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How does the global relocation of business activities affect firm innovation? An empirical analysis of the impact of offshoring on innovation in Danish firms

Eunkyung Park
Aalborg University
Department of Business and Management
eunkyung@business.aau.dk

Abstract

The relationship between offshoring and firm innovativeness has received increasing attention in the literature in the recent years. The studies related to this subject provide evidence for possible contradicting effects of offshoring on innovation as some studies suggest that the relocation of a firm's activities abroad can hamper the firm's ability to innovate while other studies emphasize how offshoring can stimulate innovation in firms. Some empirical studies investigating the direct offshoring-innovation relationship found positive relationship between offshoring and innovation in various contexts of offshoring such as offshore outsourcing, offshoring of R&D, and offshoring of services. The current study aims to provide evidence for a more general effect of offshoring on innovation regardless of the type of activities involved. More importantly, this study attempts to find the impact of offshoring on innovation, not merely a positive association, by controlling for the innovation performance before the firm's engagement in the relocation of the activities. Furthermore, how the offshoring location and the type of activities offshored are related to the firm innovativeness is also investigated. Logistic regression models are estimated based on the data extracted from three different sources: Danish offshoring survey and two innovation surveys from two different time periods. The results show that offshoring firms are more likely to introduce new products/services. Additionally, it is found that the offshore locations matter for this relationship as the firms that are offshoring to developing economies are less likely to innovate than the firms that are offshoring to advanced economies.

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1. Introduction

Innovation is an important source of competitiveness in the globalized market today. Being able to offer customers superior products and services compared to those of competitors is often highlighted as a crucial competence for firms in these days (Lengnick-Hall, 1992, Dutta et al., 2005). In order to do so, firms need to keep searching for new knowledge and find new ways to utilize existing knowledge. The recent globalization activities of firms demonstrate that firms are increasingly going global to get access to new knowledge (Maskell et al., 2007, Lewin et al., 2009), not only to exploit the existing knowledge. This means that globalization offers opportunities for firms to tap into specialized knowledge residing in the different parts of the world, and the firms operating in various locations have an advantage in utilizing the knowledge for innovation (Almeida, 1996, Dunning, 1996, Cantwell and Mudambi, 2005, Kafourous et al., 2008).

In the same vein, offshoring firms could also enhance their innovativeness by sourcing new knowledge in the offshoring location (Kenney et al., 2009). Offshoring, defined as the relocation of business activities from home country to foreign countries¹, explains a great deal of recent globalization of firms, especially in the advanced economies. Unlike other international activities like export and foreign direct investment (FDI), offshoring is mainly driven by cost saving motivation (Lewin and Peeters, 2006) and therefore might lead firms to different locations than the ones that the firms are already present in. This will increase chances for firms to be exposed to new knowledge, which will then be beneficial for enhancing innovative capabilities.

On the other hand, other concerns can arise regarding the innovative capabilities of offshoring firms. By definition, an important aspect of offshoring is the replacement of domestic workforce with foreign one, which implies that there might be loss of certain competences in the firms in the home country following the relocation. For the reason that successful innovation requires good coordination of knowledge from different functions and departments (Rothwell, 1977), the geographical disaggregation of certain competences and knowledge from the home country might not be a favorable condition for firms pursuing innovation. In the case of manufacturing firms, the importance of production knowledge in introducing

¹ This definition includes both the relocation of activities to subsidiaries and to external suppliers, which is often referred to as captive offshoring and offshore outsourcing respectively (Contractor et al, 2010).

innovation is increasingly being recognized, which raises concerns for sustaining innovation capability after the relocation of production (Dankbaar, 2007).

Previous findings on the relation between offshoring and innovation suggest in general a positive relationship. Nieto and Rodríguez (2011) found that the offshoring of R&D has a positive impact on the likelihood of a firm to innovate. Mihalache et al. (2012) studied the impact of the relocation of primary functions, identified as production, engineering and R&D activities, on innovation and found that there is an inversed u-shaped relationship between the offshoring of these functions and the introduction of new products and processes. This means that, to a certain degree, offshoring has a positive impact on firm innovativeness. However, the empirical analyses in these studies do not take into account the innovation performance of a firm prior to offshoring. Therefore, the alternative explanation for the positive relationship between offshoring and innovation can be that offshoring firms could have been more innovative than non-offshoring firms even before their engagement in offshoring. In other words, it could also suggest that more innovative firms are more likely to offshore.

This paper investigates the relation between offshoring and innovation performance and how certain attributes of offshoring such as offshoring location and offshored activity affect this relationship. The paper posits that, in the short run, the 'positive' knowledge sourcing effect of offshoring outweighs the 'negative' competence disaggregation effect and that offshoring firms will be better at introducing innovation than non-offshoring firms. It is also argued that the offshoring location and the type of offshored activities matter for the sourcing of knowledge that will influence innovation performance. This is investigated by the empirical analysis of the innovation performance of offshoring firm and non-offshoring firms in Denmark.

The current study contributes to the literature in the following ways. Firstly, the study attempts to capture more direct impact of offshoring on innovation compared to the previous studies by controlling for the innovativeness of the firm in the period before the engagement in offshoring. Since the data provides the information on offshoring activities between 2001 and 2006, innovation performance right before this period, from 1998 to 2000, is used as control variable in the empirical analysis. In this way, the results show the impact of offshoring on innovation, not merely a positive association between them.

Secondly, it provides evidence for the overall effect of offshoring on innovation performance regardless of the specific activities offshored. The few existing empirical studies depict only a part of the picture as they investigate the offshoring of specific activities such as production, engineering and R&D (Nieto and Rodríguez, 2011, Mihalache et al., 2012). Although these activities are generally considered as the primary sources of knowledge for innovation, it is argued in this paper that other activities in the value chain have

potential in contributing to innovation. Therefore, the results for both overall effect and the effect for certain type of activities are presented in this study.

Thirdly, the paper investigates how the offshoring location influences the relation between offshoring and innovation. Since the level of technological competences and the systems of innovation differ in each nation, sourcing knowledge in different countries might lead to different outcome for innovation performance (Freeman, 1995, Cantwell, 1992, Lundvall, 1992). Despite the common acceptance that offshoring from advanced economies mainly engages low income countries, there is a considerable number of firms relocating their activities to other advanced economies. The evidence from this paper suggests that the offshoring destination makes the difference for the innovation outcome of offshoring firms.

The paper is structured in the following ways. The next section presents the theoretical discussion and hypotheses. The research method, the data and the results of the empirical analyses are described in the third section. The last section discusses the results and concludes.

2. Theory and hypotheses

Understanding offshoring practice

Offshoring can be considered as a relatively new form of globalization, which involves the geographical disaggregation of value chain activities across nations with the purpose of serving either domestic or global market (Kenney et al., 2009). While offshoring in the earlier days was mostly characterized by firms from advanced economies relocating production activities to low income countries with cost saving motivation, it has diversified over the years to include various activities, motives and locations (Dunning, 1993, Vernon, 1966, Dossani and Kenney, 2007, Lewin et al., 2009). With the diversified patterns of offshoring, it can be assumed that the different attributes of offshoring influence firm innovativeness in different ways.

More and more intangible service jobs –for example, call center and help desk– are being relocated abroad thanks to the advancement in IT and communication technologies, not to mention increasing relocation of knowledge-intensive activities such as engineering, product development, and R&D (Bunyaratavej et al., 2011, Lewin et al., 2009, Massini and Miozzo, 2012). Since the knowledge-intensive activities are more strategically related to innovation, it can be assumed that offshoring of these activities exerts stronger influence on innovation activities. The diversification of activities also means that the offshoring firms can get access to different types of knowledge for innovation in different location.

The main rationale behind offshoring has been cost reduction, but other motivation like access to market and access to knowledge and qualified workers are also increasingly at work when firms consider the relocation option (Lewin and Couto, 2006). For cost reduction and market access reasons, emerging economies have become popular as offshoring destination. Other than labor costs, firms consider infrastructure, cultural/ language fit, workforce availability, risk factors in their decision on offshoring location (Graf and Mudambi, 2005, Hahn et al., 2011), which can broaden the location options in addition to the often mentioned emerging markets. Depending on the activity and the motive, 'nearshore' locations can be more attractive than 'offshore' locations despite the smaller wage discount (Hahn et al., 2011).

Another trend in offshoring is that firms are fine-slicing the value chain activities and locating these activities in different locations where they can be done most efficiently (Mudambi, 2008). As the value chain activities are being dispersed all over the world, firms are becoming more of an orchestrator in managing the operations in different places (Craig and Mudambi, 2013). Depending on the firm's capability to manage knowledge across the national borders, this can pose threat to the offshoring firms in managing innovation.

Offshoring and Innovation

Knowledge is an important source of innovation. Kogut and Zander (1992) argued that innovation is a product of "combinative capabilities to generate new applications from existing knowledge (p.391)". Nonaka and Takeuchi (1995) also assert that knowledge creation utilizing external and internal sources made continuous innovation possible for Japanese firms. Undoubtedly, managing knowledge is a crucial part of innovation activities, and the existence of knowledge management capability benefits firms' innovation (Darroch, 2005, Lundvall and Nielsen, 2007). To survive in the rapidly changing market of today, it is especially important to collect and synthesize knowledge from various sources across the firm and the national boundary.

Offshoring enables firms to get access to knowledge residing in a new location by either establishing own activities abroad or contracting certain tasks to the foreign suppliers. As it is often argued in the Economic Geography literature, knowledge is 'sticky' in place, meaning that it is hard to transfer knowledge over geographical distance (Howells, 2002, Gertler, 2003, Maskell and Malmberg, 1999). Therefore, in order to acquire the knowledge that is embedded in a certain location, firms need to 'be there.' By relocating activities, offshoring firms are able to source knowledge from different location, which will eventually increase the diversity of firm's knowledge base.

More specifically, the breadth of knowledge can be extended by employing foreign workers, whose knowledge stems from different national systems of innovation (Lundvall, 1992). As nations have idiosyncratic sets of knowledge and technologies (Cantwell, 1992), this increases the diversity of knowledge in firms. The diversity of knowledge can prevent firms from being locked-in into existing technologies (Kotabe et al., 2007) and therefore will have a positive impact on innovative capability. Firms will not only get access to specialized technological knowledge, but will also be able to possess important market knowledge that can be useful in introducing new products and services. Moreover, once the offshored operation is embedded in the local context (Meyer et al., 2011), it is possible to create networks with other local actors in the offshore location. This will lead to the diversification of the sources of knowledge, which is also positively associated with innovation success (Leiponen and Helfat, 2009).

Furthermore, offshoring can also increase the depth of the firm's existing knowledge base (Mihalache et al., 2012). Some studies found that offshoring firms can increase the depth of knowledge by capitalizing on lower wage in the destination countries (Ethiraj et al., 2005, Quinn, 2000). For instance, when the labor cost is cheaper, firms are able to hire highly specialized persons, which was not feasible in the home country (Lewin and Peeters, 2006). Chung and Yeaple (2008) found that firms engage in international sourcing of knowledge to reduce R&D costs and supplement other in-house knowledge generating activities.

One might argue that difficulties may arise in managing knowledge over distance (Ambos and Ambos, 2009, Stringfellow et al., 2008) and this might counteract the benefits from the increased breadth and depth of knowledge. However, it is argued in this paper that the offshoring firms will be diligent in securing efficient knowledge transfer between the home country and the host country. The coordination of operations of offshoring firms will resemble that of the ordinary multinational firms in that it involves knowledge transfer across distance. However, contrary to the activities in the foreign subsidiaries, the offshored activities often serve the home market of the firm, which increases the importance of knowledge transfer even more for the offshoring firms. Moreover, from the perspective of the company in the home country, offshoring has the same effect as outsourcing in terms of 'hollowing out' the competences in the organization (Kotabe et al., 2008), especially when the value chain activities are dispersed in various locations. Offshoring firms will therefore make effort into keeping and updating knowledge from the offshored unit.

Following the arguments presented above, the first hypothesis is formulated as below:

Hypothesis 1: Offshoring firms are more likely to introduce innovation compared to non-offshoring firms

Offshored activity and innovation

Although it is assumed that knowledge sourcing through offshoring leads to improved innovation performance regardless of the activities relocated, a certain type of activity can be a better channel for sourcing knowledge for innovation than others. The most influential value chain activity for innovation would be R&D, the purpose of which is to produce the direct input to develop new products and processes. Traditionally, R&D activities were considered as strategic core of a firm that needs to be kept within the organizational and national boundary according to the transaction cost theory and resource based view (Barney and Arian, 2001, Williamson, 1981). However, these activities are being relocated across the borders more and more so that it is necessary to reconsider what is strategic 'core' and what is the 'core of the core' (Contractor et al., 2010)².

Motivation for relocating R&D can be manifold. Just like the offshoring of any other type of activities, it could be labor cost saving that drives the relocation (Chung and Yeaple, 2008). If firms offshore R&D to low income countries, they will be able to hire a larger number of qualified employees at the same costs. As R&D effort is directly connected to innovation performance (Becheikh et al., 2006), this will have greater effect on innovation compared to hiring more employees engaged with any other type of activities.

The two traditional FDI patterns for R&D, asset-exploiting and asset-augmenting, are also applicable for offshoring of R&D (Dunning and Narula, 1995). Asset-exploiting R&D, in which firms adapt home-base R&D to local requirements, is mostly related to market seeking motivation in general. By locating R&D close to the market, firms will be able to introduce new products and services that are optimized for the specific market. Asset-augmenting R&D can be explained by knowledge seeking motivation, by which firms attempt to acquire specialized knowledge that cannot be attained in the home country. This motivation is found to be influenced by the lack of qualified employees in the home country (Lewin et al., 2009). In this case, the positive impact of R&D offshoring on innovation would be more apparent as the offshoring location provides rather unique knowledge that can trigger the introduction of new products and services.

These arguments lead to the following hypothesis:

Hypothesis 2: Offshoring of R&D activities has a greater impact on innovation than offshoring of non-R&D activities

Offshore location and innovation

² According to Contractor et al. (2010, p. 1427), the fine grained distinction can be made between core activities that are 'i.e. distinctive and crucial for the competitive advantage and often of more architectural nature' and essential activities that are 'i.e. advanced activities that are complementary and important for the competitive advantage.'

Due to its tacit nature, knowledge can be immobile and is therefore likely to be bounded geographically (Howells, 2002). Overtime, the knowledge becomes cumulative and context-dependent in a certain location, which often leads to the specialization of certain economic activities in that region (Cantwell, 1992). Knowledge spillover reinforces this process of agglomeration of economic activities and leads to the clustering of innovative activities (Jaffe et al., 1993). The concentration of specific economic activities in a location over time creates technological gaps among nations, which leads to the differences in economic performance (Verspagen, 1991, Fagerberg, 1994). Accordingly, it can be assumed that the level of technological knowledge of a nation, in most of the time, corresponds to the economic development of the nation. Following this argument, knowledge sourcing from the relocation of activities in the advanced economies will be more beneficial for innovation than knowledge sourcing in the emerging and developing economies due to the superior technological competences of these economies.

The concept of 'national innovation system' was developed with the realization that the success of innovation cannot be fully explained by the accumulation of technological knowledge. This concept also puts emphasis on the actors, institutions, and relations that are involved in the creation and diffusion of innovation in a nation (Lundvall, 1992, Freeman, 1995, Edquist, 2005). In an empirical study, several aspects of the national innovation system were found to make difference for how competitive and innovative some nations are compared to the others: competent firms, strong linkages among firms (upstream and downstream), education and training system, government policies, and government support for R&D (Nelson, 1992). Due to these factors, innovation processes in the countries with strong national innovation systems will be more effective and efficient. As advanced countries often have strong innovation systems, offshoring to these locations will result in more efficient knowledge sourcing. For example, interaction with local actors will yield better outcome when the system supports such interaction.

Based on the above arguments, the hypothesis on the offshoring location and innovation performance of offshoring firm is developed as follows.

Hypothesis 3: Different offshoring locations have different impact on innovation. The firms that are offshoring to developing and emerging economies are less likely to introduce innovation than the firms that are offshoring to advanced economies.

3. Empirical analysis

Data

In order to capture the impact of the relocation of activities on innovation, different sources of data on innovation and offshoring activities from different time periods will be used in the empirical analysis. Based on the period for which the offshoring data is available, innovation data before and after this period was retrieved and merged with the offshoring data. The lag between the offshoring data and post-offshoring innovation data makes it possible to analyze how offshoring influence the innovation performance of the firms after the relocation, while the pre-offshoring innovation data provide measures to control for the innovation performance of the firms before the relocation.

The three different sources used in the analysis are as follows. The first source is Danish offshoring survey conducted in 2007 by Statistics Denmark. The survey investigated offshoring activities of Danish firms between 2001 and 2006 and included questions on e.g. the activities offshored, offshoring location, motives, and barriers to offshoring. All firms with more than 50 employees were invited to the survey and a sample of firms with 20-49 employees was also included as a supplement. All in all, 4,161 firms participated in the survey. The advantage of this survey is that it provides a straight forward indicator for identifying offshoring firms. Offshoring is defined rather clearly in the survey as “the total or partial movement of business functions (core or support business functions) performed in-house or domestically outsourced by the resident enterprise to either non-affiliated (external suppliers) or affiliated enterprises located abroad” (Statistics Denmark, 2008, p.3). This is a more precise measure for offshoring activities compared to the proxies from FDI and imported input data often used in the studies on offshoring.

The second source is Community Innovation Survey 3 (CIS 3), which was the third round of survey for the European project on innovation. This survey investigates the innovation activities of Danish firms between 1998 and 2000 and therefore provides reference for innovation performance right before the period in which investigated offshoring activities took place. Information in the survey includes e.g. product and process innovation that the firms introduced, turnover from innovation, collaboration with different partners, and location of innovation partners. The industries included in the survey are manufacturing, trade, knowledge services, financial sector, and others (including raw material, construction, energy supply, transport). The survey resulted in 1,461 observations with 31% response rate.

The last source is Research, Development, and Innovation survey (FUI, in Danish) from 2009 conducted by Statistics Denmark. FUI survey is a series of annual survey on innovation that Statistics Denmark started to conduct from 2007. For each survey round, about 5,000 firms get selected based on the industry, size, and the earlier information on research and innovation activities and receive the mandatory survey questions. In the FUI survey from 2009, the innovation activities of Danish firms between 2007 and 2009 are investigated, covering the period right after the years for investigated offshoring activities. The survey

contains similar questions as the ones in CIS 3, but a bit more detailed information is collected on e.g. the different types of innovation and innovation input.

After merging the data from the three sources, there are 384 observations in the sample³. Table 1 displays the descriptive statistics for the sample.

Table 1 The descriptive statistics for the sample

Percentage of observation	Full sample	Offshoring	Non-offshoring
Size			
< 50 employees	5.7	2.5	7.1
50-200	36.5	27.1	40.6
200-500	33.9	32.2	34.6
>500 employees	24.0	38.1	17.7
Industry			
Financial sector	6.9	2.5	9.0
Manufacturing	53.9	65.3	48.6
Retail	14.1	11.9	15.2
Knowledge services	16.3	16.1	16.3
Others	8.8	4.2	10.9
Innovation in 1998-2000	63.5	74.6	58.7
Innovation in 2007-2009	52.1	69.5	44.4

Method

As the dependent variable is binary in nature, logistic regression models are specified to test the hypotheses. In all models, the dependent variable is (product/service) *Innovation performance* between 2007 and 2009, which is provided by the FUI data. The dependent variable indicates whether or not the firm has introduced new products/services during the period following the relocation. To test hypothesis 1, model 1 is estimated to analyze the general impact of offshoring on innovation performance. The explanatory variable, *Offshoring*, is a binary variable that takes the value of 1 if the firm has relocated any activity abroad in 2001-6 and the value of 0 if not. Model 2 tests hypothesis 2 and includes a dummy variable for *R&D offshoring* in addition to the *Offshoring* variable. If the relocation involves R&D activities,

³ The author is currently working on merging other sources of data in order to increase the number of observation and get more solid results.

this dummy variable takes the value of 1⁴. The third model also builds upon the first model and has a dummy variable for *Offshoring to developing countries*⁵ additionally. In the survey, firms could indicate the offshoring location in terms of the following nine regions: old EU countries, new EU countries, other European countries, China, India, Other Asian countries, USA/Canada, South America, and Africa. Following rather strictly the distinction between the advanced economies and developing economies suggested by the International Monetary Fund (IMF) (2013), only the old EU countries and USA/Canada were categorized as advanced economies. The rest of the countries are categorized as developing (and emerging) economies.

There are nine control variables in the models. One of them deals with an attribute of offshoring, while the rest captures the effect of the structural firm characteristics and other innovation-related features of the firms. *Outsourcing* is a dummy variable distinguishing the governance mode for the offshored operation. If any of the relocated activities are outsourced to an unaffiliated suppliers located abroad, then it is coded 1 to specify that the offshoring of the firm involves outsourcing. The next control variable is *Manufacturing* dummy variable to differentiate the firms in the manufacturing sector from the rest. *Size* and *Age* denotes the logarithm of the number of employees and the logarithm of the number of years that the company existed as of 2007, when the offshoring survey was conducted.

To control for different levels of effort that the firms put into innovation activities, a binary variable *Innovation effort* is included in the model. This is calculated from the in-house full-time equivalent for conducting innovation activities per year during the period of 2007-9. If this number is higher than zero, it is assumed that the firm puts innovation effort on its own and the variable takes the value 1. Lastly, *Previous innovation performance* is included in the model as control variable. This dichotomous variable captures the innovation performance of the firms before the relocation of the activities (between 1998 and 2000). As it is found that innovation-oriented firms are more likely to offshore (Park, 2013), one might argue that the results of the estimation of the models only depict a positive or negative relation between offshoring and innovation. By controlling for the previous innovation performance, it is argued that the results in this paper capture the impact of offshoring on innovation.

The last three control variables indicate whether or not the firm engaged in external collaboration for innovation activities between 2007 and 2009. As the importance of collaboration with external partners in

⁴ In the survey, firms are allowed to indicate all the activities that they have offshored during 2001-2006. Therefore, there can be multiple answers regarding the type of activities relocated for one single firm. This variable is constructed in a way that if the firms have relocated any of the R&D activities, regardless of the relocation of other activities, it will take the value of 1.

⁵ Similar to the case of the type of the activities, firms can also indicate multiple locations in the survey. For this variable, the value will be zero if the firm relocated activities both to advanced and developing economies. When the value is 1, it means that the firms offshored only to developing countries.

creating new products and services has been emphasized in the innovation literature (see e.g. Chesbrough, 2003), it is important to take account of the firm’s engagement in this type of collaboration when analyzing innovation performance. The dichotomous variables specify whether or not firms collaborated with 1) firms in the value chain including suppliers and customers (*collaboration_value chain*), 2) with competitors or firms in other industry (*collaboration_other firms*), or with knowledge institutes such as universities and other public institutions (*collaboration_knowledge institute*).

The descriptive statistics and the correlations of the explanatory and control variables are presented in Table 2. All models are checked for multicollinearity problem with the analysis of Variance Inflation Factor (VIF), which is also displayed in the table 2. Since the individual VIF values are lower than 10 and the average of the values for all variable are lower than 6, there is no concern for multicollinearity issue.

Table 2 The descriptive statistics, correlation, VIF values for the explanatory and control variables

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	VIF1	VIF2	VIF3
1. Offshoring	0.31	0.46	1												1.98	2.15	2.80
2. R&D offshoring	0.05	0.22	0.34	1												1.17	
3. Developing economies	0.13	0.34	0.59	0.12	1												1.81
4. Outsourcing	0.16	0.37	0.65	0.20	0.40	1									1.95	1.97	2.01
5. Manufacturing	0.53	0.50	0.15	0.02	0.11	0.13	1								1.12	1.12	1.13
6. Size	5.51	1.07	0.24	0.03	0.10	0.18	-0.02	1							1.11	1.11	1.12
7. Age	3.32	0.65	-0.01	-0.06	-0.03	0.02	0.05	0.15	1						1.05	1.06	1.05
8. Innovation effort	0.50	0.50	0.21	0.01	0.19	0.11	0.17	0.18	0.03	1					1.16	1.16	1.22
9. Previous innovation	0.64	0.48	0.15	0.02	0.12	0.11	0.23	0.19	0.11	0.40	1				1.13	1.14	1.14
10. Collab. value chain	0.40	0.49	0.13	0.06	0.06	0.04	0.08	0.19	0.05	0.25	0.19	1			1.33	1.33	1.36
11. Collab. other firms	0.17	0.38	0.12	0.09	0.11	0.10	-0.09	0.18	0.02	0.11	0.06	0.45	1		1.24	1.29	1.31
12. Collab. know. inst.	0.24	0.43	0.19	0.07	0.09	0.11	0.17	0.28	0.09	0.42	0.22	0.52	0.34	1	1.29	1.24	1.26

Notes: N=384. Bold coefficients are significant at the $p < 0.05$.

VIF1, 2, 3 for model 1, 2, 3, respectively

Empirical results

Table 3 summarizes the results from the logistic models. All models are significant at 1% level. Model 1 tests the hypothesis 1, stating that offshoring has a positive impact on innovation. The results show the evidence for hypothesis 1 as the positive coefficient is significant at 5 % level. It is found that offshoring firms are 2.49 times more likely to introduce new products and processes compared to non-offshoring firms. Concerning the other variables, the only control variables that are found significant are the

innovation related variables. Both *Innovation effort* and *Previous innovation* variables are significant at 1% level. If a firm has allocated a certain amount of manpower working on any innovation activities, then the firms is 4.6 times more likely to introduce innovation. If a firm introduced product/service innovation before offshoring, it is 2.76 times more likely to introduce innovation after offshoring. This shows that innovation capability can be persistent over time. The coefficients for the control variables for external *collaboration* show that the firms engaging in collaboration are more likely to introduce innovation, regardless of who they collaborate with. However, the results are more significant in the case of collaboration with other firms compared to collaboration with knowledge institutes. *Outsourcing, Industry, Size, and Age* variables do not explain the likelihood of introducing innovation in 2007-9.

Table 3 Logistic regression, dependent variable: Innovation performance 2007-9

	Model 1		Model 2		Model 3	
	Coefficient	Odds ratio	Coefficient	Odds ratio	Coefficient	Odds ratio
Offshoring	0.91 (0.4)	** 2.49	0.96 (0.42)	** 2.61	1.50 (0.48)	*** 4.48
R&D offshoring			-0.26 (0.65)	0.77		
Developing economies					-1.27 (0.51)	** 0.28
Innovation effort	1.53 (0.28)	*** 4.60	1.52 (0.28)	*** 4.58	1.64 (0.29)	*** 5.18
Previous innovation	1.02 (0.29)	*** 2.76	1.02 (0.29)	*** 2.77	1.05 (0.29)	*** 2.85
Collaboration_value chain	0.75 (0.31)	** 2.11	0.75 (0.31)	** 2.11	0.72 (0.32)	** 2.06
Collaboration_other firms	1.02 (0.43)	** 2.77	1.03 (0.43)	** 2.79	1.10 (0.44)	** 3.00
Collaboration_knowledge institute	0.78 (0.41)	* 2.18	0.78 (0.41)	* 2.18	0.76 (0.42)	* 2.13
Outsourcing	-0.46 (0.49)	0.63	-0.46 (0.50)	0.63	-0.49 (0.50)	0.61
Manufacturing	-0.07 (0.27)	0.93	-0.07 (0.27)	0.93	-0.03 (0.27)	0.97
Size	0.02 (0.13)	1.02	0.02 (0.13)	1.02	0.01 (0.13)	1.01
Age	0.27 (0.20)	1.31	0.26 (0.20)	1.30	0.25 (0.20)	1.28
Constant	-3.02 (0.92)		-3.00 (0.92)		-2.99 (0.93)	
- 2 log likelihood		372.298		372.14		365.843
R square		0.34		0.34		0.35

*p<0.1; **p<0.05;***p<0.01

Model 2 is estimated to analyze the effect of R&D offshoring on innovation. While *Offshoring* variable is still significant, the *R&D offshoring* variable does not show significant results. Therefore, the hypothesis 2 suggesting greater impact of offshoring of R&D activities compared to offshoring of non-R&D activity is not supported. Even if the coefficient had been significant, the odds ratio below 1 means that the offshoring of R&D activities do not have positive effect on innovation. The rest of the variables show almost the same results as model 1.

In the model 3, how the offshoring location affects the impact of offshoring on innovation is investigated. The dummy variable for indicating offshoring to developing economies is significant, meaning that the offshoring location matters. The negative coefficient indicates that the firms that are offshoring only to developing economies are less likely to introduce new products and services compared to the firms offshoring to advanced economies only or the firms offshoring to both advanced and developing economies. Thus, hypothesis 3 is confirmed. The innovation related control variables are still significant in model 3, with greater positive effects compared to model 1 and 2.

4. Discussion and conclusion

By relocating parts of the value chain activities abroad, firms can achieve cost efficiency, market access, or proximity to new knowledge and specialized labor. The increasing number of firms that are practicing the offshoring strategy suggests that firms are attracted to the potential benefits that the relocation of activities brings about. However, studies on the consequences of offshoring on the firm level are rather limited and, sometimes, provide inconclusive results (Olsen, 2006, Jabbour, 2010, Görg and Hanley, 2005). More studies within this area will be helpful for filling gaps in offshoring research, not to mention that it will provide valuable insight for the practitioners.

The current study aims to unveil the consequence of offshoring on innovation performance. In many advanced economies, where offshoring is becoming more and more common, there have been concerns about losing certain types of jobs to foreign countries. In relation to this discussion, some authors would argue that firms in the advanced economies can focus on innovation and create new jobs (Agrawal and Farrell, 2003), while others would fear that the loss of the relocated jobs will hamper the innovative capabilities of firms in these economies. Therefore, the findings from this study do not only contribute to the discussion on the impact of offshoring on firm level performance, but it can also contribute to the discussion on the competitiveness of offshoring nations that are going through reorganization of job structure.

The relation between the international activities of firms and innovation has been mainly discussed in the context of multinational enterprises (MNEs). Especially, the globalization of R&D activities by MNEs has been one of the main research agenda in International Business research, which is proven by abundant studies on this subject (for example, Kuemmerle, 1999, Narula and Santangelo, 2012, Kumar, 2001). As mentioned earlier, the two main rationales for the globalization of R&D in multinational firms, asset-exploiting and asset-augmenting, are in line with the motives for offshoring, access to market and access to specialized labor.

However, the current study does not focus only on R&D functions in relation to the globalization and innovation. Instead, it is argued that the knowledge sourcing advantage from the relocation of activities is applicable to all kinds of activities, not only to R&D activities. Moreover, it is also argued that offshoring has some distinctive features that might have implication for knowledge sourcing compared to the ordinary foreign direct investment (FDI). In the case of offshoring, knowledge transfer to and from the offshored location might be managed more thoroughly due to the fact that the offshore units replace the tasks that are no longer present in the home country, still serving the home market in many cases. The subsidiaries of MNEs, on the other hand, can be autonomous in their operation, focusing on serving local markets (Jarillo and Martanez, 1990), in which case, the knowledge residing in the local operations is less likely to flow to the headquarters in the home country.

The results of the empirical analysis on Danish firms show that offshoring firms are more likely to introduce new products and services than non-offshoring firms. The results suggest that offshoring firms can increase the diversity and the depth of knowledge by relocating their activities abroad. Firstly, they will be able to acquire new knowledge that is unique to the host location, and secondly, they are also able to increase the depth of knowledge by hiring a larger number of qualified workers with the discount in wage. The positive relation between offshoring and innovation is consistent with the results from earlier studies on offshoring and innovation (Mihalache et al., 2012, Nieto and Rodrguez, 2011) and suggests that offshoring in general induces positive consequence in terms of innovativeness.

It is also found that the positive relation between offshoring and innovation is stronger for the firms relocating activities to advanced economies than for the firms relocating activities to developing economies. As it is assumed in the paper, the technological competences and the national innovation system of the host location might have influence on this matter (Cantwell, 1992, Lundvall, 1992). The novelty of the knowledge that can be accessed in a certain location and the efficient innovation process in the strong national innovation system are likely to have positive impact on creating new product and services. As the different motivation for offshoring can apply for different host countries, this can also explain the relation.

The developing economies are more likely to attract firms whose main aim is to save costs and to access to new emerging markets. As mentioned earlier, when firms save costs through offshoring, they are able to hire more qualified workers or use more resources on innovation (Lewin and Peeters, 2006, Chung and Yeaple, 2008). By being present in the emerging markets, they will also be able to get market knowledge that can be valuable input for innovation. The fact that offshoring firms present in developing countries are less likely to introduce new products and services than offshoring firms present in advanced countries may indicate that the novelty of knowledge that can be achieved in the advanced economy has a stronger effect on innovation performance than the high number of qualified workers or access to market knowledge.

Contrary to what was expected, there was no significant effect from the offshoring of R&D compared to the offshoring of other types of activities. It was argued earlier that R&D activities might be better channel for knowledge sourcing as R&D effort is found to be directed related to innovation performance (Becheikh et al., 2006). One explanation for the result could be that, for R&D units, it is important to be embedded in the local science environment for knowledge sourcing (Song et al., 2011), and this could take some time to accomplish. Some R&D activities also have a longer time horizon for the realization of their activities. For these reasons, the offshored R&D activities could not have influenced the innovation performance any differently than any other types of activities during the period of the time that was under investigation.

The results from this study imply that, in the short run, offshoring firms might be well-equipped to source and manage knowledge embedded in different parts of the world as they seem to be more likely to introduce innovation compared to non-offshoring firms. What would be interesting to investigate further is the long-run impact of offshoring on innovative capabilities. Hollowing of competences and path-dependent development of specialization among firms in the value chain might have implication for the sustainability of innovative capabilities in the long-term perspective.

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