenon. Although some articles focus on the role of born-globals (e.g. Knight and Cavusgil, 1996) this is particularly evident in the MNE literature (e.g. Bardhan and Jaffee, 2005), which focuses on very large players. Based on this observation, it seems only a step away from assuming that larger firms are not only more likely to engage in but also organizationally more able to deal with off-shoring. As an instance, superior management capabilities of larger firms are often invoked, but rarely proven.

On the contrary, our results show that smaller firms find it easier to deal with the organizational tensions of innovation off-shoring, which we explained by the lower a priori complexity associated with effective management of smaller firms.. This is in line with a literature that highlight the importance of existing organizational and hierarchical structures of the companies (c.f. Hedlund, 1994; Dunning and Lundan, 1998; Kuemmerle 1999) as a driver of choice of location (Ketokivi and Ali-Yrkkö2007). This has two implications. First, the role of size cannot be fully understood of treated in isolation from organizational processes. Second, off-shoring should neither explicitly nor implicitly be understood as a pure large-company phenomenon. In fact, if it true that smaller companies find it easier to deal with the tensions called forth by off-shoring (probably due to their organizational structures), we would expect that increasingly also they will try to capitalize on the benefits associated with off-shoring activities.

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