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The Impact of Captive Innovation Offshoring on the Effectiveness of Organizational Adaptation

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1 Introduction

Internationalization and offshoring[1] of firm operations has become an increasingly important topic in management and has evolved from a strategy mainly used by very large corporations to standard management practice in many firms (Rilla and Squicciarini, 2011). For a long time, internationalization focused on manufacturing and sales processes. Recently, more and more firms started to (re)locate knowledge- based activities abroad, including R&D and innovation (Henley, 2006; Levy, 2005; Bardhan and Jaffe, 2005; Lewin et al., 2009). A growing literature on innovation offshoring reflects this increasing importance, including studies on motives and choice of location (Ambos and Ambos, 2011; Jensen and Pedersen, 2011) as well as on performance impacts (cf. Fifarek et al., 2008; Nieto and Rodriguez, 2011; Kotabe et al., 2007 for impacts on innovation capabilities; cf. Nieto and Rodriguez, 2013; Tang and Livramento, 2010 for impacts on productivity).

While it is commonly held that innovation offshoring requires organizational restructuring, this aspect has not been at the center of research interest so far (cf. the literature review in Schmeisser, 2013). Only recently a literature has emerged that relates offshoring to arguments about organizational complexity and modularity, where, however, a consensus was not achieved yet. On the one hand it is argued that offshoring makes organizational processes more complex (e.g. because of geographic separation of different management levels) and hence reduces the organizational ability to adapt to changing environments (Bartlett and Ghoshal, 2002). On the other hand, Kedia and Mukhherjee (2009) and Nieto and Rodriguez (2013) claim the existence of offshoring related disintegration advantages arising from the modularization of larger tasks into simpler subtasks facilitating organizational adaptation.

We attempt to contribute to the literature both in a theoretical and an empirical respect. On a theoretical level, we seek to reconcile the contradictory arguments on organizational consequences of innovation offshoring within the framework of complexity theory. We will argue for an inverted u-shape relationship between innovation offshoring and organizational adaptability, the latter denoting a firm's ability to respond to a dynamic environment through organizational change (Walker et al., 2004). An inverted u-shape implies that up to a certain level of innovation offshoring disintegration advantages facilitate organizational adaptability as complex tasks which used to be integrated at the companies' home base can be split into smaller and easier to manage subtasks (cf. Kedia and Mukhherjee, 2009). Beyond that threshold, offshoring

1 In line with most parts of the more recent literature we treat the term "innovation offshoring" and "innovation internationalization" interchangeably, where both refer to the (re)location of innovation activities of firms outside their home country but inside the boundaries of the firm (see OECD and Eurostat, 2005). The geographical distance between the home country and the offshore location does not matter, i.e. offshoring includes any internationalization of innovation.

becomes detrimental due to the inability to further disintegrate tasks while organizational complexity of non-linear, recursive processes that are typical to innovation (cf. Kline, 1985) further increases. This reflects the costs side of offshoring activities.

We test our theoretical framework using data from three waves of the German Innovation Survey. The data include detailed information on innovation-related offshoring activities for a large, representative sample of firms. We find strong evidence of an inverted u-shape of innovation offshoring for organizational adaptability, where the relationship, however, depends on several contingency factors, which we derive from our framework. In addition, the key findings are illustrated by innovation offshoring experiences from a large German car manufacturer in China.

2 Theory

2.1 Complexity, Organizational Adaptability and Innovation Offshoring

Conceptual analyses of benefits and costs of innovation offshoring have frequently adopted the resource based view of the firm often combined with arguments from transaction cost theory. The resource-based perspective has proven useful for analyzing impacts on the firms' innovation capabilities (Kotabe et al., 2007; Nieto and Rodriguez, 2011; Grimpe and Kaiser, 2010). Along this line of theory, offshoring changes internal capabilities of organizations, where one strand of literature emphasized the importance of tapping into new knowledge sources (Bardhan and Jaffe, 2005; Barthélemy and Quélin, 2006; DeSarbo et al., 2005; Maskell et al., 2007) which facilitates benefits from complementarities between different knowledge sources (Cassiman and Veugelers, 2006). On the cost side, it has been argued that internal resources may be weakened by excessive outsourcing of external knowledge as a firm's integrative capabilities and absorptive capacities may be hampered if internal and external investment in knowledge becomes unbalanced (Grimpe and Kaiser, 2010; Helfat and Raubitschek, 2000). Moving beyond the view that costs and benefits of offshoring primarily emerge through impacts on internal (knowledge-related) resources, some recent contributions have stressed organizational features, such as changes in managerial complexity and an organization's ability to effectively adapt to changes in the environment as another important challenge of offshoring (Bals et al., 2013; Jensen et al., 2013). We will follow this line of research and by examining the impact of innovation offshoring on organizational adaptability[2].

2 Organizational adaptability is used here to denote the effectiveness of organizational changes with respect to performance.

We employ complexity theory as our main theoretical guide (Simon 1962; 1996; 2002) since this approach allows to investigate the consequences of increasing complexity on a system's performance as well as alternative organizational designs. Its key concept is the nearly decomposable system of tasks (ND-system), where decomposable task systems are any split of overall tasks into smaller subtasks such that the subtasks are independent of each other (cf. Zhou, 2013). The main postulation of complexity theory is that decomposable systems, often also called modular systems, are able to adapt to environmental turbulence faster than non-decomposable systems (Ethiraj and Levinthal, 2004; for simulation results see for example Frenken et al., 1999; Rivkin and Siggelkow, 2007; Simon, 2002; Yayavaram and Ahuja, 2008). The reason for this is that if subsystems are linked by some sort of interdependence, the optimum state of the entire system can only be found when all subsystems are jointly optimized. If subsystems are independent the global optimum of the entire system can be found by optimizing each subsystem individually. This implies that decision making in ND systems is less complex and actual outcomes are easier to predict.[3]

In terms of a firm's innovation activities, tasks may comprise different stages in the innovation process like idea generation, research, experimentation, technological development, proto typing, testing, commercialization and implementation. Subsystems can either refer to individual projects, subject-matters, sub-divisions and teams, depending on the way a firm organizes its innovation process. Decomposability will be high if innovation projects can be executed independently from each other and can be easily shifted between sub-divisions or teams; it will be low if innovation projects are highly interlinked and are executed by different teams or sub-divisions who need to interact, as occurs when technology development is based on common technological platforms.

Innovation offshoring can be regarded as a specific form of decomposing firm activities into sub-systems (Bals et al., 2013; Nieto and Rodriguez, 2013). The consequences of innovation offshoring for a firm's organizational adaptability will depend on the extent to which offshoring de- or increases the organizations' complexity, i.e. their degree of non-modularity.

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3 This theoretical reasoning has made its way into the practical management toolbox. Steward (1981) developed the Design Structure Matrix (DSM), which models interdependencies between distributed project tasks and allows managers to assess critical issues during the planning phase. Eppinger et al. (1994) extend the DSM to the case of new product development.

2.2 Derivation of Hypotheses

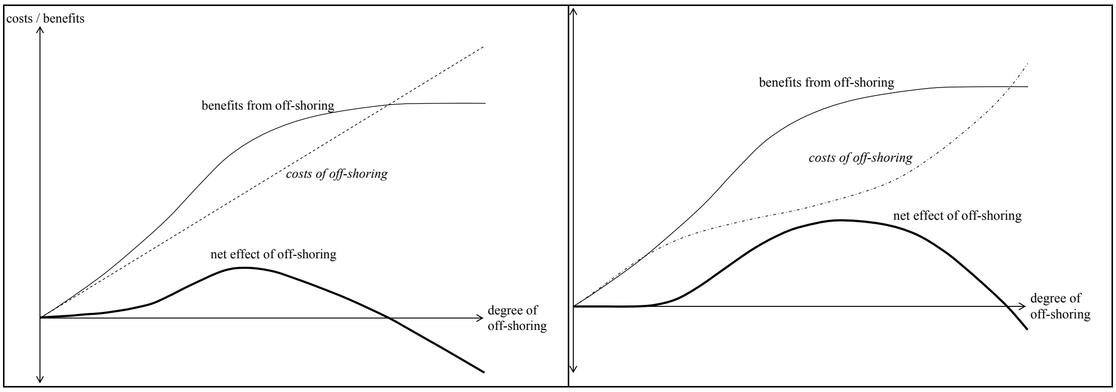
The General Relationship

The literature has discussed both organizational benefits and costs of offshoring. Kedia and Mukherjee (2009) argue for disintegration advantages that occur because through offshoring complex tasks are split into easier subtasks, which makes them more easy to manage (see also Schmeisser, 2013). On the cost side, Medcof (2001) argues that offshoring causes major disruptions in the organization of the value chain and, to the degree that these costs are not addressed, they may exceed the benefits. An important reason is that tasks are in practice not completely independent of each other and therefore require the creation of interfaces. The more complex these interfaces become the less effective organizational changes will be because complexity makes it difficult for managers to predict organizational impacts of certain changes correctly (Ethiraj and Levinthal, 2004) and thus undermines the ability to respond to environmental change (Robson et al., 2008). These costs are particularly important for innovation offshoring because these high-value activities are tightly coupled to other functions in the firm inflating costs of interface creation (Lampell and Balla, 2011).

A trade-off between costs and benefits of offshoring makes a strong point for an inverted u-shaped relationship between offshoring and organizational adaptability. The extent of such a u-shaped relationship and hence the optimal level of offshoring will depend on a number of factors (examples based on experiences from a large German car manufacturer will be given in the empirical section). An inverse u-shaped relationship may occur under different situations, for example if benefits due to disintegration advantages increase strongly for low levels of innovation offshoring but weakly for higher levels. This must logically be the case because disintegration advantages have an upper bound at the point where the organizational structure is perfectly decomposable. If the costs increase linearly there will be an optimal level of offshoring (see Graph a) in Figure 1). More likely than a linear are however over-proportionate cost increases because disintegration in ever more fine-grained subtasks requires more complex interfaces between them. In that case the inverted u-shape should be more pronounced (see Graph b).

Figure 1: Situations for an inverted u-shaped relationship between offshoring and organizational adaptability.

a) net effect of offshoring in case of decreasing returns from disintegration and linear disintegration costs	b) net effect of offshoring in case of decreasing returns from disintegration



Empirical analyses on related research questions regularly find u-shaped relationships between offshoring and measures of firm performance (e.g. profits). An inverted u-shape has been hypothesized already by Hitt et al. (1994) and Sullivan (1994). Empirical evidence was found by Geringer et al. (1989), Gomes and Ramaswamy (1999) and Hitt et al. (1997). Other studies arguing for inverted u-shapes have moved beyond general measures of firm performance and have analyzed the relationship between outsourcing and innovation (Grimpe and Kaiser, 2010) and offshoring and innovation (Kotabe et al., 2008).

Based on both the theoretical arguments presented above and results in the literature, we hypothesize that the relationship between innovation offshoring and organizational adaptability is non-linear in nature, with an optimal level of offshoring beyond which costs exceed benefits.

> *H1a: The degree of innovation offshoring has an effect on the effectiveness of organizational adaptability that follows an inverted u-shape.*

Innovation is not a homogenous set of activities but contains various activities that differ strongly in the level of routine and complexity (Ørberg Jensen and Pedersen, 2011; Liu et al., 2011). These characteristics can have important impacts on how able companies are to disintegrate tasks into easily manageable subtasks. This is because more complex tasks are usually highly integrated with other tasks (Lampell and Balla, 2011). In the context of this paper that means that the general relationship between innovation and the success of organizational adaptations will also depend on the exact type of innovation activity that is offshored. Following an innovation stage view running from idea generation through research, design and testing to market implementation (Cooper, 2008) we distinguish between R&D (i.e. activities devoted to develop new technology), design (transferring new technology into marketable products or new production processes), and downstream activities (actual production of innovative products, marketing of innovations). The general expectation is that more interconnected and therefore organizationally more complex activities are likely to impose higher offshoring costs. D'Agostino et al. (2011) suggest that firms focus on offshoring more standardized design activities, while they tend to retain core R&D at the headquarters (Mudambi, 2008). For market-related innovation activities, we assume higher costs of complexity since interconnection with other functional departments such as production and logistics is high. If costs of complexity exceed benefits from offshoring already at a moderate level, the optimal threshold will be lower, particularly if returns from offshoring do not increase anymore beyond a certain internationalization level.

H1b: The optimal threshold of offshoring is lower for core R&D and market-related innovation than for design.

Moderating Factors

The general relationship is likely to be contingent on moderating factors. We will turn to these now.

Geographical Dispersion and Firm Size

Following Contractor et al. (2010) offshoring requires two decisions. The first refers to the degree of organizational disintegration. In our context this incorporates primarily decisions on which activities to offshore and how large the desired share of offshored activities is. The second decision refers to where to locate the disintegrated tasks geographically. This duality of degree of offshoring and location choice suggests that organizational complexity results not only from the type of offshored tasks (H1b) as well as how much of it is offshored (H1a) but also how strongly these tasks have been geographically dispersed. This is because greater geographical dispersion does not only increase physical transaction costs, it also reduces cultural and or institutional proximity (Ceci and Prencipe, 2013) leading to additional complexities in management because of larger social communication costs, risks of culturally determined misunderstanding and institutionally determined transaction costs. The general expectation is thus that geographical dispersion increases organizational complexity and thereby amplifies the costs of offshoring.

H2: The optimal threshold for offshoring innovation is lower when geographical dispersion is high.

The ability to deal with additional complexity also depends on the degree of a firm's innate complexity. One important driver of this complexity is size, in which context Larsen et al. (2013) proposed the concept of combinatorial complexity referring to the fact that in a system of n subsystems the number of possible linkages is equal to n*(n-1). This number is quadratic in n, implying that complexity rises more than proportionately with size, meaning that larger firms are overproportionately complex. Thus smaller firms possess important virtues such as organizational flexibility and entrepreneurial dynamism (Roza et al. 2011), implying that small firms might have an advantage at managing internationalization-induced complexity. These arguments are empirically backed by the existence of "born-globals" (e.g. Knight and Cavusgil, 1996) and the increasing importance of offshoring in SMEs (Di Gregorio et al., 2009). We derive the following hypothesis:

H3: Small companies find it easier to deal with geographical dispersion of their innovation processes.

The Role of Onshore Innovation Networks

So far we have looked at internal organizational costs that arise because of more complex management processes. But costs can also emerge in external relations with existing networks of partners that play a decisive role in innovation processes (Nonaka and Toyama, 2005). Though offshoring may increase a firm's external links, it can also weaken a firm's network because established links may dissolve when approaching new suppliers or customers abroad. At the same time, it is not easy to establish the same links abroad because networks built on slowly accumulating trust and social capital (Laursen et al., 2012) There is both a geographical and a temporal dimension to this argument. First, trust and social capital accumulate over time, implying that recent offshorers might have to deal with low levels of trust and social capital. Second, traditional substitute mechanisms, such as monitoring, are less effective (Ceci and Prencipe, 2013), when distance increases, making network coordination more difficult. Thus, the effect of offshoring on network embeddedness will tend to be negative. In line with this view there is evidence that local embeddedness in networks reduces the potential for successful outsourcing (Grote and Täube, 2007). Because of the critical importance of R&D collaboration for the ability to innovate successfully (Aschhoff and Schmidt, 2008), and the positive complementarity between technological innovation and organizational change (Schmidt and Rammer, 2007), costs of offshoring are particularly high, when onshore innovation networks are important to the firm.

H4: The effect of innovation offshoring on organizational adaptability is more negative for firms that with a broader involvement in domestic R&D networks.

3 Data and Empirical Identification Strategy

The empirical results are derived in two subsequent steps. The main empirical identification strategy relies on the analyses of the data from the Mannheim Innovation Panel (MIP) and the core results are generated from this. These are contrasted with practical innovation-offshoring experiences from Volkswagen New Mobility Services Investment Co. Ltd. (VWNMS). VWNMS is a subsidiary of the Volkswagen Group in China and focuses its activities on the development of car-sharing and leasing models. Major results are integrated as additional, qualitative evidence in several boxes in Section 4 and influenced the discussion in Section 5.[4]

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4 A documentation describing data gathering and analytical procedures are available from the authors upon request.

3.1 Data

The data used to test the hypotheses is taken from the Mannheim Innovation Panel (MIP). The MIP is an annual survey of innovation activities of German enterprises and as the German contribution to the Community Innovation Surveys (CIS) of the European Commission fully complies with the methodological standards laid down for 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, energy and water supply, sewerage and remediation, 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 offshoring activities. Each firm reported the type and extent of offshored innovation activity with respect to product and process innovations, distinguishing five types: R&D, design, production of new products/services, introduction of new process technology, marketing of new products/services. For each type, the share of offshored activities in the firm's total innovation activities was obtained, using three categories: 1 to 10%, 11 to 50%, >50% of a firm's total innovation activities of the respective type. In addition, each firm with offshored innovation activities was asked to name the countries where these activities took place for each of the five types of activities. The information on innovation offshoring refers to activities in the year 2005.

The 2009 wave contains information on organizational changes and their impact on firm performance which is used to construct a measure of organizational adaptability. In line with the recommendations of the Oslo Manual (OECD, 2007), three types of organizational changes 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 impacts of organizational changes are covered: reducing time to respond to customer or supplier needs, improving ability to develop new products or processes, improving quality of goods or services, reducing costs per unit output, and improving communication or information sharing within the firm or with other enterprises or institutions. Data on organizational changes and their impacts refer to 2006-2008, i.e. the three years following the period for which offshoring activities were reported. The 2007 wave is used to construct various control variables for a firm's propensity to introduce organizational changes and its ability to yield certain performance effects from these changes.

Note that in what follows we restrict our sample to firms with headquarters in Germany for all three years, thus excluding firms which are subsidiaries of multinational companies with headquarters outside Germany. This approach guarantees a clear meaning of the terms ‘onshore’ and ‘offshore’. Additionally, we exclude all firms with no innovation expenditures in 2005 because the question of offshoring innovation is meaningless for them.

We end up with a sample of 447 innovation-active firms that responded in all three MIP waves and had their headquarters in Germany. Due to the item non-response, the net sample of firms used for model estimations is between 258 and 271. It should be noted that the CIS is meant to give a rather representative view of the German economy both in terms of size of the firms as well as sector belonging. Therefore the survey includes also relatively small firms from non-innovation-intensive sectors. This has two implications. First, the share of innovation offshoring firms is relatively low (see Subsection 4.1) as compared to more selective databases (e.g. FDI Markets). Second, because the average firm in the CIS is probably less innovative and less internationalized than the average firm in more selective surveys, it could be true that the organizational costs of internationalization are more apparent, because firms are on average less experienced. However, given the representative of the CIS, this is not an issue of selection bias but reflects a characteristic of the population.

3.2 Core Variables

Our dependent variable is organizational adaptability (OA), i.e. the ability of a firm to change organizational routines and processes in a way to improve its performance. We measure organizational adaptability by the extent to which organizational changes introduced in the field of business practices, work organization and external relations during a three-year period yield to significant positive changes in firm performance, distinguishing five performance dimensions: reaction times, development capabilities, product/service quality, production costs, and communication flows. For each dimension, firms provided an assessment of the impacts of organizational changes on these five performance dimensions using a 4-point Likert scale which takes the values none, minor, medium, and large. We build six alternative dependent variables: one for each performance dimension plus an aggregated index that sums up the five individual dimensions by assigning values of 0 to 3 to the four point Likert scale. The aggregated OA index can range from 0 to 15. Note that firms that did not introduce any organizational change during a three year period receive a value of zero for all OA variables. Since OA is an ordered discrete response variable, we use ordered probit regression.

The key variable to explain organizational adaptability is the share of offshored innovation activities. We distinguish three types of offshored innovation activities: R&D, design, and downstream activities (where the latter comprises the implementation of new production technologies, the production of new products/services, and marketing of new products/services at offshore locations). For each type we determine the share of offshored activities by assigning the mean value of each category (i.e. 0.055 for 1 to 10%, 0.305 for 11 to 50%, and 0.75 for >50%).

Distinguishing these three types is important for testing our hypotheses. H1a makes a postulation about the general effect of innovation offshoring on organizational adaptability, assuming an inverted u-shape while H1b postulates differences by type of innovation activity. In order to test this hypothesis, we analyze the effect of the share of offshored innovation activities and its squared term on OA for each type of innovation activity separately. From the regression results we calculate the thresholds and compare them across the type of innovation activity.

H2 investigates whether geographical dispersion amplifies costs associated with complexity. We measure relative geographical dispersion by the share of offshore locations at which not all three types of innovation activities (R&D, design, downstream activities) were simultaneously performed. We include this variable as a moderator for the share of offshoring by type of innovation activity.

H3 states that smaller firms are better able to deal with geographical dispersion. We use three measures for size. The first is turnover; the second is number of employees. Third, since firms often completely change their organizational structures when growing from SMEs to large companies, we also allow the effect to be discrete and use a dummy for whether a firm is a large firm or an SME. We choose the cut-off point at 500 employees, being the usual SME-classification at the German Statistical Office.

H4 postulates that broader involvement in onshore innovation collaborations tends to produce less favorable outcomes when innovation activities are offshored. We measure the breadth of this involvement by the extent of innovation networks. As a proxy for network extent, we take the number of different types of partners a firm collaborates with. Seven types of partners are distinguished: companies within the same enterprise group, customers, suppliers, competitors, consultants, universities, and public research institutions. The variable ranges from zero (when the firm had no on-site innovation collaborations) to seven (when it had collaborations with all types of partners).

3.3 Confounding Factors

Based on earlier findings, four groups of confounding factors are regarded as particularly relevant: size, group structure, export activities, and past experience with offshoring activities. Besides these four main groups, further factors appear frequently in related discussions, including market structure and the competitive environment, knowledge and capital intensity of the production process, R&D expenditures, location of headquarters as well as industry affiliation.

Size: While earlier studies found that primarily large firms tend to offshore (Bardhan and Jaffe, 2005), more recent literature contributions were able to show that also small and medium-sized firms undertake offshoring activities, though offshoring by SMEs is often driven by different factors (Roza et al., 2011). On the basis of these partly contradicting results, we include but have no a priori expectation on the impact of size (measured by the number of employees) on organizational adaptability.

Group structure: Offshoring is understood as a learning process (Ørberg Jensen, 2009), We believe that firms that belong to a group are much more accustomed to management of multi-site processes and therefore may find it c.p. easier to introduce organizational innovations. We use a dummy equaling unity if the company belongs to a group to be positive.

Exposure to international markets (exporting and prior offshoring experience): Exposure to international markets can create learning potentials (Gassmann and von Zedtwitz, 1999; Macharzina et al., 2001) that allow firms to handle their internationalization activities more efficiently (Ørberg Jensen, 2009). Prior offshoring experience and exporting activities should therefore allow firms to manage multi-site value chains more effectively and increase organizational adaptability. We measure offshoring experience by a dummy that takes the value one if a firm had firm innovation activities at locations abroad in 2005.

Market share of the firm: The market share of a firm as measure of its market power might impact on the organizational adaptability, because it is a measure of a firms strategic leeway. Thus firms with larger market share might be more flexible. On the other hand, high market share reduce the incentives to change due to the absence of competition (Aghion et al. 2005). Though the net effect is unclear, the market share might be an important confounder.

R&D intensity and sector dummies: R&D is one of the main drivers of innovation at the firm level. Since R&D intensity varies according to sector affiliation, but also from firm to firm, sector and firm differences in R&D are important. We thus include both sector dummies according to the OECD classification of technology levels (OECD, 2007) and R&D intensity as control variables.

The share of material costs in total costs: This variable is included as a measure of capital intensity. Literature findings are not very clear about the effects of capital intensity on innovation. On the one hand, capital intensity is positively related to the number of patents, but negatively related to innovation (Acs and Audretsch, 1989).

A dummy for a location in eastern Germany: The rationale for the inclusion of this rather idiosyncratic control variable stems from the origin of the data used for testing the hypotheses. Since industrial structures, productivity and management practices are still quite different in the Eastern and the Western part of Germany (compare Brautzsch et al., 2014) it is important to control for this characteristic.

4 Results

4.1 Descriptive Results

Table 1 presents summary statistics for the main variables used in this paper as a reference for the reader. Table 2 shows some insightful descriptives on how offshoring changes with R&D and firm size.

Table 1: Descriptive Statistics

Variable	Definitions/ units	Mean	Std. Dev.	Min	Max
OA: General	Sum of the following five OA scores	5.18	5.10	0.00	15.00
OA: Reaction time	Likert scale: 0 (no effect) to 3 (large effect)	1.14	1.21	0.00	3.00
OA: Development capability	Likert scale: 0 (no effect) to 3 (large effect)	0.95	1.11	0.00	3.00
OA: Quality	Likert scale: 0 (no effect) to 3 (large effect)	1.14	1.22	0.00	3.00
OA: Production costs	Likert scale: 0 (no effect) to 3 (large effect)	0.84	1.03	0.00	3.00
OA: Communication	Likert scale: 0 (no effect) to 3 (large effect)	1.12	1.17	0.00	3.00
Market share	Percent	22.29	26.40	0.00	100.00
Share material costs	Percent	53.93	23.41	0.09	100.00
Employees	Head counts	2260.88	22164.00	0.00	475000.00
Export intensity	Exports divided by turnover	0.20	0.26	0.00	1.00
R&D intensity	R&D expenditures divided by turnover	0.04	0.14	0.00	2.08
Eastern Germany	Dummy: 1 if firm HQ located in Eastern Germany	0.37	0.48	0.00	1.00
Group member	Dummy: 1 if firm member of a group	0.44	0.50	0.00	1.00
Share internationalized R&D	Percent of total R&D activities	2.07	8.77	0.00	75.00
Share internationalized design	Percent of total design activities	2.04	8.15	0.00	75.00
Share internationalized downstream activities	Percent of total downstream (implementation of new production technologies, the production of new products/services, and marketing of new products/services at off-shore locations) activities	4.04	8.84	0.00	75.00
# types domestic R&D partners	Count: types are firms in same group, customers, suppliers, competitors, consultants, universities, other public research institutions	0.98	1.51	0.00	7.00
Relative geographical dispersion	Percent of foreign locations at which not all three types of innovation activities are situated	95.93	19.77	0.00	100.00
Innovation internationalization in 2005	Dummy: 1 if firm had innovation had internationa	0.25	0.43	0.00	1.00
Internationalization proximity	Difference of an EU-location dummy and the sum of dummies for America, Asia, and other world	-0.01	0.36	-3.00	1.00
Medium-high-tech manufacturing	Dummy: 1 if firm member in medium-high-tech manufacturing	0.17	0.38	0.00	1.00
Medium-low-tech manufacturing	Dummy: 1 if firm member in medium-low-tech manufacturing	0.16	0.37	0.00	1.00
Low-tech manufacturing	Dummy: 1 if firm member in lowh-tech manufacturing	0.20	0.40	0.00	1.00
Knowledge-intensive services	Dummy: 1 if firm member in knowledge-intensive services	0.28	0.45	0.00	1.00
Other services	Dummy: 1 if firm member in other services	0.08	0.27	0.00	1.00

Table 2: Offshoring of innovation by R&D activity and firm size

Share of off-shored innovation	With internal R&D	No internal R&D	Total
0%	49.5	78.5	59.7
>0% to 5%	25.4	13.9	21.0
>5% to 10%	12.5	5.1	10.1
>10% to 25%	9.7	2.5	6.9
>25% to 50%	2.5	0.0	1.8
>50%	0.4	0.0	0.5
Share of off-shored innovation	**500+ employees**	**<500 employees**	**Total**
0%	43.3	62.6	59.7
>0% to 5%	19.4	21.3	21.0
>5% to 10%	10.4	10.0	10.1
>10% to 25%	19.4	4.8	6.9
>25% to 50%	7.5	0.8	1.8
>50%	0.0	0.5	0.5

Not surprisingly, we find that the propensity to offshore innovation is higher for firms with internal R&D. More than half of R&D performing firms have offshored at least some parts of their innovation activities. This shows that offshoring of knowledge-intensive processes has become very common. 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 have conducted more than 50% non-domestically. While the propensity to offshore is much lower for firms without internal R&D, the interesting observation is that still 7% of non-R&D performers had offshored some innovation activities, particularly design and downstream activities. This also shows that internal R&D, even if it is an important driver, is not a necessary condition for offshoring innovation.

Concerning size, we find that larger firms (500 or more employees) are more likely to offshore than smaller ones. About 20% of the small and medium sized companies have offshored some innovation-related activities compared to 45% for larger firms.

4.2 Investigation of Hypotheses

In H1a we argued for an inverted u-shape between innovation offshoring and organizational adaptability as the result of disintegration advantages and costs. The results are summarized in Table 3 where models 1-3 differ from Models 4-6 because the latter additionally control for past offshoring activities and the offshoring proximity. In the first three models we find our hypothesis of an inverted u-shape strongly confirmed for all three types of offshored innovation. When we additionally control for learning and offshoring proximity the u-shape remains for construction and design activities as well as downstream. For internal R&D, however, while both the linear and the squared terms have the expected sign, they are not significant anymore. However, if we run the regressions the internal R&D 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 and corroborates the inverse u-shape for design as well as downstream activities generally but also for internal R&D with respect to specific organizational effects.

Box 1 (complexity issues in Volkswagen New Mobility Services Investment Co., Ltd, VWNMS):

The Volkswagen New Mobility Services Investment Co. Ltd. (VWNMS). VWNMS is a subsidiary of the Volkswagen Group in China and focuses its activities on the development of car-sharing and leasing models taking into account on specifics to the Chinese market. So while R&D is not a major issue in VWNMS (despite existing contacts) its activities full into our category of offshored market-related innovation.

Innovation offshoring experiences from VWNMS in China likewise corroborate hypothesis H1a. The head of VWNMS argued that benefits emerged at the offshoring destination China because the Volkswagen subsidiaries in the Chinese market are smaller and in close(r) proximity to each other. Time consuming coordination processes with different divisions (and among the different brands of the Volkswagen Group) could be omitted. While it decreased complexity of the local operations, the complexity in the relationship with the headquarters increased. The offshoring initiative made decision making with the headquarters more complex as it contributed to the "plurality of opinions" within the whole company. This means that indeed complexity is a relevant issue in innovation offshoring. But in addition to what we have hypothesized this also suggests that complexity issues should can materialize at various levels of the company, as offshoring may increase the complexity in one organizational layer while it reduces it at another.

With respect to the confounding factors we see that size does not have a significant influence on organizational adaptability. The same seems to be true for export activities, with the exception of Model 1 where we find a weakly significantly positive impact. On the contrary, the dummy for the presence of past offshoring activities is clearly positive which gives a strong indication of the existence of management learning effects as hypothesized. The dummy for the group membership is also significantly positive which we interpreted as a proxy for experience in organizing multi-site processes. 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.

The inverted u-shape of offshoring and organizational innovation naturally begs a question about optimal level of innovation offshoring and whether this optimal level differs by type of innovation. The results for the first two questions are illustrated in Figure 1[5]

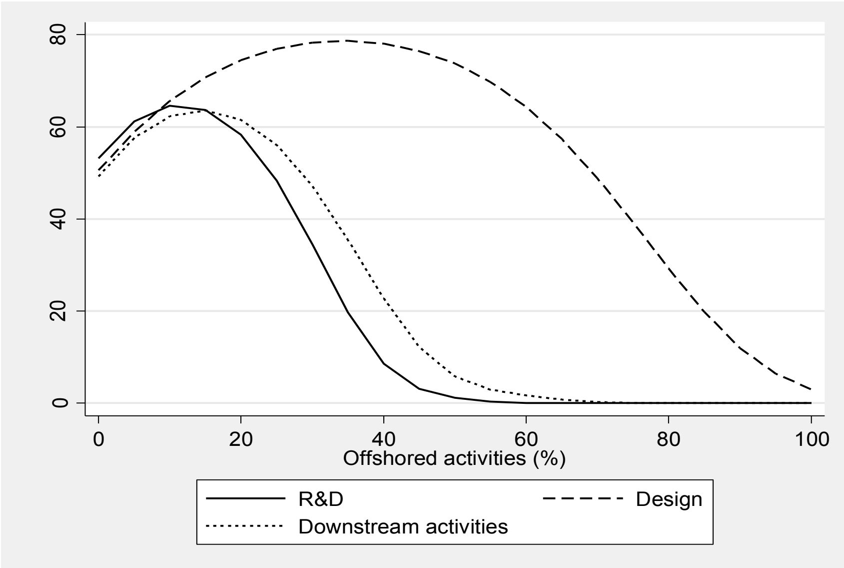
5 The optimal value follows easily directly from differentiation yielding $optval = -\beta_l / \left(2\beta_{sq}\right)$, with β denoting the coefficient of the linear and the squared value for the share of offshored innovation activities.

Table 3: Innovation Offshoring and Organizational Adaptability

	(1) OA: General	(2) OA: General	(3) OA: General	(4) OA: General	(5) OA: General	(6) OA: General
Share off-shored R&D	0.15367**			0.09366		
	(2.52)			(1.44)		
(Share off-shored R&D)*(Relative dispersion)	-0.00047			-0.00045		
	(-1.34)			(-1.29)		
(Share off-shored R&D)^2	-0.00404**			-0.00223		
	(-2.06)			(-1.07)		
Share off-shored design		0.07922**			0.06065*	
		(2.28)			(1.71)	
(Share off-shored design)*(Relative dispersion)		-0.00019			-0.00013	
		(-0.56)			(-0.38)	
(Share off-shored design)^2		-0.00083**			-0.00070*	
		(-2.00)			(-1.65)	
Share off-shored downstream activities			0.12494***			0.10326***
			(3.26)			(2.58)
(Share off-shored downstream activities)*(Relative dispersion)			-0.00053**			-0.00051**
			(-2.39)			(-2.21)
(Share off-shored downstream activities)^2			-0.00227**			-0.00184**
			(-2.47)			(-1.99)
Market share	0.34693	0.40114	0.41050	0.37134	0.39069	0.38044
	(1.30)	(1.46)	(1.50)	(1.39)	(1.41)	(1.38)
Share material costs	0.25528	0.06421	0.20704	0.22213	0.03379	0.15528
	(0.79)	(0.19)	(0.62)	(0.68)	(0.10)	(0.46)
Employees (FTE)	-0.00001	-0.00003	-0.00003	-0.00001	-0.00003	-0.00004
	(-0.33)	(-1.00)	(-0.71)	(-0.50)	(-1.19)	(-0.89)
(Employees (FTE))^2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	(0.58)	(0.92)	(0.83)	(0.72)	(1.13)	(0.99)
Export intensity	0.28972	0.27933	0.16848	0.05071	0.04630	0.02616
	(0.91)	(0.85)	(0.46)	(0.15)	(0.14)	(0.07)
R&D intensity	0.21074	-0.21761	0.06185	0.35869	-0.05048	0.13510
	(0.34)	(-0.37)	(0.11)	(0.58)	(-0.09)	(0.24)
Eastern Germany	0.19477	0.18141	0.18141	0.24574	0.25126	0.23977
	(1.30)	(1.18)	(1.17)	(1.63)	(1.60)	(1.53)
Group member	0.26632*	0.40948***	0.30604**	0.25261*	0.36628**	0.27398*
	(1.83)	(2.74)	(2.06)	(1.72)	(2.41)	(1.81)
Off-shoring in 2005				0.50738***	0.54296***	0.55039***
				(2.63)	(2.71)	(2.70)
Off-shoring proximity				0.04033	0.03541	0.05425
				(0.41)	(0.35)	(0.54)
Medium-high-tech manufacturing	0.07704	0.18126	0.13421	0.10461	0.16060	0.13312
	(0.26)	(0.60)	(0.46)	(0.35)	(0.53)	(0.45)
Medium-low-tech manufacturing	0.12442	0.38828	0.32691	0.13650	0.33663	0.28176
	(0.43)	(1.29)	(1.12)	(0.47)	(1.11)	(0.96)
Low-tech manufacturing	-0.01863	0.09555	0.11802	0.00440	0.08852	0.12013
	(-0.06)	(0.32)	(0.40)	(0.02)	(0.29)	(0.41)
Knowledge-intensive services	0.44269	0.56408*	0.65093**	0.47468	0.57800*	0.65529**
	(1.53)	(1.86)	(2.19)	(1.63)	(1.91)	(2.20)
Other services	0.26956	0.35161	0.49045	0.27088	0.35202	0.48425
	(0.71)	(0.89)	(1.26)	(0.71)	(0.89)	(1.23)
Observations	277	261	261	277	261	261
Pseudo R^2	0.021	0.027	0.029	0.027	0.035	0.037
AIC	1,134.87	1,052.47	1,055.96	1,131.55	1,048.85	1,052.19

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

Figure 1: Threshold values for Innovation Offshoring by Type[6]



The results in Table 4 strongly show that the optimal threshold is highest for design (31.13%) and much lower for R&D (11.84%) and downstream activities (14.79%). Furthermore this phenomenon appears to be quite prevalent, as between 4.9% and 38.2% of the offshoring firms operate in the decreasing part of the function. This clearly corroborates H1b.

Table 4: Optimal thresholds by innovation type

	Optimal value (%)	z-value	Larger values total (%)	Larger values off-shorers (%)
Share of off-shored internal R&D	11.18 ***	2.24	4.3	38.2
Share of off-shored design	34.49 ***	8.7	0.7	4.9
Share of off-shored downstream activities	14.49 ***	4.73	8.0	19.9

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

Box 2 (managing costs and benefits of offshoring at VWNMS – a case for a trade-off): The possibility of negative net effects on organizational adaptability suggests that firms should seek to prevent excessive offshoring levels. As Box 1 already showed the disintegration advantages occurred through moving the subsidiary closer to its relevant network of firms and its market. This however caused both issues of control and complexity. In order to retain that control, the headquarters subjected VWNMS to a

[6] The y-axis represents the estimated probability function for not belong to the lowest success group, implying that no organizational successes were achieved at all. In an alternative interpretation, the y-axis in Figure 1 gives the probability had at least some success with their organizational changes.

strict hiring strategy, which was monitored by the centralized, corporate HR unit. While this prevented the subsidiary from growing faster (reducing issues of complexity at the level of the headquarter-subsidiary level) it reduced the ability of VWNMS to react fast and flexibly to local needs. Weighting organizational costs and benefits of further growth (i.e. increase of offshoring) were central to the determination of the operations of VWNMS. There was a new to find the right scale of operations.

More precisely the head of VWNMS emphasized it was very important to understand the particular cultural and regulatory framework conditions affecting the development of the Chinese car sharing and leasing market. First, the offshoring unit had to acknowledge the area of conflict emerging from the perception of cars as status symbol and a culture of "sharing" in very narrow personal environments. Second, the offshoring unit had to respect restrictive regulatory framework conditions for foreign investors, concerning the issuing of business licenses, necessary for the set-up of payment systems for the car-sharing and licensing business. In reaction to that the Volkswagen Group had to found an additional new subsidiary (VWNMS), concentrating on insurance, warranty and investment issues in the Chinese leasing market as well as on the provision of consulting services. This increased the issues of control and thus complexity in the relations to the headquarters and forced the originally rather independent offshoring unit to reintegrate into hierarchical group-structures. This does not only emphasize the existence of a trade-off but also documents how cultural or regulatory differences that naturally occur to varying degrees in processes of offshoring can become a driver in this trade-off by creating first a need for flexibility and then a need for increasing organizational control. This is precisely the complexity trade-off defined by Zhou (2012)

Turning to the question of possible moderators, H2 argued that geographical dispersion amplifies the costs of offshoring which leads for any level of offshoring to lower optimal thresholds. We indeed find that the interaction effects which measure for relative dispersion are negative for all categories in Table 3. However, it is significant only for the offshored downstream activities. In this case, the optimal threshold is lower the higher the geographical dispersion. Therefore, we can corroborate H2 but only with respect to the downstream activities.

Turning to the question of possible moderators we have suggested in H3 that smaller firms find it easier to deal with geographical dispersion because of lower combinatorial complexity. In fact, what we find in Model 1 in Table 5 is that the coefficient on the moderation effect with an indicator for large companies is negative, while the main effect is insignificant. The same hold true for the continuous turnover measure of size. If we measure size by number of employees, the effect goes into the predicted direction but is marginally not significant. Overall, however the results show that there is ample evidence that small firms indeed have some traits that allow them to effectively deal with geographical dispersion that larger firms do not have.

In addition to size, we have hypothesized in H4 that offshoring innovation might generate problems for firms that are strongly involved in local innovation collaborations. This is because innovation has increasingly become a collaborative and open process which is often taking place in networks impeding decomposability due to recursive information flows and cooperation processes. Offshoring then implies that local network participation might be weakened because local network interaction receives less attention.

If this was true, we would expect a negative coefficient for the interaction term of the share of offshored innovation activities and the number of different types of local collaboration partners in innovation. In Table 5 we analyze this effect for each type of innovation activity. We find the effect is corroborated for R&D and design. The coefficient for downstream activities has the predicted negative sign but fails to reach the significance level. Therefore, we can confirm H4 for R&D and design only.

It is noteworthy that the effect from the degree of remoteness from local innovation networks seems to become stronger from R&D over design to downstream investment as the coefficient becomes more negative and more significant. This is an intuitive observation because collaborative development of innovation should be more compelling for core R&D activities in comparison to more remote downstream activities.

Table 5: Interaction of cooperation and geographical dispersion as moderators of innovation offshoring impacts on organizational adaptability: results of ordered Probit models

	(1) OI: General	(2) OI: General	(3) OI: General	(4) OI: General	(5) OI: General	(6) OI: General
Market share	0.37580	0.32151	0.32501	0.22872	0.26470	0.26544
	(1.35)	(1.16)	(1.17)	(0.79)	(0.92)	(0.92)
Share material costs	0.11008	0.02216	0.01547	0.07461	0.05982	0.06867
	(0.31)	(0.06)	(0.05)	(0.22)	(0.17)	(0.20)
Employees (FTE)	-0.00001	0.00007	-0.00004	-0.00003	-0.00003	-0.00002
	(-0.12)	(1.08)	(-0.99)	(-1.05)	(-0.90)	(-0.56)
(Employees (FTE))^2	0.00000	0.00000	0.00000	0.00000*	0.00000	0.00000
	(1.55)	(1.14)	(1.12)	(1.65)	(1.07)	(0.70)
Export intensity	0.28144	0.25032	0.22830	0.06994	0.04375	0.11121
	(0.76)	(0.67)	(0.61)	(0.19)	(0.12)	(0.30)
R&D intensity	0.24600	0.23393	0.29326	0.37019	0.02975	0.00512
	(0.39)	(0.37)	(0.46)	(0.56)	(0.05)	(0.01)
Eastern Germany	0.23899	0.25212	0.20898	0.22607	0.23460	0.21194
	(1.52)	(1.61)	(1.33)	(1.43)	(1.48)	(1.34)
Group member	0.39655**	0.38136**	0.42022***	0.31479**	0.33185**	0.31096*
	(2.52)	(2.43)	(2.62)	(1.99)	(2.08)	(1.95)
Relative geographical dispersion	0.00024	0.00015	0.00711			
	(0.06)	(0.03)	(1.25)			
Turnover	0.00042					
	(0.63)					
(Relative dispersion)*Turnover	-0.00001**					
	(-2.01)					
(Relative dispersion)*Employees(FTE)		-0.00000				
		(-1.62)				
Large company			1.87582**			
			(2.50)			
(Relative dispersion)*(Large company)			-0.02182***			
			(-2.85)			
# types domestic R&D partners				0.19898***	0.17754***	0.18152***
				(3.30)	(3.04)	(2.81)
(Share off-shored R&D)*(# types domestic R&D partners)				-0.03141**		
				(-2.27)		
(Share off-shored construction and design)*(# types domestic R&D partners)					-0.01021*	
					(-1.83)	
(Share off-shored downstream activities)*(# types domestic R&D partners)						-0.00625
						(-0.93)
Low-tech manufacturing	0.08545	0.09249	0.10851	0.09030	0.05765	0.01165
	(0.28)	(0.31)	(0.36)	(0.30)	(0.19)	(0.04)
Knowledge-intensive services	0.58216*	0.56465*	0.59870**	0.59321*	0.56326*	0.51928*
	(1.92)	(1.87)	(1.97)	(1.94)	(1.85)	(1.71)
Other services	0.34410	0.33953	0.38477	0.38545	0.33956	0.35918
	(0.86)	(0.85)	(0.97)	(0.97)	(0.85)	(0.90)
Observations	258	258	258	253	253	253
Pseudo R2	0.039	0.038	0.043	0.045	0.043	0.040
AIC	1042.8745	1041.7496	1039.0669	1013.8952	1015.8288	1018.3115

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

5 Discussion

We believe that our empirical results provide implications both for management literature and managerial practice in firms. We focus the discussion on three issues: the cost of offshoring innovation activities, the type of innovation activity that is being offshored, and the link between size and organizational complexity.

While the offshoring literature has been relatively enthusiastic about the associated benefits, the cost side has often been only marginally touched. Only recently it has been highlighted that there are substantial costs associated with offshoring and that these are consistently underestimated by management (Dibbern et al., 2008; Larsen et al., 2013; Stringfellow et al., 2008). Our analysis builds on this finding and identifies not only positive but also negative effects of offshoring. In certain circumstances additional costs are triggered by management decisions, even due to the resistance of the subsidiary. We show that there seems to be a level of offshoring of innovation activities beyond which the ability to implement organizational changes effectively decreases.

The strong emphasis on the benefits of offshoring in the existing literature can be linked to the role that agency problems have played as a motivator of costs in the analysis of outsourcing activities. For offshoring these opportunism-related costs may 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 offshoring increases management complexity, particularly with regard to the management of knowledge generation processes, communication processes and headquarter subsidiary management. In terms of the knowledge perspective of the firm (in particular Grant, 1996; Kogut and Zander, 1992), excessive offshoring might weaken the knowledge-integration capacities of firms. Our findings hence imply a trade-off between global knowledge sourcing and a firm’s ability to use this knowledge effectively. The VWNMS case suggested that this trade-off might be driven by a need for flexibility of the subsidiary and control issues that accompany this flexibility.

The trade-off between benefits and costs also provides a framework for analyzing back-shoring activities which has gained in importance recently. The existing literature on this topic mainly investigates back-shoring of production activities and identified a loss of flexibility as well as quality problems as major motives for back-shoring (Kinkel, 2012; Kinkel and Maloca, 2009). The reasons for back-shoring of innovation activities may be quite different from the motives to back-shore manufacturing activities and may relate rather to managing knowledge generation and exchange, regulatory issues and IPR protection and thus possess a distinct flavor of complexity considerations.

The literature on internationalization of firm activities both through outsourcing and offshoring argues for a considerable diversity of motives, commonly distinguishing market-driven, technology-driven and knowledge-driven motives for R&D activities

(Kuemmerle, 1999; Patel and Vega, 1999; e.g. von Zedtwitz and Gassmann, 2002). Linked to the variety of motives, there is also a variety of firm activities which are subject to internationalization. With regard to innovation, our results show that offshoring of different types of innovation activities has different implications on organizational adaptability. The threshold level is lower for innovation activities that are more closely related to core functions of the firm, i.e. R&D and marketing of innovation. If a substantial part of these activities take place at firm locations abroad, coordination costs increase and organizational changes become more complex. In case of R&D offshoring, our results show that organizational adaptability diminishes with respect to responding quickly to changes in a firm's environment, communicating effectively within the organization, and producing goods and services efficiently when the level of R&D offshoring amounts to more than ~15% of total R&D. This low threshold value indicates that keeping most R&D activities at the home base is beneficial in a world where innovation cycles become shorter and developing new technologies more challenging. However, we do not find negative impacts of R&D offshoring on organizational processes that are more closely related to innovation, e.g. to keep the quality of products/services high. This result implies that firms aiming to internationalize their R&D activities beyond that threshold should at the same time invest into their organizational capabilities and put special emphasis on the interfaces between offshored R&D and other organizational functions. This is particularly the case for firms that have extensive local innovation networks.

Finally, a dominant pattern in the literature is the claim that larger firms have both higher propensities to offshore as higher shares of offshored activities. In many cases, this has led to the assumption that offshoring is primarily a large-company phenomenon. Although some articles focus on the role of born globals (e.g. Knight and Cavusgil 1996) or production offshoring in SMEs (Di Gregorio et al. 2009), this focus on large companies is particularly evident in the MNE literature (e.g. Bardhan and Jaffe 2005). 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 offshoring. For example, superior management capabilities of larger firms are often invoked as an argument but rarely proven.

Our results show that smaller firms find it easier to deal with the organizational tensions of innovation offshoring, which we have explained by the lower initial complexity associated with effective management of smaller firms and higher organizational flexibility. This is in line with a strand in the literature that highlights the importance of existing organizational and hierarchical structures of the companies (Dunning and Lundan, 1998; cf. Hedlund, 1994; Kuemmerle, 1999) as a driver for choice of location (Ketokivi and Ali-Yrkkö, 2007). We therefore believe that offshoring should neither explicitly nor implicitly be understood as a pure large-company phenomenon. Managers of smaller firms with no offshored innovation activities should hence consider the opportunities of offshoring parts of the firm's innovation activity in order to gain from globalization. Our findings imply that many smaller firms have already managed to internationalize innovation without hurting their competitive advantage of high organizational adaptability.

6 Conclusions and Lines for Future Research

This paper has investigated the relationship between innovation offshoring and a firm's ability to effectively introduce organizational change using firm panel data from the German Innovation Survey. Based on complexity theory we have developed hypotheses on an inverted u-shape impact of the level of innovation offshoring on organizational adaptability and how this impact may depend on geographical dispersion of offshored innovation activities, the extent of a firm's local innovation networks, and a firm's strategic focus on R&D. In contrast to most of the existing literature on innovation offshoring, we have distinguished three types of offshored innovation activities: R&D, design, and downstream activities such as producing and marketing of new products. This allows us to investigate the impacts of different offshoring strategies and derive more tailored management conclusions.

Our empirical results confirm the expected inverted u-shape for all three types of offshored innovation activities. The threshold levels for an optimum level of innovation outsourcing are lower for R&D (13%) and downstream activities (16%) than for design (38%). The latter activity often includes the adaptation of existing technologies to specific environments in foreign markets and is less closely linked to domestic innovation processes than R&D or marketing. The inverted u-shape effect of offshored design and downstream activities holds for all five dimensions of organizational adaptability that were distinguished in this paper (ability to develop new products, improving product/service quality, reducing reaction times, reducing costs, improving communication) while the effect of R&D is confined to the latter three dimensions.

The implied costs of offshoring are further inflated if geographical dispersion of offshoring is high. Likewise, firms that are embedded in extensive local innovation networks experience a lower level of organizational adaptability when offshoring R&D or design activities. For offshored downstream innovation activities no significant effect was found.

The results of our paper shed some new light on the role of innovation offshoring in a firm's ability to effectively change organizational processes at its home base. They imply that firms can easily run the risk of jumping into levels of offshoring activities which threaten their organizational flexibility and their capacity to effectively react to changes in their environment. Hence managers need to balance the trade-off between gains from internationalizing innovation (such as access to new knowledge and disintegration advantages) and drawbacks on organizational adaptability. While this research has given some indication of a likely optimal level of offshoring for different types of innovation activities, more research is needed on the longer term consequences of very high levels of innovation offshoring. In particular, the trade-off suggests the possibility of over-offshoring, which was already proposed by Grimpe and Kaiser (2010). While our results are indicative of this, more detailed research would be needed to justify this. In this context, it would be particularly interesting to analyze whether it is really the companies that have very high (possibly excessive) of offshoring which later backshore innovation activities since one could argue that offshoring is a capability which firms learn over time (cf. Anderson et al., 1998), and extensive offshoring is done primarily by firms which are further on the learning curve. In this view, back-shoring firms may be primarily those that were discouraged by short-term failures.

Furthermore our results on size effects have revealed some advantages of SMEs over larger firms when linking offshoring to the effectiveness of organizational change. The mechanisms, however, are not completely clear. More in-depth analyses would be needed to show how exactly small firms organize offshoring activities and how they profit from internationalized innovation. Since most empirical research on innovation offshoring so far has focused on larger organizations, much more research on offshoring in SMEs is needed, including case studies and sector-specific studies.

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