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THE GLOBALIZATION OF VALUE CHAIN ACTIVITIES, KNOWLEDGE DYNAMICS, AND INNOVATION

AN EMPIRICAL STUDY ON DENMARK

**BY
EUNKYUNG PARK**

DISSERTATION SUBMITTED 2015



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AALBORG UNIVERSITY
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Østergaard, C. R. & Park, E. (2015) "What makes clusters decline? - A study on disruption and evolution of a high-tech cluster in Denmark" Regional Studies DOI:10.1080/00343404.2015.1015975

SUMMARY

Firms are increasingly relocating diverse activities in the value chain abroad to reap the locational advantage available in other countries. One of the issues raised in this context is that, as global operations can function as channels for knowledge flows, the involved firms and locations may gain or lose knowledge associated with the activities that are being globalized. Since knowledge is a critical input for innovation, this has some implications for the capability of firms to create new products and services. At the macro level, it will have influence on the competitiveness of the involved regions and countries. The purpose of this thesis is to study these issues in the empirical setting of Denmark with a broad research question, *“What implications does the globalization of value chain activities have on innovation in firms and locations?”*

All in all, the thesis contains seven chapters, including introduction, four papers, a case study, and conclusion. Introduction (*Chapter 1*) discusses theoretical backgrounds for offshoring and innovation and introduces the research design describing the overall structure of thesis, the data, and the general empirical setting of the thesis. The first part of thesis (*Chapter 2-4*) deals with offshoring practice in particular and contains three articles studying the dynamic capabilities, codified knowledge transfer, and innovation performance of offshoring firms. These papers show that the different aspects of offshoring such as activities offshored, motivation behind offshoring, governance mode, and offshore location are important in understanding the knowledge dynamics and innovation in offshoring firms. The second part of thesis (*Chapter 5-6*) is comprised of a paper and a short case study showing how ‘knowledge-seeking’ investment by multinational firms influences collective innovation effort and new firm creation in a regional cluster. *Chapter 7* sums up the results from the previous chapters and concludes.

The findings in the thesis show that the relocation of value chain activities has a positive impact on innovation performance of firms in an advanced economy.

It is argued in the thesis that offshoring firms can enhance their innovation performance by getting access to new knowledge from diverse sources abroad, by increasing the investment on innovation, or by rearranging the skill composition of employees that are more beneficial for innovation activities. The findings also imply that offshoring firms have capabilities for implementing changes in organizational configuration and for managing knowledge dispersed geographically, which support them in yielding better performance in terms of innovation after the relocation of the activities.

The findings in the second part of the thesis show that the operations of multinational firms have contradicting effects on a regional economy in the host country. In the early growing phase of the cluster, multinational firms entered the cluster by taking over troubled local firms and thereby brought financial and knowledge resources. However, over the years of their existence, the foreign firms were found to be less embedded in the local environment compared to local firms, which means that they did not engage actively in collective competence building and other joint action to overcome the threats arising from disruptions in the industry and market.

RESUME

Virksomheder udflytter i stigende omfang forskellige aktiviteter i værdikæden til udlandet for at udnytte diverse ressourcer tilgængelige i andre lande. En problemstilling, der ofte er taget op i diskussion i denne sammenhæng er, at de involverede virksomheder og steder kan vinde eller tabe viden i forbindelse med globalisering af aktiviteter, eftersom udenlandske aktiviteter kan fungere som kilder til vidensdeling. Da viden er et vigtigt input for innovation, har dette konsekvenser for virksomhedernes evner til at skabe nye produkter og tjenester. På makroniveau vil det ligeledes have indflydelse på konkurrenceevnen i de involverede regioner og lande. Formålet med denne afhandling er at undersøge disse problemstillinger med udgangspunkt i dansk empiri med det overordnede forskningsspørgsmål, "Hvilke implikationer har globaliseringen af værdikædeaktiviteter på innovation i virksomheder og lokaliteter?"

Afhandlingen indeholder syv kapitler, herunder introduktion, fire artikler, et casestudie og konklusion. Introduktionen (*kapitel 1*) diskuterer teorier om offshoring og innovation og introducerer forskningsdesign med en beskrivelse af den overordnede struktur for afhandlingen, de anvendte data og den empiriske baggrund for de første tre artikler. Den første del af afhandlingen (*kapitel 2-4*) omhandler offshoring og indeholder tre artikler, som undersøger sammenhængen mellem offshoring og dynamiske evner (capabilities), kodificeret videnoverførsel i forbindelse med offshoring samt effekten af offshoring på innovation på virksomhedsniveau. Disse artikler viser også, at de forskellige aspekter af offshoring såsom udflyttede aktiviteter, strategiske motiver for offshoring, koordineringsformer og offshore destination er vigtige i forståelsen af videndeling og innovation i de virksomheder, der offshorer. Den anden del af afhandlingen (*kapitel 5-6*) består af en artikel og en kort casestudie, som viser, hvordan "viden-søgende" investeringer fra multinationale virksomheder påvirker kollektiv innovationsindsats og

iværksætter i en regional klynge af virksomheder. Kapitel 7 opsummerer resultaterne fra de foregående kapitler og konkluderer.

Resultaterne fra afhandlingen viser, at udflytning af værdikædeaktiviteter har en positiv effekt på virksomheders innovationsperformance i en avanceret økonomi. Det hævdes i denne afhandling, at offshore virksomheder kan forbedre deres innovationsperformance ved at få adgang til ny viden fra forskellige kilder i udlandet, ved at øge investeringerne på innovationsaktiviteter, eller ved at omorganisere sammensætningen af kompetencer af ansatte så den er mere fordelagtigt for virksomhedernes innovationsaktiviteter. Resultaterne viser også, at offshore virksomheder har evner til at gennemføre ændringer i organisationsstruktur og administrere viden, som er spredt forskellige steder i verden. Disse evner støtter virksomhederne i at opnå bedre resultater med hensyn til innovation efter udflytning af aktiviteterne.

Resultaterne i den anden del af afhandlingen viser, at multinationale selskabers aktiviteter har modstridende effekter på en regional økonomi. I den tidlige vækstfase af virksomhedsklyngen, etablerede multinationale virksomheder sig ind i klyngen ved at overtage kriseramte lokale virksomheder og derved medbragte finansielle og videnressourcer til den regionale økonomi. Senere hen viste de udenlandske firmaer sig at være mindre indlejrede i det lokale miljø i forhold til lokale virksomheder, hvilket betød, at de ikke havde engageret sig aktivt i den kollektive kompetenceopbygning og andre fælles indsatser for at overvinde de trusler, som klyngen stod overfor, i forbindelse med teknologiske og markedsmæssige forstyrrelser.

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Aalborg, March 2015

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CHAPTER 1. INTRODUCTION

In advanced economies, offshoring, which is defined as relocation of firm activities to foreign country, has not only been a subject of strategic decision in firms, but has also been an issue frequently brought up in political debates on industrial policy. In the business world, there is general acceptance of the necessity to relocate activities abroad to stay competitive in the global market. Offshoring could be regarded as a burning platform on which firms are 'forced' to act upon in order to stay in the market or as a rather proactive strategic move to streamline the firm activities before it comes down to the matter of life and death. Depending on the idiosyncratic firm history and the peculiar developments in the markets and the industry dynamics, offshoring implementation and the benefits from offshoring may differ (Pyndt and Pedersen, 2006), but in any case, offshoring is considered as a decision that is critical for the long-term survival and prosperity of firms.

Parallel to the understanding of the need to relocate, there has also been growing concern on the economic consequences of offshoring in the home country. Unlike other global activities of firms such as export and foreign direct investment, offshoring entails disaggregation and relocation of activities that have been conducted in the home country, which has some critical implications for the welfare of the home country. First of all, offshoring leads to a rather immediate consequence of unemployment of the laid-off workers following the relocation. The welfare of these workers, including where and how these workers find new jobs, has received much attention in the political debate. This matter also expands into the question of what skills and competences will be needed in the home country in the future and how the development of the education system should reflect this.

Another concern with more long-term perspective is placed upon the influence of offshoring on innovation capacity. The argument that offshoring of labor-intensive activities can provide more benefits to the home country as long as more knowledge-intensive activities stay in the country is losing its ground as

more knowledge-based activities such as research and development (R&D) are being relocated. Moreover, it is increasingly acknowledged that the loss of 'labor-intensive' manufacturing activities in the home country can lead to the deterioration of the innovative capabilities of firms. It is argued that knowledge on manufacturing process provides crucial input to creation of new products and services, and the distance between manufacturing and R&D activities created by relocation could be harmful for innovation. In other words, the offshoring firms are in danger of becoming 'hollow' corporations (Kotabe and Mudambi, 2009) without certain knowledge and competences necessary for maintaining competitiveness. This means that offshoring firms might be chasing short-term gains (cost saving) while compromising the long-term gains. Moreover, as the knowledge travels from one place to another in the implementation of offshoring, firms in the offshore locations might get a chance to develop competences, which could pose threat to the offshoring firms.

These consequences have also raised the awareness on the trend of 'reshoring (or backshoring)', by which firms bring once offshored activities back to the home country. As it is highlighted in the special report in *The Economists* (2013), a growing number of American firms are moving manufacturing activities back to the U.S. One of the downsides of offshoring pointed out in the report is exactly that the separation of production from R&D risks harming a firm's innovation capability in the long-run. As indicated in the report, Boeing's outsourcing experience in developing the new 787 Dreamliner proved that offshoring can also interfere with the timely introduction of new products (*The Economists*, 2013).

Similar debates on offshoring are on-going in other advanced economies that have attempted to reap the benefits from the labor arbitrage by relocating activities to low income countries. In Denmark, the notion that knowledge and innovation eventually follow production after the relocation of production activities to foreign locations has created more critical view on offshoring, drawing more attention upon the relation between offshoring and innovation

(Rostgaard, 2013). In a recent report by Centre for Economic and Business Research (CEBR), Junge and Sørensen (2011) revealed that there is a positive relation between offshoring and the likelihood of having own R&D at the firm level and between offshoring of R&D and R&D intensity of firms. However, there is still lack of evidence to enrich the discussion on the implication of offshoring on innovation in the home country. Especially, the underlying mechanisms in which the relocation of business activities influences the creation of innovation need to be clarified in more detail. The main purpose of the thesis is to contribute to the current discussion on this matter, incorporating diverse offshoring pattern in terms of activities offshored, strategic motive, and location choice. The main research question is formulated as follows.

“What implications does the globalization of value chain activities have on innovation in firms and locations?”

The thesis directs focus on the relation among knowledge, geography, and innovation in answering the main question. The creation, diffusion, and utilization of knowledge are at the core of innovation activities. In the literature of innovation studies and economic geography, the ‘tacit’ nature of knowledge is often highlighted to explain why knowledge and innovation activities tend to be localized (Fagerberg, 1994, Maskell and Malmberg, 1999, Feldman, 2000). While knowledge is likely to be bounded geographically, it can travel from one place to another through various channels such as the trade of goods and services, the mobility of humans, and information and communication media. Especially, the globalization of firm activities is recognized for providing pipelines for transferring knowledge that is otherwise anchored in geography (Zander and Kogut, 1995, Mowery et al., 1996, Gupta and Govindarajan, 2000). The pipelines created through the globalization of firms promote the redistribution of knowledge by allowing knowledge flows between the home country and the host country in both ways (Singh, 2007). From the perspective of the economic entities, this can either create an opportunity to enhance their innovative capabilities by getting

access to new knowledge or it could threaten their competitive advantage by allowing others to catch-up. Aggregated at a higher level, globalization will also influence how locations in different geography enhance or lose their innovation capacity.

In the first part of the thesis, the main focus is on offshoring, which is conceptualized as a business practice of a strategic art that accompanies changes in knowledge dynamics in the involved firms as well as the locations. I take the perspective of the home country in the phenomenon of offshoring and investigate what implications the relocation of business activities has on managing knowledge and innovation at the firm level. In doing so, how different aspects of offshoring such as activities, governance mode, strategic motive, and location are associated with or influence the knowledge management and innovation activities of offshoring firms is highlighted. The research question for the part I of the thesis is:

What implications does the relocation of firm activities have on knowledge transfer and innovation capacity of firms in the home country?

The empirical context for this part of the thesis is Denmark, which is a country with a relatively high share of firms engaged in offshoring in Europe. According to the most recent survey data on international sourcing, almost one fifth of responding firms in Denmark have relocated activities abroad between 2009 and 2011, which makes Denmark a country with the highest share of offshoring firms among the 15 European countries¹ that have participated in the survey (Eurostat, 2013). Danish firms' active engagement in offshoring can be explained by a high wage level in the domestic market and strong dependence on international markets for their product and services. With the continuous interest in offshoring by Danish firms, the fear of losing certain competences in relation to offshoring (especially in manufacturing) is growing in the public discussion. Moreover, Denmark is a small advanced economy, which relies heavily on knowledge assets for the competitive edge. Therefore,

¹ The participating firms are Belgium, Bulgaria, Denmark, Estonia, Finland, France, Ireland, Latvia, Lithuania, Netherlands, Norway, Portugal, Romania, Slovakia, and Sweden.

studying how offshoring influences knowledge and innovation activities in Danish firms is very much relevant for the country. Overall, Denmark provides a good complementary empirical context for the U.S., which is the dominant setting for the studies on offshoring currently.

The second part of the thesis takes the view of the host country in the globalization process and shows how a region in an advanced economy is affected by 'knowledge-seeking' FDI activities by multinational corporations (MNCs). This part contains an article and a case study on a regional cluster in Denmark, with two different focus areas, namely, cluster evolution and knowledge-intensive entrepreneurship. Despite the two different focus areas of the chapters, the common empirical setting, a cluster that had once hosted R&D activities by MNCs, but later experienced closure of these activities, sheds light on the implications of global innovation activities of MNCs on innovation and entrepreneurship in an advanced economy as the host country. This compliments the perspective of the home country in the first part of the thesis in studying the aspects of global value chain, geography, and innovation.

The research question for the part II of the thesis is:

What are the implications of global innovation activities of MNCs on the development of a region in an advanced economy?

The rest of the introduction is written with more emphasis on offshoring, the subject of part I, which is the main focus of the thesis. A review of empirical studies on offshoring is presented first to show the evolution of offshoring as a business practice, followed by some theoretical backgrounds for understanding offshoring. Then, the discussion on offshoring in relation to global value chain, geography, knowledge, and innovation is presented before the research design is introduced.

1.1. UNDERSTANDING OFFSHORING AS A BUSINESS PRACTICE

Offshoring can be defined as relocation of business activities from home country to foreign locations in order to serve the firm's domestic as well as foreign operations (Kenney et al., 2009, Contractor et al., 2010). This definition encompasses both internal organization of the activities abroad and outsourcing of the activities to unaffiliated suppliers located outside the home country. The two-by-three matrix with governance mode on one axis and geographical dimension on another is a rather simplified illustration of how firms can manage their activities, but it still serves as a good starting point to discuss the basic modes of organization of firm activities (see Table 1-1). As it is defined in this thesis, the right column of the matrix represents the different forms of offshoring. With varying degrees of internal control and geographical dispersion of activities, offshoring can also be found within and in between the boxes defined in the matrix.

Table 1-1 Location and control choice for business activities

	Domestic	Foreign
In-house	Onshore in-house	Captive offshoring
Cooperative	Joint venture	International joint venture
Market transaction	Onshore outsourcing	Offshore outsourcing

Adapted from Mudambi (2008) and Contractor et al. (2010)

Offshoring has been studied rigorously within the field of international business and strategic management. The studies in these fields analyze the conditions or motivation factors that affect the decision to relocate activities (antecedents of offshoring), implementation strategies including activities, location, and governance mode (implementation characteristics), and firm-level consequences of offshoring (performance) (Larsen, 2013). The literature shows that, although offshoring has traditionally been associated with the

relocation of manufacturing to low-cost destinations, the practice has diversified enormously to include various locations, activities, and motivation over the recent years (Kenney et al., 2009). It is argued in this thesis that some of these factors may influence the relation between offshoring and the dynamic capabilities, codified knowledge transfer, and innovation performance, which will be the subject of investigation in the following chapters. The following five aspects of offshoring: activities, motivation, location, governance, and performance outcome are discussed below one by one to illustrate how offshoring practice has diversified over time.

1.1.1. ACTIVITIES

As early as 1960s, Vernon (1966) suggested that firms start relocating manufacturing facilities to low-cost countries from advanced countries as a product becomes mature in its life cycle. Leading US firms began to build foreign plants from the 1960s and 70s to get access to cheaper labor, mainly in developing countries (Ferdows, 1997). Throughout the 80s and 90s, scholars have shown great interest to international production and foreign direct investment (FDI) in tangible assets by multinational firms as the internationalization of large firms accelerated (see for example, Dunning, 1980, Cantwell, 1991). The early contribution on offshoring therefore had mainly been related to the relocation of labor-intensive manufacturing activities to less-developed countries with low labor costs.

However, with the advancement in information and communication technologies (ICT) in the 90s, firms have been able to relocate other types of business activities across borders. The 'new' wave of offshoring involves support functions and business services such as customer services, payroll, accounting, IT services, and drug development (Massini and Miozzo, 2012). The distinctive features of offshoring of these administrative and technical services compared to offshoring of manufacturing activities include that the offshored activities are mostly non-physical and traded through telecommunication and that it involves highly-educated workforce (Kenney et

al., 2009). Knowledge-intensive activities such as R&D that were traditionally seen as core element of firm's competitiveness are also increasingly being relocated (Lewin et al., 2009, Martinez-Noya et al., 2012), indicating that the boundary of core activities of a firm has also been challenged. Contractor et al. (2010) assert that a more fine-grained distinction between core and non-core is needed, pointing out that 'contract research organizations' in the pharmaceutical industry provides series of innovation activities such as product development and clinical trial management that were traditionally considered to be the strategic core of firms' operations. The authors suggest that, following Quinn (1999), the activities can be distinguished between "1) core activities, those that the firm performs better than any other company; 2) essential activities, those that are needed for sustaining its profitable operations; and 3) non-core activities, those that can easily be outsourced (2010, p.1427)." The determination of the boundaries of core, essential, and non-core activities and the decision to keep certain activities geographically and organizationally close to the headquarters becomes a truly firm-specific choice.

In determining what types of activities to relocate or to keep in the home country, the distinction does not necessarily have to be demarcated by the functional division. Jensen and Pedersen (2011, 2012) stress that the distinction between standardized and advanced activities that cut across different functional tasks can have implications for implementation of offshoring. For example, within manufacturing activities, one can distinguish between volume production, which is rather standardized, and prototype and niche production, which is more advanced than volume production. Similarly, simple coding in IT programming is standardized whereas the design of programs is more advanced. The authors found that the more knowledge-intensive the firm is and the more experience the firm has in offshoring, the more advanced tasks the firm tends to offshore (Jensen and Pedersen, 2012).

1.1.2. MOTIVATION

The rationale for relocating activities can be manifold, but the primary motivation for many firms has been cost reduction (Lewin and Peeters, 2006, Manning et al., 2008). Since firms started to transfer manufacturing plants abroad, the efficiency-seeking motivation has been the predominant factor for firm's decision to relocate activities. The cost advantage mainly comes from inexpensive labor costs in less developed part of the world and therefore has been highly associated with the relocation of labor intensive activities. This motivation also goes for offshoring of service activities like call center and IT services, which have been largely relocated to emerging countries with low wage level.

Although the efficiency-seeking motivation is what underlies most of offshoring decisions, other typical motivations for the internationalization of firms can also be relevant in the context of offshoring. Market-seeking motivation that has often been emphasized in the traditional internationalization theories (Hymer, 1976, Johanson and Vahlne, 1977) is one of them. Lewin and Peeters (2006) found that a third of offshoring firms indicated access to new markets as the strategic driver behind offshoring. Indeed, a large portion of offshoring has emerging markets like China and India as destination. Especially in the case of manufacturing activities, relocation to emerging markets has an advantage of being physically close to the markets that the products will be sold, by making the distribution and logistics easier and cheaper. Hutzschenreuter et al. (2011) argue that offshoring can provide opportunities for conducting groundwork for sales-oriented operations in the future by building local relationship and getting used to the local culture and business environments.

Resource-seeking motivation is gaining more attention in relation to the relocation of knowledge-intensive activities. Here, the emphasis is made on access to qualified human resources rather than to physical resources like raw materials. Access to abundant technical and scientific personnel as well as skilled middle management at a lower cost is what makes certain emerging

countries attractive for offshoring of advanced and knowledge-intensive tasks (Couto et al., 2006). The 'global race for talents', as some authors put it, is initiated partly due to lack of skilled labor in the home country, let alone the cost advantage in offshore location (Manning et al., 2008). Lewin and Peeters (2006) show that the growing shortage of US postgraduate engineers and scientists is what leads some US firms to relocate their activities. With the knowledge-seeking motivation, advanced countries are also likely to be chosen as offshore destination as they possess certain specialized knowledge, especially for the emerging market multinational firms (Luo and Tung, 2007, Kedia et al., 2012).

1.1.3. LOCATION

Firm's choice of offshore location is often based on complex sets of location-specific factors. Based on the relative importance of these factors to the firm and the range of the factors at the location, firms will choose the destination for the activities to be offshored (Jensen and Pedersen, 2011). In the international business (IB) literature, location choice for firm's international activities has been explained as a part of Dunning's ownership, location, and internalization (OLI) paradigm, which provides a framework to determine the extent and the pattern of FDI (Dunning, 1980). Dunning (1988) has identified infrastructure, country risk, and government policy as three main categories of factors for the location decision. Based on this, some authors developed and expanded the factors that are important to consider in the context of offshoring. Reflecting the importance of human touch in executing offshore tasks, Graf and Mudambi (2005) added human capital as a new category in addition to the three categories identified by Dunning. Kedia and Mukherjee (2009) have also expanded the framework with human capital-related advantages such as labour arbitrage, knowledge arbitrage and time arbitrage. Jensen and Pedersen (2011) suggested four groups of location attributes that are relevant, incorporating the earlier studies on this matter. The four groups

are cost levels, human capital, business environment, and the interaction distance between onshore and offshore locations.

One important thing to remember is that the activities to be offshored and the motivation behind the relocation set the conditions for assessing these factors. Jensen and Pedersen (2011) find that the functional division of activities and how advanced the activities are have implications for which regions the activities are relocated to. Studying offshoring of Danish firms, the authors show that manufacturing is more likely to be located in Central and Eastern Europe (CEE), R&D activities in North America, and IT activities to Asia and CEE, compared to the probability of locating these activities in Western Europe. For advanced activities, North America becomes a more favorable destination compared to Western Europe regardless of the functional type of activities.

In line with this, different locational factors gain importance depending on the type and the attributes of activities offshored. Hahn and Bunyaratavej (2010) emphasize that cultural attributes are much relevant for the location choice for service offshoring. Utilizing Hofstede's measures, they show that the level of uncertainty avoidance, power distance, individualism, and masculinity of a country has association with the likelihood of hosting service offshoring. Doh et al. (2009) show that different attributes of service activities requires different sets of factors to be fulfilled in the offshore location. They find that service activities with interactive component are more likely to be offshored to a location with a high level of ICT infrastructure and a relatively high use of the home country language while activities with repetitive component are likely to be relocated to a country with low wage and relatively stable political environments. For R&D activities, R&D wage costs, knowledge infrastructure, country risk, the firm's prior R&D experience in the country, the industry's competitive advantage in the country seem to be important factors for location choice (Demirbag and Glaister, 2010, Ambos and Ambos, 2011).

All in all, the location choice of offshoring firms is very much nuanced with different factors at play and it is not easy to apply simple patterns of offshoring

in this regard. Nevertheless, China and India are the two emerging countries that have received particular attention as offshore target country. The two countries seem to attract different types of activities and thus became specialized in these activities over time. According to 2006 ORN survey, almost 50% of all IT and product development offshore projects by responding firms were relocated in India (Manning et al., 2008). India provides a large pool of highly skilled labour that can be employed at a lower wage level compared to North American and Western European countries. China has attracted a large portion of manufacturing and procurement activities and now is now becoming a preferable location for product development activities based on the competences in manufacturing (Lewin and Couto, 2007). Although, China and India somewhat dominate as popular offshore location, firms are also increasing turning to alternative options. Other emerging countries in Asia, Latin America, and Eastern Europe provide different advantages compared to China and India. For European firms, countries from Eastern Europe such as Czech Republic and Hungary can be attractive as they offer qualified workforce, cultural proximity and stable infrastructure (Marin, 2006). Similarly, Philippines and Latin America also attracts call centers and business processes from US and Spanish speaking firms, respectively (Lewin and Couto, 2007).

1.1.4. GOVERNANCE MODE

Firms can choose how much control and ownership that they want to exert over offshored activities. They could 1) retain full ownership and control the activities by establishing wholly-owned subsidiaries abroad when relocating activities abroad, 2) have a partial ownership by engaging in joint ventures at offshore location, or 3) outsource the activities to independent suppliers located abroad. In reality, very few firms go into joint venture in the context of offshoring as less than 5% of offshoring US firms employ joint venture as governance mode (Lewin and Couto, 2007). The choice is then often between captive offshoring and offshore outsourcing.

Hutzschenreuter et al (2011) suggest a multidimensional framework that explains firm's choice on governance mode with four different levels of perspective. They argue that, firstly, firms are influenced by the institutional settings of the home country, which shape organizational structure and processes. Secondly, population surrounding of a firm affects the firm's choice as the conventional governance mode of other offshoring firms are likely to be preferred by 'novice' offshoring firms. When firms are engaged in a new practice, they are likely to follow what has been done by other firms. Then, the firm-specific factors such as previous chosen governance mode and managerial intentionality of the firm come into play, which means that the development path of a firm will have implications for its decision on the governance mode. This is well illustrated in different control strategies of Nokia and Apple for their value chain activities (Mudambi, 2008). Although the two firms are in the same mobile handset industry, how they manage their activities are very different. Nokia is highly integrating the value chain activities based on its manufacturing expertise while Apple outsources low value activities such as manufacturing and assembly and focuses on R&D and marketing activities which are at the upstream and downstream end of the value chain respectively. Lastly, implementation-specific aspects such as the type of activities to be relocated, offshore location, and transferring mechanisms will influence the decision. The authors also find support for the usefulness of these different perspectives in the framework in their empirical analyses. On the firm- and implementation- level, the cost-saving motivation is found to be associated with offshore outsourcing while market-seeking motivation is associated with captive offshoring. Activities that are autonomous are more likely to be offshored to an unaffiliated supplier compared to knowledge-intensive or idiosyncratic activities.

1.1.5. PERFORMANCE OUTCOME

Some firm-level performance outcomes have been studied as the consequence of relocation of activities. Bertrand (2011) found that offshore outsourcing

enhances export performance of firms and that the positive effect increases if the firm exports to the country where they outsource. The argument here is that firms can get local market information through outsourcing which will be beneficial for exporting activities. Similarly, Di Gregorio et al. (2009) found that offshore outsourcing increases the scope and the extent of internationalization of sales of SMEs, arguing that offshore outsourcing enables SMEs to save costs, expand international relations, and leverage foreign suppliers. While there is evidence that export performance seems to increase with offshoring, Mol et al. (2005) did not find significant effects of offshoring on financial performance and market performance.

Olsen (2006) states that there is no consistent empirical evidence on the impact of offshoring on productivity as the results seem to be influenced by firm- and sector-specific or implementation-specific factors. For example, some studies show that profitability and productivity are positively related to offshoring, but the results are contingent on specific settings of offshoring. Jabbour (2010) shows that the positive impact of offshoring is found only in the case of offshore outsourcing to developing countries, and Görg and Hanley (2005) found the effect when large firms are engaged in offshore outsourcing.

Regarding innovation, R&D offshoring seems to have a positive impact on innovation and the impact is greater in the case of captive offshoring than offshore outsourcing (Nieto and Rodríguez, 2011). Bertrand and Mol (2013) also found that offshore outsourcing is positively related to innovation performance. Focusing on offshoring of production, R&D, and engineering, Mihalache et al. (2012) found an inverted u-shape relationship between innovation performance and offshoring of these activities, which indicates that offshoring has a positive impact only to a certain degree of offshoring.

1.2. TRANSACTION COST ECONOMICS, RESOURCE BASED VIEW OF FIRM, AND OFFSHORING

The transaction cost economics (TCE) and resource based view (RBV) of firm provide some theoretical backgrounds for understanding offshoring from the perspective of firms.

TCE explains how firms set organizational boundaries in their operations (Williamson, 1981, Coase, 2007). Put it simply, firms can either manage their activities internally in the hierarchy or organize them through market transactions, depending on asset specificity, frequency of contracting, and uncertainty in the environment and relationships, which are the factors that determine the transaction cost. If these factors are found to be high, the transaction costs will also be too high for the firms to rely on market transactions. This will make firms engage in vertical integration even in the case of low market price. In the context of offshoring, TCE is utilized to explain the cost saving rationale of offshore outsourcing. According to the traditional internationalization literature, MNEs internalized activities abroad due to uncertainty and risk associated with international transaction (Dunning, 1988). However, when the cost saving due to low wage level in offshore location compensates for the high transaction costs in the international market, firms will outsource their activities to foreign suppliers. For the firms to prefer offshore outsourcing to domestic outsourcing, the difference in wage level between the home country and the foreign country should outweigh the increase in transaction costs due to higher uncertainty in international transaction (Stratman, 2008, Roza et al., 2011).

According to the RBV, the firm's competitive advantage comes from unique, scarce, and inimitable resources that the firm possesses, acquires, or develops (Barney, 1991, Wernerfelt, 1995). The resources can be *physical resources* such as facilities and raw materials, *human capital resources* such as expertise and relationships, or *organizational resources* such as reporting structure and planning processes (Barney, 1991). In other words, the ability to acquire or develop these resources and combine them in a unique way is at the core of the

competitiveness of the firm. In the perspective of RBV, offshoring of standardized activities could be seen as strategic decision to seek efficiency by relocating 'replicable' and therefore less important resources. Offshoring as a business practice can thus be seen as "a direct application of firms-level capabilities as envisioned by the RBV (Doh, 2005, p. 700)". RBV also provides explanation for the resource-seeking motivation of offshoring, through which firms get access to human capital resources such as specialized knowledge or other types of resources. In this case, offshoring is the endeavor to get hold of resources that could have strategic importance.

As an extension of RBV, 'dynamic capabilities' refer to firm's capability to "integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al., 1997, p.516). The firms that are relocating activities abroad can therefore be considered to possess dynamic capabilities as they are actively reconfiguring their value chain activities in order to adapt to the environments and stay competitive in the market. Moreover, the emerging market firms such as Infosys and Satyam, specialized in managing offshored tasks for other firms, are also the ones with dynamic capabilities, recognizing and acting on the opportunities arising in the increasing trend of offshoring of firms from advanced economies (Doh, 2005).

1.3. GLOBAL VALUE CHAIN AND GEOGRAPHY OF KNOWLEDGE

The previous sections discussed offshoring in the perspective of firm as to describe the extent and the evolution of offshoring as an outcome of strategic decision. Seen from the perspective of economic geography, offshoring as a phenomenon provides insights into what kind of activities are being relocated to which locations and help reconfigure the map of economic activities to show the divergence/convergence of economic development in various regions around the world. In this context, global value chain (GVC) approach can be a good starting point to elevate the level of perspective regarding the relocation of business activities.

GVC places focus upon how value-creating activities are fragmented and distributed among different types of firms located in different part of the world (Gereffi, 1999)². In the perspective of GVC, the unit being traded globally can be a value-adding ‘activity’, and not necessarily a ‘commodity’. Following the principles of the transaction cost economics (Williamson, 1975), GVC perspective does not only provide a framework to understand the global organization of industry in terms of which activities are performed by whom and where these activities are placed in the world, but it also shows that some firms might have more control over other firms in the same value chain through several governance modes³. This means that there are various roles that firms can take in the supplier-buyer relationship within a value chain and that firms can choose their strategic role according to their competitive advantage. Firms can either be an orchestrator that controls the overarching organization of activities or can be specialized firms providing rather narrow sets of activities in the value chain (Craig and Mudambi, 2013). For example, firms like Wal-Mart and Dell are like orchestrators that have developed expertise in building relationships and integrating different activities dispersed to partners worldwide (Levy, 2005).

Geographically, the global division of labour has shown a pattern that high-value activities are mostly located in advanced economies while low-value activities are performed in emerging economies (Gereffi, 1999, Mudambi, 2008). Mudambi (2008) illustrates this with the ‘smile of value creation’ which demonstrates that high value added activities are concentrated at the downstream and upstream ends of the value chain. Downstream activities like basic and applied R&D, design, and commercialization and upstream activities like marketing, advertising, and brand management all contribute to high value

² Gereffi originally used the term ‘global commodity chain’, but as Humphrey and Schmitz (2000) argued, GVC has an advantage over this term in that it draws attention to “who adds value where along the chain (p.10)”.

³ According to Gereffi et al. (2005)’s distinction, firms in market governance will have equal power, whereas firms in the other four types of governance, namely, modular, relational, captive, and hierarchy, will have unequal distribution of power in their relationship. Humphrey and Schmitz (2000) also distinguish between network, quasi-hierarchy, and hierarchy governance. The two latter governance types suggest that some firms can exert control over others in the transaction.

creation compared to manufacturing and standardized services that are in the middle of the value chain. In his analysis of value chain of the mobile handset industry, he shows that R&D and marketing activities are mostly located in advanced countries while low value added activities like manufacturing and assembly are located in emerging countries (Mudambi, 2008). As mentioned earlier, Jensen and Pedersen (2011) also found empirical evidence that advanced R&D is more likely to be relocated to North America and less likely to Central Europe than to Western Europe, which shows that high value added activities are more likely to be located in advanced economies.

This division of labour could be seen as a result of different levels of knowledge and competences accumulated in different locations around the world. The emergence of GVC implies that global labour market is created for certain skills (Levy, 2005) and the activities are likely to be located where the most competitive price for the quality is offered. The more advanced the skills and competences are and therefore the less replicable they are, the more likely that they will be concentrated in a location where these skills are available. In other words, standardized and routinized activities that can be done in many different locations are increasingly relocated to emerging countries with favorable wage level, and advanced activities will be located in advanced countries where the scarce competences exist.

The fact that certain activities 'follow' specific geographical location is due to the nature of 'knowledge' that are fundamental for developing skills and competences needed to perform the activities. Within the tradition of evolutionary economics, knowledge is conceived to be tacit and cumulative, and largely embedded in organizations. Organizational knowledge, which co-evolves with the dynamics in the industry and the economy as a whole, provides the source of heterogeneity for firms. Nelson and Winter (1982), in their seminal work, explained the working of firms in terms of organizational routines, which is understood as knowledge-based organizational behavior memorized in the operation of firms. This repetitious, patterned behavior

makes it possible for a firm to define what it is capable of doing, thus creating the basis for organizational capability.

When knowledge is tacit, it also becomes geographically localized, meaning that it is not easy to access the knowledge from distance (Fagerberg, 1994). Moreover, the cumulative characteristic of knowledge indicates that knowledge created and utilized in a certain location tends to stick around and provide a trajectory for further development of the knowledge (Dosi, 1988). Thus, knowledge is created in different rates in different parts of the world and is known to have an impact on the competitiveness of economic actors in different levels of economy. On a national level, innovation is found to be an important factor for economic growth and the competitiveness of a nation (Porter, 1990, Baumol, 2002, Fagerberg and Verspagen, 2002). Empirical findings indicate that the ability to create and utilize technological knowledge differs among countries, which then leads to the divergence in economic development (Fagerberg et al., 2007, Castellacci and Archibugi, 2008). The notion of 'the national systems of innovation' explains the systematic character of the innovative capability of a nation, focusing on various actors, their interaction, and the surrounding institutions that foster knowledge creation and diffusion (Lundvall, 1992, Nelson, 1993). The knowledge accumulation and the innovative capability of a nation largely explain what kinds of activities are attracted to the country.

In the same vein, knowledge is unevenly distributed in various regions within the boundary of a nation. This is captured by the idea of the regional innovation system, which was introduced in the 1990s with the inspiration from the national systems of innovation and the emergence of regional clusters (Cooke, 1992, Asheim and Isaksen, 1997). The regional innovation system view illuminates the network-like characteristic of knowledge production within the region and the importance of the 'regional culture' in encouraging the interaction in such networks. As Asheim and Gertler (2005, p.299) put it, "regions are importance bases of economic coordination at the meso-level" as the regional governance is often devolved from the national government and

the localized learning can be more efficient in this level where geographical proximity is greater than the national level (Malmberg and Maskell, 2006).

The geographical perspective in GVC does not only explain how different activities are being distributed among countries, but it also raises the issue of the uneven distribution of economic activities among the regions within a country as a result of offshoring, particularly in emerging countries. Manning et al. (2008) noted that offshoring has contributed to the emergence of geographical clusters in emerging countries. Unlike industrial clusters in advanced economies such as Silicon Valley, the clusters are specialized in certain types of activities regardless of industries. For example, Bangalore is home to many domestic and foreign firms offering IT-related services and Moscow and St. Petersburg have highly trained scientists for the development of new technologies and products. The existence of clusters in emerging countries (Tan, 2006) indicates that divergence in economic development as well as in accumulation of knowledge among regions in these countries is accelerated by offshoring.

1.4. OFFSHORING, KNOWLEDGE, AND INNOVATION

In offshoring literature, what is gaining more attention is the relocation of innovation activities – what Lewin and Couto (2007) called “next-generation offshoring.” According to the authors’ survey, offshoring of core innovation activities (product development, engineering, and research and development) has increased significantly in the recent years, and the companies’ future plans indicate even greater growth in the near future. Within this area, scholars have focused especially on R&D offshoring, examining the determinants of the decision to offshore these activities (Manning et al., 2008, Lewin et al., 2009, Demirbag and Glaister, 2010, Ambos and Ambos, 2011), implications of R&D offshoring (Bardhan and Jaffee, 2005, Ernst, 2006) and the relation between R&D offshoring and innovation performance (Nieto and Rodríguez, 2011).

However, what is considered to be core innovation activities are not so neatly separable from other functions. It also takes more than R&D functions to develop new products and services. For example, Simons and Isely (2010) found that offshoring of manufacturing had consequences for innovation performance of firms in the automobile industry in the U.S., which confirms that manufacturing activities contribute to innovation to a certain degree. Depending on the industry and the size of a firm, the existence and the role of the R&D functions might vary as well, and it does not necessarily mean that innovation is irrelevant for the firms without R&D functions or with less dominant R&D functions.

Thus, in relation to innovation, the capability to manage knowledge embedded in various types of the activities of a firm is important and this is also how innovation and innovation activities are conceptualized in this thesis. While acknowledging the importance of technological knowledge, the author directs focus on the process of combining knowledge from various sources in creating innovation. As innovation literature also emphasize the interactive process between various internal and external actors in the process of innovation (Lundvall, 1992, Chesbrough, 2003), it is also appropriate to broaden the spectrum of types of knowledge relevant for innovation. In short, it is the intention of this thesis to expand the focus beyond R&D activities when discussing offshoring in relation to innovation activities. In the following sections, how knowledge dynamics change after relocation of activities and what implications this has on innovation performance is discussed in the perspective of firm and location.

1.4.1. FIRM PERSPECTIVE

The relocation of activities entails change in knowledge dynamics in the firm's operation. Firstly, the relocation of existing activities to another location involves transfer of knowledge embedded in the activity over geographical distance. This inevitably requires a certain level of codification of knowledge in order to ease the transfer. For example, when LEGO decided to offshore

outsource its production facilities from Denmark to other countries, it realized that much effort was needed in codifying production knowledge that have been regarded as 'common' knowledge in their operations (Larsen et al., 2010). The extent of documentation of knowledge that was necessary in this process came as a surprise to the firm and some years later, LEGO decided to in-source the activities back after realizing that the 'ingrained' knowledge in their home operations is valuable for their competitiveness. The story of LEGO suggests that codification does not only allow firms to manage knowledge efficiently over geographical distance, but it also provides firms opportunities to rediscover their own knowledge stock and capabilities. Firms realize what they are capable of and what kind of knowledge they possess when they go through intensive codification process. Thus, all in all, codification exercise can enhance firm's capabilities to manage and utilize existing knowledge and furthermore help firms detect the kind of knowledge they need to acquire to complement the existing knowledge. In most cases, the transfer of knowledge through codified form only is not enough and the mechanisms to transfer tacit knowledge should be accompanied. Firms often arrange opportunities for the employees in home country and the employees abroad to interact face-to-face in workshops and job rotation.

Secondly, offshoring brings different kinds of distance into knowledge flows between the value chain activities. In addition to the 'obvious' geographical distance, the institutional, cultural (or contextual), organizational, cognitive, or social distance could exist among the workers in various locations, which is likely to interfere with efficient transfer of knowledge and mutual learning (Kogut and Singh, 1988, Boschma, 2005, Ambos and Ambos, 2009). Thirdly, firms can get access to new knowledge in offshore location. As discussed before, countries and regions offer unique sets of knowledge and skills that are 'sticky' to geographical location. By relocating activities and being physically present in the offshore location, firms are able to tap into local knowledge (Gertler, 2003).

The knowledge dynamics listed above have different implications for firm innovation. Since relocation of knowledge follows relocation of activities, firms are in the risk of becoming 'hollow corporations' without competences and knowledge that are necessary for innovation (Kotabe and Mudambi, 2009). This could be a concern especially for the firms engaged in offshore outsourcing (Grimpe and Kaiser, 2010). Even if the offshored activities are managed within the firm boundary, the distance between the home country and offshore location will make knowledge sharing and learning less efficient. On the contrary, knowledge sourcing aspect of offshoring will contribute to increase in the diversity of knowledge, which is likely to have a positive impact on innovation. In the case of knowledge-seeking offshoring (Maskell et al., 2007), it will be able to bring in advanced knowledge and thereby increase the depth of knowledge, which could be beneficial for innovation. The contradicting effects could be exerted in a varying degree depending on the specificities of offshoring implementation such as activities, governance mode, and offshore location and the capabilities of a firm to manage knowledge and related innovation activities.

1.4.2. LOCATION PERSPECTIVE

The impact of offshoring on innovation in the regions and countries that are involved in the relocation of activities could work in a similar way as it does on firms since the performance of geographical locations could be seen as the aggregate of performance of the firms in these locations. The home countries could experience a certain level of hollowing-out in terms of knowledge and competences or they could benefit from offshoring if it complements the operations in the home country in a synergetic way. While the possible hollowing-out effect has been frequently raised in the discussion (Lieberman, 2004, Pro Inno Europe, 2007), the empirical evidence for this effect is scarce. On the other hand, the positive effect of offshoring on knowledge production and productivity in home country has been reported in some recent studies (Criscuolo, 2009, Piscitello and Santangelo, 2010, Castellani et al., 2013,

D'Agostino et al., 2012). Criscuolo (2009) show that there is reverse technology transfer from foreign subsidiaries to home country firms in the study of European chemical and pharmaceutical firms engaged in R&D offshoring in the U.S. D'Agostino et al. (2013) argue that knowledge production in advanced home countries is more efficient if the offshored R&D activities have different technological intensity and therefore provide complementarity to the R&D conducted in the home countries and found empirical support for this. Knowledge spillover to home country also exists in the context of production offshoring. Simons and Isley (2010) found that there is knowledge spillover from certain offshore location such as Mexico, China, South Korea, and Taiwan to home country in the US automobile industry.

For the developing countries as a host country of efficiency-seeking offshoring, offshoring can provide a chance to upgrade their competences through the knowledge transfer in the firms that are directly receiving tasks from abroad and also through knowledge spillover to other local firms, depending on the absorptive capacity of the country (Xu, 2000). Technology transfer and knowledge spillover in the host country have been studied rigorously in the context of foreign direct investment (FDI). The studies show mixed results in that, while some studies find knowledge flows and technology transfer in terms of increase in productivity in local firms in the host countries, other studies do not find significant results supporting the existence of positive knowledge spillover (see for example, Haddad and Harrison, 1993, Aitken and Harrison, 1999, Görg and Greenaway, 2004, Kugler, 2006). In the context of offshoring, a study by Qu et al. (2012) show that R&D offshoring has a positive effect on R&D effort by firms in the host country.

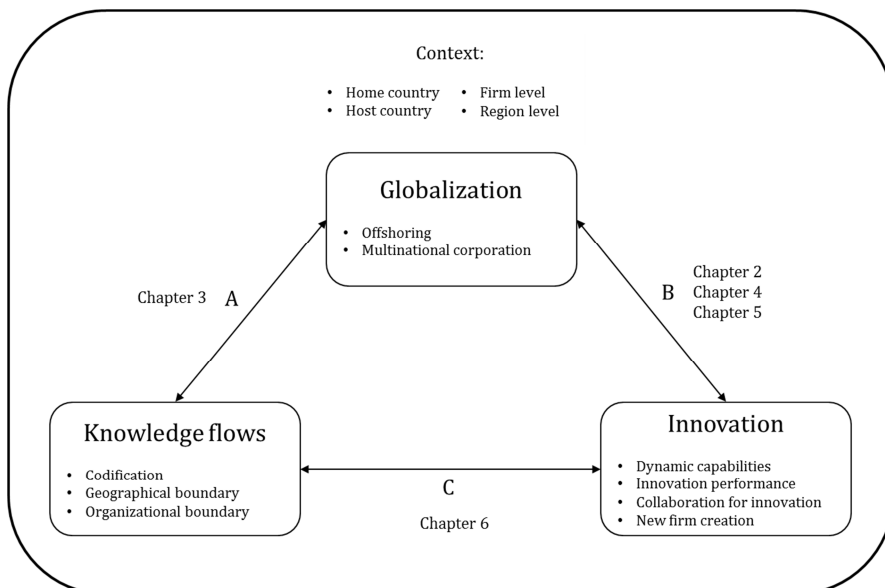
1.5. RESEARCH DESIGN

In this section, the general research design including the overview of the thesis, data description, and research methodology is discussed.

1.5.1. OVERVIEW OF THE THESIS

The main purpose of the thesis is to investigate the implications of globalization of value chain activities on innovation. The underlying mechanism of how globalization influences innovation is mainly explained in terms of knowledge flows that globalization activities create. Accordingly, globalization, innovation, and knowledge flows constitute the main conceptual pillars of the thesis, and the five empirical studies in the thesis each deal with some elements of these concepts (see figure 1-1). How these concepts are operationalized in each chapter of the thesis varies. The empirical setting of the *globalization* of value chain activities being investigated in the chapters are represented by offshoring and FDI by multinational corporations. Similarly, *innovation* is studied in various forms such as dynamic capabilities, firm-level innovation performance, collaborative effort for innovation in a cluster, and new firm creation. Lastly, *Knowledge flows* can find place either within or across geographical and organizational boundary depending on the setting of globalization. The level of codification of knowledge also varies depending on the specific implementation of global activities.

Figure 1-1 The three conceptual pillars of the thesis



How the papers in the thesis are positioned in relation to the three concepts is as follows. The three main papers presented in the following three chapters (part I) study offshoring in relation to knowledge dynamics and innovation at the firm level in the empirical context of Denmark as the home country. To begin with, the *Chapter 2* posits that offshoring firms have certain characteristics that are associated with the firms' engagement in offshoring. The understanding of association of certain firm characteristics with offshoring will provide some background knowledge for studying the consequences of offshoring on organizational coordination and performance, which are the subjects to be studied in *Chapter 3* and *4*. The findings in this chapter suggest that offshoring firms are different from non-offshoring firms with regards to innovative capabilities and adaptive capabilities as two aspects of dynamic capabilities. The positive association between innovative capabilities and offshoring found in *Chapter 2* deals with the relation denoted as B in figure 1-1.

The next paper in *Chapter 3* explores the part A in the figure 1-1 as it studies how knowledge is transferred between the operations that are relocated abroad and the operations at home, casting the light on the utilization of codified knowledge transfer mechanisms in offshoring firms. It is argued that the level of codification in knowledge flows between the home country unit and the host country unit depends on the attributes of offshoring implementation such as the characteristic of offshored activity and the strategic motivation. The discussion on the utilization of codified and tacit knowledge in the context of offshoring is relevant as codification is closely related to how offshorable certain activities are and how easily controllable the activities are from abroad. The mechanism in which knowledge flows in offshoring firms is not only an important matter for the implementation of the relocation, but it also has implications for managing innovation in these firms.

The last chapter in part I (*Chapter 4*) studies how offshoring affects innovation performance at the firm level, focusing on the knowledge sourcing aspect of

offshoring. This chapter argues that the fear of 'hollowing-out' of a firm after relocation can be compensated by new knowledge that the firms get access to through offshoring. Although the focus of the chapter is mainly on part B in the framework, it also deals with the relations from part A and C at the same time. The results from this chapter demonstrate that the level of disaggregation in offshoring implementation in terms of activities and location is positively related to the likelihood of innovation, which suggests that accessing new knowledge from diverse sources increases the possibility for creating innovation.

In the part II of the thesis, the implication of globalization activities of multinational firms on the competitiveness of region can be drawn from two chapters with quite different focus. *Chapter 5* studies the decline of a regional cluster and identifies different factors that have influenced the evolution of the cluster over time. This chapter identifies the presence of foreign firms in the cluster as one of the factors affecting the innovation dynamics in the cluster negatively and thereby contributing to the decline of the cluster eventually. By investigating the relation between the activities of multinational corporations and the innovation dynamics in a group of firms, this chapter focuses on part B in figure 1-1, but is also deals with part A and C. Contrary to the papers in the part I, this paper takes the perspective of a host country in knowledge-seeking FDI as the foreign firms in this particular cluster established R&D units in the region to get access to specialized labour force and knowledge in a certain field. The level of analysis is region, as the paper studies the decline of an industrial cluster that is based in a particular region.

In *Chapter 6*, new firm creation induced by the closure of a multinational firm in a cluster is described in a case study. This case shows that knowledge gained in the previous employment influences the pattern of new firm creation. As the previous employment for the entrepreneurs in this case found place in a multinational firm, knowledge flows across geographical boundary (within multinational firm setting) and organizational boundary (among multinational

firms and local firms) are implied in the process of new firm creation, which means that this chapter primarily touches upon the relation C in the figure.

1.5.2. DATA

As illustrated in the overview of the thesis, all papers in this thesis contain empirical analyses that deal with at least one of the three main concepts in the framework. The three papers in part I present results from quantitative analyses, utilizing survey data from various sources. The detailed methodology for each paper can be found in the respective chapters. The papers in part II include analyses of more qualitative character although the data used for these papers have both quantitative and qualitative aspect. The rest of the section is devoted to describe the data sources used in the empirical analyses.

Global Operation Network data

The dataset used in the first two papers comes from a research project, Global Operations Network (GONE), established in 2009. Four universities⁴ from Denmark and Sweden participated in the project, which had the purpose of studying global operations of certain industries and companies. In this project, a survey was conducted to investigate to what extent and how Danish and Swedish firms relocate business activities from home country to foreign countries. The survey reveals the specifics of the latest implementation of offshoring of firms as well as general offshoring experience in the past. The survey was sent out to all Danish firms with more than 50 employees regardless of industries (2,908 firms) and all Swedish firms with more than 50 employees in the manufacturing sector (1,529 firms) in fall 2011. The CEOs of the firms were invited to participate in the online survey either via postal mail or e-mail. The response rate was 24.4%, which means that 1,086 usable questionnaires were collected at the end of the survey period.

⁴ Aalborg University, Chalmers University of Technology, Copenhagen Business School, and University of Southern Denmark.

One of the strengths of this data is that a direct measure of offshoring practice is provided. In some previous offshoring studies, the definition and the measurement of offshoring appear rather inconsistent and imprecise. The distinction between offshore outsourcing and captive offshoring is often not clear and the measures for offshoring do not capture the relocation aspect, which reflects that the activities that have already existed in the home country are being moved. The latter case is found in the studies that measure offshoring based on the import and sourcing of activities and FDI activities (Coucke and Sleuwaegen, 2008, Nieto and Rodriguez, 2011, Castellani and Pieri, 2013, D'Agostino et al., 2013). The GONE survey has a relatively well-defined question regarding offshoring, which provides a solid measure for offshoring phenomenon with attention to the relocation aspect. A rather detailed description of the implementation of offshoring such as the type of activities relocated, destination countries, implementation year, characteristics of offshoring implementation, control mechanisms, and organizational consequences is another merit that this survey provides compared to other data on offshoring. Comprehensive account of operations of offshoring allows more fine-grained firm-level analyses on the phenomenon.

Along with the advantages that it provides, GONE data require careful consideration with regards to biases in the sample. To start with, as in any survey data, there might be non-response bias in the survey estimates. Non-response bias implies that, if the response collected in the survey does not reflect the pattern of the phenomenon in the whole population, the generalizability of the findings can be questioned. Although this bias can be present regardless of the level of response rate, a low response rate, as in the case of this survey, can influence response representativeness to a higher degree (Tomaskovic-Devey et al., 1994)⁵. In GONE data, offshoring firms might be more likely to respond to the survey compared to non-offshoring firms, simply because they are engaged in the phenomenon that is under

⁵ The debate on the acceptable level of response rate is inconclusive and is still on-going in various disciplines in social science (Forza, 2002, Baruch and Holtom, 2008). Some researchers argue that response representativeness is more important than response rate (Cook et al., 2000).

investigation and therefore be overrepresented in the sample. In relation to the biases in the sample, one should also note the fact that the Swedish sample only includes firms in the manufacturing sector. As the operations of manufacturing firms differ from those of service firms, the analysis in chapter 3, which utilizes the Swedish sample, should take this into account. How the possible bias in the sample is dealt with in the analyses will be discussed more specifically in the respective chapters.

International sourcing data from Statistics Denmark

The second data source is Statistics Denmark, which has conducted two rounds of survey on international sourcing of Danish firms. The international sourcing survey was conducted as a part of initiative by EUROSTAT, in which 12 European countries participated to provide policy makers relevant statistic information on offshoring. Although the name of the survey indicates that it investigates 'international sourcing' and this might create confusion in that the survey only includes the aspect of offshore 'outsourcing,' what is actually being asked in the survey is the phenomenon of offshoring as it is defined in the thesis. The first round of survey was conducted in 2007 and investigated offshoring activities of firms in these 12 countries between 2000 and 2006. The second round followed in 2012 to study the relocation of activities between 2009 and 2011. Both rounds of survey contain questions regarding the type of activities relocated, the regions where the activities were relocated, motivation factors, backshoring (taking back the activities once relocated broad to home country), barriers to offshoring, consequences of offshoring and job loss/gain. With only minor revision on the answer choices in the 2012 survey, the comparison of the results from the two periods is made possible. 4161 and 4461 firms participated in 2007 and 2012, respectively, and 2770 firms participated in both periods. The response rate is 96.5 percent for the 2007 survey and 97 percent for the 2012 survey.

Compared to the GONE survey data, this data has more emphasis on the topics for macro-level policy development such as the extent of the relocation of jobs, the extent of backshoring, motivation for relocation, barrier for relocation, and

the future plans for relocation. The response rate for this survey is high and the sample size is also bigger than the data from GONe project, which is a big advantage for doing quantitative analyses. The more favorable size also makes it possible to combine the data with other survey data like Community Innovation Survey and the firm register data provided by Statistics Denmark. However, combination with other various data sources results in a significantly smaller sample in the analyses. This also can lead to biases in the sample, depending on the response rate and the sample size of other data sources that are being merged together with this data. International sourcing data from 2007 is used in the analysis in combination with various innovation survey data in the fourth chapter. The newer data from 2012 is used in the next section of this chapter in describing the offshoring practice in Denmark.

Innovation-related survey data

Several innovation survey data from different time periods are used in chapter 4. The first 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. 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 second source is DISKO 2/PIE survey on technological and organizational change in Danish firms in the time period 1998-2000. This survey was a follow-up survey to the first DISKO survey conducted in 1996 with the similar focus areas. This survey covers the issues such as major organizational changes, training and education, innovation, internal and external collaboration, competence requirements, and the contents of work tasks. Including the firms that have already participated in the first DISKO survey (1363 firms with more than 20 employees, if the firm is in manufacturing

sector, or the firms with more than 10 employees, if they are in other sectors), there were 6975 firm in the total sample. 2007 firms responded, yielding about 29% of response rate.

The next source is Research, Development, and Innovation survey (FUI, in Danish) from 2009 and 2010 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 and 2010, the innovation activities of Danish firms between 2007 and 2009 and between 2008 and 2010 are investigated respectively. 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. In 2009 and 2010 survey rounds, 4545 and 4322 firms participated and as the survey is mandatory for these firms, the response rate is 100%.

Combined with the offshoring data, the innovation survey data provides detailed information on innovation activities of the offshoring and non-offshoring firms, with more detailed information in the case of the more recent FUI data. Comparing the CIS and DISKO data with the FUI data, the two former sources have smaller samples and lower response rates, but they provide an important variable for innovation performance before the period of engagement of offshoring. Concerns with earlier innovation surveys such as CIS 3 and DISKO have been that the questions could not capture the wide spectrum of innovation activities. For example, early CIS surveys have been criticized for lack of attention to innovation in service sector and non-technological innovation such as organizational innovation (Smith, 2004). Although the continuous evaluation of the innovation survey resulted in improvements in recent surveys, utilization of the earlier data should therefore be done with care. It should be noted that the innovation performance measure obtained from CIS 3 and DISKO is restricted to product/service innovation.

Data on the wireless communication cluster in North Jutland

Different from the data described earlier, the data used in chapter 5 and 6 contain both qualitative and quantitative part. As the evolution of a cluster is the context of the study, the empirical data are longitudinal in nature, covering all the years of the existence of the cluster, and include the birth and the death of the cluster firms, the number of employees in the firms, important events of the firms and the cluster, and the history of the cluster organization among other facts about the cluster and the cluster firms.

The data on the cluster were collected in the following ways. First of all, the archives from earlier studies on the emergence and development of the cluster (e.g. Dalum, 1995; Dahl et al., 2003) were gathered. The list of all firms that have been active in the cluster until 2003 had been compiled by Dahl et al. (2003) with the founding and exit year (if any), the names of founders and their previous workplaces, and the main events in the history of the firm such as acquisition and bankruptcies. Then, new entrants from 2003 and onwards were identified by consulting cluster organization's archive on member companies and searching in the various online databases for newspaper articles, media reports and corporate information with the keywords on the fields within which the cluster operates. After updating the list of firms, the founders of the new companies and their former employers were identified in similar ways, relying mainly on online corporate database, corporate websites, online network platforms, and newspaper articles. Each firm has been researched thoroughly for main events including ownership change and closedown mainly on internet sources. Some formal and informal interviews with the firms and the cluster organization conducted by one of the authors have also provided insights into the main events in the history of the cluster.

The next step was to collect data on the number of employees of each firm for the last two decades. The early employment data until 2002 came from earlier scholarly work on the Norcom cluster (Dalum, 1993, 1995, 1998; Dalum et al., 1999; Pedersen, 2001; Dalum et al., 2002). The numbers from 2002 and onwards are collected from diverse corporate databases, depending on the

time periods that the firms existed. For the firms that still exist now, an online corporate database was used to track the number of employees up to five years back. A different corporate information archive was used to find the numbers for the firms that have already exited the cluster before 2011. Since not all firms are covered by those databases, newspaper articles and media reports were used additionally to find the numbers that are missing. Then, for the numbers still missing, estimation was made by taking the average of the numbers before and after the missing period, assuming that the number of employee grew or decreased linearly.

The last part of the data includes a list of former Motorola and Texas Instruments employees who were laid off when the two firms exited the cluster in 2009 and their new workplace, including the location and the new job function. The data for the former Motorola employees came from one employee who kept track of where his colleagues found new jobs. He collected information directly from the colleagues or from an online network platform. This data was later updated by the authors mainly through online search. The list of former TI employees was compiled by the authors by searching on the same online network platform. It is hard to find the accurate number of employees who were affected by the closure of the two companies as many employees changed job before the date of official exit. However, comparing the number of fired employees officially reported in the media and the number of employees identified on our list, it can be concluded that our data is rather complete. Furthermore, the spinoffs established by former Motorola and TI employees after the company closure were identified by searching on online media sources. Then, this list was double-checked with the data on new jobs of the former employees.

The strength of the data is that it is collected over a period of time along with the development of the cluster itself. Therefore, many of the firms and their events were documented with contemporary view rather than retrospective view. The immediate documentation also reduces the chance of missing out the cluster firms that exist for a short period of time and disappear and thereby

help explain the underlying firm dynamics during the course of the evolution of the cluster. However, the list of the cluster firms still might not be fully comprehensive as there has been pause in the collection of the data and the identification of the firms do not strictly follow the classification by the industry codes.

1.6. EMPIRICAL SETTING – OFFSHORING IN DENMARK

During the last two decades, offshoring has become a wide-spread practice among firms. While some other forms of international activities of firms – such as FDI – have traditionally been perceived as the property of large multinational corporations (MNCs), offshoring is penetrating the operations of ‘average’ firms, especially in Europe, where the share of small and medium sized firms is relatively high. According to Statistics Denmark (2008), about 10 per cent of Danish firms with 20-50 employees have offshored at least one function abroad between 2001-2006, which demonstrates that offshoring is leading a broad spectrum of firm to the arena of international operations. This exact point makes Denmark a unique and interesting empirical setting for studying offshoring as the findings in the thesis complement previous studies that are mostly based on data on large, multinational firms in bigger economies like the U.S. This section describes the offshoring pattern of Danish firms utilizing the two sets of international sourcing survey data collected by Statistics Denmark in 2007 and 2012.

Table 1-2 show how many firms that participated in the surveys have offshored in the two periods of investigation, 2000-2006 and 2009-2011. In both periods, about 17 per cent of responding firms have relocated activities abroad. For the firms that have responded in both rounds of survey, about 9 per cent of firms have offshored in both periods and 21 per cent of firms have offshored during one of these periods (Table 1-3). Table 1-4 shows that, as the firm size increases, the higher percentage of firms are engaged in offshoring in

the defined size categories. Manufacturing sector has a higher share of firms relocating activities than service sector.

Table 1-2 Number of offshoring firms in the sample

	2000-6		2009-11	
	%	N	%	N
Offshoring	17.6	732	17	755
Non-offshoring	82.4	3,429	83	3,678
Total	100	4,161	100	4,433

Table 1-3 Number of firms, firms that are present in both samples

	2000-6	2009-11	%	N
Offshoring	Offshoring		8.8	243
Offshoring	Non-offshoring		10.7	295
Non-offshoring	Offshoring		10.4	286
Non-offshoring	Non-offshoring		70.1	1,934
Total			2,758	100.0

Table 1-4 Percentage of offshoring firms by size and sector

Size	2000-6		2009-11	
	Off	Non-off	Off	Non-off
-50	12.7	87.3	14.6	85.4
50-250	17.1	82.9	16.6	83.4
250-	30.4	69.6	25.9	74.1
Manufacturing	22.5	77.5	20.4	79.6
Service	13.5	86.5	14.6	85.4

The rest of the section describes the pattern of offshoring in terms of offshored activities, offshore location, motivation, and governance mode. In terms of

activities, core business functions⁶ are the most offshored activities for Danish firms in both periods (Table 1-5). Among the support functions, IT related services were one of the most relocated activities as 26 and 28 per cent of offshoring firms relocated this type of activities in 2000-6 and 2009-11 respectively. During 2000-6, R&D and engineering activities were the most relocated activities after the core business functions. Between the two periods, the number and the percentage of firms offshoring administrative functions has increased.

Table 1-5 Activities relocated by the offshoring firms

	2000-6		2009-11		Both periods			
	%	N	%	N	%	N	%	N
Core	52	380	60	456	50	121	65	158
Distribution	21	152	15	111	23	55	16	38
Marketing	17	126	14	106	21	50	13	32
IT	26	191	28	209	28	69	27	65
Administrative	17	123	25	185	18	43	27	66
R&D	30	219	18	132	32	78	22	53
Other	6	46	8	60	7	18	9	21
Multiple activity	40.0	293	37.4	282	44	107	42	103

Dividing the firms according to the sector, there is difference in the types of activities that are being relocated (Table 1-6). Manufacturing firms are much

⁶ Core business function is defined as "production of final goods or services intended for the market/for third parties carried out by the enterprise and yielding income" (Statistics Denmark, 2008, p. 13). Statistics Denmark (2008) also noted that "the core business function equals in most cases the primary activity of the enterprise", but "it may also include other (secondary) activities if the enterprise considers these to comprise part of their core functions (p.13)". All the other activity categories defined in the survey belong to support business functions.

more likely to relocate core function, which in this case is manufacturing activity, while service firms are likely to relocate IT related activities and administrative activities. The rise of offshoring of knowledge intensive activities seems to hold more for firms in the service sector than the firms in manufacturing sector. In the survey, firms were asked to indicate all types of activities that were relocated in the period of investigation. It appears that 40 per cent of firms have relocated more than one type of activities in 2000-6, and the figure does not seem to change much for the next period (Table 1-5). Analyzing the offshoring firms that have responded in both periods, offshoring of core business functions and administrative functions has increased over time while offshoring of the rest of activities has decreased.

Table 1-6 Offshored activities by sector

	2000-6				2009-11			
	Manuf.		Service		Manuf.		Service	
	%	N	%	N	%	N	%	N
Core function	68.9	293	28.3	87	77.1	293	44.1	163
Distribution	19.5	83	22.5	69	15.8	60	13.8	51
Marketing	12.5	53	23.8	73	12.6	48	15.7	58
IT	14.8	63	41.7	128	17.6	67	38.4	142
Administrative	8.7	37	28.0	86	16.3	62	33.2	123
R&D/engineering	28.9	123	31.3	96	18.2	69	17.0	63
Other	7.3	31	4.9	15	8.2	31	7.8	29

The degree of offshoring of multiple activities seems to vary depending on the types of activities, firm size, and the sector (Table 1-7). More than half of cases for offshoring of core functions do not involve relocation of other types of activities. On the other hand, support functions are rarely relocated by themselves and show tendency to be offshored with other types of activities. Firms with more than 250 employees have a higher share of firms relocating multiple activities compared to the firms of a smaller size. Firms in service sector are slightly more likely to offshore multiple activities compared to firms in manufacturing sector. Offshoring of multiple activities implies that firms are

fine-slicing activities and becoming more like an orchestrator in managing activities that are geographically dispersed. Larger firms and firms in the service sector are more likely to operate in this way.

Table 1-7 Share of firms relocating more than one type of activities

	2000-6		2009-11	
	Single	Multiple	Single	Multiple
Core function	56.6	43.4	61.8	38.2
Distribution	11.8	88.2	18.0	82.0
Marketing	15.9	84.1	15.1	84.9
IT	35.1	64.9	32.1	67.9
Administrative	19.5	80.5	27.0	73.0
R&D/engineering	27.4	72.6	20.5	79.6
Other	76.1	23.9	18.3	81.7
-50	64.0	36.0	65.3	34.7
50-250	61.2	38.8	67.0	33.0
250-	53.1	46.9	47.3	52.7
Manufacturing	65.2	34.8	66.8	33.2
Service	52.8	47.2	58.4	41.6

As it is well recognized, the most important motivation for offshoring is cost saving, especially labour cost (Table 1-8). More than half of the offshoring firms indicated that cheap labour cost is the determining factor for relocation of the activities. The next most important motivation is to follow the strategic decision made by the parent company and to focus on core activities of the firm.

While the importance of each motivation factor has not changed much over time, it clearly showed difference among manufacturing firms and service firms (Table 1-9). It appears that access to knowledge and improvement of quality are the factors that are more important for firms in service sector than firms in manufacturing sector. Lack of qualified labour at home is increasingly

affecting service firms' decision to relocate their activities over time. Access to market, better regulation, reduced delivery, and following the competitors are the factors that are more critical for manufacturing firms than service firms in both periods.

Table 1-8 Motivation for offshoring (Number of firms indicating that the listed items were the determining factor for offshoring decision)

	2000-6		2009-11	
	%	N	%	N
Low labour cost	52.2	382	54.7	413
Low cost excl. Labour	35.1	257	36.0	272
Decision by parent corp.	20.2	148	29.9	226
Focus on core activity	20.2	148	13.4	101
Lack of work force	13.8	101	4.2	32
Knowledge/technology	12.4	91	6.0	45
Market access	11.5	84	9.4	71
Quality/ new products	8.9	65	4.2	32
Other motivation	5.6	41	N/A	N/A
Follow competitors	4.1	30	N/A	N/A
Tax reduction	1.8	13	N/A	N/A
Better regulation	1.5	11	2.9	22
Reduced deliver time	N/A	N/A	7.3	55

For Danish firms, Old EU countries are the most popular offshore destination regardless of time period being investigated (Table 1-10). The next popular location is New EU countries, which includes most of East European countries. Other than Europe, Asia attracts many Danish offshoring firms as China alone received 23 per cent of all offshored activities in 2000-6. India and other Asian countries also took 14 and 15 per cent of activities, respectively, during the same period. Interpreting the trend by activity, core functions are relocated in the New EU countries the most for both periods. Then, Old EU countries and China follow New EU as the offshore location for core functions. For all the support functions, Old EU countries are the most popular destination. For most support functions, New EU countries are the

second popular location except for the IT activities, for which India has relative huge importance as offshore location. Engineering and R&D is most evenly distributed activity of all in both periods, although Old and New EU countries still top the list.

Table 1-9 Motivation by sector

	2000-6		2009-11	
	Manuf.	Service	Manuf.	Service
Low labour cost	69.6	30.4	61.7	38.3
Low cost excl. Labour	65.8	34.2	61.4	38.6
Decision by parent corp.	35.8	64.2	38.0	62.0
Focus on core activity	57.4	42.6	56.4	43.6
Lack of work force	55.5	44.6	28.1	71.9
Knowledge/technology	37.4	62.6	37.8	62.2
Market access	61.9	38.1	62.0	38.0
Quality/ new products	46.1	53.9	50.0	50.0
Other motivation	56.1	43.9	N/A	N/A
Follow competitors	70.0	30.0	N/A	N/A
Tax reduction	53.9	46.2	N/A	N/A
Better regulation	63.6	36.4	72.7	27.3
Reduced deliver time	N/A	N/A	60.0	40.0
Total	58.0	42.0	50.3	49.7

The conventional understanding of specialization of two emerging countries, China and India, is confirmed in that China dominates as an offshore location in offshoring of core functions and India in offshoring of IT-related and knowledge-intensive (R&D and Engineering) activities. Bundling of activities, which means that more than one type of activity is relocated in the same region, finds place mostly in Europe and does not show much variance from the distribution of regions for all activities. Dividing firms by sector, New EU countries and China attract mainly manufacturing firms, while Old EU, India, and North America attracts more service firms in relative terms (Table 1-11).

Table 1-10 Offshore location by activity

2000-6	Total		Core		Dist		Mark		It		Adm		Eng		R&D		Other		Bundling		
	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	
Old EU	46	339	29	109	55	84	66	83	65	124	63	77	29	43	43	52	26	12	17	122	
New EU	40	296	52	199	29	44	22	28	11	20	25	31	27	40	21	25	59	27	10	75	
Other Europe	14	99	12	47	9	14	7	9	10	19	11	14	11	16	11	13	7	3	3	25	
China	23	169	33	126	16	24	14	17	4	8	11	13	20	30	12	14	24	11	6	43	
India	14	103	8	31	4	6	9	11	14	27	10	12	16	23	20	24	7	3	3	24	
Other Asia	15	113	16	60	15	22	16	20	7	13	13	16	20	29	14	17	9	4	6	43	
USA & Can.	9	67	7	25	9	13	12	15	5	9	6	7	10	14	16	19	2	1	3	25	
C. America	3	20	2	9	3	4	4	5	0	0	1	1	4	6	1	1	0	0	1	5	
Africa	1	8	1	3	1	2	2	2	1	2	3	4	1	1	1	1	0	0	0	3	
2009-11																					
Old EU	40	304	28	127	46	51	44	47	53	110	50	92	34	45	38	23	14	108	40	304	
New EU	38	284	46	210	37	41	26	27	13	28	30	55	26	34	33	20	11	81	38	284	
Russia	1	10	2	7	0	0	3	3	0	0	1	2	1	1	0	0	0	2	1	10	
Other Europe	16	120	15	70	6	7	9	10	15	32	10	19	13	17	7	4	3	22	16	120	
China	19	142	27	124	11	12	9	9	3	6	6	11	14	18	15	9	4	30	19	142	
India	17	128	14	63	5	6	10	11	19	40	15	28	19	25	13	8	4	30	17	128	
Oceania/Asia	13	101	14	62	7	8	14	15	9	19	8	15	10	13	13	8	4	28	13	101	
USA & Can.	7	49	4	19	5	5	12	13	8	17	4	7	6	8	8	5	2	13	7	49	
Brazil	1	7	0	2	0	0	4	4	0	0	0	0	1	1	0	0	0	0	1	7	
Other	2	16	2	8	0	0	5	5	0	0	1	1	1	1	5	3	0	1	2	16	

Two other emerging countries, Russia and Brazil, seem to appeal more to firms in specific sector, as Russia attracts more firms in service sector while Brazil attracts more manufacturing firms.

In the survey, firms indicated all the relevant governance modes for each type of activities offshored and therefore the governance modes are distinguished between captive offshoring only, offshore outsourcing only, and both captive offshoring and offshore outsourcing (Table 1-12). A larger share of offshoring firms engages in offshore outsourcing only in 2000-6 than in 2009-11. On the contrary, the share of firms involved in captive offshoring only increases in 2009-11. About 15 per cent of firms utilize both captive offshoring and offshore outsourcing when they relocate activities. Governance mode by activity shows that offshoring firms preferred captive offshoring in all the activities except for R&D and engineering activities in 2000-6 (Table 1-13). In 2009-11, a larger share of offshoring firms relocates activities to subsidiaries for all types of activities than to independent suppliers.

Table 1-11 Offshore location by sector

	2000-6		2009-11	
	Manuf.	Service	Manuf.	Service
Old EU	46.3	53.7	39.8	60.2
New EU	72.3	27.7	66.6	33.5
Russia			40.0	60.0
Other Europe	51.5	48.5	39.2	60.8
China	77.5	22.5	78.2	21.8
India	40.8	59.2	30.5	69.5
Other Asia	60.2	39.8	45.5	54.5
USA & Canada	50.8	49.2	36.7	63.3
Brazil			71.4	28.6
Central America	60.0	40.0		
Africa	50.0	50.0		
Others			37.5	62.5
Total	58.0	42.0	50.3	49.7

Table 1-12 Governance mode for offshored activities

	2000-6		2009-11	
	%	N	%	N
Captive offshoring	38.1	279	47.8	361
Offshore outsourcing	47.1	345	35.8	270
Both	14.6	107	16.4	124

Table 1-13 Governance mode by activity

	2000-6			2009-11		
	Cap	Out	Both	Cap	Out	Both
Core	168	168	44	222	183	51
Distribution	91	54	6	75	30	6
Marketing	85	34	7	74	28	4
IT	106	81	4	141	66	10
Administrative	82	39	2	138	38	9
R&D/engineering	92	115	18	78	39	15
Other	9	35	2	39	17	4

Lastly, the growth rates of offshoring firms are compared to those of non-offshoring firms to see whether or not there is statistically significant difference in the growth rates for the two groups of firms. Growth rates are calculated in terms of employment and turnover and for the period of 2001-2006 and 2006-2011⁷. The results with significant difference are presented in the Table 1-14.

⁷ Growth rates are measured using the index suggested by Davis, Haliwanger, Schuh (1996). The changes in turnover or employment between the two years are divided by the average size of the firms in those two years. The index is written as follows.

$$Growth = (X_{t_1} - X_{t_0}) / (X_{t_1} + X_{t_0}) / 2$$

This index is symmetric about zero and takes a value between -2 and 2. This index also integrates death and birth of the firm, with the two extreme values -2 and 2 respectively.

Table 1-14 Comparison of growth rates for offshoring and non-offshoring firms

		Growth Turnover		Growth Employment	
		2001-6	2006-11	2001-6	2006-11
	Total	O: 0.29 (0.53)		O: 0.05 (0.52)	O: -0.26 (0.54)
Offshoring (O)				NO: 0.19 (0.47)	NO: -0.19 (0.5)
vs.				O: -0.03 (0.4)	O: -0.33 (0.52)
Non- offshoring (NO)	Manuf.			NO: 0.11 (0.4)	NO: -0.27 (0.44)
	Non- manuf.	O: 0.32 (0.65)		O: 0.16 (0.64)	
		NO: 0.43 (0.53)		NO: 0.26 (0.51)	
Offshoring firms only			J: -0.08 (0.58)		
Jobs abroad (J) vs. No jobs abroad (NJ)			NJ: 0.10 (0.53)		

In terms of growth in employment, there is significant difference between offshoring firms and non-offshoring firms in both periods of time, 2001-2006 and 2006-2011. In both periods, offshoring firms show lower growth rates than non-offshoring firms, which is not a surprising result. For the period 2001-2006, this trend is consistent for both manufacturing firms and non-manufacturing firms. For manufacturing firms, this trend even continues for the next period, showing a lower mean growth rate for offshoring firms than for non-offshoring firms, while there is no difference in mean growth rates between offshoring and non-offshoring firms for non-manufacturing firms between 2006 and 2011. Interestingly, there is no significant difference in the mean growth rate for the offshoring firms that have relocated jobs abroad

However, the firms that have been established or have disappeared between the two time periods are not included in this analysis.

(reduced domestic jobs) in relation to offshoring and the offshoring firms that have not. The latter type of firms can be labeled as the ones pursuing 'expansive offshoring', where the domestic employment will not be directly affected by the decision of offshoring. Nevertheless, it is found that the mean growth rates do not differ for the two groups of firms with different offshoring strategies that have different direct effects on domestic employment level.

In general, the comparison of growth in turnover shows similar results as the comparison of growth in employment in that, where significant, the mean of the growth rates of offshoring firms are lower than that of non-offshoring firms. However, the results are not consistent over a longer period of time, as the significant results are only present for either one of the periods of investigation. Comparing offshoring and non-offshoring, the significantly lower mean growth rate for offshoring firms is found in the period of 2001-2006, but not in the period of 2006-2011. The same tendency is found for non-manufacturing firms in the same period of time, but not for manufacturing firms. Comparison between offshoring firms with direct job effect in domestic employment and the firms without, the former has lower mean growth rate of turnover than the latter in the period of 2006-2011.

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Part I

Offshoring and innovation at the firm level

CHAPTER 2. MORE INNOVATIVE, YET LESS RESPONSIVE TO CHANGES?¹

Unveiling the relation between offshoring and dynamic capabilities in Danish firms.

2.1. INTRODUCTION

When firms relocate their activities from their home country to foreign location, it is often induced by changing market conditions and industry dynamics. Be it price competition brought about by new competitors from emerging countries, new market opportunities in foreign countries, or technological advancement and specialization of certain location, firms offshore activities in order to cope with shifting environment or to create change ahead of others. As Doh (2005) puts it, offshoring can therefore be seen as the direct application of dynamic capabilities of a firm (Teece and Pisano, 1994).

This seemingly plausible association between offshoring and dynamic capabilities does not only work in one direction. Once implemented, offshoring can also have influence on the firm's capabilities to adapt to and create changes. The core aspect of offshoring is that it involves the geographical disaggregation of a firm's value chain activities (Mudambi, 2008) in order to focus on core activities in the home country and reap the benefits of location advantages of the host country (Kedia and Mukherjee, 2009). This organizational restructuring will have an impact on how firms can utilize and manage resources in times of change in the future.

¹ Earlier drafts of this paper were presented in Druid Academy conference 2013, European Meeting on Applied Evolutionary Economics (EMAE) 2013, MIUR-PRIN Workshop "Production, R&D and Knowledge Offshoring: Economic Analyses and Policy Implications".

This paper studies the relation between some aspects of dynamic capabilities and offshoring implementation in an attempt to unveil more qualitative characteristics of offshoring firms compared to non-offshoring firms. This will contribute to the current literature on offshoring by directing the focus on the actors of offshoring phenomenon rather than the specificities of offshoring implementation such as motivation (Lewin et al., 2009, Maskell et al., 2007, Kedia and Mukherjee, 2009, Kenney et al., 2009), locations (Hahn and Bunyaratavej, 2010, Jensen and Pedersen, 2011, Demirbag and Glaister, 2010, Flores and Aguilera, 2007, Dunning, 2009), and activities offshored (Bardhan, 2006, Ambos and Ambos, 2011, Ficarek and Veloso, 2010, Massini and Miozzo, 2012), which is rather frequently studied in the literature. Understanding ‘who the offshoring firms are’ is valuable because it may help firms in making the strategic decision on offshoring and it also has implications for understanding the economic and social impact that offshoring has on different levels of the economy. A study on the capabilities of offshoring firms will also balance out the scarce literature on the characteristics of offshoring firms by providing insights into more qualitative characteristics compared to the structural or performance-related characteristics of offshoring firms such as size, profitability, and productivity that previously have been touched upon in the literature (Kotabe, 1990, Jabbour, 2010, Jensen and Pedersen, 2012).

Drawing on firm-level survey data from Denmark, the paper investigates how innovative capabilities and adaptive capabilities, as two aspects of dynamic capabilities, are related to offshoring. The two capabilities, by representing the underlying factors that constitute dynamic capabilities, clarify and operationalize the concept of dynamic capabilities that are often found puzzling when applied in the empirical setting (Wang and Ahmed, 2007). In addition, the relevance of *the type of offshored activities* and the *offshore location* in explaining the association will also be investigated. Since the offshoring configuration differs for the different types of activities and the location (Massini and Miozzo, 2012), the capabilities of firms are also expected to be related to offshoring implementation differently depending on this two factors. The conventional structural characteristics such as *size, age, ownership*

structure, and industry will be included in the empirical analysis as controls, which will provide supplementary information on the characteristics of offshoring firms.

The paper is organized as follows. In the next section, hypotheses are developed and presented, discussing the literature on offshoring and resource based view of the firm. The third and fourth sections present the data and the methodology, respectively. The fifth section discusses the results of the empirical analyses, and the discussion and conclusion is derived in the last section.

2.2. OFFSHORING AND THE RESOURCE BASED VIEW OF FIRMS

The resource based view of firms (RBV) suggests that the competitive advantage of firms comes from resource configuration that firms develop with unique, scarce, and inimitable resources (Barney, 1991, Wernerfelt, 1995). In line with this, the concept of dynamic capabilities², defined as the processes of firms to integrate, reconfigure, acquire, and discard resources in accordance to or to create market changes (Eisenhardt and Martin, 2000), has gained popularity in understanding the sources of competitiveness in rapid changing business environments (Teece and Pisano, 1994, Teece et al., 1997).

² In the RBV literature, how resources and capabilities are defined is inconsistent and the distinction between resources and capabilities is also unclear (Kraaijenbrink et al., 2010). For example, while Barney (1991, p.101) defines firm resources as “all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness” and sees capabilities as a sort of resources, Eisenhardt and Martin (2000, p.1107) distinguish capabilities from resources by defining dynamic capabilities as “the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die”. In this paper, capabilities are defined as organisational routines and processes by which firms manage their resources.

From the perspective of RBV, offshoring implementation can be seen as a resource allocation practice through which firms actively reorganize internal and external resources that are present in various locations. Deciding on which operations to relocate and where the activities should be located involves the assessment of the current resources in the home country and the available resources in foreign location, and the implementation is the result of the reconfiguration of these resources. Indeed, offshoring can be considered the direct application of dynamic capabilities (Doh, 2005) in that firms often relocate activities abroad in response to changes in the business environment such as increasing price competition and lack of qualified workers in the home country (Lewin et al., 2009).

It is the intention of this paper to investigate how offshoring is associated with some capabilities of firms that provide competitive advantage in the fast-changing current business environment. As argued above, firms that have implemented offshoring are likely to be the ones with capabilities to adapt to rapid-changing markets and industries, which suggests that there may be positive relation (ex-ante) between offshoring and dynamic capabilities. However, offshoring implementation brings about some internal changes regarding the utilization and management of resources that might in turn affect the firm's dynamic capabilities. This means that there may also be 'ex-post' influence on capabilities following the implementation of offshoring. As it is hard to separate the two mechanisms empirically, the association between offshoring implementation and dynamic capabilities will be discussed, considering both ex-ante and ex-post relation.

The two aspects of dynamic capabilities that are in focus in this paper are 1) innovative capabilities and 2) adaptive capabilities, which are also referred to as innovativeness and responsiveness in the rest of the paper. These two capabilities are also identified by Wang and Ahmed (2007) as the component factors of dynamic capabilities that together explain the mechanisms through which firms manage their resources and achieve marketplace-based competitive advantage. Adaptive capabilities are defined as the ability to

identify and react on market opportunities, which are often measured as a firm's ability to adapt product-market scope according to new opportunities in the market, monitor customer needs and market trend, and to respond to market changes in a speedy manner. Innovative capabilities typically refer to a firm's ability to develop new products, markets, new methods of production, and organizational forms (Schumpeter, 1934). The indicators for this capability could have multiple dimensions such as strategic innovative orientation, behavioral, process, product, and market innovativeness (Wang and Ahmed, 2004). These two types of capabilities are conceptually distinctive in a way that the former emphasizes the ability to react in a 'timely fashion' through flexible resource utilization while the latter underlines the ability to realize new output with regards to products and/or markets.

2.2.1. OFFSHORING AND INNOVATIVENESS

Renewal through innovation makes firms more competitive as they are able to provide something new and unique ahead of competitors when there are changes in technologies, markets, and customer needs. In what follows, it is argued that the strategic drivers behind offshoring implementation and the ability of firms to successfully execute offshoring as organizational renewal has implications for the relation between offshoring and the innovativeness of firms.

The reconfiguration of the activities in the value chain is the major consideration when firms are engaged with outsourcing and offshoring. In the outsourcing literature, it is often argued that firms are able to focus on their core, strategic activities while outsourcing more generic activities (Jacobides and Winter, 2005, Dess et al., 1995). Jacobides and Winter (2005) contend that activities like data handling, customer relation management, information processing and call centers are all generic across different sectors and therefore can be contracted to external suppliers without much harm. Companies can then utilize their resources in the areas where they have competitive advantages.

Similarly, offshoring firms are likely to offshore non-core activities while increasing their commitment to core activities. Kedia and Mukherjee (2009) argue that the disintegration advantage is one of the major rationales behind the firm-level offshoring, meaning that offshoring firms get to reconfigure their value chain and focus on the activities that generate most value for the organization. In relation to the reconfiguration of the activities, what has traditionally been considered as 'core' activities such as engineering, marketing, and R&D are increasingly offshored to foreign location. Contractor et al. (2010) therefore call for more refined definition of core activities and divide the core activities into two groups: "true core activities, i.e. those that are distinctive and crucial for the competitive advantage and often of more architectural nature, and essential activities, i.e. advanced activities that are complementary and important for the competitive advantage" (p. 1247). Although the segmentation of the activities has been fine-tuned following the current pattern of offshoring activities, firms still seem to keep relatively more advanced and valuable activities in the home country. The firms engaged in offshoring therefore have rather clear strategic focus on certain 'true core' activities.

For the firms offshoring with cost reduction motivation, this is likely the logic behind the implementation of offshoring as they can invest more on value creating activities, i.e. innovation activities, based on the cost saving through offshoring. For the firms that are offshoring with knowledge seeking motivation, it is rather clear that these firms have strategic focus on development and innovation. In addition, even the firms that have not specifically focused on development activities prior to offshoring might acknowledge the need to develop new competences and knowledge once they realize that the competences of the foreign workforce can be developed further through offshoring (O'Donnell and Blumentritt, 1999). This can threaten the businesses of the offshoring firms in the long run, if the foreign firms continue to develop their competences and eventually 'catch-up' via offshoring.

The whole process of reconfiguring the value chain activities in relation to the firm's strategic core activities can be regarded as 'organizational innovation,' which is one of the five areas of innovation mentioned by Schumpeter (1934). Although the original idea of 'organizational innovation' by Schumpeter mainly concerns the organization of industry, this concept has later been broadened to "cover processes for gathering, managing and using information, as well as for the implementations of decisions based on such information (Drejer, 2004, p. 558)." Drejer (2004) also argues that the internal organization of a firm can be included in this concept as outdated management form is mentioned by Schumpeter as one of the factors that hinders economic development. Moreover, offshore outsourcing can lead to the reorganization of industry through increasing specialization of the firms. The ability of a firm to successfully implement offshoring therefore demonstrates to some extent the 'innovativeness' of the firm.

H1: The 'innovativeness' of a firm is positively related to the likelihood of the firm to offshore.

2.2.2. OFFSHORING AND RESPONSIVENESS

While being innovative is typically associated with the processes to produce specific outcomes such as new products/services, processes, and organizational structure, 'responsiveness' is a more general capability of an organization that is embedded in the operations. How fast firms can react to changes depends, for example, on the efficiency in decision making procedures or the flexibility in the organizational structure and operations. Wang and Ahmed (2007) also argue that adaptive capability of a firm is exhibited through strategic flexibility (Sanchez, 1995) and that the alignment between resources, organizational form and shifting strategic needs is important.

In the case of offshore outsourcing, flexibility of the operation can be achieved by orchestrating value chain activities with close interaction with suppliers. Fine-slicing firm's activities in the value chain and placing them in dispersed

geographic areas suggested by Mudambi (2008) can increase the flexibility of operation as the firm is able to assess and choose the best suppliers according to the needs at the time being. Certain multinational firms in emerging countries have grown rapidly in the wave of offshoring by providing flexible and specialized talents to the firms in the advanced economies (Manning et al., 2008). In other words, offshore outsourcing helps increase flexibility in resource utilization, and this will enhance the firm's capability to react to changes in the markets.

On the other hand, offshoring can also influence the responsiveness of the firms negatively. The international aspect of offshoring entails increasing distance between the activities remaining at home and the offshored activities abroad, which may interfere with efficient coordination throughout the firm's operation. Increasing geographical distance makes the coordination of activities harder as it influences other types of distance (or proximity), i.e. institutional distance, cognitive distance, organizational distance, cultural distance, and social distance, which in turn hamper efficient communication in general as well as interactive learning and knowledge transfer (Kogut and Singh, 1988, Boschma, 2005, Ambos and Ambos, 2009). As offshored activities often support home-based activities along the value chain, the coordination from the home country across distance is inevitable, and this will increase the difficulties in reacting promptly to the changes in the environment.

Although there are different mechanisms in which offshoring can affect the responsiveness of a firm, it is assumed in this paper that the difficulties in timely management arising from increasing geographical distance overshadows the flexibility of operation that offshoring provides. Therefore, the relation between a firm's likelihood of offshoring and the capability to be responsive is hypothesized as follows.

H2a: The 'responsiveness' of a firm is negatively related to the likelihood of the firm to offshore

H2b: The geographical distance between the home country and the offshore location matters for the relation between offshoring and the 'responsiveness' of a firm.

2.2.3. THE IMPLICATIONS OF THE TYPES OF OFFSHORED ACTIVITIES

The offshoring of manufacturing has long been documented in the international business (IB) literature (see for example, Hymer, 1976, Vernon, 1966). Since 1960s, locational advantages like rich natural resources, low labour costs, and market access have been driving the foreign direct investment (FDI) of multinational enterprises (MNEs). What is relatively new in offshoring is that firms started to offshore not only manufacturing functions but also service/administrative functions (Massini and Miozzo, 2012), which has been traditionally considered 'non-tradable' in the international setting. Since firms started to offshore service/administrative functions, some studies have been conducted focusing on the specificities of service offshoring (Liu et al., 2011, Kenney et al., 2009, Bunyaratavej et al., 2011, Hahn et al., 2011). Kenney et al. (2009) pointed out some distinctive features of offshoring of administrative and technical services. Firstly, the offshored activities are almost non-physical and transferred mainly through telecommunication channels. Secondly, for some companies, the scale of offshoring of these activities has grown to match the percentage of global white collar workers. Lastly, the offshored activities are mostly conducted by highly-educated persons (college-graduates). These features suggest the reconceptualization of offshoring to include more diversified forms of offshoring operations.

An often highlighted issue in the context of service offshoring is the offshoring of R&D. The previous studies on the internationalization of R&D by MNEs found that it is driven either by the motivation to exploit the existing technological competences in the home country (Kuemmerle, 1999, Bas and Sierra, 2002) or by the motivation to seek new competences in foreign locations (Cantwell and Janne, 1999, Manning et al., 2008). In the context of

offshoring, the driver for the internationalization of R&D is the replacement of the current competences at home with the competences abroad. The perception that R&D is the core activity of a firm with strategic importance, which should be kept central in the firm, is therefore being challenged.

In addition to the focus on different functions to be offshored, some studies began to distinguish offshored activities in another way that cut across the different functional categorization. For example, Jensen and Pedersen (2011) differentiate advance functions from standard functions, suggesting that the simple categorization of manufacturing and service is not able to capture different offshoring patterns. This reflects that offshoring today encompasses a wide variety of activities from standardized manufacturing activities to advanced development activities.

As argued above, the positive association between offshoring and innovativeness comes from the strategic focus of offshoring firms on 'core' activities. Similar to the distinction between advanced- and standard activities, this division cut across the functional categorization since what constitutes 'core' for a firm may not depend on the functional division. For example, within production activities, there might be activities that are more core than others, and the same goes for service/administrative functions. As long as the division between core and non-core activities is concerned in defining the relation between innovativeness and offshoring, the categorization of activities by functions does not seem to make a difference for this relation. Therefore, it is assumed that the relation in the first hypothesis holds regardless of the functions that are offshored.

H3: The positive relation between the 'innovativeness' and the likelihood of the firms to offshore applies to all offshoring firms regardless of the functional division of the activities that are relocated.

The distinctive features of the offshoring of service/administrative activities mentioned earlier suggest that responsiveness might be less relevant for the firms relocating these functions. The fact that service/administrative activities are almost non-physical and easily transferable via telecommunications

implies that the outcome of the activity can be codified, making the transfer over distance easier and faster (Malmberg and Maskell, 2006). On the other hand, the offshoring of production and development activities requires either physical transfer or personal interaction for transferring tacit knowledge.

H4: The negative relation between the 'responsiveness' and the likelihood of the firms to offshore applies to the firms that relocated production and development activities, but does not necessarily apply to the firms that relocated service/administrative activities.

2.3. DATA

The analysis in this paper is based on the GONe (Global Operation Networks) survey conducted in Denmark in 2011. In the survey, firms in diverse sectors were asked to answer questions regarding their offshoring experience anonymously. The survey was sent out to 2900 Danish firms, 675 of which came back with responses, resulting in 23 percent response rate. After sorting out the cases with missing values for the variables used in the analysis, the base sample consists of 559 firms with 50 or more employees in various sectors (see Table 2-1)³.

The survey asks specifically about the relocation of functions from Denmark to foreign countries, allowing more precise measure for offshoring activities compared to other data sources commonly used in offshoring research (e.g. FDI data). The questionnaire was roughly divided into three parts. The first part deals with general company descriptions such as the number of employees, the number of countries that the company is present in, and the

³ The sample is overrepresented by large firms in manufacturing, and ICT sector. The descriptive findings should be interpreted with caution as our sample is biased towards the firms that have offshored, who are more likely to find the survey interesting and relevant. In the econometric models, the size and the industry are included as control variables. Another thing to note regarding the sample is that not all firms answered all the questions in the questionnaire, which means that the descriptive statistics in this section and some econometric models do not utilise the full base sample of 559 firms.

ownership. The second part inquires about the overall offshoring experience including the first year of offshoring, the first country of destination, governance mode, and the effects of offshoring among others. In the last part of the survey, the respondents were asked to give more detailed information on the last implementation of offshoring. Besides the same questions asked for the overall experience, questions on the types of functions, unexpected challenges, and the coordination mechanisms for offshored functions were added.

Table 2-1 Sample descriptive statistics

Size (Domestic employees)	N	%
Medium 50-99	265	47.4
Large 100+	294	52.6
Total	559	100.0
Industry	N	%
Manufacturing	161	28.8
Trade and Transport	154	27.6
ICT & financial services	84	15.0
Other industries	160	28.6
Total	559	100.0
Offshoring	N	%
No	339	60.6
Yes	220	39.4
Total	559	100

What distinguishes this dataset from other offshoring data is the detailed information on the qualitative characteristics of the firm and the offshoring activities. The respondents rated the firm and the offshored activities in terms of some qualitative characteristics (see Table 2-2 for the characteristics of the

offshored activities), which enhances the understanding of the firms and the functions involved in offshoring.

Table 2-2 Characteristics of the offshored activities

	N	Min	Max	Mean	Std.Dev
Simple and routine	201	1	7	4.51	1.88
Labour intensive	202	1	7	5.14	1.72
Independence of company's other activities	201	1	7	4.01	1.94
Integrated with the company's other activities	203	1	7	4.71	1.67
Standardized	202	1	7	4.91	1.59
Creative and innovative	202	1	7	3.03	1.70
Requires high knowledge content	202	1	7	3.72	1.76

2.3.1. OFFSHORING PATTERNS OF DANISH FIRMS

Activities offshored

According to the survey, 39 percent of the respondents in our sample have offshored at least one function abroad in the past. A large share of these firms (about 85-90% depending on the question) gave more detailed information about their last implementation. In this part of the survey, the offshored activities were initially divided into three categories: production, service/administration (will be referred to as service), and design/development (will be referred to as development). Then, the three types of activities were classified into sub-functions as can be seen in the table 2-3. The production activities are the most commonly offshored activities among Danish firms as more than half of the firms offshored production in their last implementation. Among the detailed sub-functions, manufacture accounted for more than 70 percent of the cases. Regarding service activities, more than one fourth of the firms relocated these functions in their last

offshoring implementation. The implementation of sub-functions of service is more evenly distributed than that of production sub-functions, with IT services being the most popular service sub-function to be offshored. In spite of the recent attention towards ‘innovation offshoring’ in the literature (Couto et al., 2007), development (innovative) functions are not offshored as much as other functions. Among development sub-functions, software development is the dominant sub-function to be offshored, accounting for almost 60 percent of the development function offshore.

Table 2-3 Activities offshored in the last implementation

Activity offshored	N	%
Production	107	53.2
Production technology	4	3.7
Production preparation	2	1.9
Manufacture	75	70.1
Assembly	13	12.1
Test and quality management	1	0.9
Maintenance	2	1.9
Other	10	9.3
Service/Administration	55	27.3
Finance/Accounting	10	17.9
Marketing and sales	7	12.5
IT	12	21.4
Call center/Customer service	3	5.4
Procurement and supply management	3	5.4
Logistics	8	14.3
After sale support	2	3.6
Other	10	17.9
Design/Development	39	19.4
Product design	4	10.3
Product development	8	20.5
Software development	23	59
Other	4	10.3
Total	201	100.0

Offshore location

Popular offshoring locations for Danish firms do not differ from the conventional destination countries mentioned in the literature (Massini and Miozzo, 2012). The three most popular countries are China and India, Poland, followed by Germany (see table 2-4). Besides these four countries, Thailand, USA, two east European countries – Ukraine and Czech Republic– and two neighboring countries – Sweden and Norway – are the countries that often host offshoring units of Danish firms.

Table 2-4 Offshoring destination

Regional distribution	N	%	Popular countries	N	%
Asia	55	39.9	China	22	15.8
East Europe	40	29.0	India	14	10.1
Rest of Europe	30	21.7	Poland	14	10.1
America/Middle East	13	9.4	Germany	12	8.6
Total	138	100.0	Thailand	8	5.8
Location	N	%			
Nearshore	115	54.5			
Offshore	96	45.5			
Total	211	100			

When dividing the country distribution by activities, a clear division is observed between production and service activities. While China is dominant in hosting production activities, it is not in the fifth most popular countries for service activities. For service functions, India and neighboring European countries are the most popular ones. It seems that geographical proximity is an important factor for location choices for service offshoring as the four countries except India are European countries. Germany and Norway, despite their relative high wage levels, ranked high as service offshoring location. On the other hand, all of the 5 most popular destination locations for development

activities are developing economies, which implies that the offshoring of innovative activities is primarily driven by cost advantage rather than the need to get access to specialized labour. The regional distribution shows that Asia and Eastern Europe are the most popular regions for Danish firms. Distinguishing the destination countries in terms of their distance to the home country, it seems that Danish firms have a slight preference to relocation to nearshore countries, which is defined in this article as the countries in the European continent.

Ownership and establishment of the offshored unit

Among the offshoring firms, about 60% of the firms offshored to their own subsidiary abroad whereas 31% offshored to independent suppliers (see table 2-5). This shows that captive offshoring is more common than offshore outsourcing when Danish companies relocate their functions. Only a small fraction of the firms offshored to joint venture. About 68% of the firms that offshored to subsidiary have moved the function to already existing units abroad, which implies that the previous international presence of the firm might influence offshoring choice in relation to location.

Table 2-5 Ownership of the offshored unit

	Newly established unit	Existing unit	Do not know	Total
Subsidiary	34	75	1	110
External supplier	3	54	1	58
Joint venture	5	12	0	17
Total	42	141	2	185

2.4. THE ECONOMETRIC MODEL AND VARIABLES

To enhance the understanding of offshoring firms' capabilities compared to non-offshoring firms, logistic regression models are estimated. The first model has the general offshoring experience as dependent variable. If the firm had

offshored at least one function abroad in the past, the variable takes the value of 1, and otherwise, the value of 0. This variable is obtained from the GONe survey, in which the firms answered whether or not the firm has relocated functions from Denmark to foreign countries. This is a direct measure for offshoring experience, following the definition of offshoring in this paper.

The second and third models have dependent variables that distinguish between 'near'shore and 'off'shore location. The second model includes 'near'shore binary variable, which takes the value of 0 in the case of non-offshoring firms and the value of 1 if the firm has offshored to European countries. The third model has 'off'shore binary variable, which assigns 0 for non-offshoring firms and 1 for firms that are offshoring to the countries outside Europe.

Furthermore, the distinction between the three types of activities is made, and the additional dichotomous dependent variables are constructed for production-, service-, and development offshoring, respectively. For the firms that have relocated the specific activity, the dependent variable for that function will take the value of 1, while the firms that have not offshored will take the value of 0. Firms that are offshoring two other types of activities will be treated as missing value and will not be included in the analysis.

The two explanatory variables, *Innovativeness (Innovative capability)* and *Responsiveness (Adaptive capability)*, represent the two types of dynamic capabilities of a firm. These variables are taken from the GONe survey. The two variables are constructed from the following 7-point Likert-type items in the questionnaire, indicating to what extent the firm is characterized by certain features. *Innovativeness* is the sum of the firm's rating on the two statements: 1) Use of the newest technology on a regular basis, and 2) Renewal through development and innovation. *Responsiveness* variable is constructed based on

the following two statements: 1) Fast reaction to changes, and 2) Adaptability of the products and services.⁴

Furthermore, four additional independent variables are included in the regression as control variables. The first control variable indicates which *industries* the firms belong to. The firms in the survey are classified into 4 industries: 1) Manufacturing, 2) Trade and transport, 3) ICT and financial services, and 4) Other industries. This information is obtained from the public business register data. Since production activities have been the most common function to offshore historically, manufacturing firms are expected to have relocated functions to foreign countries more than firms in the rest of the industries. Service activities have been assumed to be less ‘tradable’ than manufacturing activities, but recently this view has changed along with the technological advances that allow easy transfer of service goods. Yet, service industries in which human interaction is crucial are less likely to offshore (Blinder, 2006). Similarly, industries with service and products that are bound to certain geographic locations are less likely to offshore. Regarding the activities offshored, it is expected that the industry is an important factor determining which activities are being relocated. Firms in manufacturing industry will be mostly active in relocating production activities, while development activities are most likely to be offshored by ICT related firms. As service activities are rather generic in the nature, it is not expected that specific industries are involved in this type of functions.

⁴ Using Likert-scale as interval variable has been criticised by some scholars (see for example, Jamieson, 2004). Carifio and Perla (2007) asserted that one should distinguish between using single Likert-type item and using Likert-scale, which is constructed with inter-related set of items, in parametric analysis. They argue that, as long as one uses 5 to 7 point Likert response format and use the results at the scale level, it is acceptable to use parametric analysis techniques with the Likert-type items. Although the optimal number of items they suggest in order to construct Likert-scale is 6 to 8, this is not possible with the design of the GONE survey. It is argued in this paper that the ‘two-item’ Likert-scale utilised in the regression models will at least be a better construct than a single Likert-type item. Moreover, it is accepted in the International Business literature to use single Likert-type items in regression analyses as there have been some empirical studies on offshoring utilising survey data and single Likert-type items (Lewin et al., 2009, Larsen et al, 2013).

The next control variable is a binary variable indicating the corporation type. The firms in the survey are divided into two categories in terms of corporate type: 1) Part of a business group, and 2) Not part of a business group. The firms that are not part of a group are expected to be less likely to offshore compared to the firms that are part of a group. This is because business groups are well-established firms that are more likely to have a concrete strategy for internationalization, and the firms are likely to be affected by an overall offshoring strategy of a group that they are part of.

The third control variable, *Firm size*, is the logarithm of the number of employees that company has worldwide in 2011. Firm's employment worldwide is used instead of domestic employment since the firms that have offshored will inevitably have less domestic employees after the implementation of offshoring and the employment worldwide is a good indicator for the total size of the work force⁵. The number of employees worldwide is acquired from the GONe survey. Firm size might have different underlying effects for the likelihood of offshoring of a firm according to the internationalization literature and the outsourcing literature⁶. An empirical study on offshoring indicated that size is not related to the propensity to offshore (Jensen and Pedersen, 2007). However, offshoring as it is defined in the paper requires that the firm has a considerable employee base before it can

⁵ If a firm has been engaged in offshore outsourcing, the number of employees worldwide could have decreased after the implementation of offshoring. As the governance mode of offshoring has an influence on the number of employees, two separate analyses, one for captive offshoring and one for offshore outsourcing, have been conducted to check the effect of the governance mode on this relationship. Although less significant, the worldwide employment still had the same relation to the likelihood of a firm to offshore outsource, as to the likelihood of a firm to offshore internally.

⁶ For example, researchers do not agree on how resource constraints of small- and medium-sized enterprises affect the likelihood of the internationalisation of these firms (see for example, Buckley, 1989, Coviello and McAuley, 1999, Calof, 1994 for different views on this matter). The literature on core competence would suggest that small firms are more likely to offshore as they can use scarce resource to the core activities while outsourcing other activities. On the other hand, large firms are also more likely to have higher wage, which is related to the likelihood of outsourcing (Girma and Görg, 2004).

relocate activities abroad, and therefore it is expected that the firm size is positively related to the propensity of a firm to offshore.

Firm age is the logarithm of the years that the firm has existed since the establishment, and it is obtained from the company register database. Considering the unique characteristic of offshoring –replication of activities–, the firm needs to be ‘established’ in a sense that it possesses some routines and processes that can be considered for relocation. Offshoring entails the decision of whether the firm wants to keep the current activities at home or move these to foreign locations. Following transaction cost theory (Coase, 1937, Williamson, 1981), the firm will have to decide which option is more economically beneficial for the organization. In order to make such a decision, the firm needs to have established routine and processes that they can consider for offshoring. As establishing routines and process will take time, it is expected in this paper that firm age is positively related to the likelihood of offshoring

2.5. RESULTS

The correlation matrix of the explanatory variables is shown in table 2-6. The correlation coefficients show that most correlations are low. All the independent variables are checked for multicollinearity, and there was no sign for it. Table 2-7 and 2-8 summarizes the results of the logistic regression analyses. Model 1 specifies the model with overall offshoring experience as the dependent variable. The base model marked with ‘a’ includes the control variables on industry, ownership, size, and age. The ‘b’ model includes the entire variable set. The model 2 and 3 have the dependent variable that is distinguished by whether or not the offshoring location is located in the same continent or not (nearshore and offshore). Model 4-6 distinguish each type of offshored activity. Just like the model 1, the ‘a’ model includes the control variables, while ‘b’ model includes all the variables. All models are significant at the 0.001 level.

Table 2-6 Correlation matrix

	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9
1. Innovative	9.608	2.356	2	14	1								
2. Responsive	11.114	2.085	2	14	0.256	1.000							
3. Manufacturing	0.288	0.453	0	1	0.057	0.033	1						
4. Trade&Transp.	0.275	0.447	0	1	-0.093	-0.022	-0.392	1					
5. ICT & Finance	0.150	0.358	0	1	0.074	-0.052	-0.268	-0.259	1				
6. Other industry	0.286	0.452	0	1	-0.024	0.030	-0.403	-0.391	-0.266	1			
7. Group	0.676	0.468	0	1	-0.016	-0.010	0.077	0.050	0.056	-0.171	1		
8. Size	5.710	1.962	0.693	13.190	0.095	-0.120	-0.038	0.006	0.179	-0.109	0.339	1	
9. Age	3.286	0.972	0.000	5.958	-0.054	-0.012	0.240	0.071	0.023	-0.328	0.107	0.139	1

Bold coefficients are significant at 0.05 level

Table 2-7 Logistic regression, dependent variable: Offshoring, Near shore offshoring and Offshore offshoring

<i>Explanatory variables</i>	Model 1 - Offshoring overall		Model 2 - 'Near'shore		Model 3 - 'Off'shore	
	a	b	a	b	a	b
Innovativeness		0.099 **		0.101 *		0.125 **
Responsiveness		-0.119 **		-0.067		-0.210 ***
<i>Control variables</i>						
Manufacturing (ref)						
Trade and transport	-1.340 ***	-1.312 ***	-1.369 ***	-1.369 ***	-1.502 ***	-1.479 ***
ICT & Financial S	-0.907 ***	0.954 ***	-1.045 ***	-1.071 ***	-0.710 *	-0.809 **
Other industries	-1.375 ***	-1.347 ***	-1.687 ***	-1.677 ***	-1.152 ***	-1.061 ***
Part of a group	0.819 ***	0.881 ***	0.494 *	0.549 *	1.542 ***	1.555 ***
Size	0.325 ***	0.301 ***	0.297 ***	0.278 ***	0.292 ***	0.260 ***
Age	0.188 *	0.114 *	0.105	0.122	0.326 **	0.366 **
Constant	-4.035 ***	-3.622 ***	-4.189 ***	-4.407 ***	-5.582 ***	-4.380 ***
Log likelihood	-309.74	-305.54	-218.92	-217.04	-183.21	-177.59
Pseudo R square	0.173	0.185	0.148	0.155	0.202	0.227
N	559	559	454	454	435	435

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

Table 2-8 Logistic regression, dependent variable: Production offshoring, Service offshoring, and Development offshoring

	Model 4 - Production		Model 5 - Service		Model 6 - Development	
	a	b	a	b	a	b
<i>Explanatory variables</i>						
Innovativeness		0.087		0.148 *		0.206 **
Responsiveness		-0.140 **		-0.048		-0.287 ***
<i>Control variables</i>						
Manufacturing (ref)						
Trade and transport	-1.903 ***	-1.939 ***	-0.172	-0.088	-1.600 **	-1.635 **
ICT & Financial S	-2.129 ***	-2.172 ***	0.076	0.089	0.897 *	0.869 *
Other industries	-2.636 ***	-2.645 ***	0.055	0.155	-0.425	-0.328
Part of a group	0.552 *	0.567 *	1.179 **	1.269 ***	1.497 ***	1.658 ***
Size	0.215 ***	0.198 ***	0.371 ***	0.348 ***	0.252 ***	0.202 **
Age	0.147	0.174	0.226	0.245	0.378 *	0.450 **
Constant	-4.602 ***	-3.869 ***	-5.618 ***	-6.476 ***	-6.277 ***	-5.198 ***
Log likelihood	-190.41	-187.90	-131.35	-129.44	-98.01	-92.54
Pseudo R square	0.225	0.235	0.175	0.187	0.219	0.263
N	446	446	394	394	378	378

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

The results show that there is predicted relation between the investigated capabilities and the likelihood of a firm to offshore. First of all, as firms have better innovative capabilities, they are more likely to offshore in general. The coefficient for the *innovativeness* variable in the model 1 is positive and significant at the 5% level, confirming the hypothesis 1. However, when it comes to the association of this capability with the propensity to offshore each of the three activities, the results are not the same as they are predicted. *Innovativeness* has a positive relation to the offshoring of service and development at the 10% and 5% level respectively, and not to the offshoring of production. Therefore, hypothesis 3 cannot be supported.

Regarding the *responsiveness*, both hypothesis 2a and 2b can be confirmed. The coefficient for the overall offshoring experience is negative and significant at 5% level. Comparing the coefficients for the *responsiveness* variable in model 2 and 3, although they both show negative sign as in model 1, the coefficient is only significant in model 3 at the 1% level. As the coefficient in model 2 is not significant, offshoring to nearby countries does not have negative association with responsiveness like offshoring to distant countries does. These results suggest that the distance to offshoring implementation makes difference in this relation, and therefore hypothesis 2b is confirmed.

Moving onto model 4-6, the coefficients for production offshoring and development offshoring are all negative and significant at the 5% and 1% levels, while there is no significant result for service offshoring. Thus, firms that are associated with low adaptive capabilities will be more likely to have offshored production or development activities, but there is no evidence that this relation exist for offshoring of service functions. Therefore, hypothesis 4 is confirmed.

The coefficients for the control variables indicating *industry* and *ownership* structure are found to be significant in most of the models, with the predicted sign. In general, firms in the manufacturing industry are more likely to offshore than firms in other industries in Denmark. A strong effect is found for the likelihood of production offshoring by manufacturing firms, while there is no

significant effect for service offshoring by the firms in this industry. For development offshoring, firms in ICT and Financial service industry were more likely to offshore than firms in the manufacturing sector. Regarding the *ownership* structure, firms that belong to a business group are more likely to offshore than the firms that are not part of a group. The coefficients are positive and significant at either 1% or 5 % level in almost all models. The next control variables, *firm size* is strongly associated with the likelihood of offshoring in the predicted manner. Bigger firms are more likely to have offshored at least one function in the past. *Age* seems to be associated with the likelihood of offshoring in the case of development offshoring and offshoring to far-away destinations.

2.6. DISCUSSION AND CONCLUSION

The purpose of this study is to reveal how innovative capabilities and adaptive capabilities, as capabilities constituting dynamic capabilities, are associated with offshoring implementation. The paper argues that offshoring, which can be seen as the realization of a firm's dynamic capabilities, may also have consequences for the capabilities that together reflect a firm's ability to manage resources in response to changes in the industry and markets. Taking into account both 'ex-ante' and 'ex-post' association of offshoring and these capabilities, the hypotheses are formulated on the relation between offshoring implementation and innovativeness and responsiveness. The hypotheses are tested with Danish offshoring survey data in logistic regression models by comparing offshoring and non-offshoring firms with regard to the two capabilities. This paper also investigates the implications of the distance between the home country and offshoring location and the type of activities offshored in this relation.

The results confirm that *innovative capabilities* and *adaptive capabilities* are indeed related to the firm's likelihood of being engaged in offshoring. Innovativeness is positively related to the propensity of a firm to offshore

while responsiveness is negatively related. It seems that these two capabilities, together with the conventional structural characteristics such as industry, ownership structure, size, and age, contribute to explaining what kinds of firms are more prone to relocate activities abroad.

Innovative capability is an interesting topic to discuss in relation to offshoring as innovation is often regarded as a way to stay competitive in the current era of globalization. Being able to offshore means that there are suppliers or subsidiaries in other locations that can deliver the similar products and services cheaper. Therefore, in order to be able to compete, the firms need to develop better products and services by focusing on innovation. The rationale behind offshoring in developed countries has been that the threat of the 'foreign firms (workers)' can be overcome as long as domestic firms continue to innovate. Scholars advocating the positive effects of offshoring argue that innovation can create high level, high paying jobs and therefore replace the offshored jobs. Cuoto et al. (2006, p. 12) state that "the United States can groom future innovators in other areas where it retains its advantage- where physical and/or cultural proximity to the end customer is important (e.g. content creation in digital entertainment)."

The fact that innovative firms are more likely to offshore might indicate that the firms are offshoring less advanced tasks abroad while keeping the complex innovation activities in the home country. However, if the more innovative firms are offshoring innovation-related activities (Lewin et al., 2009), it may in the long run threaten the competitive advantage of these firms, as the firms in the offshore locations get the chance to upgrade their competences through 'learning' (Iammarino et al., 2008). One of the findings in this paper shows that the more firms are equipped with innovative capabilities, the more likely that they offshore development functions. Although how advanced and 'core' the development function are in the company can vary, the offshoring of development functions might lead to unfavorable situation for the firms in the offshoring nations. The more detailed investigation of offshoring by innovative firms will shed light on how big a threat offshoring will be as many believe so.

Being able to react fast seems to be an area that the offshoring firms either are less focused on or are not able to cope with in the complex setting of offshoring. The finding shows that the more reactive the firms are, the less likely they are to relocate activities abroad. The relationship is stronger for the firms offshoring development activities than the firms offshoring production activities. On the one hand, this might indicate that the firms that are offshoring development functions are the ones with long-term development strategies, which do not subject to small scale changes in the market or in the industry. On the other hand, this could mean that the rather complex nature of development activities restricts the offshoring firm's ability to react fast as the relocation complicates the operation of development activity even more.

Dividing the offshoring implementation into 'near'shore offshoring and 'off'shore offshoring, this paper also studies the implication of distance between home operations and offshored operations for adaptive capabilities. The results suggest that the negative relation between adaptive capabilities and offshoring exists for offshoring implementation in far-away location ('off'shore implementation), but not for offshoring to near-by countries. This result is in line with previous studies showing that the geographical distance hampers communication and interactive learning (Kogut and Singh, 1988, Boschma, 2005, Ambos and Ambos, 2009), which can deteriorate the firm's capability to react immediately to changes in the environment and coordinate activities accordingly.

The finding on the association of firm size and age to the likelihood of offshoring shows that offshoring is likely to be conducted when the firm is rather 'established.' This contrasts to the findings in the recent internationalization literature focusing on 'Born global' firms (McDougal et al., 1994; Knight and Cavusgil, 2004). These firms are found to be engaged in international activities from the very early years of their establishment. The explanation could be that the international activities discussed in this stream of literature are mainly related to export and FDI, which are of quite different character than offshoring. As argued earlier, offshoring brings about the

decision on where to locate the activities according to the transaction cost, and to make the decision, the firm needs to have established routines and processes in their activities. Moreover, the transaction costs for offshoring are perhaps smaller once the activity to be offshored is standardized and routinized, which takes time to develop.

Another interesting point that can be derived from the findings is that, for firms offshoring certain type of functions, the relation is stronger than in the case of offshoring of other types of activities. Development offshoring is more highly characterized by the two capabilities at investigation than service offshoring.

The above findings have some implications for firms making decision on offshoring. As there is negative relation between offshoring and responsiveness of a firm, firms in rapid-changing industries may need to pay more attention in designing offshoring implementation in such a way that will not increase the complexity in coordinating resource in keeping up with the changes and development in the industry and the markets. The distance to the offshoring destination and the type of activities can be important aspects to consider in this regard.

From the macro perspective, the findings in this paper have implications for the fear of job destruction in the home country. The job destruction by offshoring might not be as serious as it is perceived to be since cost savings can be reinvested to create jobs elsewhere (Agrawal and Farrell, 2003). As offshoring firms are likely to have better innovative capabilities, bigger, and older, they may have the ability to invest the resources gained from the cost advantage of offshoring in their 'core competences' or in new entrepreneurial projects, and thus contribute to create jobs through offshoring.

Considering that offshoring is inescapable for some firms to be competitive in the global market, the short-term direct job destruction can be considered a strategic 'loss.' What the offshoring nations can then do is to prepare to re-educate the workers in advance so that they can have smooth transition to a

new job. For example, the finding in this study showed that firms in the manufacturing sector are more likely to offshore than other industries. The type of the skills needed in this industry can be transformed into the competences that are required in other industries that are less likely to offshore.

The limitation of this study points to some potential ways to enhance the understanding of the relation between dynamic capabilities and offshoring. With the current data and the methodology, it is not possible to reveal 'ex-post' influence of offshoring on the investigated capabilities. As the literature on the consequences of offshoring on the firm level is still scarce, attempt to collect data more purposefully to study firm-level effects of offshoring will be valuable. Furthermore, more systematic way to measure innovative and adaptive capabilities than to depend on the self-reported characteristics of firms in survey data will provide more concrete results.

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CHAPTER 3. CODIFIED KNOWLEDGE TRANSFER IN OFFSHORING FIRMS¹

A study on the association between the attributes of offshoring and the level of codification

3.1. INTRODUCTION

In 2004, the LEGO group (LEGO) decided to offshore outsource the majority of its production activities, which have mainly been conducted in Denmark and the U.S., to low-cost countries like Hungary, Czech Republic, and Mexico. The company wanted to improve its supply-chain that was found to be ineffective and inflexible. LEGO chose Flextronics as the main supplier who would be in charge of the offshoring process and the production activities in these new locations. During the offshoring process, the company realized that much of its production knowledge has not been codified and consequently started an intensive codification process, which involved documentation and standardization. However, after four years of the offshoring journey, LEGO made a decision to in-source the activities from Flextronics and announced that the company expects to increase its production capacity in Denmark. LEGO explained that the production of LEGO blocks requires some unique competences and that the company has gained much 'ingrained' knowledge after 50 years of its experience in production. It simply took much more time to train the new employees than the company has expected. (For a detailed description of LEGO's offshoring, see Larsen et al., 2010)

This case shows that the codification of knowledge related to the relocated operations is critical for the success of offshoring. When the firms disaggregate value chain activities, they need to transfer knowledge from the home unit –

¹ An earlier draft of this paper was presented in EU-SPRI Early Career Researcher Conference 2013.

where the activity was originally conducted – to offshored unit – where the activity is being relocated – in order to replicate the original operation successfully. Beyond this initial stage of transferring operation, more reciprocal knowledge transfer takes place as knowledge starts to be created in the offshored unit as well.

The ubiquitous character of codified knowledge makes the transfer of knowledge over geographical distance less challenging when compared to the transfer of tacit knowledge that typically requires some personal interaction and ‘learning’ by doing (Balconi et al., 2007). Therefore, knowledge transfer in the international setting tends to depend highly on the mechanisms that can transmit the knowledge in the codified form. This is also true for offshoring firms. In the context of offshoring, the codifiability of knowledge is often discussed as one of the attributes of firm activity that determines its offshorability (Leamer and Storper, 2001, Welsum and Reif, 2005). The easier it is to codify the knowledge related to a certain activity, the higher the likelihood of offshoring of the activity is (Contractor et al., 2010). While the importance of the codification of knowledge has gained attention in relation to offshorability, what is less studied empirically in the literature is how firms transfer knowledge in the codified form once they are engaged in the relocation of the activities. Although firms are likely to offshore activities that are easily codifiable and transferable, how much effort firms actually put into codification in the implementation may vary depending on the specific setting of offshoring.

It is the intention of this paper to investigate how different configuration of offshoring implementation is related to the level of codification in managing offshored operations. In recent years, the patterns of offshoring have diversified greatly in terms of the type of activities that are offshored, the strategic intent behind offshoring, and the offshore location (Contractor et al., 2010). For example, service activities that were once considered untradeable are increasingly being relocated and so are the activities with high knowledge content. The paper argues that the level of codification will vary depending on

these attributes of offshoring implementation and presents empirical evidence to support this. The results from the analysis on the Danish offshoring survey data show that the characteristic of the relocated activity and the motive for offshoring are associated with codification effort by firms, while the location factors are not found to be associated with codification. The factors that call for effective ‘replication’ of operations seem to be positively related to the level of codification in offshoring implementation.

This study contributes to the literature in the following ways. Firstly, it provides empirical evidence that certain aspects of offshoring are related to how much codification is involved in offshoring implementation and thereby enhances the understanding of offshoring practice as a process of managing knowledge. Secondly, this study contributes to the literature on international knowledge transfer by bringing in the context of offshoring in the discussion. Offshoring shares some similarities and differences with the operations of multinational corporations (MNCs), which has been the primary empirical setting for studying international knowledge transfer and therefore can provide an insight that complement the previous findings on MNCs. Especially, Denmark as an empirical setting makes it possible to study knowledge transfer in ‘average’ firms in a small open economy, as opposed to large MNCs from bigger economies such as the U.S.

The paper is structured as follows. In the next section, theoretical discussion on offshoring and knowledge transfer will be provided. The hypotheses are introduced in the third section, which is followed by the description of the data and methodology. The results of the empirical analysis are presented in the sixth section, and the very last section discusses the results and concludes.

3.2. OFFSHORING AND KNOWLEDGE TRANSFER

Knowledge transfer is an important matter for offshoring firms. The relocation of the activities means that the firms need to replicate a part of the existing operation and make it function in the foreign location as well as it did in the

home country. In the context of replication, knowledge transfer is treated as a process of recreating ambiguously-defined routines rather than as one-time event of transmitting a certain body of clearly-defined knowledge as knowledge transfer is normally conceptualized (Winter and Szulanski, 2001). As such, offshoring requires intensive, continuous knowledge transfer from home country to offshore location in the initial stage of implementation. However, once the replication is completed and the offshored unit becomes routinized in the operation, the knowledge transfer becomes more reciprocal. The offshored unit begins to create and accumulate knowledge from its own operation, from which the home unit can benefit in coordinating and improving the overall value chain activities. The recent offshoring trend also shows that firms are increasingly fine-slicing their activities in the value chain and relocating them in geographically dispersed locations according to the competitive advantages offered by these locations (Mudambi, 2008, Buckley, 2011). One of these competitive advantages could be specialized labor and knowledge within a certain field, like the IT competences of India. As knowledge seeking motive is appealing to firms more than ever (Lewin et al., 2009), the knowledge transfer from the offshore location to the headquarters can be considered as crucial and important as the knowledge transfer from the headquarters to offshored unit.

While knowledge transfer is critical for offshoring firms as argued above, disaggregating knowledge from streamlined chain of firm activities is a big challenge for the firms (Larsen et al., 2010), not to mention the difficulties in transferring the 'disaggregated' knowledge over geographical distance. Knowledge transfer is indeed often mentioned as one of the factors increasing the "hidden costs" of offshoring (Dibbern et al., 2008, Larsen et al., 2013). The complications of knowledge transfer over distance has not only been discussed in organizational and international business studies (e.g. Goodall and Roberts, 2003, Hansen and Løvås, 2004, Ambos and Ambos, 2009), but also in the literature of economic geography (e.g. Howells, 2002, Bathelt et al., 2004). In these lines of literature, it is well acknowledged that the 'tacitness' of knowledge makes the transfer over geographical distance costly, if not

impossible (Teece, 1977, Galbraith, 1990). These issues direct attention to the codification of knowledge as a mechanism to identify the knowledge to be transferred and to actually transmit the knowledge in the process of relocation. In the following paragraphs, the concept of codified knowledge is discussed in order to provide the theoretical background for the conceptualization of codification in this paper.

Since Polanyi's seminal work on knowledge (Polanyi, 1962, 1966), different interpretation and use of tacit and codified (explicit) aspect have found place in the field of management and economics. Some consider codified knowledge as articulated knowledge (Cowan et al., 2000), while others argue that codified knowledge is more than articulated knowledge. Balconi et al. (2007) assert that codification is different from articulation in that it requires that this knowledge is understood by other subjects as it was meant to be. In their explanation, codification has two important characteristics, namely intersubjectivity and completeness. Intersubjectivity means that the understanding of codified knowledge involves cultural and linguistic specificity. Completeness of knowledge means that "each component can be translated into a linguistic representation that successfully reflects the same meaning as the original (Balconi et al., 2007, p. 832)." They refuse the dichotomous use of codification term, as 'absolute codification' is impossible considering intersubjectivity and completeness. This is similar to how Johnson et al. (2002) perceive knowledge as they believe that it is seldom that "a body of knowledge can be completely transformed into codified form without losing some of its original characteristics (p. 246)."

Following this tradition of understanding knowledge and codification², this paper also posits that knowledge cannot be fully codified and will always have some tacit element in it. In the context of knowledge transfer, knowledge will

² A different point of view on codified knowledge by 'the proponents of codification' (Nightingale, 2003) postulates that tacit knowledge is not so useful and needed as it can be transformed into codified knowledge through cost and benefit consideration. See for example, Cowan et al. (2000).

be codified before the transfer to reduce the cost of transfer, but it may perhaps not be fully codified due to the tacit element. In some cases, a certain body of knowledge is left uncoded because the cost of codification exceeds the benefit of codification. In other words, the codification of knowledge in this paper does not necessarily imply the complete codification of knowledge, but the codification to the degree that it is possible or to the degree that it makes sense economically.

In relation to knowledge transfer, codified and tacit knowledge require different types of knowledge transfer channels. Pedersen et al. (2003) identify that there can be two different channels: Rich communication media and written media. The authors found that tacit knowledge is likely to be transferred through rich communication media that involves face-to-face interaction, while codified knowledge is likely to be transferred through written media. Similarly, this paper assumes that knowledge transferred through written media such as manuals and information systems represents codified knowledge and that the level of utilization of these media shows the level of codification of knowledge.

Codification in the context of offshoring has mostly been discussed in relation to the 'offshorability' of a specific value chain activity (Lewin, 2011). It is mentioned as one of the characteristics of a task that drives the growth of offshoring, together with information intensity (Mithas and Whitaker, 2007), need for physical presence (Blinder, 2009), standardizability (Davenport, 2005), and modularizability (Gospel and Sako, 2010). Following this, it can be assumed that the nature of offshored activities is highly associated with the level of codification. This paper argues that this association does not only determine the offshorability of a task in decision-making stage, but it also influences the level of codification once offshoring is implemented. Furthermore, other attributes of offshoring implementation such as the motivation for relocation and destination location are going to be studied in relation to the level of codification of knowledge.

3.3. OFFSHORING ATTRIBUTES AND CODIFICATION OF KNOWLEDGE

3.3.1. ACTIVITY

When firms started to offshore in the 1960s, it was primarily the matter of relocating manufacturing in order to reap the location advantages such as rich natural resources, low labor costs, and market access. This has been studied intensively in the context of foreign direct investment (FDI) of MNCs (Vernon, 1966, Hymer, 1976). The product life cycle (PLC) model by Vernon (1966) explained the gradual internationalization process of MNCs following the growing market demand in foreign countries. Firstly, production activities will be established in other developed countries with similar market demand. Later on, demand for the product will emerge also from developing countries, and the production for more standardized products will find place in developing countries for cost saving reasons.

More recently, the offshoring of service functions has gained attention as the development of information technology allowed the relocation of these functions that have been traditionally considered as being 'non-tradable' (Doh et al., 2008). As pointed out by Kenney et al. (2009), offshoring of administrative and technical services such as information technology (IT) activities, call centers, engineering services, and financial services is characterized by being 'non-physical' and mostly conducted by highly-educated white-collar workers. Among service functions, the offshoring literature also pays special attention to the offshoring of 'innovative' (or development-oriented) functions (Couto et al., 2007, Lewin et al., 2009, Nieto and Rodríguez, 2011). These tasks have traditionally been perceived as strategic activities that need to be kept close to the headquarters, but are increasingly being relocated to foreign location recently (Contractor et al, 2010).

As mentioned earlier, the increasing possibility of relocating service activities is due to the advancement in information technologies. Technology

development in ICT helps diversify the range of the services that can be provided through telecommunication media. When tasks can be conducted using information technologies, the transfer over distance is also easier. Accordingly, service activities with certain characteristics suitable for electronic transfer are often the ones considered for relocation from home to foreign countries. As codifiability is one of these characteristics that determines offshorability (Wagner, 2006, Blinder, 2006), services offshoring is in general highly associated with codification. On the other hand, production activities are less dependent on codification via written media as the knowledge is largely embedded in artifacts like tools and machinery and the manual labor. This implies that the functional division of offshored activity has association with the level of codification of knowledge in offshoring implementation.

H1a: Offshoring of service activities are more likely to be associated with high level of codification than offshoring of production activities.

Offshored activities can also be distinguished based on how advanced the activities are regardless of functional division. When relocating activities, firms do not take large groupings such as production, R&D, and marketing, but rather fine-slice the activities within these groups and examine how much value these fine-sliced activities bring to the firm (Contractor et al., 2010). For software companies, they can offshore actual programming tasks while keeping the architecture and system design activities in house. Similarly, Jensen and Pedersen (2011, 2012) also distinguish between more or less advanced activities. Within manufacturing, one could argue that volume production is more standardized and less advanced compared to niche production. They assert that this distinction, besides the functional division, has implication for the implementation of offshoring and show that knowledge intensive firms and the firms with more experience in offshoring are more likely to relocate advanced activities.

As opposed to standard activities, advanced activities can be more challenging to codify. Jensen and Pedersen (2012) relate this type of activities with a

higher order capability that combines and integrates day-to-day problem solving competence, which is more routinized and standardized. Therefore, more advanced activities tend to be more complex, which could then complicate the codification process. Advanced activities can also be interpreted as involving more customized processes (Sako, 2006), which often requires creative skills and personal interaction in problem solving. Moreover, advanced activities are strategically more important for firm competitiveness and the risk of potential knowledge leakage from codification can be higher when firms offshore this type of activities. Thus, firms are more likely to utilize personal interaction rather than codification in transferring knowledge when offshoring more advanced activities.

H1b: Offshoring of advanced activities are negatively associated with the level of codification.

3.3.2. MOTIVATION

When firms started to offshore production activities, they were primarily motivated by access to cheaper labor in less developed countries as it was suggested in Vernon (1966)'s product life cycle theory. Other than the needs to achieve 'efficiency' or cost-saving (efficiency-seeking motivation), a couple of other factors are often mentioned as strategic drivers for offshoring in the literature. One is to get access to new markets (market-seeking motivation) and the other is to get access to knowledge and talented people (knowledge-seeking motivation) (Kenney et al., 2009, Contractor et al., 2010). The firms that are offshoring development functions are often driven by the need to access specialized knowledge/talents in foreign location either because these talents are not available in the home country or because they can reduce costs without compromising the quality of the workers (Manning et al., 2008). In reality, offshoring implementation is motivated by combination of these factors although firms tend to place main focus on one of the factors, efficiency-seeking motivation. According to Offshoring Research Network (ORN) survey, 95% of services offshoring firms indicated cost-saving to be the strategic

driver behind offshoring while 55% and 33% of firms had knowledge-seeking and market-seeking motivation respectively (Lewin and Peeters, 2006).

When firms are highly driven by cost-saving rationale rather than market-seeking and knowledge-seeking rationale, the aspect of ‘replication’ of activities in offshoring implementation becomes quite important. This means that firms will have to put effort into duplicating the operations in foreign location as well as possible to keep the productivity and the quality level that they used to have in the home country. In order to do so, firms are likely to be engaged in intensive codification to ease the transfer of knowledge involved in the operation. Firms with strong knowledge-seeking motivation will be interested in transferring the specialized knowledge that they can get access to in offshore location back to home country. Thus, they will be diligent in the codification of knowledge arising from offshoring.

On the other hand, offshoring with market-seeking motivation will lead to rather independent operation in the foreign location, with special effort to be embedded in the local environment. The valuable local knowledge for developing new markets will most likely to be utilized and kept in offshore operation, meaning that neither transferring knowledge from the home country nor transferring local knowledge to home country is primary concern of the offshoring firm with this motivation.

H2a: Offshoring with high knowledge-seeking motivation is positively associated with the level of codification of knowledge.

H2b: Offshoring with high efficiency-seeking motivation is positively associated with the level of codification of knowledge.

3.3.3. LOCATION

When it comes to offshoring location, the match between activities, motives, and locational advantages such as available resources, geographical distance,

and cultural alignment seems to determine the final offshoring destination (Doh et al., 2009, Hahn and Bunyaratavej, 2010, Jensen and Pedersen, 2011). For example, firms with efficiency-seeking motivation are likely to choose offshore location with low wage level, which are represented by emerging economies like China and India. A study based on ORN survey data showed that while India is undoubtedly the most preferred destination for offshoring of administrative and technical work, other Asian countries and East European countries are increasingly chosen for recent offshoring implementation (Lewin and Peeters, 2006). China seems to attract a large share of manufacturing and procurement activities and also started to host product development activities with the advantage of being close to manufacturing facilities (Lewin and Couto, 2007).

However, offshoring destination is much more diversified than these emerging countries often mentioned in the literature. When control is critical to the operations, firms also choose nearby countries to ease the coordination over distance. It is also found that firms relocating service activities with interactive components prefer nearshore offshoring in order to deal with language and cultural issues (Doh et al., 2009). Accordingly, East Europe can be an attractive destination for European countries as Central America is for the US.

With regards to codification, the competence level of the offshore destination could have some influence on how engaged firms will be in codifying the relevant knowledge for the relocated activities. As each country has idiosyncratic sets of competences and knowledge (Cantwell, 1992), countries might have different levels of competence with regards to the specific tasks being relocated. In general, the level of technological competence is found to be associated with the economic development in nations (Verspagen, 1991, Fagerberg, 1994). As the majority of firms are offshoring with cost-saving motivation, they are likely to choose offshore location with low wage level, and these places may not possess the similar competence level as the home country. In this case, offshoring firms need to codify knowledge as much as possible to be able to replicate the operation without compromising the quality

of the outcome. On the contrary, if firms are relocating activities to advanced economies with high level of technological competences, the knowledge needed for the relocated operation might already present in this location so that the codification does not have to be done so diligently.

H3a: The competence level of the offshore location is negatively associated with the level of codification in offshoring firms.

As it was mentioned earlier, geographical distance makes knowledge transfer more challenging because of its tacitness (Galbraith, 1990). As distance increases, the utilization of transfer mechanisms for tacit knowledge such as personal interaction in meetings or training sessions become more of a costly option for firms. Therefore, it can be assumed that as distance increases, firms are more likely to utilize codified knowledge transfer mechanisms to substitute for tacit knowledge transfer mechanisms.

H3b: The distance between offshore location and the home country is positively associated with the level of codification in offshoring firms.

3.4. DATA

The data used in this study is mainly from an offshoring survey conducted in the GONe (Global Operations Networks) project between September 2011 and January 2012. A questionnaire with questions regarding the different aspects of offshoring experience was sent out to all Danish firms with more than 50 employees (about 2900 firms). In total, 675 firms responded to the questionnaire, resulting in about 23 percent response rate.

The survey contains information about overall offshoring experience and the most recent implementation of offshoring. For overall offshoring experience, whether or not the company has relocated any existing activity in the home country to a foreign location is asked, which provides a direct and precise measure for offshoring as it is defined in this paper. Furthermore, the first

relocation year, the destination for the first offshoring implementation, the characteristics of the offshored activity, and the effect of offshoring implementation are informed. The last part of the survey directs attention to the most recent offshoring implementation. Some of the questions asked for the overall offshoring experience are repeated, but more detailed information on the types of activities, the unexpected challenges, the benefits in relation to access to different resources, and the coordination mechanisms was obtained in this part of the survey.

The analysis in this study mainly relies on the information on the most recent offshoring implementation. About 39 percent of the respondents (229 firms) to the question on overall offshoring experience reported that they have offshored at least once in the past. However, due to missing values for the variables used in the analysis, the sample in this study is smaller than the number of firms that reported to have offshored in the past. The sample has 119 companies in diverse industries (see Table 3-1).

Table 3-1 Sample descriptive statistics

Size (Domestic employees)	N	%
Medium 50-99	50	42
Large 100+	69	58
Total	119	100.0
Industry	N	%
Manufacturing	54	45.4
Trade and Transport	29	24.4
ICT & financial services	20	16.8
Other industries	16	13.5
Total	119	100.0

3.4.1. THE OFFSHORING PATTERNS OF THE FIRMS IN THE SAMPLE

The 119 firms in our sample provided rather detailed information about their latest implementation. To begin with, the types of the offshored activities were informed. Initially, the activities were categorized into the following three types: *production*, *service/administration*, and *design/development*. For simplicity, these types will be called production, service, and development in the rest of the article. These three types are divided further into the sub-categories as it can be found in Table 3-2. The *production* activities are the most commonly relocated activities for the firms in the sample. Among the sub-categories, *manufacture* dominates with more than 50 per cent of the firms in the sample. *Service* activities are offshored more frequently than *development* activities, and the sub-categories in the *service* activities are more evenly distributed than those in the *development* activities. Among the sub-categories in the *development* activities, *software development* is the activity that is most common to relocate abroad.

The offshore location for the implementation of the latest offshoring experience was also indicated by the firms. The regional distribution shows that the firms offshored to Asia most frequently (see Table 3-3). In terms of countries, China tops the list as one fifth of the firms in the sample relocated their activities to China. Followed by India very closely, Poland is the second most popular destination. When the geographic distribution is divided according to the offshored activities, a different pattern emerges for the service activities. Germany and Norway, which are the neighboring countries to Denmark and Sweden, are among the top three destinations, while China is found further down the list. Development activities are mostly relocated to emerging countries like China and India.

Table 3-2 Activities offshored by the firms in the sample

Activity offshored	N	%	
Production	60	50.4	
Production technology		2	3.3
Production preparation		2	3.3
Manufacture		43	71.7
Assembly		7	11.7
Maintenance		1	1.7
Other		5	8.3
Service/Administration	34	28.6	
Finance/Accounting		6	17.7
Marketing and sales		4	11.8
IT		7	20.6
Call center/Customer service		4	11.8
Procurement and supply management		1	2.9
Logistics		6	17.7
After sale support		2	5.9
Other		4	11.8
Design/Development	25	21	
Product design		4	16
Product development		6	24
Software development		14	56
Other		1	4
Total	123	100.0	

Table 3-3 Offshore destination

Regional distribution	N	%	Popular countries	N	%
Asia	45	37.8	China	18	15.1
East Europe	37	31.1	India	13	10.9
Rest of Europe	27	22.7	Poland	12	10.1
America/Middle East	10	8.4	Germany	9	7.6
Total	119	100.0	Thailand	6	5.0

3.5. THE ECONOMETRIC MODEL AND VARIABLES

A multiple linear regression analysis is conducted to find out how the following aspects of offshoring are associated with the level of codification in offshoring implementation: 1) activity, 2) motivation, and 3) location.

3.5.1. DEPENDENT VARIABLE

The dependent variable is the *level of codification*, which is the codification index calculated with the items from the GONe survey. This index (Min=8, Max=35, Mean= 23.52, SD= 5.95, Skewness=-0.22, Kurtosis=2.57) is calculated by summing the following five 7-point Likert-type items: 1) The offshoring implementation is defined through procedure, manuals, blueprints, etc. (1= Not at all, 7= To a high degree)³, 2) To coordinate the implementation, the company used mechanisms based on information systems, 3) To coordinate the implementation, the company used mechanisms based on formalization, 4) Knowledge and information sent from Denmark to the offshored unit is documented, and 5) Knowledge and information sent from the offshored unit to Denmark is documented⁴.

3.5.2. INDEPENDENT VARIABLES

The independent variables for the type and the attribute of offshored activities come from GONe survey. The first variable is the *functional type of offshored activity*, which is categorized into the following three types: 1) Production activities (*Production*), 2) Administrative service activities (*Service*), and 3)

³ All the items from the GONe survey mentioned in the rest of the paper are all 7-point Likert-type items that are scaled in the same way, unless indicated otherwise.

⁴ Although there is still reservation for using Likert-type items as interval variable, Carifio and Perla (2007) argue that it is acceptable to use Likert-scale measures that are constructed from Likert-type items as interval variable in parametric analysis. The normality of this variable is checked to meet the assumption of the linear regression.

Development and Design activities (*Development*). The reference group in the models is *Production* activities. The second variable indicates how advanced the activities are (*Advanced*) regardless of the functional division of the activities. This variable is derived from principal component analysis conducted on the following six Likert-type survey items on the characteristics of activity: 1) Simple and routinized, 2) Independent from other activities, 3) Standardized, 4) Creative and innovative, 5) Contains many sub-processes, and 6) High knowledge content. Table 3-4 shows the results from the principal component analysis. Based on the eigenvalue, it seem that two components are important, which explain 32% and 30% of the variance of the included items.

The first component is highly associated with the first three items, while the second component is highly associated with the last three items (see Table 3-5). It can be interpreted that a high score on component 1 means that the relocated activity is independent and standardized and a high score on component 2 means that the activity is complex and advanced. As the hypothesis on the characteristic of the activity deals with 'how advanced the activity is', the second component (*Advanced*) is included in the regression models.

Table 3-4 The number of components

Components	Eigenvalue	Difference	Proportion	Cumulative
Component 1	1.9270	0.1255	0.3212	0.3212
Component 2	1.8014	1.1601	0.3002	0.6214
Component 3	0.6414	0.0057	0.1069	0.7283
Component 4	0.6357	0.0582	0.1059	0.8343
Component 5	0.5775	0.1605	0.0962	0.9305
Component 6	0.4170	.	0.0695	1.0000

Table 3-5 Variable loading for each component

Variable	Component 1	Component 2
Simple and routinized	0.5567	-0.0524
Independent	0.6005	0.1479
Standardized	0.5398	-0.0806
Creative and innovative	0.1226	0.6444
Many sub-processes	-0.1456	0.4862
High knowledge content	-0.0432	0.5632

The next couple of independent variables represent the two motivation factors for relocation: 1) Knowledge-seeking (*Knowledge*) and 2) Efficiency-seeking (*Efficiency*). These variables also come from GONE survey, in which firms indicated to which extent the offshoring implementation led to access to 1) Knowledge and technology (Min=1, Max=7, Mean=3.21, SD=1.88) and 2) Cheap labor (Min=1, Max=7, Mean=5.38, SD=1.71). The upper 30 percent of the firms with the highest scores (firms that gave 5 or higher for knowledge-seeking and 7 for efficiency-seeking) take the value 1 for the dummy variable indicating the high level of motivation for each factor⁵.

The last two independent variables denote the location aspect of offshoring implementation. They are not taken directly from the GONE survey, but are collected and calculated with the data from two other sources, based on the information on the offshoring location specified in the survey. To denote the general competence level of a country, the Innovation Input index from Global Innovation Index (Dutta, 2010) is utilized (Min=2.88, Max=5.54, Mean=4.17, SD=0.69). The upper quartile of the firms with highest scores (cut-off at GII score of 4.94) takes value 1 for the dummy variable *High_GII*. The next variable

⁵ For the robustness check, another dummy variable dividing the upper half and the lower half of firms based on the scores on the same item was constructed and this variable gave similar results in the regression models.

on location is *Nearshore* dummy variable, with value 1 if the offshoring location is in European countries⁶.

3.5.3. CONTROL VARIABLES

The first control variable is the *Size* of the firm, calculated as the logarithm of the number of employees worldwide. *Size* is expected to have positive relationship with the level of codification. The larger the firm is, the higher the need is to codify knowledge in order to share it with the larger number of employees. The next control variable is a dummy variable for manufacturing firm (*Manufacturing*). This variable is included in the model to control for sectoral differences in the general level of codification. These two control variables are constructed based on the company register data. The last control variable is a dummy variable, indicating whether or not offshoring is implemented in a subsidiary (*Subsidiary*). If offshoring is implemented internally in a subsidiary, there might be better opportunities to transfer knowledge in tacit form compared to the case where the activity is offshored to an independent supplier. Captive offshoring is therefore expected to lead to a lower level of codification compared to offshore outsourcing. This variable comes from the GONe survey. Furthermore, past offshoring experience (dummy variable) and the level of globalization of the firm (proxied by the number of countries that the firms are established in) had been added as controls in earlier estimation models, but due to the insignificant coefficients and very little contribution of these variables for the fit of the model, they are not presented in the final models.

⁶ In the sample, the countries in this category includes Norway, Sweden, Finland, Iceland, Germany, Belgium, France, Switzerland, Poland, Estonia, Czech republic, Lithuania, Bulgaria, Slovakia, Ukraine, Latvia, Romania, United Kingdom, Hungary, Spain, and Italy.

3.6. RESULTS

The correlation matrix and the estimates of the multiple linear regression models are reported in Table 3-6 and 3-7 respectively. As it can be seen from Table 3-6, the overall correlation level among the explanatory variables is low. Collinearity was checked for all the variables using Variance Inflation Factor (VIF), and there was no sign for concern. Model 1 is the base model with control variables only. In Model 2, activity related variables – *the type of activity* and *Advanced* – are included in addition to the control variables. Model 3 includes the two motivation variables, *Knowledge* and *Efficiency*, and model 4 includes location related variables, *High_GII* and *Nearshore*. Model 5 includes all the explanatory variables at once.

In both model 2 and 5, the coefficients for the type of activities are not significant. This suggests that the functional division of the activities does not make difference for the level of codification of knowledge. Hypothesis 1a cannot be supported. Moving on to the coefficient for *Advanced* variable, the results show the opposite relationship between how advanced activities are and the level of codification than what was expected. The coefficients are 0.706 and 0.72 and are significant at 5 % level in both models. All other variables held constant, one unit increase in advancedness measure will lead to about 0.7 unit higher codification index score. The more advanced the activities are, the more intensively the offshoring firms codifies the knowledge related to offshored operations. Hypothesis 1b is therefore rejected.

Model 3 and 5 show the similar results for the relationship between motivation factors and codification. There is no empirical support for hypothesis 2a as the coefficients for knowledge-seeking variable are not significant. On the other hand, the results for efficiency-seeking motivation show significant positive relationship between this motivation factor and the level of codification as it is hypothesized. If the firm has the high motivation level for cost-saving, they are likely to have about 3.6 unit higher codification level. Hypothesis 2b is supported.

Table 3-6 The correlation matrix

	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10
1. Service	0.29	0.45	0.00	1.00	1.00									
2. Development	0.21	0.41	0.00	1.00	-0.33	1.00								
3. Advanced	6.69	2.15	1.55	11.7	-0.15	0.33	1.00							
4. Knowledge	0.31	0.46	0.00	1.00	-0.10	0.23	0.29	1.00						
5. Efficiency	0.29	0.46	0.00	1.00	-0.12	-0.06	-0.07	0.08	1.00					
6. High_GII	0.25	0.44	0.00	1.00	0.28	-0.16	0.05	0.07	-0.29	1.00				
7. Nearshore	0.52	0.50	0.00	1.00	0.20	-0.21	-0.23	-0.16	-0.12	0.32	1.00			
8. Size	6.35	1.96	3.40	11.5	0.28	-0.01	-0.02	0.03	-0.03	-0.02	0.02	1.00		
9. Manufacturing	0.45	0.50	0.00	1.00	-0.35	-0.14	0.08	-0.03	0.19	-0.06	0.00	-0.21	1.00	
10. Subsidiary	0.61	0.49	0.00	1.00	0.02	-0.13	0.11	-0.01	0.07	-0.01	0.09	0.25	0.15	1.00

Bold coefficients significant at 5% level

Table 3-7 Multiple linear regression, Dependent variable: Level of codification

	Model 1	Model 2	Model 3	Model 4	Model 5
<i>Explanatory variables</i>					
Service		0.672 (1.423)			1.336 (1.415)
Development		-0.633 (1.555)			-0.680 (1.518)
Advanced		0.706** (0.270)			0.72** (0.276)
Knowledge			1.475 (1.136)		0.670 (1.203)
Efficiency			3.553*** (1.175)		3.778*** (1.221)
High_GII				-0.494 (1.326)	-0.448 (1.375)
Nearshore				-1.576 (1.154)	-0.677 (1.148)
<i>Control variables</i>					
Size	0.430 (0.298)	0.424 (0.301)	0.420 (0.286)	0.423 (0.297)	0.382 (0.291)
Manufacturing	-0.830 (1.144)	-0.874 (1.228)	-1.400 (1.117)	-0.892 (1.143)	-1.359 (1.194)
Subsidiary	-0.321 (1.177)	-0.727 (1.178)	-0.432 (1.132)	-0.170 (1.179)	-0.809 (1.140)
Constant	21.36*** (2.052)	16.88*** (2.624)	20.25*** (2.007)	22.29*** (2.129)	16.29*** (2.718)
N	119	119	119	119	119
R-squared	0.028	0.087	0.119	0.050	0.187
Adj. R-squared	0.003	0.038	0.08	0.008	0.112

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The last group of explanatory variables regarding offshoring location does not show significant results although the direction of the relationship seems to be as they are hypothesized. The proximity to the home country and the competence level of the country do not seem to be associated with the level of codification in offshoring implementation. Hypothesis 3a and 3b are not supported. The control variables do not seem to have much explanatory power in the analyses. All three control variables, *Size*, *Manufacturing*, and *Subsidiary*, do not have significant coefficient in any of the models.

3.7. DISCUSSION AND CONCLUSION

Besides being one of factors that determine the offshorability of activities (Wagner, 2006, Blinder, 2006), codification is also found to be an important matter for the success of the offshoring implementation (Larsen et al., 2010). In general, it can be expected that offshored activities involves easily codifiable knowledge compared to activities that are not relocated. What is argued in this paper is that the level of codification also varies among offshoring firms and that it depends on the specification of offshoring implementation such as activities, motivation, and location. The results of empirical analyses show that some of aspects of offshoring are indeed related to how intensive offshoring firms codify knowledge that is relevant for offshored operations.

Firstly, it is found that the 'advancedness' of activity is associated with the level of codification in offshoring firms, while the functional division of activities is not found to influence the firm's codification effort. This result directs attention to the importance of the distinction between more advanced and less advanced activities in discussing offshoring. As some authors have already pointed out, this distinction explains the different patterns of implementation of offshoring practice in terms of the characteristics of firms (how experienced the firms are in offshoring and the knowledge intensity of the firm) and the location choice (Jensen and Pedersen, 2011, 2012). As the more conventional view of distinguishing activities in terms of their functional division is still

prevalent in the offshoring literature, the evidence on the importance of more fine-grained division of activities is valuable (Contractor et al., 2010).

What is also noticeable with this result is that the relation between advancedness of activity and codification is the opposite from what was expected in the hypothesis. The hypothesized negative relation between advancedness and codification was based on the arguments that codification can be more challenging for the advanced activities due to their dependence on tacit aspect (requiring more personal interaction and creativity) and that firms will be less keen on codifying knowledge related to advanced activities due to the risk of knowledge leakage (Contractor et al., 2010). However, this argument might be more applicable for determining which activity to relocate prior to offshoring implementation or offshorability of activities (Lewin, 2011). The result suggests that, once the decision on offshoring is made, the more advanced activities may require a higher level of codification for transferring the activity to offshore location and for managing the activity from headquarters due to the complexity and knowledge intensity in its character (Jensen and Pedersen, 2012). Compared to simple and standardized activities, more advanced activities will need more detailed manual and guideline to be replicated in the offshore location without misunderstanding and potential decrease in quality (Aron and Singh, 2005).

One motivation factor for offshoring that is found to be highly associated with the codification level is efficiency-seeking motivation. It seems that the firms with strong motivation for saving cost have a higher level of codification. The explanation that replication aspect is especially important for firms with this motivation seems to hold based on this result. On the other hand, there is no clear evidence that knowledge-seeking motivation is associated with codification effort of offshoring firm. This can perhaps be explained by the 'explorative' character of operations associated with this motivation as opposed to 'exploitative' operations, which is more likely to be relocated with efficiency-seeking motivation and market-seeking motivation (March, 1991). For explorative operations, knowledge transfer in the codified form from the

home country to offshore location will not be as necessary as it is for more exploitative offshoring. Furthermore, although offshoring firms may be interested in documenting knowledge gained from foreign location, this might be challenging since the knowledge gained from offshoring is rather new for the firms. These factors might offset the firm's willingness to codify knowledge when there is strong knowledge-seeking motivation behind the relocation.

Lastly, the empirical results from this paper suggest that the location-related factors, the geographical proximity of the offshoring destination to the home country and the general competence level of the country, are not associated with the level of codification. One might expect to see a higher degree of codification as the geographical distance increases to compensate for the difficulties in transferring tacit knowledge, but this relationship is not supported by the empirical results. This may suggest that the mechanisms for transferring codified knowledge cannot substitute the transfer of tacit knowledge as the transfer of the tacit aspect of knowledge by definition involves personalized learning (Balconi et al., 2007, Howells, 2012). The association between the distance and utilization of codified knowledge transfer should perhaps be discussed independent of transfer of tacit knowledge. In fact, the codified knowledge itself is ubiquitous and the effectiveness of transfer of codified knowledge is found to be less dependent on geographical distance (Ambos and Ambos, 2009).

Turning to the next locational factor, no evidence is found for the relationship between the competence level of the offshore location and the level of codification. The effort offshoring firms put into codification does not seem to be influenced by how capable the foreign work force is in general on the country level. This may be explained by the rise of clusters and firms in the emerging economies that are specialized in their areas of expertise, i.e. IT services, manufacturing, and product development (Manning et al., 2008), which means that there is no huge gap in the competence level between the foreign workforce and the workforce in the home country.

All in all, what firms offshore and why they offshore, rather than where firms offshore to, matter for the level of codification effort by offshoring firms. These factors seem to be related to the 'replication' aspect of offshoring. The firms that are relocating activities with cost-saving motivation will focus on duplicating the operation in the foreign location without compromising the productivity of the operation and the quality of the output, which will lead to more intensive documentation of procedures and guidelines. In the case of relocation of advanced and complex operations, firms also need more detailed codification to convey all the necessary knowledge in replicating the operations abroad, compared to simple and standardized operations, which are likely to be already familiar to the workforce or at least easier to understand without detailed instruction.

The current study, focusing on the codification of knowledge related to offshoring implementation, sheds light on one aspect of managing knowledge in offshoring firms. Empirical studies on the transfer of tacit knowledge will complement the findings in this study in enhancing the understanding of knowledge dynamics in offshoring implementation, which has increasing strategic importance in firm these days.

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CHAPTER 4. DIVERSIFYING THE SOURCES OF KNOWLEDGE FOR INNOVATION¹

An empirical analysis of the impact of offshoring on innovation

4.1. INTRODUCTION

The increasing trend of relocation of business activities from home country to foreign countries, referred to as offshoring, raises concerns for retaining competitiveness in the home country, where the loss of certain jobs is inevitable in relation to relocation. One of the often debated issues is the implications of offshoring on the innovation capability of firms as the ability to offer customers superior products and services compared to those of competitors is an important source of competitiveness in the globalized market today (Lengnick-Hall, 1992, Dutta et al., 2005).

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. As successful innovation requires efficient coordination of knowledge from different functions and departments (Rothwell, 1977), the geographical disaggregation of certain competences and knowledge from the home country may not be a favorable condition for firms pursuing innovation. In the case of manufacturing firms, the importance of production knowledge in introducing innovation is increasingly being recognized, which means that firms may have difficulties in sustaining innovation capability after the relocation of production (Dankbaar, 2007).

¹ Earlier draft of this paper was presented in Druid Society conference 2014.

Pisano and Shih (2012) warn that relocating manufacturing activities purely on the basis of financial criteria can lead to the deterioration of innovation capabilities of firms, especially when there are opportunities for improving manufacturing processes and when the process technologies are inseparable from product innovation. They assert that a number of U.S. industries such as flat-panel displays, machine tools, solar energy, and wind turbine have already lost their lead in global competition due to offshoring. Therefore, preserving certain competences that could be crucial input for developing new products and services is needed although it makes sense to offshore the activities in terms of reducing immediate costs.

Moreover, offshoring increases cultural as well as geographical distance among the value chain activities, which could induce coordination issues. In case of offshore outsourcing, it also brings organizational distance, which can be a critical setback in organizing innovation activities. Denning (2013) illustrates how Boeing's international sourcing strategy in the development of Dreamliner 787 interfered with timely introduction of new products to the market. By offshore outsourcing a number of parts in the complex system of an aircraft, Boeing lost control in assuring quality and compatibility of components in the final assembly.

In recent empirical studies, however, the majority of the results suggest that there is a positive relationship between offshoring and innovation. On a macro-level, some studies found evidence that there might be reverse knowledge transfer from host country to home country when firms offshore R&D activities (Castellani and Pieri, 2013, D'Agostino et al., 2012). Firm-level studies also suggest that offshoring has a positive impact on innovation performance. 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 inverted u-shaped relationship between the offshoring of these functions and the introduction of new products and processes. In their study on emerging

market countries as home countries, Fritsch and Gorg (2013) found that offshoring is associated with a greater possibility for firms to increase R&D spending.

The main arguments in the studies revealing a positive relationship between offshoring and innovation are that, firstly, offshoring can be a channel for reverse knowledge transfer, which may be beneficial for introducing new products and services, and secondly, offshoring firms can invest and focus more on innovation activities with the extra resources that are released through offshoring. Furthermore, offshoring is found to bring skill upgrading in the home country, which will also exert a positive impact on conducting innovation in the home country (Becker et al., 2013).

Building on these previous studies, this paper also shows that offshoring has a positive impact on firm innovation in the home country and argues that this is done mainly through knowledge sourcing aspect of offshoring. The paper posits that, in the short run, the 'positive' knowledge sourcing effect of offshoring outweighs the 'negative' competence disaggregation effect and confirms that offshoring firms are more likely to introduce new products and services compared to non-offshoring firms. Acknowledging that offshoring implementation has become much more complex than the stereotypical setting of relocation of labor-intensive activity to low-cost countries, the analysis in this paper investigates further whether certain offshoring setting has greater positive influence on firms innovation than others. The empirical analysis incorporates various attributes of offshoring such as types of activities, motivation, governance, and location in deciphering the impact of offshoring on innovation. The main finding suggests that internally organized offshoring implementation with a high degree of disaggregation in terms of activities and location proves to have a positive impact on innovation.

The current study contributes to the literature in the following ways. Firstly, 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 might have potential in contributing to innovation. Moreover, firms that are engaged in offshoring often have relocated different types of activities at the same time, which suggests that the impact of relocation of certain activities is best understood in the context of overall offshoring implementation. Therefore, the effect from offshoring of multiple activities is presented in this study together with the overall effect of offshoring and the effect from relocation of certain type of activities.

Secondly, the paper investigates how certain attributes of offshoring implementation such as offshoring location, motivation, and governance influence the relation between offshoring and innovation. As offshoring practice has diversified over the years to include different motivation, activities, and locations, one needs to take into account the heterogeneity of the implementation of offshoring when analyzing its impact on innovation. For example, 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 are 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. Similarly, the governance mode of offshored operation matters for the relationship between offshoring and innovation.

Thirdly, the study attempts to capture a 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. This addresses the reverse-causality issue suggesting that innovative firms may be more likely to relocate activities than firms that are not innovative.

The paper is structured in the following ways. The next section presents the diversified pattern of offshoring implementation in recent years. The third section contains theoretical discussion on innovation and offshoring and introduces the hypotheses developed from the theoretical discussion. The data and the econometric model used in the empirical analysis are described in the fourth and fifth section respectively, followed by the results presented in the sixth section. The last section discusses the results and concludes.

4.2. UNDERSTANDING THE 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 such as India and China. 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 either pose threat to the offshoring firms in managing innovation or provide opportunities to tap knowledge in diverse locations

In terms of the governance of the offshored activities, firms are increasingly utilizing outsourcing option and letting service providers take over the operations abroad instead of owning and controlling the offshored activities in foreign location themselves. Similar to the case of domestic outsourcing, firms tend to outsource activities that add relatively little value to them and focus rather on their 'core competences' (Prahalad and Hamel, 1990). This is also possible due to the emergence of large specialized service providers based in

low-cost countries such as Infosys, Flextronics and Wipro that offer attractive services to firms that consider the relocation of activities.

4.3. 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.

Studies on the change in skill and employment in offshoring firms provide evidence that the composition of skills and competences becomes more favorable for innovation activities after the relocation of activities. Head and Ries (2002) found that offshore production increased domestic skill intensity in Japanese multinationals and Crinò (2010) showed that service offshoring increases relative labor demand for high skilled workers. Becker et al. (2013) found that onshore workers in multinational firms that expand offshore employment perform more advanced tasks, which are defined as being non-routine and more interactive. In their study, offshoring is also found to be associated with higher workforce education. The increase in skill intensity and the level of education in workforce will also be more beneficial for managing new knowledge sourced through knowledge and utilizing it for innovation.

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. Depending on the degree of the interaction required between the offshore operations and the activities in the home country, it is likely that there are designated channels to share knowledge among them.

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 regardless of the activities offshored.

4.3.1. 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. As noted above, the relocation of service activities with high knowledge content has become more common in recent years (Massini and Miozzo, 2012). The increasing availability of qualified workers in low-cost location has been one of the drivers for the offshoring of knowledge-intensive (KI) service activities such as IT-services and R&D. India, for example, hosts the majority of offshored IT-services with the abundant IT engineers with expertise in this field. As KI service activities in general require innovativeness in their operation and are closely related to the development of new products and services, they are likely to be a better channel for sourcing knowledge for innovation.

Among different KI service activities, 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 Arikan, 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 cost reduction motivation 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 a 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 (Dunning and Narula, 1995), are also applicable for offshoring of R&D. 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 relocating R&D close to the potential markets, firms will be able to gain market knowledge that would be direct input for new products and services targeted for the specific markets. 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 associated with the lack of qualified employees in the home country (Lewin et al., 2009). In this case, the positive impact of R&D offshoring

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.'

on innovation would be more apparent as the offshoring location provides rather unique knowledge that can trigger the introduction of new products and services.

IT-related service activities could also be relatively more effective in transferring new knowledge relevant for the introduction of new products and services than other types of activities that are characterized with more routinized and repetitive tasks. Massini and Miozzo (2010) distinguish IT services as requiring more innovativeness (novelty, creativity, and change) than other service activities as they often deal with the development of unique applications and solutions. They also argue that IT-related activities are closely integrated with production technologies and are influential for transforming business processes and structure, which suggests that new knowledge accessed through the relocation of these activities will have higher impact on innovation.

Hypothesis 2: Offshoring of knowledge-intensive service activities has a greater positive impact on innovation compared to offshoring of other types of activities.

As the pattern of offshoring becomes diversified, it has also become more common to offshore diverse sets of activities in different locations. As in the case of Apple, some firms employ the strategy of retaining only certain strategic activities in the home country and offshoring the rest of activities to locations where there is competitive advantage for conducting these activities. Mudambi (2008) illustrates how value chain activities can be fine-sliced (modularized) and disaggregated all over the world depending on the level of value added by each activity and the location advantage provided by different countries. Apple, for example, has high-value activities such as chip design and touchscreen in advanced economies like Germany and UK while it has repetitious manufacturing placed in Taiwan. Then, the most value adding activities like R&D, product design and commercialization at the one end of the value chain and marketing and brand management at the other end are being done in the US.

With regards to sourcing knowledge, the degree of disaggregation of value chain activities indicates how diversified knowledge the firm can get access to in different places. First of all, diversity in the type of activities offshored suggests that there will also be diversity in offshoring destination as countries and regions tend to specialize in certain types of activities and provide competences within certain areas (Mudambi, 2008). As argued earlier, this will increase the diversity of knowledge, which is beneficial for innovation (Kotabe et al., 2007). Second of all, even if different types of activities are relocated in the same region or country, there will still be increase in diversity of knowledge that firms get access to. Firms are likely to cooperate with different types of local actors in the host location depending on the type of activities being offshored, meaning that the pool of knowledge they get access to will be more diverse as firms are involved with relocation of more diverse set of activities. As innovation requires knowledge input from different functions or activities (Rothwell, 1977), the diverse types and sources of knowledge gained through offshoring will increase the likelihood of introducing new products and services. Assuming that the firms possess the organizational capabilities to successfully manage the scattered operations and reap the various location advantages from their presence in different places, the diversity of the type of the relocated activities will increase the impact of offshoring on innovation.

Hypothesis 3: The likelihood of introducing innovation increases with the level of disaggregation of value chain activities.

4.3.2. OFFSHORE LOCATION AND INNOVATION

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.

Hypothesis 4: Offshoring to advanced economies has a greater impact on innovation than offshoring to developing economies.

4.3.3. GOVERNANCE MODE AND INNOVATION

As mentioned earlier, relocated activities can either be operated by the firm itself (captive offshoring) or it can be outsourced to local independent suppliers (offshore outsourcing). In terms of sourcing new knowledge, the

ownership and control of the relocated activities might have implications for how effective firms can manage knowledge across distance. In case of captive offshoring, the unit in the host country is a part of the home organization, which means that there are internal channels and procedures for transferring knowledge from the host country to the home country as it is typically assumed in the setting of multinational corporations (MNCs) (Ghoshal, 1987, Kogut and Zander, 1993, Gupta and Govindarajan, 2000). In contrast, knowledge transfer from outsourcing partners will be more limited as the independent suppliers will not be so motivated to share knowledge freely as it can eventually harm their competitive advantage. Besides, learning across the organizational boundary is more challenging than learning within an organization (Boschma, 2005). Thus, knowledge sourcing via offshoring will only be effective for the firms engaged in captive offshoring and not for the firms engaged in offshore outsourcing.

Additionally, when firms retain control over the offshored activities, the competences and knowledge related to the activities are still kept in-house so that they can continue to be useful input for innovation activities, unlike in the case of outsourcing, through which certain knowledge can disappear in the organization after the relocation of the activities.

Hypothesis 5a: Captive offshoring has a positive impact on innovation.

Hypothesis 5b: Offshore outsourcing does not have a positive impact on innovation.

4.3.4. OFFSHORING MOTIVATION AND INNOVATION

What firms want to achieve with the relocation of activity can also have influence on the impact of offshoring on innovation. The three main motivation factors for offshoring are efficiency-seeking, market-seeking, and resource-seeking motivation (see, for example, Roza et al., 2011, for theoretical perspective underlying each factor). Efficiency-seeking motivation mainly

deals with saving costs and can be explained by transaction cost economics (TCE) (Williamson, 1981). While transaction costs increase due to uncertainty associated with the internationalization process, firms can save labor costs by relocating activities to low-cost locations. The offshoring firms still benefit from the relocation if the cost-saving outweighs the transaction costs incurred by offshoring. Resource-seeking motivation, with which firms intend to acquire certain complementary resources in the host country, is mainly explained by resource-based view of firms (Barney, 1991). In the context of offshoring, it is mostly associated with knowledge-seeking, which means that firms relocate activities in order to get access to qualified workers with special knowledge. Lastly, firms with market-seeking motivation are often the ones with expansion strategy and therefore relocate activities to location where potential customers are in order to get geographically closer to them.

According to the Offshoring Research Network (ORN) survey, which investigated offshoring of administrative and technical functions, 95 percent of offshoring firms have indicated 'taking out cost' as an important driver for offshoring, which shows that cost reduction purpose underlies in almost all offshoring decision (Lewin and Peeters, 2006). Among other strategic drivers studied in the survey, 'responding to competitive pressure', 'improving service levels', and 'getting access to qualified workers' are the drivers that more than half of the respondents indicated as being important, and more than one third of the firms found 'access to new market', 'business process redesign', and 'industry practice' as important drivers. The survey results suggest that cost reduction is a common motivation factor that most offshoring firms are associated with and that offshoring firms often have other various purposes related to market-, and resource-seeking rationale besides efficiency-seeking motivation when they make decision to relocate part of their value chain activities.

While it is not easy to separate different motivation factors apart from one another, one can assume that firms with resource-seeking motivation are more likely to be active in sourcing knowledge and other resources that can be

valuable input for improving existing products/services and developing new products/services. In other words, these firms will be more deliberate in getting access to new knowledge and utilize it in their innovation activities than the firms that do not have these specific purposes.

Hypothesis 6: Offshoring with knowledge-seeking motivation has a greater positive impact on innovation compared to offshoring initiated without knowledge-seeking motivation.

4.4. 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 analyse how offshoring influences 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 lag structure of the data is illustrated in figure 4-1.

Figure 4-1 Data sources and the lag structure

1998-2000	2001-2006	2007-2009
CIS3/DISK02	International sourcing survey	FUI 2009
Pre-offshoring innovation	Offshoring activities	Post-offshoring innovation

The three different sources used in the analysis are as follows. The first source is Danish International Sourcing 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 third source is DISKO 2/PIE survey on technological and organizational change in Danish firms in the time period 1998-2000. Following up on the first DISKO survey conducted in 1996, DISKO 2 investigated topics such as organizational changes, competence requirements, education and training, technical and market innovation, and collaboration for innovation. Firms with more than 25 employees in the private sectors were included in the total

sample of 6975 firms. Out of 6975 firms, 2007 responded the survey, yielding about 29% of response rate. Merged with CIS3 data, this data provide information on the innovation performance (introduction of new products/services) in 1998-2000, which is the pre-offshoring period.

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 the data from the three sources were merged, there are 513 observations in the final sample. Table 4-1 displays the descriptive statistics for the sample. In terms of firm size, offshoring firms and innovating firms have a higher share of large firms compared to non-offshoring and non-innovating firms. Especially, firms with more than 500 employees take up a significantly larger share of the sample for offshoring firms and innovating firms. Comparing industry composition of the sample, manufacturing firms are more highly-represented in the sample of offshoring and innovating firms than in the sample of non-offshoring and non-innovating firms. In relation to innovation performance, a larger share of offshoring firms introduced innovation in 1998-2000 and 2007-2009 compared to non-offshoring firms.

It is also important to note that the sample used in this paper is biased in terms of size and industry when compared to the total population of firms in Denmark. To begin with, the original samples in the offshoring survey and innovation surveys are biased, with a larger share of medium- and big-sized firms (firms with more than 50 employees) and manufacturing firms compared

to the shares of the respective categories in the total population of firms. The final sample, which is the product of merging data from these surveys, has even higher share of large firms and manufacturing firms than the original samples in the various survey data. All in all, firms with more than 50 employees and firms in manufacturing firms are overrepresented in the final sample used in the analysis in this paper. Therefore, interpreting results from the analysis should be done with consideration for the bias in the sample. The comparison of size and industry composition in different samples and the total population of Danish firm are presented in Appendix A.

Table 4-1 The descriptive statistics for the sample

Percentage	Full	Offshoring	No-offshoring	Innovation*	No-innovation
Size					
< 50 employees	7.4	3.9	8.9	6.5	8.4
50-200	44.6	37.7	47.6	38.4	51.2
200-500	30.1	29.8	30.1	33.5	26.4
>500 employees	17.9	28.6	13.4	21.6	14
Industry**					
Manufacturing	55.4	64.9	51.3	62.7	47.6
Retail	18.5	13.6	20.6	16.4	20.8
Knowledge serv.	17.1	17.5	17	16.4	18
Others	9	4	11.1	4.5	13.6
Innovation 98-00	66.9	76	63	79.1	54
Innovation 07-09	51.3	67.5	44.3		
Offshoring	30			39.5	20

* Innovation in terms of introduction of new products/services in 2007-2009

** Industry is divided into 5 categories: Finance, Manufacturing, Retail, Knowledge services, and Others. In the sample, there is no firm in the finance sector.

4.5. THE ECONOMETRIC MODEL AND VARIABLES

As the dependent variable is binary, 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. The models have different explanatory variables depending on the aspect of offshoring implementation that is being investigated. In all categorical explanatory variables, non-offshoring firms are coded 0 and are the reference category.

To test hypothesis 1, model 1 is estimated to analyse the 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 categorical variable, *Type of activity*, as explanatory variable. Firms are divided into the following four groups in terms of the type of activity that they relocated: 1) firms that relocated core activity, 2) firms that relocated knowledge-intensive support activity (KI activity), 3) firms that relocated administrative support activity (Adm. activity), and 4) firms that relocated more than one type of activities. In model 3, the *degree of disaggregation of value chain* is included as explanatory variable. This variable has a value from 0 to 8, depending on the number of different type of business functions that have been relocated (thereby, 0 for non-offshoring firms).

In the fourth model, *Offshore region* is included as explanatory variable. Firms are divided into those that have relocated activities to developing economies, those that have relocated activities to advanced economies, and those that have relocated activities both to developing and advanced economies. The fifth model has *Governance mode* as explanatory variable. In terms of governance mode, firms are grouped as follows: 1) firms engaging in captive offshoring, 2) firms engaging in offshore outsourcing, 3) firms engaging in both governance modes. The last model has a categorical variable for *Offshoring motivation*,

which distinguishes 1) firms that have relocated activities with knowledge-seeking motivation and 2) firms that have relocated activities without knowledge-seeking motivation³. The detailed description of how the explanatory variables are structured based on survey questions and the cross tabulation of each explanatory variable for offshoring firms is provided in Appendix B and C respectively.

There are seven control variables in the models. The control variables capture the effect of structural firm characteristics, performance measures and some innovation-related features of the firms. First of all, representing the structural firm characteristics, *Size* and *Age* denote 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. *Profitability*, measured as return on sales in 2007, is included as control variable as more profitable firms may be more innovative. *Export* is a binary variable, indicating whether the firm exports its products/services or not. This variable is included as exporting firms are found to be more innovation intensive (Salomon and Shaver, 2005). Since export could be another channel to access knowledge abroad, it is important to control for this when investigating the knowledge sourcing aspect of offshoring.

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. *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

³ This model has 498 observations in the sample as there are some missing values for motivation

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 next 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 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 descriptive statistics and the correlation matrix of the explanatory and control variables are presented in Table 4-2 and Table 4-3. All models are checked for multicollinearity with the analysis of Variance Inflation Factor (VIF) and the results show that there is no sign of multicollinearity problem.

4.1. RESULTS

Table 4-4 and 4-5 summarize 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 1.78 times more likely to introduce new products and processes compared to non-offshoring firms. The marginal effect of offshoring shows that the predicted possibility of introducing innovation in 2007-9 is 0.141 greater for offshoring firms than for non-offshoring firms, holding the control variables at their means (see Table 4-6 for the marginal effect).

Table 4-2 The descriptive statistics

Variable	Mean	SD	Min	Max
1. Offshoring	0.28	0.45	0	1
2. Core activity	0.07	0.26	0	1
3. KI activity	0.06	0.24	0	1
4. Adm. Activity	0.03	0.17	0	1
5. Mixed activity	0.11	0.32	0	1
6. Disaggregation	0.53	1.11	0	8
7. Developing economies	0.13	0.33	0	1
8. Advanced economies	0.07	0.25	0	1
9. Developing & Advanced	0.08	0.28	0	1
10. Captive offshoring	0.11	0.31	0	1
11. Offshore outsourcing	0.11	0.31	0	1
12. Captive & Outsourcing	0.06	0.23	0	1
13. Know-seeking	0.1	0.3	0	1
14. Other motivation	0.17	0.38	0	1
15. Innovation effort	0.46	0.5	0	1
16. External collaboration	0.4	0.49	0	1
17. Innovation 98-00	0.67	0.47	0	1
18. Profitability	0.04	0.9	-18.25	5.34
19. Export	0.84	0.37	0	1
20. Size	5.26	1.07	3.02	9.23
21. Age	3.28	0.59	1.79	4.61

Table 4-3 The correlation matrix (variable numbers as presented in Table 4-2, bold coefficients are significant at 5% level)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1	1.00																					
2	0.51	1.00																				
3	0.41	-0.04	1.00																			
4	0.37	-0.04	-0.03	1.00																		
5	0.55	-0.06	-0.05	-0.04	1.00																	
6	0.79	0.19	0.19	0.18	0.82	1.00																
7	0.68	0.53	0.25	0.17	0.28	0.46	1.00															
8	0.50	0.09	0.31	0.34	0.23	0.39	-0.07	1.00														
9	0.43	0.11	0.11	0.10	0.43	0.45	-0.06	-0.05	1.00													
10	0.58	0.25	0.18	0.22	0.40	0.54	0.38	0.35	0.20	1.00												
11	0.65	0.40	0.40	0.29	0.16	0.37	0.50	0.32	0.19	-0.08	1.00											
12	0.35	0.11	0.02	0.04	0.42	0.40	0.16	0.07	0.38	-0.04	-0.05	1.00										
13	0.55	0.16	0.43	0.16	0.31	0.45	0.25	0.40	0.30	0.31	0.35	0.24	1.00									
14	0.79	0.51	0.17	0.31	0.45	0.62	0.64	0.28	0.31	0.47	0.52	0.26	-0.08	1.00								
15	0.17	0.06	0.05	0.06	0.13	0.17	0.16	0.00	0.10	0.07	0.06	0.18	0.11	0.12	1.00							
16	0.15	0.03	0.08	0.03	0.11	0.14	0.07	0.02	0.15	0.08	0.07	0.10	0.15	0.06	0.29	1.00						
17	0.15	0.07	0.03	0.08	0.09	0.12	0.08	0.04	0.12	0.08	0.09	0.05	0.07	0.12	0.26	0.17	1.00					
18	-0.02	-0.01	-0.01	-0.01	0.00	0.00	-0.01	0.00	-0.02	0.00	-0.01	-0.01	-0.01	-0.01	-0.04	-0.02	1.00					
19	0.21	0.13	0.06	0.08	0.11	0.16	0.17	0.07	0.10	0.13	0.13	0.08	0.08	0.17	0.19	0.09	0.23	1.00				
20	0.17	0.03	0.11	0.07	0.12	0.15	0.06	0.07	0.17	0.10	0.08	0.11	0.11	0.11	0.16	0.28	0.15	0.03	0.08	1.00		
21	0.03	0.01	0.01	0.02	0.01	0.02	0.02	0.03	0.00	0.01	0.02	0.03	-0.01	0.04	0.03	0.05	0.05	-0.01	0.17	0.14	1.00	

Table 4-4 Logistic regression, Product/service innovation in 2007-9, Model 1-3

	Model 1		Model 2		Model 3	
	Coef.	Odds ratio	Coef.	Odds ratio	Coef.	Odds ratio
Offshoring	0.57** (0.24)	1.78				
Core activity only			0.31 (0.39)	1.36		
KI activity only			0.17 (0.43)	1.18		
Adm activity only			0.37 (0.58)	1.44		
Mixed activities			1.17*** (0.38)	3.21		
Degree of disaggregation					0.41*** (0.13)	1.52
Innovation effort	1.62*** (0.22)	5.07	1.63*** (0.22)	5.09	1.61*** (0.22)	5.03
External collaboration	1.05*** (0.22)	2.85	1.03*** (0.22)	2.8	1.02*** (0.22)	2.79
Innovation 98-00	0.71*** (0.23)	2.04	0.72*** (0.23)	2.06	0.72*** (0.23)	2.06
Profitability	0.56* (0.38)	1.76	0.61 (0.39)	1.84	0.4 (0.3)	1.7
Export	0.08 (0.3)	1.08	0.04 (0.3)	1.05	0.04 (0.3)	1.04
Size	0.03 (0.11)	1.03	0.02 (0.11)	1.02	0.01 (0.19)	1
Age	0.36** (0.18)	1.44	0.38** (0.19)	1.46	0.39** (0.19)	1.48
Constant	-3.15*** (0.81)		-3.12*** (0.81)		-3.09*** (0.81)	
log likelihood		-271.63		-269.35		-268.2
R square		0.24		0.24		0.25

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

Table 4-5 Logistic regression, Product/service innovation in 2007-9, Model4-6

	Model 4		Model 5		Model 6	
	Coef.	Odds ratio	Coef.	Odds ratio	Coef.	Odds ratio
Developing economies	0.15 (0.32)	1.16				
Advanced economies	0.87** (0.41)	2.40				
Both dev and adv	0.98** (0.43)	2.67				
Captive offshoring			0.90** (0.37)	2.47		
Offshore outsourcing			0.37 (0.32)	1.45		
Both cap and out			0.47 (0.49)	1.61		
Knowledge motivation					0.29 (0.39)	1.34
Other motivation					0.41 (0.31)	1.51
Innovation effort	1.69*** (0.23)	5.42	1.64*** (0.22)	5.14	1.72*** (0.23)	5.56
External collaboration	1.02*** (0.22)	2.78	1.04*** (0.22)	2.83	1.04*** (0.23)	2.81
Innovation 98-00	0.71*** (0.23)	2.04	0.71*** (0.23)	2.04	0.72*** (0.24)	2.04
Profitability	0.65 (0.4)	1.93	0.57 (0.38)	1.77	0.43 (0.38)	1.54
Export	0.08 (0.3)	1.08	0.07 (0.3)	1.08	0.14 (0.31)	1.15
Size	0.02 (0.11)	1.02	0.03 (0.11)	1.03	0.04 (0.11)	1.04
Age	0.36* (0.19)	1.43	0.36** (0.18)	1.44	0.38** (0.19)	1.46
Constant	-3.09*** (0.81)		-3.14*** (0.81)		-3.35*** (0.83)	
log likelihood		-269.77		-270.89		-258.07
R square		0.24		0.24		0.24

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

Table 4-6 The marginal effects of the explanatory variables at the mean

	Margin	S.E.	P>z	[95% conf. Interval]	
Model 1					
Offshoring	0.141	0.057	0.014	0.029	0.253
Model 2					
Core activity	0.077	0.096	0.420	-0.11	0.265
KI activity	0.041	0.108	0.702	-0.17	0.253
Adm. Activity	0.091	0.142	0.519	-0.187	0.369
Mixed activity	0.268	0.075	0.000	0.121	0.416
Model 3					
Disaggregation at 1	0.104	0.031	0.001	0.043	0.164
Disaggregation at 2	0.102	0.03	0.001	0.044	0.16
Disaggregation at 3	0.092	0.022	0.000	0.049	0.134
Disaggregation at 4	0.077	0.011	0.000	0.055	0.099
Disaggregation at 5	0.06	0.004	0.000	0.052	0.069
Disaggregation at 6	0.045	0.007	0.000	0.032	0.058
Disaggregation at 7	0.032	0.009	0.001	0.014	0.051
Disaggregation at 8	0.023	0.01	0.022	0.003	0.042
Model 4					
Knowledge-seeking	0.073	0.095	0.442	-0.114	0.260
Other motivation	0.102	0.075	0.170	-0.043	0.249
Model 5					
Developing econ.	0.037	0.081	0.643	-0.121	0.195
Advanced econ.	0.209	0.089	0.019	0.035	0.383
Both dev. & adv.	0.232	0.090	0.010	0.056	0.407
Model 6					
Captive off.	0.215	0.080	0.007	0.059	0.371
Off. Outsourcing	0.092	0.078	0.239	-0.061	0.245
Both cap. & out.	0.117	0.118	0.320	-0.114	0.348

Model 2 is estimated to analyse whether the types of activities relocated in offshoring implementation make a difference for the impact of offshoring on innovation. Results suggest that there is no support for hypothesis 2, which claims that offshoring of knowledge-intensive service activity has a greater positive impact on innovation compared to offshoring of other types of activities. Firstly, the coefficient for KI activity is smaller than the coefficients for core activity and administrative activity, and secondly, the results are not statistically significant. On the other hand, the coefficient for relocation of more than one type of activity (mixed activity) is much higher than coefficients for the relocation of any single type of activity and is also significant at 1 % level. The marginal effect of offshoring of mixed activity type is also much higher (0.268) than those of offshoring of single type, which are all under 0.10. In line with this result, the degree of disaggregation of value chain in model 3 has a significant positive impact on the likelihood of introducing new products and services. The marginal effect of this variable shows that the probability of introducing innovation increases as the degree of disaggregation increases. The hypothesis 3 is therefore confirmed.

In the model 4, how the offshoring location affects the impact of offshoring on innovation is investigated. The results show that firms offshoring to advanced economies are about 2.5 times more likely to innovate compared to non-offshoring firms. This positive relation holds not only for the firms offshoring to advanced economies only, but also for the firms offshoring to both advanced and developing economies. Comparing the two groups of offshoring firms, firms that are offshoring to both advanced and developing economies have a slightly higher marginal effect on the probability to innovate than firms offshoring to advanced economies only. However, the impact of offshoring to developing countries only is not significant although it is positive, which means that offshoring to developing countries do not show any effect on innovation. These results show support for hypothesis 4, but one should be careful in interpreting the hypothesis as there is no significant result for offshoring to developing economies only.

The fifth model tests the hypothesis on the governance mode of offshoring. The results show that firms that have full control over offshored activities are more likely to innovate than non-offshoring firms. The predicted probability of introducing innovation is 0.215 greater for offshoring firms engaged with captive offshoring than for non-offshoring firms. However, the marginal effect of offshoring without ownership is smaller and not significant. Hypothesis 5a and 5b are confirmed.

The results from model show that there is no evidence to confirm hypothesis 6. The coefficient and the odds ratio for offshoring with knowledge-seeking motivation are smaller than offshoring without this motivation. Moreover, the results for both groups are not significant.

Concerning the control variables, innovation related variables and age are found to be significant in all models. All three innovation related control variables, *Innovation effort*, *External collaboration on innovation*, and *Previous innovation*, are significant at 1% level. If a firm has allocated a certain amount of manpower working on any innovation activities, then the firm is about 5 times more likely to introduce innovation, and if a firm has collaborated with external partners on innovation, then the firm is about 2.8 times more likely to innovate. If a firm introduced product/service innovation before offshoring, it is about 2 times more likely to introduce innovation after offshoring. This shows that innovation capability can be persistent over time. *Age* variable, which has significant coefficients at 5 % and 10 % level in the models, shows that larger firms are more likely to introduce new products and services. *Profitability*, *Export*, *Size* variables do not explain the likelihood of introducing innovation in 2007-9.

4.2. DISCUSSION AND CONCLUSION

The current study aims to unveil the consequence of offshoring on innovation performance at the firm level. As 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.

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, but still serve 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 Martínez, 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 Rodríguez, 2011) and suggests that offshoring in general induces positive consequence in terms of innovativeness.

Furthermore, the empirical results presented above indicate that some specifics of offshoring implementation make difference in the effect of offshoring on innovation. Contrary to what was expected, the type of relocated activity does not affect the relationship between offshoring and innovation. . It was argued earlier that knowledge-intensive service activities might be better channel for knowledge sourcing as these activities are found to be more directed related to innovation performance (Becheikh et al., 2006). However, there is no greater effect from offshoring of knowledge-intensive service activities on innovation compared to offshoring of core and administrative service activities. In fact, the results for different types of activities as they are defined in this paper show that firms that are relocating only one type of activity are not necessarily more innovative than non-offshoring firms. Rather, a significant positive effect was found for the group of firms that have relocated more than one type of activities. Furthermore, the degree of disaggregation of value chain shows a significant positive impact on innovation. The results suggest that it might be more critical to have diverse channels of knowledge

sourcing abroad than to have one channel that are 'closer' to the process of creation of innovation.

With regards to offshoring location, it is found that the positive relation between offshoring and innovation does not seem to exist for the firms relocating activities to developing economies only. 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 results may imply that the novelty of the knowledge and the efficient innovation process in the strong national innovation system in advanced economies are likely to have a positive impact on creating new product and services while knowledge and the technological environment from developing economies do not contribute significantly to creation of new products and services. The results for offshoring to both developing and advanced economies show a stronger positive impact compared to offshoring only to advanced economies, which might indicate that the diversification of knowledge sourcing, as in the results for the degree of disaggregation, is important.

Next, firms that have full control over the offshored activities are more likely to innovate than non-offshoring firms while there are no significant results for the firms outsourcing the activities to independent suppliers. This confirms that internal knowledge transfer mechanisms present in captive offshoring contributes to keeping and sourcing relevant knowledge for creation of new products and service, while knowledge transfer and learning can be more challenging across organizational boundary in the case of offshore outsourcing.

Contrary to what was expected, firms that relocated activities with knowledge-seeking motivation do not necessarily have a higher probability to be innovative compared to offshoring firms without knowledge-seeking motivation. This result might be due to the fact that firms often relocate activities with various strategic drivers and therefore it can be hard to isolate the impact of this specific motivation factor. In the sample, the majority of

firms (more than 85%) indicated that offshoring decision is influenced by more than three different motivational factors.

All in all, investigating some specific offshoring attributes in relation to their impact on innovation performance demonstrates a pattern that can be summarized as follows. Internally organized offshoring implementation with a high degree of disaggregation in terms of activities and location proves to have a positive impact on innovation. The results suggest that offshoring firms that are disaggregating value chain activities to a higher degree and thereby diversifying the channels and sources for new knowledge with various types of activities and location are more likely to innovate than non-offshoring firms. In other words, offshoring firms that have a role of orchestrators (Craig and Mudambi, 2013) are likely to be the winners in terms of innovation performance.

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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APPENDIX A. Size and industry distribution in the survey samples

Percentage	Total*	Off.	FUI 209	CIS3	DISKO	Sample
Size						
< 50 employees	97.7	26.4	57.1	65.2	51.8	7.4
50-200	1.8	57.4	27.2	22.8	35.6	44.6
200-500	0.3	10.6	9.7	7.5	8.8	30.1
>500 employees	0.2	5.6	6	4.5	3.8	17.9
Industry						
Finance	1.2	3	5	5		
Manufacturing	5.9	45.3	24	41.8	33.5	55.4
Retail	16.7	16.6	18.5	20.5	30.8	18.5
Knowledge serv.	13.4	18.8	36.1	15.7	10.7	17.1
Others	62.8	16.3	16.4	16.9	25	9
Innovation firms			36.2	46.1	67.5	66.9/51.3**
Offshoring firms		17.6				30

* Total population based on firm register data from 2007

** Percentage for innovating firm in 1998-2000 and 2007-9 respectively

APPENDIX B. The description of explanatory variables

Type of activity

In the offshoring survey, firms could indicate whether or not they have relocated each of the business activities that are categorized in the following eight functions: 1) Core business function, 2) Distribution and logistics, 3) Marketing, sales, and after sale support, 4) ICT services, 5) Administrative and management functions, 6) Engineering and related technical services, 7) Research and development (R&D), and 8) Other. Core business function is defined as "production of final goods or services intended for the market/for third parties carried out by the enterprise and yielding income" (Statistics Denmark, 2008, p. 13). Statistics Denmark (2008) also noted that "the core business function equals in most cases the primary activity of the enterprise", but "it may also include other (secondary) activities if the enterprise considers these to comprise part of their core functions (p.13)". All the other activity categories defined in the survey belong to support business functions. For the analysis, these functions are grouped in the following three categories: 1) Core activity, 2) Knowledge-intensive (support) activity, and 3) Administrative (support) activity. Among the support functions, ICT services, Engineering and related technical services, and R&D are grouped as knowledge-intensive activity and the rest of the functions are grouped as administrative activity. In the survey, firms were allowed to indicate all the activities that they have offshored during 2001-2006, which means that there can be multiple answers regarding the type of activities relocated by each firm. The variable is constructed in a way that, if a firm has relocated only one type of activities out of the three categories, it will belong to the group for relocating this specific activity type, and if a firm has relocated more than one type of activities, it will belong to a group for relocating mixed activities.

Level of disaggregation of value chain

Based on the eight business functions provided in the survey question mentioned above, this variable counts the number of functions that have been

relocated by a firm. It is assumed that, as the number of relocated functions increases, the more disaggregated the value chain is. Non-offshoring firms take the value zero while offshoring firms have values from one to eight.

Offshoring motivation

Similar to the type of activities, firms could indicate whether or not the following motivation was critical for the decision to relocate activities. The motivation factors were 1) Lower labor costs, 2) Lower costs, other than labor costs, 3) Access to new markets, 4) Industry practice (following what competitors do), 5) Enhancing quality or introducing new products, 6) Headquarter strategy, 7) Focus on the firm's core activity, 8) Access to special knowledge and technology, 9) Lack of labor force, 10) Tax reduction, 11) Better regulation, and 12) Other motivation. Cost reduction is a common motivation factor for offshoring firms and the majority of firms indicate that this factor has been critical in making offshore decision. It is also common for offshoring firms to have more than one motivation factor. The firms are grouped in the following way. If a firm indicated that Access to special knowledge and technology was a critical factor (by indicating that this factor was either somewhat critical or very critical), regardless of indication of other factors, then the firm is categorized in the group of offshoring firms that relocated activities with knowledge-seeking motivation. The rest of the firms are grouped as firms offshoring without knowledge-seeking motivation.

Offshore region

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. Similar to the case of the type of the

activities, firms could also indicate multiple locations in the survey. For this variable, the firms that offshored only to developing countries form a group while the firm that relocated activities only to advanced economies form another group. If a firm offshored both to advanced- and developing economies, then it will belong to the third group.

Governance mode

For each relocated business functions, firms indicated which of the following entities undertook the offshored activities: 1) Existing subsidiary, 2) Newly acquired subsidiary, 3) Newly established subsidiary, and 4) Other foreign firms (without any ownership or less than 50% ownership). If the first three types undertook the relocated operations, then the firm is engaged with captive offshoring, and if foreign firms undertook the offshored operations, then the firm is engaged with offshore outsourcing. The explanatory variable categorizes firms that have relocated activities only to subsidiaries in a group (captive offshoring only), while it categorizes firms that have relocated only to foreign firms in another group (offshore outsourcing). Lastly, the firms that relocated to both subsidiary and foreign firms belong to the third group (both captive offshoring and offshore outsourcing).

APPENDIX C. Cross-tabulation and frequency table of explanatory variables

Percentage	Core activity	KI activity	Adm. activity	Mixed activity
Motivation				
Knowledge-seeking	8%	8%	4%	16%
Other motivation	17%	14%	7%	26%
Location				
Developing econ.	14%	10%	4%	16%
Advanced econ.	5%	9%	6%	5%
Both dev. & adv.	7%	3%	1%	19%
Governance				
Captive offshoring	5%	8%	6%	16%
Outsourcing	17%	12%	5%	8%
Both cap. & out.	4%	1%	0%	16%

Percentage	Developing	Advanced	Both
Motivation			
Knowledge-seeking	12%	12%	12%
Other motivation	34%	11%	19%
Governance			
Captive offshoring	16%	11%	10%
Offshore outsourcing	22%	13%	8%
Both cap. & out.	6%	1%	14%

Percentage	Know-seeking	Other motivation
Governance		
Captive offshoring	18%	23%
Offshore outsourcing	10%	28%
Both cap. & out.	8%	13%

Degree of disaggregation	Frequency	Percentage
0	359	70
1	86	16.8
2	30	5.9
3	19	3.7
4	11	2.1
5	3	0.6
6	4	0.8
7	1	0.2

Part II

Multinational firms and innovation in a regional economy

CHAPTER 5. WHAT MAKES CLUSTERS DECLINE?^{1,2}

A study on disruption and evolution of a high-tech cluster in Denmark

5.1. INTRODUCTION

Regional clusters have gained much attention from scholars and practitioners over the last 20 years. One of the aspects investigated intensively in cluster research is the emergence and growth of clusters. In contrast, relatively little is known about how clusters evolve over time and why some clusters decline. The survival of clusters is of great interest for policy makers, as decline will cause turmoil in regional economies. Detailed empirical studies on cluster decline are thus crucial in order to reveal patterns in how clusters decline.

It is commonly observed that disruptions, which often come from sudden changes in the industry, key technologies, and the market, pose threat to clusters. The seminal work by Grabher (1993) on the decline of the Ruhr district describes how the cluster started to decline after a disruption in demand. He argues that firms were not able to adapt to the disruption because of lock-in. Examples of Silicon Valley and Route 128 also show how disruptions affect clusters. Both clusters experienced disruption in the 1980s: Silicon Valley faced fierce competition from Japanese chipmakers and had to give up the RAM module market, while Route 128 lost its customers as they shifted

¹ A revised version of this paper is forthcoming in a special issue of *Regional Studies on Evolutionary Economic Geography* as Christian R. Østergaard and Eunhyung Park (2015) "What makes clusters decline?- A study on disruption and evolution of a high-tech cluster in Denmark" *Regional Studies* DOI:10.1080/00343404.2015.1015975

² Earlier drafts of this paper were presented at DRUID Society conference 2012, Regional Innovation Policy conference 2012, and the AAG Annual meeting 2012. The authors are grateful for the discussants at these events as well as the two anonymous reviewers for their useful comments.

from minicomputers to workstations and personal computers (Langlois and Steinmueller, 1999; Best, 2001). Both clusters survived the threats, but in other cases, clusters start to decline after disruptions. The lack of capabilities to make changes to overcome internal and external disruptions – adaptive capabilities – (Martin and Sunley, 2006; Hervás-Oliver and Albors-Garrigós, 2007) appears to be a key issue in explaining cluster decline.

Clusters are often defined as “geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in a particular field, linked by commonalities and complementarities” (Porter, 1998, p.199). The adaptive capabilities and the evolution of clusters need to be studied in consideration of the interaction among these various economic actors, taking into account the developments in industry, technology, and institution and the heterogeneity in actions of firms. As Evolutionary Economic Geography (EEG) is concerned with the processes by which the spatial organization of economic activities is transformed over time with attention to micro-behaviors of economic agents (Boschma and Martin, 2007), it provides an important research framework for studies of evolution of clusters (Menzel and Fornahl, 2010; Martin and Sunley, 2011) and evolutionary processes of regional economic development (Martin and Sunley, 2006; Boschma and Frenken, 2006; Boschma and Martin, 2007).

This paper investigates the process of cluster decline. The conclusions derived in the paper are based on a detailed case study of the wireless communication cluster in North Jutland, Denmark. The high-tech cluster emerged in the 1980s and grew quickly during the 1990s; however, it showed signs of decline around 2004. In its history, the cluster experienced three disruption periods. The cluster survived the first technological disruption in the late 1980s. When the second disruption period, with a technological disruption and an economic recession, hit the cluster in the early 2000s, entry of new firms stopped, while exits increased. This process of decline was enhanced in 2009, when the third technological disruption and another economic recession came, and the two largest R&D firms closed down within a few months.

The paper contributes to the literature in the following ways. Firstly, the paper provides a detailed longitudinal study on cluster decline, which is rather scarce in the literature. The data that span the whole history of the cluster allowed the analysis of the decline in light of the development path that the cluster has experienced. Secondly, the explanation for cluster decline with attention to disruptions and lock-in contributes to the discussion in EEG. The paper argues that clusters are often exposed to disruptions and they start to decline when the cluster's adaptive capabilities are limited in the time of disruptions. Firm-level dynamics including the relations among the firms and the joint action in the cluster can shed light on how adaptive capabilities change. Lastly, unlike other decline studies focusing on the industries that are in decline itself, this paper studies a cluster in a growing high-tech industry.

The analysis reveals that technological and cognitive 'lock-in' and the exit of focal firms in the cluster was the major force that hampered the adaptive capabilities of the cluster. Innovation and new firm formation are identified as the factors that increase the cluster's ability to overcome threats, while the presence of foreign multinational corporations (MNCs) is found to have two contradicting effects. On the one hand, foreign MNCs increase the employment level and bring investments and new knowledge into the cluster, but on the other hand, they are ultimately footloose and will quickly withdraw from the cluster in times of crisis.

Theories of cluster decline are presented in Section 2. Section 3 describes the methodology. The case is described in section 4. The conclusions and discussion follow in section 5.

5.2. THEORIES OF CLUSTER DECLINE

5.2.1. CLUSTER DECLINE AND LIFE CYCLE

The cluster literature has focused on the positive effects that lead to clustering, such as the Marshallian externalities, explaining that firms benefit from co-

location in a cluster through economies of specialization, economies of labor pooling and localized knowledge spillovers. However, most of these positive factors also have a negative side. When many related firms are co-located, the congestion effects raise prices and wages. Labor pooling increases competition for specific skills and thus raises wages. It is also easier for employees to change jobs within a cluster, which means that companies can lose valuable knowledge to potential competitors. In addition, the localized knowledge spillovers also lead to the loss of information that could weaken firms' performance. The attraction of other firms to the cluster might therefore hamper the incumbent firms' growth (Falck et al., 2013). Sorensen and Audia (2000) find both a higher start-up rate and a higher exit rate in clusters, which indicates the existence of negative externalities. These negative externalities might hamper the development of the cluster and even be the cause of decline.

In the literature, there has been a tendency to link cluster evolution with industry life cycle. Klepper (2010)'s theory on the origin and growth of industrial clusters implies that the growth in the industry gives opportunity for clusters to grow through spinoff activities. Ter Wal and Boschma (2011) explain how clusters co-evolve with the industry and its technological properties at the macro-level, with the firms at the micro-level, and with the knowledge network of firms in the industry. As the industry matures, it experiences shakeout, during which less-competent firms end up exiting the cluster (Klepper and Simons, 2005; Klepper, 2010). At the same time, the variety of firm capabilities decreases and the network of firms become more stable, which might lead to cognitive lock-in and interfere with future learning. On the other hand, some studies suggest that cluster life cycles are different from industry life cycles. Menzel and Fornahl (2010) argue that different growth paths of the computer industry in Boston and Silicon Valley indicate that the cluster life cycle is not the local representation of the industry. Instead, they suggest a four-staged cluster life cycle going from emergence, growth, sustainment and decline and argue that the diversity and the heterogeneity of knowledge within the cluster provide foundation for the cluster's development.

According to them, clusters decline when the heterogeneity cannot be sustained.

The critics of the life cycle approach claim that the concept implies a deterministic and smooth evolution that does not fit with empirics (Martin and Sunley, 2011). The emergence or growth of a potential cluster might be stopped and turn into decline at any point of the life cycle. Martin and Sunley (2011) therefore suggest a modified 'adaptive cycle model' in conceptualizing cluster evolution. This model recognizes that there exist two-way interactions between a cluster and its external environment and posits that there are numerous development trajectories for cluster evolution, based on the four basic phases of the adaptive cycle model: exploitation, reorganization, conservation, and release. Among the trajectories, non-generative decline and cluster disappearance, which correspond to the decline in the standard life cycle terminology, is found to be the outcome of high internal connectivity and rigidity. High internal connectivity and rigidity may indicate poor adaptive capability, which is considered one of the important characteristics of a cluster that changes over the phases in the adaptive cycle model.

Therefore, to understand cluster decline, it is necessary to look at the cluster's adaptive capabilities in relation to shocks, such as economic recessions, environmental disasters, market disruptions and technological disruptions. Technological disruptions in particular change the underlying knowledge base for an industry and can easily lead to decline if the cluster firms are not able to move into the new technology (Storper and Walker, 1989; Christensen, 1989; Dalum et al., 2005; Klepper, 2010). The disruptions could also be linked to changes in the industry life cycle during an industry shakeout. During the shakeout phase, exogenous innovations (Jovanovic and MacDonald, 1994) or endogenous innovations (Klepper and Simons, 2005) create less space for new firms and increase the exit of technology laggard firms, which change the industry structure and leave room for fewer clusters.

5.2.2. CLUSTER DECLINE, IDENTITY, AND ADAPTATION

Cluster decline does not necessarily lead to disappearance of all activities within a thematic field, but is linked to a loss of identity. The identity can be understood as the regional industrial identity, suggested by Romanelli and Khessina (2005), which emerges from the shared perception of internal and external audience about the features of the industrial activity in a certain region. Internally, clustered firms share the sense of community that are often tied to specific technology and product characteristics e.g. a software cluster, or a wireless communications cluster (Staber and Sautter, 2011). Menzel and Fornahl (2010) state that a declining cluster can transform itself by moving into a completely new field. Similarly, Martin and Sunley (2011) suggest that, when a cluster reorganizes itself, it can either renew itself and start a new cycle of growth or it can be replaced with a new one, with new identity and new function. However, when the replacement or transformation happens, it cannot be considered the same cluster afterwards due to the change in the identity.

A cluster is a population-level concept. It is important to remember that a cluster consists of many firms and organizations that have different strategies. The only way the cluster can change is through the actions of individuals, firms and other organizations, all of which may react very differently to the same change. However, the reaction of a cluster as a whole appears to be more than the combined effect of reaction of individual actors because of the interconnections among them. Schmitz (1995) argues that the joint action of clustered firms can be an important element in overcoming challenges. Therefore, it is necessary to investigate the actions of different actors and the joint action among them at the same time when studying cluster evolution. The adaptive capabilities of the cluster depend on various factors, such as the rate of new firm creation, the innovativeness of incumbents, and the willingness of the firms to move into new fields, (Best, 2001; Hervás-Oliver and Albers-Garrigós, 2007; Menzel and Fornahl, 2010; Martin and Suley, 2011; Holm and Østergaard, 2015). On the other hand, the lack of these factors will affect the

evolution of the cluster negatively. In the rest of the section, the key factors that influence cluster evolution will be discussed.

Lock-in

According to Grabher (1993), lock-in consists of factors that diminish a cluster's ability to recognize and make adjustments to sudden changes. Grabher identifies three kinds of lock-ins: the first is a functional lock-in, which refers to hierarchical inter-firm relationships that hinder suppliers from developing critical functions such as marketing and R&D. Cognitive lock-in means that clustered firms share a common worldview or mindset that makes it hard for them to respond to outside changes. Political lock-in concerns institutional effort to maintain existing industry structures which might damage the development of creativity.

The case of the Ruhr area shows that lock-in affects cluster evolution negatively (Grabher, 1993). The Ruhr area faced disruptions stemming from falling demand and rising competition as early as in the 1960s. However, the functional lock-in led to lack of innovation among suppliers, which were suffering from 'dependent supplier syndrome', and the groupthink from the cognitive lock-in made the firms believe that the worrying demand trend was only a short-term disruption. The firms were thus not able to respond in a timely manner to the changes in the environment. Cognitive lock-in is a fundamental problem for cluster firms in reacting to external changes. Pouder and St. John (1996) assert that the managers in the clustered firms have similar mental models because they have similar industry experience and educational training within a certain field. Through the origination and convergence phase of cluster, the existence of similar mental models and the proximity among the clustered firms induce groupthink as managers direct attention mostly towards the other cluster firms rather than firms outside the cluster and create narrow focus on their strategies. The clustered firms will eventually act differently than non-clustered firms and can miss out signals from outside the cluster, which can be critical for the continuity of the cluster.

Cognitive and functional lock-in can also lead to technological lock-in, if the firms are too focused on the current products and technologies or if the firms have not developed sufficient innovative competences. Then, they are less attentive to developing new technologies and products, which will also lead to a low level of entrepreneurship within firms (intrapreneurship). All in all, lock-in in incumbents leads to lack of innovation and intrapreneurship, which in turn makes the cluster less adaptive when the technologies shift in the specific field.

Lack of new firm creation

When clusters experience lock-in and show tendency to decline, new firms can be a source of revitalization. The Ruhr case described by Grabher (1993) proves that new firms contributed to the eventual reorganization of the industrial district that followed the decline. During the last half of the 1980s, some firms moved headquarters and R&D departments to other regions. Steel firms changed their strategic direction and began to focus more on 'processing of steel', diversifying into plant engineering, environmental technology, mechanical engineering, and electronics. A new industrial complex in environmental technology was formed, comprised mainly of newly established firms. Thus, entrepreneurship was one of the forces that drove the renewal of the old industrial district.

Similarly, Saxenian (1990) found that the high rate of new-firm formation in Silicon Valley fostered industrial adaptation in the 1980s, when semiconductor producers were challenged by Japanese competitors. Unlike the established companies in the region, these new firms began to specialize in certain areas of expertise, such as chip design and fabrication processes, and contributed to strengthening the competitiveness of the region as a whole. Simmie and Martin (2010) argue that the Cambridge high-tech cluster recovered from the early 1990s recession by continuously branching out in sub-clusters based on a strong knowledge platform in advanced mathematics and computing. New firms played an important role in this process. On the contrary, lack of new firms could lead a cluster to a declining phase. As it is illustrated in the cases

above, new firms provide an opportunity for a cluster to move into related areas of expertise. When clusters experience shocks and need to adapt to the change, new firms can be the driver for the change.

Among the different types of entrants into clusters, spinoffs are found to be especially important for cluster evolution (Buenstorf and Klepper, 2009; Dahl and Sorenson, 2009). Spinoffs, defined as firms established by entrepreneurs with experience from existing firms in the same industry, tend to locate close to the 'parent' companies and perform better than other entrants, thereby driving the formation of clusters. However, some firms are better training grounds for entrepreneurs and create more spinoffs than others, while some companies never produce a single spinoff (Klepper, 2010). If the first type of company closes down, it limits the cluster's adaptability through entrepreneurship.

Role of foreign multinational corporations

MNCs are increasingly basing their knowledge-intensive activities in clusters, "affecting both the nature and intertemporal evolution of local innovative activities" (Mudambi and Swift, 2012, p.1). The knowledge activities by the MNCs will depend on their motives for entering in the cluster and their roles in the MNC knowledge networks.

Cantwell and Mudambi (2005) distinguish the subsidiaries with competence-creating mandate from the ones with competence-exploiting mandate, using the analogies to exploration and exploitation in organizational learning theory. As the subsidiaries with competence-creating mandate invest in R&D activities that are qualitatively different from the 'locally adaptive' R&D activities of the subsidiaries with competence-exploiting mandates, this kind of subsidiary will be more active in innovation activities and therefore will have positive influence for cluster's adaptive capabilities. However, when competence-creating subsidiaries are located in a highly concentrated industry, they become more like an outsider in the inter-firm network in the host country and

therefore are inhibited in terms of knowledge inflows from the local innovation systems (Cantwell and Mudambi, 2011).

De Propris and Driffield (2006) found a positive spillover effect of FDI in clusters. This demonstrates that MNCs can have positive influence on the cluster's adaptive capabilities by enhancing other cluster firms' competitiveness. The knowledge acquired via the global pipelines can be beneficial not only for the firms directly connected to the pipeline, but also for the other firms in the cluster through spillover effect (Bathelt et al., 2004). The connection outside the cluster also contributes to increasing the heterogeneity of knowledge, which makes the cluster sustainable over a longer period of time (Menzel and Fornahl, 2010).

The existence of foreign MNCs in the cluster can also have some negative sides. Birkinshaw and Hood (2000) found that a high level of foreign ownership in cluster is negatively related to cluster dynamism, which may indicate that clusters with high foreign ownership are less sustainable in the long run. High foreign ownership was also negatively associated with subsidiary autonomy and capabilities in this analysis. Moreover, foreign-owned firms are less-committed than indigenous ones. Foreign firms are more likely to restructure, relocate, sell, and close down units in times of economic downturn (Görg and Strobl, 2003). The effect of foreign MNCs on the cluster's adaptive capabilities is thus a double-edged sword, as these companies bring knowledge and resources to the cluster, but might also leave quickly and hamper the dynamics within the cluster. If the MNCs are not embedded in the local knowledge network and do not participate in the joint action when it is needed, they can affect the cluster evolution negatively.

5.3. METHODOLOGY

5.3.1. DATA COLLECTION

The wireless communication cluster in North Jutland is a relatively small and young cluster in a high tech industry that emerged in the 1980s and began to decline in the mid-2000s. Despite its small size and relative short history, firms from the cluster were important players in the early growth phase of the mobile communications industry. In addition, several important innovations, such as the embedded mobile phone antenna, were developed in the cluster. This well-studied cluster makes it possible to follow the cluster's evolution closely and to study how the firms and institutions in the cluster reacted to three periods of disruption. The case resembles a critical case, and therefore it can be argued that what makes this high-tech cluster decline can also lead other clusters to decline (Flyvbjerg, 2006).

The data was collected in the following ways. First of all, the archives from earlier studies were used to identify cluster firms and the early history. This includes newspaper clippings, company reports, interview transcripts, draft papers and cluster association material. The list of all cluster firms until 2003 had been compiled by Dahl et al. (2003) with the founding and exit year, the names of founders and their previous workplaces, and the main events in the history of the firm. Then, new entrants from 2003 onwards were identified by consulting the cluster association's archive on member companies and searching various online databases for newspaper articles, media reports and corporate information. With the updated list of firms, the founders of the new companies and their former employers were investigated from similar sources. Each firm has been researched thoroughly for main events including ownership changes and close-downs, mainly using online sources, but also by formal and informal interviews.

The next step was to collect data on the number of employees of each firm for the last two decades. The early employment data until 2002 came from earlier work on the cluster (Dalum, 1993, 1995, 1998; Dalum et al., 1999; Pedersen,

2001; Dalum et al., 2002). The recent numbers are collected from diverse corporate databases, but since not all firms are covered by those databases, newspaper articles and media reports were used to find the numbers that are missing.

5.3.2. THE GENEALOGY OF THE CLUSTER

The genealogy of the wireless communication cluster until 2011 summarizes the development of the cluster (see Figure 5-1 in page 198-199). Fine arrows between firms show that one or more employees from existing firms established spinoff firms. Dotted arrows represent parent spinoffs where the management has come from local firms. Bold arrows show change in the original structure of the company, including acquisition by another firm and reconstruction after financial difficulties. Firms with a dotted box have exited.

5.1. THE WIRELESS COMMUNICATION CLUSTER IN NORTH JUTLAND

The cluster includes firms in the field of maritime communication and navigation, telecom and land-based satellite communications equipment, and mobile and cordless communication. In 2011, it consists of 45 firms, 2294 employees, a university and a cluster association.³

In the early years of development, the relations among the firms could be explained by competition and “production-chain-like-character” (Reinau, 2011, p. 296). Later on frequent job change within the cluster and the technical educations provided by local university encouraged the engineers to build

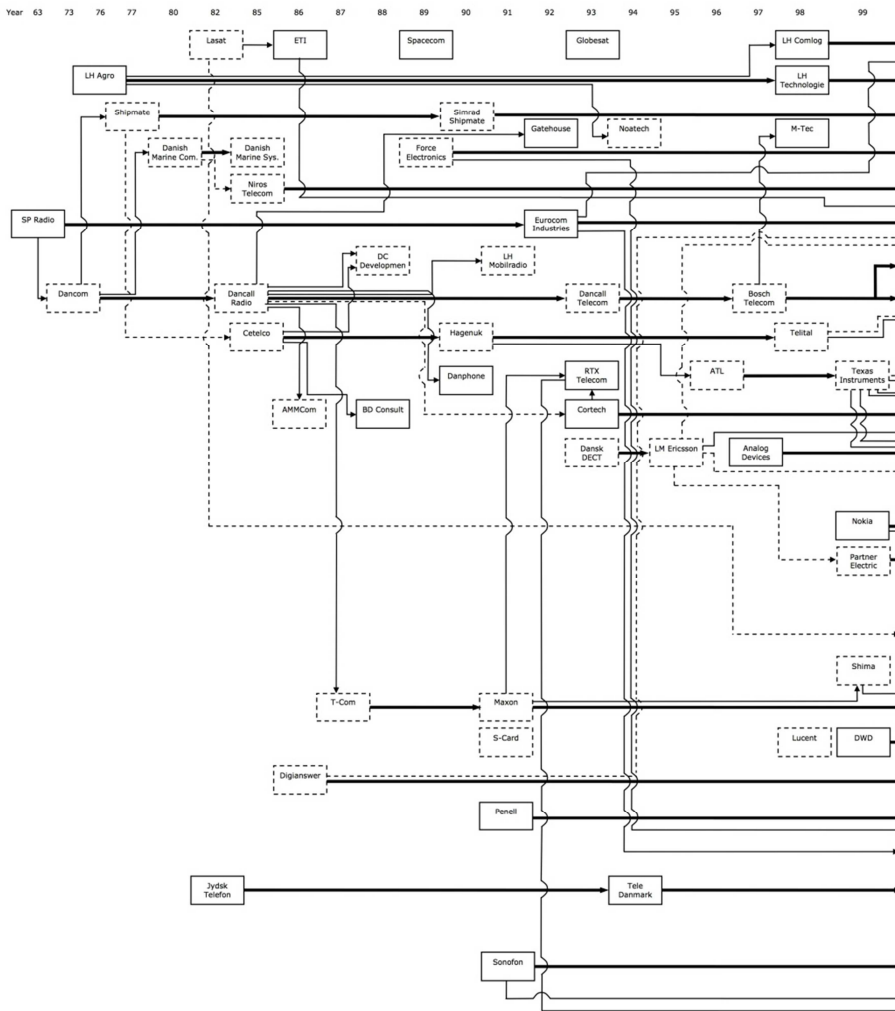
³ The average age of the cluster firms is about 11.5 years. The average size in terms of employees is 51, while the average size in terms of gross profit is about 3 million euros (this figure is only available for 38 firms). 14 companies (about 30% of the cluster firms) are foreign owned and their employees account for about 66% of the total employee population in the cluster.

personal relationships with former colleagues and fellow students, which then induced a high level of knowledge diffusion via the informal networks (Dahl and Pedersen, 2004). The university also played a role in promoting interaction among employees and firms by organizing research projects that helped build relationships and trust between the participants, which then contributed to informal knowledge sharing afterwards (Østergaard, 2009). Lastly, the firms were also interconnected through the cluster association. The cluster association created a platform for dialogue and collective actions among the cluster firms and the university.

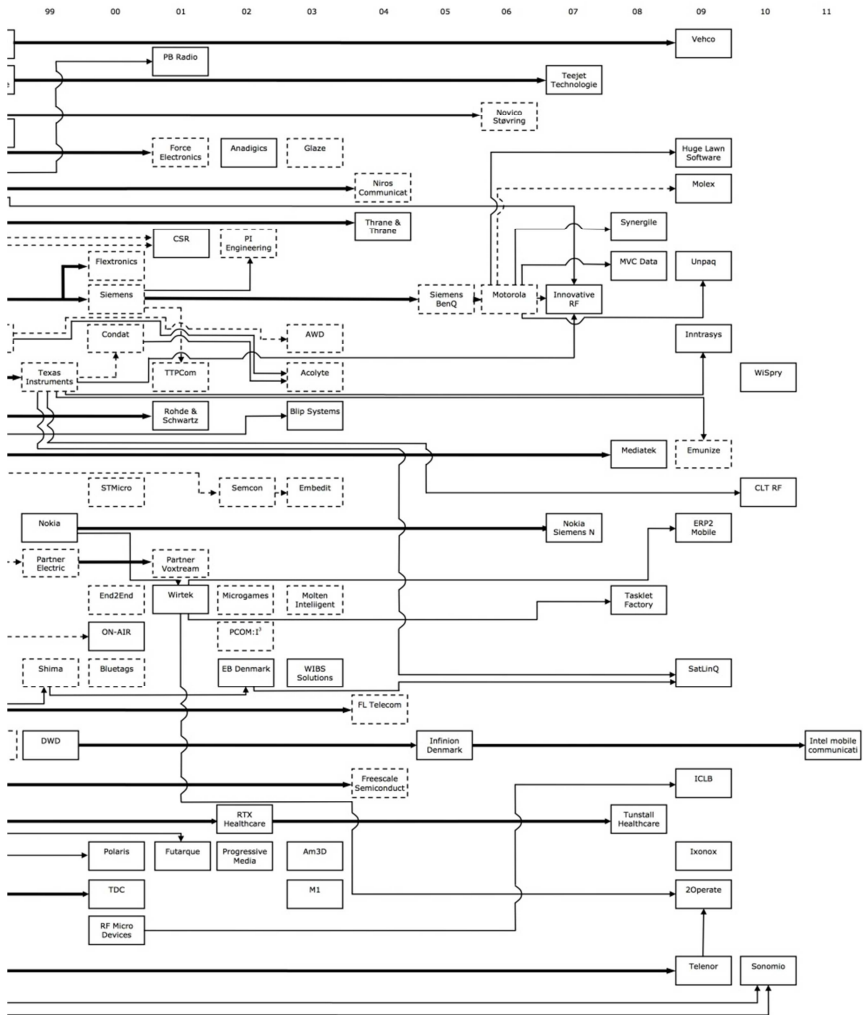
The cluster has experienced three periods of major external disruptions: 1) from 1988-92, following the shift of the mobile communications standard from the Nordic NMT standard to the European GSM standard⁴; 2) from 2000-3, when the European standard shifted to a world communications standard, and the telecommunications industry was in turmoil following the 3G spectrum auctions and the dot-com crisis; and 3) from 2007-9, during the financial crisis, the new standards, and the introduction of Apple's iPhone and the Android smart phones and new business models. The shifts in standards were not unexpected disruptions, but they were an immense technological and market challenge that disrupted the cluster and the entire industry (see Table 5-1 in page 210-211 for more details). The next sub-section investigates in more detail how the disruptions affected the cluster and how the firms reacted, while the following sub-sections analyze the evolution of the number of firms and employees in the cluster.

⁴ The evolution of mobile communication technologies can be explained well by technological life-cycles (Dalum et al., 2005). Different generations of mobile communication technology (1G, 2G, 3G, and 4G) have life-cycles of their own. Within each generation, different systems were developed in different parts of the world (e.g. Nordic countries, central Europe, the U.S., and Asia), and competed with each other. The first-generation technology system (1G) was represented by analogue mobile systems. In 1981, the Nordic mobile telephony operators launched the first cross-national public mobile telephony system, called NMT.

Figure 5-1 The genealogy of Norcom cluster



CHAPTER 5. WHAT MAKES CLUSTERS DECLINE?



5.1.1. THE WIRELESS COMMUNICATION CLUSTER IN NORTH JUTLAND

The emergence of the wireless communication cluster (1960-80s)

The history of the cluster (named NorCOM) started with the success of the leading producer of maritime communication equipment, S.P. Radio located in a peripheral region with half a million inhabitants that was characterized by traditional industries, such as agriculture, food, fishery, tourism, textiles, tobacco, and metal manufacturing. The company started producing radio communication equipment for maritime use for small and medium-sized vessels in the early 1960s with huge success. A couple of successful local spinoffs sprang up from S.P. Radio in the 1970s. In 1973, three engineers from S.P. Radio established the first spinoff company, Dancom. It also produced maritime communication equipment, and competed with S.P. Radio in the same markets. A few years later, two engineers from Dancom started Shipmate, which also produced radiophones for maritime use.

In the 1980s, a range of next-generation spinoffs came from Dancom (restructured and renamed Dancall Radio in 1983) and Shipmate. These companies diversified into the related area of mobile communication equipment, which was led by the introduction of the common Nordic standard for mobile telephony (NMT). Inheriting capabilities from the parent companies, the spinoffs were well-equipped for this diversification. One example of next-generation spinoff is Cetelco, which was established as a parent spinoff by Shipmate. Cetelco developed its first NMT phone in 1986, and began to produce mobile phones for several European and East Asian countries. At the end of the 1980s, there were 15 firms in the cluster, and the majority of those were spinoffs.

The first disruption (1988-1992) and the result (1990s)

In the late 1980s, the European telecommunication operators decided to create a pan-European system (GSM) based on digital technology. This new generation (2G) became the first technological disruption that the cluster faced. The GSM networks allowed for semi-global roaming, which created a larger

market, but also attracted new entrants. Thus, the cluster firms faced both increased technological complexity and international competition. To overcome this disruption, Dancall and Cetelco formed a joint venture company, DC Development, to develop the basic modules of a GSM phone together with Aalborg University. DC Development succeeded and its parent companies were among the first to produce a GSM phone. Other firms in the cluster followed other strategies; for example, Maxon decided to continue to make 1G phones and then moved into 2G later on when the technology had matured slightly.

In the 1990s, more spinoffs were founded based on GSM technologies, producing mobile phones, chips and other supporting technologies. This development, however, was not smooth, since several companies in the cluster faced severe financial and technological problems following the shift from 1G to 2G. Most of the troubled companies and laid-off employees were taken over by other companies in the cluster, which shows that the cluster was resilient in this period. For example, Cetelco, suffering from financial constraints, was acquired by Hagenuk in 1990. Dancall also experienced financial trouble, as their newly developed GSM phone was not competitive because of its high price. Furthermore, the export of NMT phones suffered from the growing GSM phone market and the closing of the markets in the Middle East during the Iraq war. Consequently, Dancall was acquired by Amstrad in 1993.

Despite these financial difficulties, the total employment in the cluster increased constantly from 1992. By the end of the 1990s, the number of firms in the cluster had more than doubled, mainly due to entry by spinoffs. Among the 20 entrants in the cluster, seven were entrepreneurial spinoffs and six were parent spinoffs of foreign companies such as Analog Devices, Lucent, Infineon, and Nokia. In this period, the ownership structure of the cluster changed significantly, as many foreign MNCs entered the cluster to access the competencies of local development engineers (Lorenzen and Mahnke, 2002).

In Denmark, the wireless communications industry was mainly located in North Jutland and in Copenhagen, where the latter mainly consisted of a very large R&D unit of Nokia (employing more than 1,200) and a series of smaller

firms. In North Jutland, the firms and the local university had formed a cluster association in 1997 and were increasingly visible. The cluster accounted for approximately 2.6 per cent of the total regional private sector employment in 2000, but it had become an important part of the regional identity. The location quotient of manufacturing of telecommunications equipment in North Jutland was more than five in 2000 (Pedersen, 2005).

The second period of disruptions (2000-2003)
–economic recession and technological disruption

The cluster experienced an external shock in the early 2000s when the telecommunication sector was hit by stagnating sales after the burst of the dot-com bubble. After this economic shock, the foreign MNCs in the cluster changed their strategies and either collected R&D units in the home country, or reduced R&D expenses in the subsidiaries. Consequently, many of the MNCs downsized and sacked local engineers. Some existing and new firms were able to absorb the released work force from the foreign MNCs, and some engineers even established their own companies. When Telital closed down in 2002, some employees joined new parent spinoffs established by two foreign companies. Nokia decided to move its R&D unit to Copenhagen in 2001, and former employees established Wirtek. Some local firms were also affected by this crisis and closed down. Despite the downsizing and exits, the number of companies grew, as there were many new companies entering the cluster. In terms of the wider economy, the economy was in a recession in the beginning of 2001, followed by slow growth in 2002 that increased the regional unemployment rate by less than 0.5 percentage points. The ICT sector employment also decreased slightly from 8,700 to 8,200 from 2000-2. The cluster accounted for half of the employment in the regional ICT sector.

In a report from 2002, some of the managers for foreign MNCs complained about the lack of local decision-making power in deciding R&D strategies (Dalum and Pedersen, 2002). Others feared that distance to end-users and lack of knowledge related to production might become a problem. Many of the foreign MNC subsidiaries were dependent on single customers or on internal

sales. The shift from 2G to 3G, the technological disruption, also posed a threat to the cluster. The standardization process for 3G had become global planning to create a global standard, bringing about intense global competition. The complexity of the technologies and the pressure on time-to-market had also increased. The firms in the cluster had various strategies. Some firms were initially active in 3G research (e.g. L.M. Ericsson, which closed down the unit in the cluster in 2003), and others decided to adopt wait-and-see approach to the development. Some firms tried to cooperate with others in developing the new technologies, but failed (Dalum et al., 2005). As a result, the cluster was not very active in the new technology, which affected its adaptive capabilities negatively.

The impact of the second wave of disruptions started to show in 2004, as many firms closed down or downsized, while there were no new entries. One of the big companies, Flextronics, closed down with 500 employees in 2004. The headquarters in Singapore decided to move the production to lower-cost locations. The close-down was considered a tragic event and marked the end of mobile phone manufacturing in Denmark, but the overall R&D employment was stable in the cluster, as the main layoffs were of low-skilled production workers.

The third period of disruption (2007-2009)
–technological disruption and economic recession

The introduction of the iPhone and Android-based smart phones in 2007 disrupted the industry and resulted in a significantly decreased demand for traditional mobile phones. These innovations, coming from the computer software industry, initiated a Jovanovic and MacDonald (1994) type of industry shakeout that completely changed the industry and led to the demise of the dominant firms like Nokia, Motorola and SonyEricsson that accounted for 60 per cent of the market in 2007. In addition, the financial crisis from the second half of 2008 and the following economic crisis decreased the general demand. From 2008-10, the Danish gross domestic product shrank with almost 8

percent and the unemployment rate doubled from three to six per cent. The effect on North Jutland region was similar to that on the rest of the country.

These technological and economic disruptions posed serious threats to the cluster. As a result, two central players in the cluster, Motorola and Texas Instruments (TI), ceased their activities in the cluster in 2009. The entry of Apple and other new competitors made Motorola's market share drop from 14.3 per cent in 2007 to 4.8 per cent in 2009. Motorola's Aalborg division had focused on development of new mobile telephones and production planning until the headquarters reduced the number of newly developed models, and eventually closed its European mobile-phone divisions. TI suffered from focusing on chipsets for 2G phones instead of 3G phones, and ended up closing most of its European divisions. Motorola and TI had to lay off 275 and 75 employees respectively, consisting mainly of highly skilled R&D engineers. Unlike former instances in which foreign MNCs had laid off many engineers, this time the cluster could not take in all the released talent. This resulted in workforce migration to other regions and to other industries. It seems that the cluster was not able to adapt to this major crisis.

5.1.2. THE ROLE AND ACTION OF THE LOCAL UNIVERSITY AND THE CLUSTER ASSOCIATION

Aalborg University has been very influential for the development of the cluster. Since the university was established in 1974, its main role has been to supply highly-skilled graduates. Although the indirect transfer of knowledge via graduates has been the most substantial role of Aalborg University, direct research transfer also occurred. Center for Personal Communication (CPK), established in 1993 and supported by the Danish Council for Technical Scientific Research, played an important role in this type of knowledge transfer as this center was established to focus on basic research in radiocommunications technology and speech recognition. CPK had several research projects involving both the researchers at the university and the employees in the cluster. The research effort in the field was followed by the

establishment of the large research unit Centre for TeleInfrastructure (CTIF) in 2004.

During the first disruption, the university contributed to the development of GSM competences, when DC development was established. Since the establishment of CPK, the center organized research projects aiming at developing other related technologies together with the cluster firms and the leading foreign firms in the industry. However, when the technology shift from 2G to 3G took place, the fundamental technologies for this new system were mainly developed in the other parts of the world. 3G research has been conducted at the university, but it did not have the same impact in the cluster as previously. One could argue that, during the second disruption, the university, as a source of new knowledge, failed to provide timely input for firm innovation. Realizing the need to develop new competences for the next generation of wireless communication technologies, CTIF has since initiated research projects for the upcoming 4G technologies with the participation from local firms and leading firms located abroad.

The cluster association, NorCOM, started in early 1997 as a club of firms and knowledge institutions and was formally founded as association with a board of directors in January, 2000. The mission of NorCOM was to improve and expand the scope of business opportunities, technological development and innovation in the cluster. Internally, NorCOM provided a meeting place for the cluster firms to discuss some issues within the cluster and to network with other firms. Externally, it placed effort in promoting the cluster so it is visible to the external environment as a cluster with strong expertise in wireless communication. More specifically, NorCOM organized industry-specific activities such as symposia, recruiting events, and plenary sessions.

As more foreign MNCs located their subsidiaries in the cluster by acquiring local firms, the share of foreign firms in the cluster increased, but they were not as keen on keeping the membership in the association as local firms (Reinau, 2011). The local firms were small in their size and therefore needed the brand of NorCOM in doing their business. On the other hand, foreign MNCs

did not see the necessity to be a part of the association as they already have strong brands. Additionally, some MNCs in the cluster were direct competitors to each other, which made them reluctant to participate in the joint action, especially on technology development. Therefore, the membership in the association decreased over time and the formal linkage of firms through association has weakened as well. The changed dynamics among firms in the association over time could have inhibited them to pursue efficient joint action during the crises. The decline of the cluster also affected NorCOM. It could not keep its specialized profile and it merged in January 2009 with the local industry association for the broader ICT sector.

5.1.3. OVERVIEW OF THE CLUSTER IN GROWTH, SUSTAINMENT AND DECLINE

The effects of the disruptions are also present in the data on employment and number of firms. Figure 5-2 shows the change in the population and the number of entries and exits. The number of firms had increased steadily until 2003, as there were very few exits before then, and plenty of entries. Then, after the second disruption, between 2004 and 2006, the cluster started to show signs of decline; there was no entry at all, while firms continued to exit. There are several acquisitions and reconstructions in this period which are not counted as new entry. A decrease in new-firm formation is also observed in the Cambridge cluster in its declining phase around 2005-6 (Stam and Garnsey, 2009). In 2009, entries peaked, as 10 new firms were established. The majority of these were founded by former Motorola and TI employees. However, the survival of these entrants is questionable. Among eight spinoffs, four have founders with a regular job other than the start-up. Moreover, the majority of the new firms have no employees except the founders and most of them do not show employment growth.

Figure 5-2 Total population and entry and exit of firms in the cluster

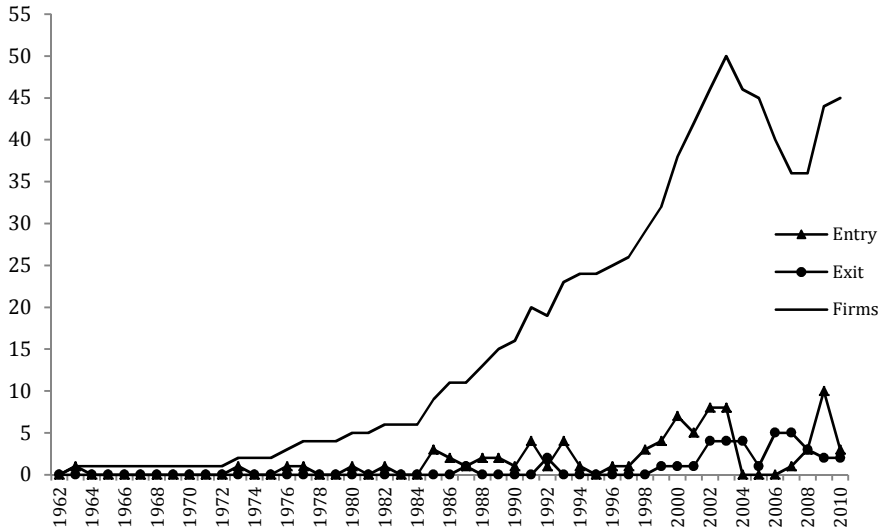
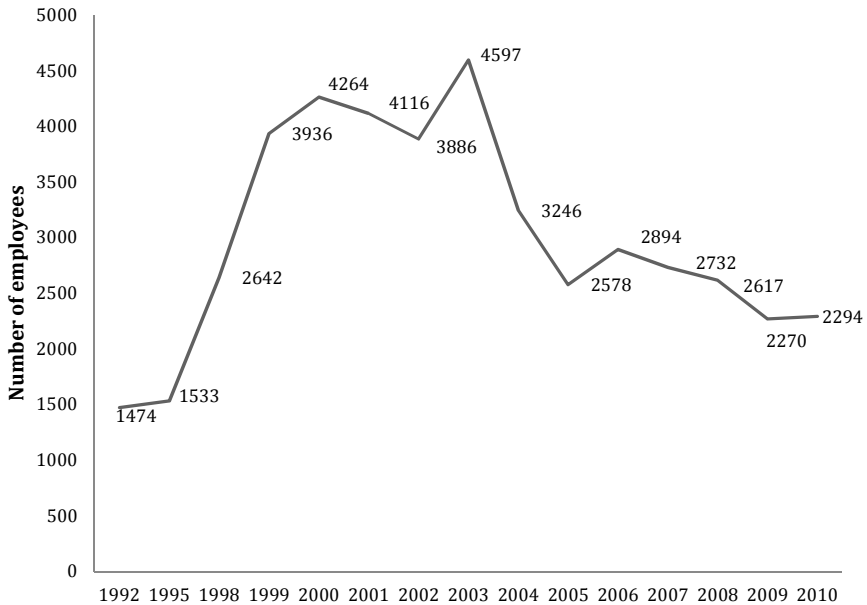


Figure 5-3 shows the change in the number of employees in the cluster. The declining trend is apparent from 2004. Following the second disruption, total employment decreased slightly from 2000 to 2002, but increased again in 2003. From 2003, the number decreased drastically until 2005, as many firms downsized and exited in this period. Except for 2006, the number of employees continued to decline until 2010, when the number increased by merely 24. Figures 5-2 and 5-3 reveal the cluster life cycle with a long emergence phase followed by a growth phase and a short sustainment phase (2000-3 in the employment data). It could be argued that the sustainment period last until 2007 despite the decline in the number of firms and employees, because the qualitative description of the cluster suggest that it is during the third period of disruptions that the large companies close down, the technological heterogeneity and diversity shrinks, R&D employees leave to non-cluster industries and the identity as a wireless communications cluster is being challenged.

Figure 5-3 Employment in the cluster



5.1.4. WHAT CHANGED THE ADAPTIVE CAPABILITIES OF THE CLUSTER AND MADE THE CLUSTER DECLINE?

The decline of the cluster is clearly linked to the lack of adaptability in the third period of disruptions. Table 5-1 shows the three periods of disruptions that the cluster faced, the dynamics within the industry and cluster at the time of disruptions, the impact of the disruptions, and the change observed after the disruptions.

The most important factor that changed was the presence of relevant technological competence at the time of transition from one generation of system to another. During the first transition, two firms formed a successful joint venture in order to develop the new technologies. The technological heterogeneity broadened as some companies founded a joint venture to focus on cordless phones while others went into related fields. This broadening of

the market and knowledge base must have increased the cluster's adaptive capabilities during the growth phase as suggested by Menzel and Fornahl (2010).

However, when 3G emerged, the development of basic technologies did not take place in the cluster to the same degree as with previous standards. Collaboration efforts initiated by some firms did not succeed. Furthermore, MNCs decided that R&D in 3G technologies should take place elsewhere. When TI acquired a cluster firm in 2002, it simply closed the 3G technology division. The 3G technology, which became a major disruption, was vastly more complex than 2G and required huge investments in R&D that only large companies could afford. The rise in innovations thus increased the entry barriers and put pressure on less efficient innovators (Klepper and Simons, 2005). Consequently, the technological competencies within 3G were mainly developed in other parts of the world.

This technological lock-in was initially not a problem, because 3G had a slow start and initially seemed unsuccessful, while 2G products still sold well. A few years later, smart phones boosted 3G sales. Facing this disruption, the lack of 3G competencies became a major problem. In addition, the innovations introduced by Apple and Google disrupted the entire industry and increased the pressure for firms to innovate or implement the disruptive innovation (e.g. switch to the Android system) or simply exit. The technological lock-in did not only lower the opportunities for new firms to emerge when the technology standard shifted, but it also deteriorated the competitiveness of incumbents by limiting intrapreneurial opportunities within firms, which eventually led to the exit of some important players in the cluster.

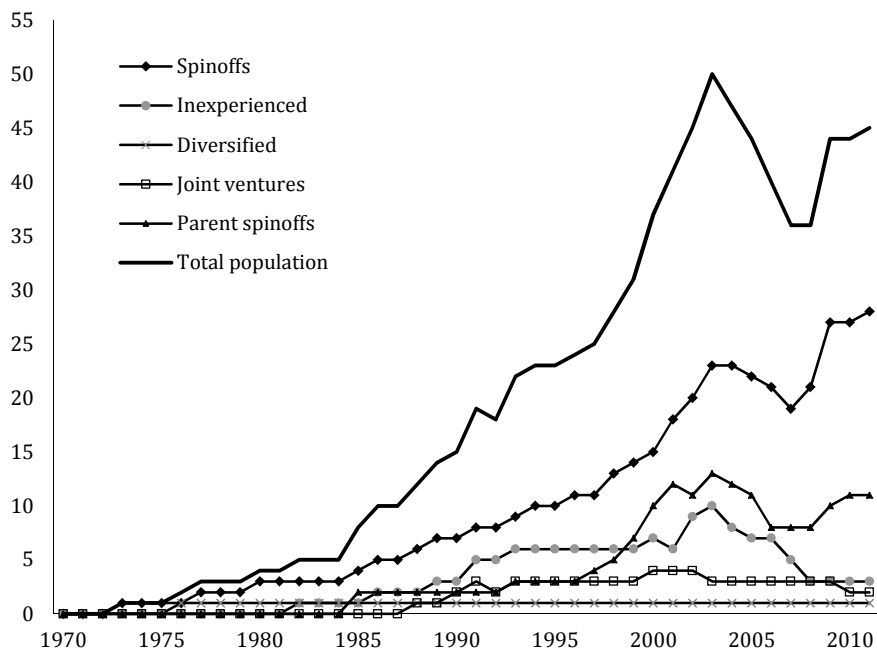
Table 5-1 Major disruptions in the cluster and change after each disruption

	1988-1992	2000-2003	2007-2009
External disruptions/ Threats	<p><u>Technological disruption</u></p> <ul style="list-style-type: none"> • New standard: 1G (NMT) to 2G (GSM) - From analogue to digital - From Nordic to European - Increasing complexity 	<p><u>Technological disruption</u></p> <ul style="list-style-type: none"> • New standard: 2G (GSM) to 3G (WCDMA/UTMS) - From European to worldwide standards - Increasing complexity • Tele service providers and 3G spectrum auctions <p><u>Economic recession</u></p> <ul style="list-style-type: none"> • Dot-com crisis 	<p><u>Technological disruption</u></p> <ul style="list-style-type: none"> • New standard: 3G (WCDMA/UTMS) to 4G (LTE) - Importance of data transmission • Introduction of smartphones - Convergence with computer industry <p><u>Economic recession</u></p> <ul style="list-style-type: none"> • Financial crisis
Industry dynamics	<ul style="list-style-type: none"> • Larger market spanning the whole Europe • Increasing demand • Increasing competition • Entry by large electronics firms • Large scale production • Intense technology development • Shorter product life cycle 	<ul style="list-style-type: none"> • Larger market spanning the whole world • Increasing demand • Mega competition • Alliance between incumbents (e.g. Sony Ericsson) • Entry of MNCs from other industries • Large scale production • Intense technology development • Shorter product life cycle • Increasing modularization 	<ul style="list-style-type: none"> • New entry: Apple, Google, and Microsoft • New operating systems • Increasing importance of software products • New path in technology development • Decline of old incumbents such as Nokia, Motorola, and Sony • Emergence of new leaders: e.g. Apple, Samsung, • Emergence of new markets: e.g. China, India

<p>Cluster dynamics</p> <ul style="list-style-type: none"> - Structure - Strategies - Policy 	<ul style="list-style-type: none"> • Around 15 firms in the cluster • Joint venture by Dancall and Cetelco to develop basic 2G technologies. • Some other firms continued with 1G phones (e.g. Maxon) • Science park NOVI providing entrepreneurial environment to firms • Collaboration with Aalborg University and National Telecom Agency 	<ul style="list-style-type: none"> • Around 45 firms and 4000 employees in the cluster • Increasing number of MNCs in the cluster • Specialization in different components of mobile phones • CTIF established at Aalborg University to focus on 4G technologies • Seedbed firms exited • Fragmented strategies of firms led to lack of 3G competences in the cluster <ul style="list-style-type: none"> - Attempt on collaboration on 3G failed - Others did not move into 3G - Ericsson with 3G competence closed down - Siemens started offshore outsourcing 	<ul style="list-style-type: none"> • Around 40 firms and 2200 employees in the cluster • Increasing number of software firms • MNCs in crisis • Exit of some major firms • Diversification among firms • Aalborg University focusing on 4G technologies • Entry by spinoffs from exiting firms
<p>Result</p> <ul style="list-style-type: none"> - Evolution 	<ul style="list-style-type: none"> • Increasing number of firms • Troubled firms acquired by MNCs • Laid-off employees were hired by other firms in the cluster. • Adaptive capabilities were strong and the cluster was still in the growing phase 	<ul style="list-style-type: none"> • Number of firms and employees started to decrease in 2004 • No entry between 2004 and 2006 • Adaptive capabilities were weakened and the cluster showed signs of decline 	<ul style="list-style-type: none"> • Decrease in the number of employees seems to be stabilized while the number of firms increased with new spinoffs from exiting firms • Limited adaptive capabilities <ul style="list-style-type: none"> - Firms that generated many spinoffs closed down - Survival of new firms is also in doubt • Cluster decline

Another factor that might have affected the adaptive capabilities after the second disruption is the exit of firms that had created many spinoffs. Looking at the change in the population of firms by entry type (see Figure 5-4), it can be seen that entrepreneurial spinoffs largely account for the development of the cluster over the whole time period. The spinoff process was especially important in the emergent phase, which is also seen in other studies (Klepper, 2010). These companies became seedbeds for many spinoffs later on, and were crucial for further development of the cluster as these function as training grounds for entrepreneurs who gain relevant capabilities and routines from the parent companies. The exit of these firms possibly affects the level and quality of entrepreneurship in the cluster in the future. This might explain the low level of entry from 2004-10.

Figure 5-4 Firms population by entry type



The next factor that changed was the concentration of foreign MNCs in the cluster. After the first disruption, some local companies were acquired by foreign firms due to financial problems. Moreover, more foreign MNCs entered the cluster in the 1990s, as they were attracted to its competence level. Initially, this increased the heterogeneity, creating global links and financial strength. However, the high concentration of foreign firms proved to be a weakness during the times of crisis. Many subsidiaries did not have much influence on strategic decisions made by the MNCs' headquarters and were also limited in their search for innovation (Reinau, 2011). Furthermore, when the industry was in crisis, many of the foreign MNCs relocated their development activities to bigger R&D centers. These negative effects of MNCs in clusters is in line with findings in the literature (Birkinshaw and Hood, 2000; Görg and Strobl, 2003; Cantwell and Mudambi, 2011).

5.2. CONCLUSIONS AND DISCUSSION

Regional clusters are constantly exposed to external disruptions from changes in the industry and the market. A cluster's ability to adapt to these changes determines the evolution of the cluster after such disruptions. This paper analyses the process of cluster decline, which has been a rather neglected subject in cluster research. An in-depth case study on a wireless communication cluster shows that changes in the cluster's adaptive capabilities are important in understanding how and why a well-functioning cluster turns into a declining cluster following several periods of disruption. What is interesting in the NorCOM story is that these adaptive capabilities can change over time, and that a once highly adaptive cluster can decline if some factors diminish its ability to renew itself.

The quantitative data points toward the signs of decline following the second period of disruption, while the qualitative signs of decline becomes evident in the third period of disruption, where large MNCs leave the cluster, the heterogeneity and diversity shrinks and highly skilled employees leaves the

cluster. Furthermore, the strong identity as a wireless communications cluster becomes challenged as the dominant firms close down and in particular with the closing of the cluster association when it merged into a broader association for the regional ICT sector. The longitudinal study on the cluster examined here enhances the understanding of the factors that influence its development over time.

The major force that affected NorCOM's adaptive capabilities was lock-in. The fact that the firms were not able to develop the newly dominant technologies in the industry implies that there was a technological lock-in. Cognitive lock-in among cluster firms have brought about the technological lock-in, as they focused on further development of the already-existing technological competencies in 2G instead of being active in developing new technologies. Organizational lock-in could be found in the operations of subsidiaries of the MNCs, where the R&D divisions in different locations had to compete against each other for headquarters' choice of new products. Sometimes, the new initiatives of local employees were turned down because they did not fit with the headquarters' overall strategy (Reinau, 2011). What happened in the cluster is also in line with the argument by Martin and Sunley (2006) that processes and configurations built up in the phase of 'positive' lock-in – in this case, the phase when GSM technologies flourished and created positive externalities – become a source of increasing inflexibility and rigidity.

However, it seems that lock-in is only part of the explanation for the cluster's limited adaptive capabilities. While Martin and Sunley (2011) almost solely focus on the reorientation of existing companies (intrapreneurship) as a source of adaptive change, new-firm creation is also critical to adaptability. One way for a cluster to reorganize itself and recover is entrepreneurship (Menzel and Fornahl, 2010). This is proven in the case when the cluster experienced the first crisis in the late 1980s. During this crisis, when firms started to exit, new organizations entered the cluster by either acquiring troubled firms or establishing new entities engaging laid-off employees. Silicon Valley, the Cambridge high-tech cluster, and the Ruhr area all demonstrate the

importance of new firms to a cluster's ability to reorganize when facing disruptions.

In addition, the strong presence of foreign MNCs in the cluster also influenced the evolution, yet with some contradictory effects in different time periods. When the cluster was in a growing phase, many foreign firms entered the cluster to get access to its highly skilled labor. After the first disruption, MNCs did in fact save the leading cluster firms that had severe financial troubles by acquiring them. In this way, the technological competencies that otherwise were in danger of being dissolved remained within the cluster. The foreign MNCs also provided access to new markets, financial resources and knowledge (Bathelt et al., 2004; Cantwell and Mudambi, 2005). Entry of MNCs therefore had a positive effect on the cluster's adaptive capabilities in this period.

However, during the next disruptions, foreign firm's presence proved vulnerability. They were largely reactive to changes in the industry, as they readily downsized or simply exited the cluster during the crises, proving that they are much more 'footloose' than local firms (Görg and Strobl, 2003). The MNCs' decision to withdraw from a location also depended on the overall performance of the company and was also affected by the severity of the third period disruptions that resembles a Jovanovic and MacDonald (1994) industry shakeout. For example, Motorola suffered from a sharp decrease in its market share in the mobile phone market, which directly influenced the company's decision to exit the cluster.

Some policy implications can be inferred from the above findings. In terms of creating diversity in the cluster and developing pipelines to other external actors, the attracting MNCs can strengthen the cluster's adaptive capabilities (see also Menzel and Fornahl, 2010; Martin and Sunley, 2011). MNCs can also takeover failing firms and preserve the activities in the cluster in the time of disruption. However, policies towards foreign MNCs should ensure that these firms are embedded in the cluster environment and maintain their commitment to the cluster over time. The existence of foreign firms clearly brings both positive and negative effects to the clusters. The footloose nature

might be a challenge when adapting to a major disruption. In order to deal with these issues, policies should also direct attention to supporting the local actors in retaining the technology leadership within the cluster. For a declining cluster, policies could also be directed towards helping the laid off employees entering related industries and avoiding a chaotic decline.

The findings in this paper point to some relevant future research areas. Firstly, studies on evolution of other wireless communication clusters within the same period of time will reveal more location-specific factors that may affect the decline of clusters. Secondly, how the adaptability of a regional economy is related to that of a cluster is an area of study that needs more attention, as this has policy implications for both regional economies and clusters.

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CHAPTER 6. KNOWLEDGE INTENSIVE ENTREPRENEURSHIP FROM FIRM EXIT IN A HIGH-TECH CLUSTER¹

The case of the wireless communications cluster in Aalborg, Denmark

6.1. INTRODUCTION

This chapter addresses how the existence of a cluster of firms with a specific knowledge base in a region affects future knowledge intensive entrepreneurship (KIE) in that region. Focusing on spinoff activities, the case of the wireless communication cluster in North Jutland in Denmark demonstrates how entrepreneurs develop knowledge, skills, routines, social capital and networks while working in an industry and then go on to use these resources to create new business in the same or related industries in the same approximate location.

Various studies show that spinoffs, firms established by entrepreneurs with prior experience gained from existing firms in the same industry, perform better than other types of start-ups (see, for example, Dahl and Reichstein, 2007). It is believed that when the founder has pre-entry experience in the industry, relevant routines, skills and knowledge are transferred from the incumbents to the new firms, providing a competitive advantage to spinoffs as compared to other entrants into the industry. Since spinoffs tend to locate close to the 'parent' companies and perform better than other entrants, spinoff activities often lead to the geographical clustering of firms. This means that the

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existing industry structure of a region may affect the development of that industry in that region in the future. Empirical studies of the semiconductor industry in Silicon Valley, automobile industry in Detroit, tire industry in Akron and the high-tech cluster in Cambridge, UK illustrate this mechanism quite well (Klepper, 2010; Buenstorf and Klepper, 2009; Garnsey and Heffernan, 2005).

The main purpose of this chapter is to highlight knowledge intensity with reference to spinoff activities in a high tech cluster. More specifically, it shows how the entrepreneurs' knowledge of markets, products, technologies, unmet customer demand, competitors, suppliers and skills gained from pre-entry experience affect their search for and utilization of new business opportunities. Unlike studies focusing on the spinoff activities that drive the formation of clusters, however, this chapter intends to take a closer look at spinoff activities in a cluster originating from company closure.

The chapter investigates KIE in the wireless communications cluster around the city of Aalborg in northern Denmark. The cluster consists of firms in the field of maritime communication and navigation, telecom and land-based satellite communications equipment, and mobile and cordless communication. This comprises a high technology knowledge intensive industry characterized by fast technological change and a growing global market. The first company here was established back in the 1960s, but the main growth in the cluster occurred during the 1990s, when the 15 firms grew to 40. The cluster peaked in 2003 with 50 firm employing 4,500 people. Recently, the turbulence in the global wireless communications industry coupled with financial crisis hit the cluster hard and caused the downsizing and even exit of firms. In 2009, a research and development subsidiary of Motorola located in the cluster closed down. About 275 employees were laid off, but at the same time 20 new firms were founded by former employees. The case to be studied in detail is the KIE following the closure of the Motorola subsidiary. It will describe how these firms were founded and explore relations in general between the previous company and the new firms. Then, one of the new firms is chosen for a more detailed description of this type of knowledge intensive entrepreneurship.

6.2. THE CASE: KIE IN A HIGH-TECH CLUSTER FOLLOWING FIRM CLOSURE

This section starts with a brief history of the wireless communication cluster by way of an introduction to the past KIE pattern. There follows a description of KIE after the closure of Motorola in 2009. The rapidly changing landscape of the mobile communication industry in recent years and the process of closure will be presented before KIE by the spinoffs are described in detail.

6.2.1. EARLY SPINOFF ACTIVITIES IN THE CLUSTER

The development of the wireless communication cluster in Aalborg, Denmark was always highly characterized by spinoff activities. The very first firm in the cluster, S.P. Radio, had diversified into wireless communication equipment for maritime use (small and medium sized vessels) in the early 1960s. The company was very successful and its products were considered technologically more advanced than those of the few competitors at the time. In 1973, three engineers from S.P. Radio established the first spinoff company, Dancom, producing maritime communication equipment. In 1977, two engineers from Dancom founded Shipmate, which also produced radiophones for maritime use. Shipmate developed a very successful satellite navigation system in 1981 at a third of the cost of its competitors and subsequently grew from three employees to 200.

Dancom went through severe financial difficulties in the early 1980s and was restructured and renamed Dancall Radio in 1983. At the same time, the company diversified into the related market of onshore mobile communications. Dancall grew quickly in the 1980s following the opening of the market based on the new common Nordic standard for mobile telephony (NMT). The size of Dancall and its technological base in the growing market for mobile phones and other wireless communication technologies made it a main seedbed of KIE in this cluster. The firm went through several crises and owners, but continued through the 1990s and 2000s to be a key company in

the cluster, with many of the local entrepreneurs in the industry coming from this company. Shipmate, meanwhile, also expanded into mobile communications with the purpose of exploiting the promising business opportunities in the new market, through the establishment of a company named Cetelco. Cetelco developed its first NMT phone in 1986 and began to develop and produce mobile phones for several European and East Asian countries. In the 1980s and early 1990s, several spinoffs arose from Dancall and Shipmate, such as Danish Marine Communication (1980), Ammcom (1986), T-COM (1987), BD consult (1988), LH Mobil Radio (1991) and Gatehouse (1992). The founders of these firms often list new market opportunities not followed by the parent company or disagreement with the company strategy as reasons for starting their own ventures.

In the late 1980s, the work on a common European standard for mobile telephony (GSM) began. Dancall and Cetelco established a joint venture, DC Development, to develop the basic modules of a GSM phone together with Aalborg University at the local science park, NOVI. DC Development succeeded in developing the basic technologies, and these parent companies were among the first to introduce a GSM phone, in 1992. By this time Cetelco had more than 100 employees, but it faced financial problems and was gradually taken over by the German company Hagenuk, in 1988-90. Dancall had grown to more than 600 employees by 1993, but it too went into financial difficulties and sold its cordless telephony division. The problems continued, however, and Dancall was taken over by Amstrad, and then, in 1997, acquired by Bosch, which wanted to enter the industry and grew it to 1,700 employees by 1999. A year later the company was split into two, with the production side sold to Flextronics, and the R&D to Siemens.

The wireless communication cluster grew rapidly in the 1990s with its competences in the GSM standard attracting various types of start-ups, including parent spinoffs, but which mainly represented multinational corporations (MNCs) acquiring local firms or making green field investments. Motorola was one of the MNCs to create a subsidiary in the cluster so as to

access the specialized knowledge of workers in the mobile telecommunication technology there. The cluster started to decline when the new standard (3G) emerged, however, mainly due to a lack of competences in the new technologies. After the peak of 2003, the number of firms and employees in the cluster started to drop, a decrease that continued with the (ongoing) major changes in the industry and the financial crisis from 2007. The decline of the cluster intensified when Motorola and Texas Instruments closed down in 2009. At the time of writing, the cluster consists of 45 firms employing some 2,300 people, together with a university and science park. The next section explains the changes in the industry that led to the Motorola closure.

6.2.2. TURBULENCE IN THE MOBILE COMMUNICATION INDUSTRY

The introduction of the iPhone and Android smart phones in 2007 and the subsequent rise of new competitors proved to be a disruption to the mobile phone industry. These were 'disruptive' technologies in the sense of significant changes in the basic technologies that effect an alteration of the pattern of the existing industry. Christensen (1997) describes the disruption as not necessarily brought about by the new technology itself, but often coming from the new business models, applications or customers that follow the introduction of the new technology. The disruption often comes from new firms entering the industry and the outcome is often a shift of market leaders and location (Utterback 1994). The Apple's iPhone OS (iOS) and Google's Android operating system radically changed the industry. The iPhone was initially not considered to be a good product by many of the traditional mobile phone companies in terms of its functioning as a phone, but together with the new technology it managed to change the entire industry in the years that followed.

According to Gartner, the market shares of the mobile phone market in 2008 were: Nokia 38.6 per cent, Samsung 16.3 per cent, Motorola 8.7 per cent (dropping from 14.3 per cent in 2007), LG Electronics 8.4 per cent, and Sony Ericsson 7.6 per cent, while Apple sold 11,417,500 units, or 0.93 per cent. In

2011, Nokia's overall market share of mobile phones had dropped to 23.8 per cent followed by Samsung (17.7 per cent), Apple (5 per cent) and LG electronics (4.9 per cent), while Motorola had fallen to 2.3 per cent market share. The sale of smart phones reached 31 per cent of the total number of mobile phones sold in 2011. The dominating operating system in the fourth quarter of 2011 was Android (50.9 per cent) followed by Apple's iOS (23.8 per cent) and Nokia's Symbian (11.7 per cent)².

The financial crisis also created problems in the industry. Commencing in 2007 in the US housing sector and financial industry and drastically worsening in September 2008, when Lehmann Brothers collapsed, the crisis then spread to the real economy causing an almost worldwide recession. Sales of mobile phones were adversely affected, especially in the West where consumer confidence plummeted. In Denmark the unemployment rate rose from 2 per cent in the summer of 2008 to 6.5 per cent in January 2010, while GDP growth was at -1.1 per cent in 2008 and -5.9 per cent in 2009 (the worst recession in the Danish economy since the Second World War).

Focusing on rather traditional mobile phone technologies, Motorola in particular faced a survival challenge during this phase of disruption. This worsened during the economic crisis which created a rather unfriendly business environment. This is illustrated in more detail in the next section.

6.2.3. CLOSURE OF MOTOROLA IN THE CLUSTER

Motorola had entered the cluster in 1999 by acquiring a local firm called Digianswer. In 2006, it acquired the activities of BenQ in the cluster, which had taken over Siemens' activities there in 2005. It also acquired TTP Com's subsidiary in the cluster, which had been founded by former Siemens employees and operated as a supplier to Motorola. Motorola's Aalborg division

² Numbers from Gartner reports on 'Market Share: Mobile Devices by Region and Country'. Available at: <http://www.gartner.com>

focused on development of new mobile telephones and preparation of the production (initiating ramp- up production and finding production partners). As a result of the severe trouble in which Motorola found itself, the company headquarters decided to restructure the division, shift to the Android platform and reduce the number of newly developed models. Then it decided to move out of the European mobile market altogether, and Motorola in Aalborg was closed down.

The closure of Motorola in Aalborg was announced in November 2008, its 275 employees laid off in mid-December and the company officially wound up at the end of March 2009. At first the local management contacted Invest in Denmark and made a list of potential companies that might be able to take over the operation. Then it started to contact these companies by formal and informal channels. The formal assignment was to recoup the fixed capital (selling the equipment, buildings etc.), but the management also worked on a strategy to help the employees find employment or start new firms if the continuation of the company as a whole was to fail.

The management organized a seminar with 34 local and national firms to help the employees back to work. It also held an idea generation seminar and invited entrepreneurs and local entrepreneurship organizations to explain various ways to start a new company. The seminar generated many good ideas for new firms and also created connections between the former employees and the invited companies. The employees received up to six months full salary when they were laid off. Despite the troubled economic situation, 24 per cent of the employees had found a new job by February 2009, a share that had risen to 40 per cent by June and 52 per cent by August. And former Motorola employees also founded several new companies.

6.2.4. KIE BY FORMER MOTOROLA EMPLOYEES

Twenty new companies were founded by ex-Motorola employees during the period 2008–2010, and two parent spinoffs were also attracted to the region.

Regarding the latter, the US based company Molex founded a subsidiary by taking on a group of employees with special competencies in antenna technology. The head of the antenna unit at Motorola Aalborg started in November 2008 to look for a firm to take over their group if a takeover of the division failed. He had worked many years in building the group of employees with unique antenna competencies and acquiring equipment. Making use of their network, they ended up contacting Molex, with whom they had worked previously as a supplier. As a result, Molex took on seven employees, acquired the specialized equipment and rented office space in the old Motorola building. Today they develop, design and test antenna solutions and have a joint project with Aalborg University on 4G LTE antennas. This type of entrepreneurship has an established history in the cluster, where several parent spinoffs have been founded by local engineers. Mobility in teams is also a frequent phenomenon when companies close down since employers look to take on well-functioning units. The Finnish company Ixonos also founded a parent spinoff at the NOVI Science Park in Aalborg, employing some of the former Motorola employees working on Android solutions.

Compared to Motorola, the two new parent spinoffs are more specialized, focusing on certain (antenna and software) functions of mobile phones. Moreover, both companies are engaged in developing technological competences in rather new systems such as 4G and the Android operating system. Therefore, we can conclude not only that KIE in the form of parent spinoffs (subsidiaries) secured the continuation of the existing competences stemming from Motorola, but more importantly, that the influx of new competences from the parent firms advanced the further development of existing competences towards the new, now dominant mobile communication systems.

Regarding the 20 new companies, these employed a total of 44 employees including the founders. Seven of the start-ups can be labeled as hobby start-ups since the founder has a regular job in another firm. Most of the companies are based on the entrepreneurs' pre-entry experiences. However, only four of them

can be characterized as spinoffs in the cluster following a narrow definition of the cluster that is, including only firms dealing with wireless communications technologies. Many of them used their competencies in software development gained at Motorola to establish companies in the broader ICT sector (see Table 6-1). These mostly work on developing software for other companies as IT consultants. For example, PCB-Support was founded by printed circuit board (PCB) designers working on PCB design, while Code Craft was founded by software engineers developing software for a broad range of customers.

Other firms established after the Motorola closure also show how entrepreneurs' knowledge and experience gained in former job functions at the defunct operation may be transferred to new firms. A technician, a senior design engineer and a metrology engineer founded a company called 3D-CT, which specializes in CT measuring. While working in Motorola, they were the first to be introduced to CT technology in the mobile industry and in Denmark. When Motorola closed down, they bought the CT scanners from the company and started providing consultancy services. The former director of the division established a management consulting firm specializing in helping firms through the liquidation process. He continues to draw on his experience of managing rounds of layoffs and the process to final close-down, and including the organization of job-searching seminars for the laid-off employees.

All the spinoffs created from Motorola's exit are presented in Table 6-1. As most of the firms were created outside the wireless cluster, this illustrates that there has been knowledge dissemination from the wireless communication industry to other adjacent industries through KIE. Furthermore, a high correlation between the former position in Motorola and the new ventures indicates that the competences gained in Motorola are highly utilized in the new firms, which demonstrates transferability of the competences to other industries.

Table 6-1 Spinoffs by former Motorola employees

Firm name (Founding year, exit year)	Industry	Jobs	Founder's prior position(s) at Motorola	Field of activity
3D-CT (2009)	Other	7	Technician, Senior Design Engineer, Metrology Engineer	Measurement center with CT scanner
Arcane labs (2009)*	ICT	2	Software Engineer/Team Leader, System Engineer	X-box games, Classicard games
Cloud Circus (2010)	ICT	5	System Engineer	Software development
Code craft Aps (2008)	ICT	3	System Engineer	Software development
Createitreal (2009)	ICT	1	Project Leader Engineering	Developing 3D printing and automated fabrication technologies
Flexmanagement (2010)	Others	1	Director	Management consulting
Full circle design.dk (2009, 2010)	ICT	1	Product Manager	Embedded UIs, Documentation of UI Design
Huge Lawn software (2009)	Wireless	5	Quality Manager	iPhone and iPad applications
MVC-data (2008)	Wireless	2	Senior Software Engineer	SW and HW development , solutions with Bluetooth technology
NeoGrid Technologies (2010)	ICT	3	Line manager, Function manager	Solutions for controlling electricity demand
NordicRefurb (2009)*	Others	1	Department Manager	Electronic test and manufacturing equipment.
North Development consult (2009, 2009)	ICT	1	Senior Electrical Engineer	Engineering consulting
OR Pro (2009)*	Others	1	Requirement Manager	Project management
PartDesign (2009)	Others	2	Sourcing manager, Mechanical project leader	Mechanic construction, FEM analysis, Sourcing in China

PCB-support (2009)	ICT	2	Printed Circuit board (PCB) Designer	PCB design
Proint s.m.b.a. (2009)*	ICT	2	Project Leader , Program Manager	IT consulting
SES IT (2010, 2010)	ICT	1	Software Test Engineer	IT consultant
Synergile (2008)*	Wireless	1	Engineering Lead	RF Engineering solutions
Unpaq (2009)*	Wireless	1	Software Engineer	Software, Mac OSX, iPhone
Utopia Solutions (2009)*	ICT	2	Software Engineer	Web shops and custom web-solutions

* Hobby start-ups: the founders have regular jobs in another company. HW: Hardware; RF: Radio frequency; SW: Software; UI: User interface

6.2.5. HOW AN ENTREPRENEURIAL SPINOFF IS BORN FROM AN EXISTING COMPANY: THE STORY OF HUGE LAWN SOFTWARE

In this section, entrepreneurial process of one specific spinoff company, Huge Lawn Software, will be described in detail to show how the founder developed a business idea from his experiences in an existing firm and how firm closure provided a good opportunity to start up a venture.

Uffe Koch, the founder of Huge Lawn Software, has an engineering education with specialization in IT and computer technology. He was working in British TTPCom's local subsidiary when Motorola acquired the firm, in 2004. TTPCom developed mobile phones and software for other firms and Motorola was one of their biggest customers. When the firm was acquired by Motorola, Koch had high hopes of the opportunities that Motorola would bring as one of the major companies in the industry. However, the software that he and his colleagues had worked on for many years was given a low priority compared to the other projects already running in Motorola and in the end the project was completely curtailed. It was about then that he realized the potential of iPhones (smartphones). He tried to convince Motorola that the company needed to pay

more attention to the new technologies for smartphones, but he did not succeed.

When his ideas were not accepted in the Motorola, Koch started to think about establishing his own company, to develop applications and other small programs for smartphones. He started investigating how to start up a business and took a (weekly) course in entrepreneurship. In this way, he was taking the first step toward starting his own business while he was still employed at Motorola. When the news on the closure of Motorola came out in 2008, he had already decided to quit his job and had written a letter of resignation. However, it turned out that, due to his seniority in the company, he could get a half year's full salary from the time of closure. He decided to utilize this opportunity to realize the idea of establishing his own company. Since he had been developing the idea and had prepared for the opportunity, he was able to start as self-employed from the day he lost his job at Motorola.

The local entrepreneurship organization offered 12 hours of consulting for a good price and Koch took the offer to bring the idea into practice. Although he had experience in developing applications and software for a different operating system, he decided to enter the market for iPhone applications as he found the Apple development tools and environment exciting and saw huge business opportunities in this market. He knew that he had the relevant knowledge, experience and not least network to make this work. In the starting phase, Huge Lawn Software was mostly hired to develop applications for large company and organization marketing. These apps were distributed free to customers and other stakeholders, and Huge Lawn Software was paid for the development work directly by its customers. However, in some cases, some applications developed for marketing purposes were found to be unique and so useful that they were sold in Apple's app store and even became very popular as a category in their own right. The company grew quite quickly and three in-house developers and various freelancers were hired. Since its foundation, this company has developed, among others, an interactive application for a major Danish radio station, a weather forecasting application for a windmill company

and an application for a campaign that the National Board of Health is running. In 2012, it announced that it now is also capable of developing Android apps.

6.3. CONCLUSION

The case in this chapter describes KIE in the form of spinoff activities in the wireless cluster in a region of northern Denmark. To start with, the history of the cluster showed that firms that were successful in a certain industry have created spinoffs of many generations that diversified into related fields. The KIE was indeed the driving force behind the formation of the cluster, and this demonstrates how existing firms and the knowledge base affect future KIE.

Moving on to the focus of the case, namely the KIE from the exit of Motorola in the cluster in 2009, a similar pattern of spinoff activities is observed. The spinoff pattern shows that the knowledge and the experience gained by the founders in the former workplace contributed positively to new venture creation. Firstly, most founders established new firms in either the same wireless communications industry or the related ICT industry. As most of the employees in Motorola were R&D engineers, the technological competences that they possess were transferred to the new company, which is clearly shown in their choice of industry. It is also apparent that there is a connection between the former job functions in Motorola and the services and products that the new firms provide. Most of the spinoffs are consulting firms that offer services that fall within their competences utilized in their old jobs. Software developers and hardware developers founded consulting firms that offer consulting within software development and hardware development, respectively; a technician who used to work with CT technology on the measurement of industrial products took over the equipment from Motorola and started a company measuring diverse industrial products for customers.

Moreover, the knowledge the founders accumulated on the market and the industry also helped them detect good business opportunities. In the case of Huge Lawn Software, the founder spotted a lucrative business opportunity in the iPhone app market because he was engaged in developing software in one

of the biggest mobile phone producers in the industry. He knew exactly how the industry and the technologies were developing in this field. Not only did he have the skills to try out Apple's development tools, but he also had enough knowledge of the market to analyze the business potential of the idea. All this goes to show that existing firms and their knowledge base can strongly affect the future KIE in a region and that the entrepreneur's pre-entry experiences influence the creation of new ventures.

The knowledge diffusion in this case took place through the mobility of the employees released through the Motorola firm closure. To find out to what extent the knowledge diffusion took place through KIE, it is necessary to take a look at how many of the 275 former Motorola employees found a new job in existing companies and how many participated in KIE through spinoff activities. Out of 247 employees that had found employment as of 2011, 220 people were working in existing companies and 27 had founded new ventures. This means that about 10 per cent of the released workforce from the existing company contributed to the knowledge diffusion by KIE. Thus most diffusion of knowledge would seem to have taken place through the mobility of employees who simply got new jobs. The share of KIE appears to be high given the unfriendly business environment during the financial crisis, but it is uncertain if many of these will survive or grow substantially in the future.

We have also learned that firm exit in one industry has an effect on KIE in other industries in the region. The closure of Motorola created spinoffs, the majority of which were in industries other than that of wireless communications. Only four out of 20 new firms were established within the boundary of the wireless communications cluster. A total of 11 companies can be identified as operating within the broader boundary of the ICT industry, while five firms moved into totally different areas. As many founders utilize their specialized competences in their start-ups, we can assume that the ICT and other unrelated industries will benefit from the knowledge these new firms bring. Thus, knowledge diffusion does take place through KIE from existing firms, but it appears that, in this case of a declining cluster, most KIEs start up in related industries. This

is because a declining cluster and the very turbulent mobile phone industry do not favor the entry of small start-ups. However, the KIE from Motorola are to a large extent still based on the existing knowledge base from Motorola.

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CHAPTER 7. CONCLUSION

This thesis investigates what implications the globalization of value chain activities of firms has on innovation in the involved firms and locations. The first part of the thesis studies offshoring practice in particular and focuses on the implications of offshoring on innovation at the firm level. The second part of the thesis looks into what implications the activities of multinational firms have on a regional economy.

7.1. PART I

The three chapters in part I focus on offshoring firms and investigate how offshoring implementation is associated with dynamic capabilities, how offshoring firms manage knowledge, and how they perform in terms of innovation after offshoring implementation.

Chapter 2 studies the association between offshoring and the two underlying factors of dynamic capabilities, innovative capabilities and adaptive capabilities, by comparing the capabilities of offshoring firms with non-offshoring firms. The adaptive capabilities refer to a firm's ability to react to market changes in a timely fashion while, the innovative capabilities refer to ability to develop new products, markets, processes, and organizations. The results from this chapter shed light on the characteristics of the offshoring firms compared to the firms that have not offshored and thereby enhance the understanding of the actors of offshoring. Identifying the characteristics of offshoring firms helps interpreting the implications of offshoring on firms and locations. The findings show that the two types of dynamic capabilities have opposite association with a firm's engagement in offshoring. While there is a positive relation between innovative capabilities and offshoring, a negative relation is found between adaptive capabilities and offshoring. When the distance between the home country and the host country is included in the analysis, the results indicate that the negative relation between adaptive

capabilities and offshoring only exists for the offshoring implementation to distant locations and not for the implementation to nearby location. This suggests that the geographical distance between value chain activities increases the complexity of operations and works against offshoring firms' timely-reaction to changes in the environment. On the other hand, the positive association of offshoring to innovative capabilities is consistent in the case of 'near'shore destination and 'off'shore destination. This association can be explained by the conceptualization of offshoring as the implementation of organizational innovation. Offshoring as a new way to organize value chain activities can be seen as the realization of organizational innovation, which means that firms need to have innovative capabilities in order to implement offshoring. Furthermore, it is found that the two association patterns only exist for the offshoring of certain type of activities. The positive relation between innovative capabilities and offshoring does not exist for production offshoring and the negative relation between adaptive capabilities and offshoring does not exist for administrative service offshoring.

Chapter 3 studies how the level of codified knowledge transfer varies among offshoring firms depending on the various attributes of offshoring implementation. The codification of knowledge related to the activities that are being relocated is a critical matter for the success of offshoring implementation, which deserves more attention in the offshoring literature. The results from this chapter show that efficiency-seeking motivation for offshoring is positively related to the level of codification effort in offshoring implementation. Efficiency-seeking offshoring has the primary purpose of cutting out costs by relocating activities to low income countries. It is argued in the paper that firms with this strategic motive need to replicate the home operations as closely as possible in order to maintain the quality of the output from the relocated operations, and this requires more intense upfront codification of knowledge. It is also found that while locational factors such as the competence level of the offshore destination and the geographical distance do not have any influence on the level of codification, the type of activity that is relocated shows association with codified knowledge transfer. How advanced

the activity is, which is a characteristic that cuts across the functional division, is related to how much firms codify knowledge in relation to offshoring. Advanced activities are more complex, knowledge intensive, and perhaps less familiar to the workers in the foreign countries when compared to more standardized and simple activities. Managing this type of activities across distance will therefore necessitate more intense codification to secure common understanding between the headquarters and the offshored unit.

Chapter 4 investigates how offshoring affects innovation performance of firms after the offshoring implementation, studying a direct relation between offshoring and innovation. The empirical analysis on Danish data shows that there is a positive impact of offshoring for innovation, meaning that offshoring firms are more likely to introduce new products and services compared to non-offshoring firms. It is argued in this paper that firms are able to diversify the sources of knowledge and increase the depth of knowledge for innovation through offshoring. The skill composition in the firms in the home country may also change to a more favorable setting for innovation activities. Testing different attributes of the offshoring implementation, it is furthermore found that the more disaggregated the firms' value chain is, the more likely it is that the firm introduces innovation. In terms of offshoring location, offshoring to developing countries did not have any significant effect on innovation while offshoring to advanced countries showed a positive impact. Interestingly, it is found that, when firms offshore to both developing and advanced countries, they become more likely to introduce innovation than firms that only offshore to advanced countries. These results suggest that the diversification of knowledge sources can be the main explanation for this positive impact of offshoring on innovation. The finding that the likelihood of innovating increases with the degree of disaggregation of value chain activities indicates that the firms that have a role of an orchestrator in managing highly-disaggregated activities are more likely to innovative. The underlying mechanism could be that these firms are specialized in managing knowledge in various locations and combining it to create new products and services.

Analyzing the impact of different governance modes, offshore outsourcing did not have any significant impact on innovation while captive offshoring did.

As mentioned earlier, the positive association between innovative capabilities and offshoring found in *Chapter 1* suggests that the firms that are more innovative can be more likely to be engaged in the reorganization of value chain activities. Innovative firms will be more strategically oriented towards the renewal of the routines and are also likely to possess capabilities for implementing changes in the organization. This finding helped designing the empirical analysis of *Chapter 4*, in which the impact of offshoring on firm-level innovation is analyzed. As more innovative firms are more likely to have offshored activities, their innovation performance before the relocation needs to be controlled for in order to study how offshoring affects innovation performance after the relocation. The results from the estimation model, which controls for innovation performance prior to offshoring, show that offshoring has indeed a positive impact on the firm's likelihood of introducing new products and services. However, with this finding, it is not clear whether the positive association between innovative capabilities and offshoring from *Chapter 1* reflects the self-selection of innovative firms into offshoring implementation or the positive influence of offshoring after the firms have relocated activities.

Throughout the chapters, some attributes of offshoring implementation such as offshored activity, strategic driver, governance mode, and location have been included in the analyses to investigate if the specific setting of offshoring makes difference in the relation between offshoring and the respective subject of investigation.

Firstly, the offshore location is found to influence the relation between offshoring and adaptive capabilities and the impact of offshoring on innovation. The spatial distance between the home- and the host country hinders firms from being responsive to changes in the environment. With regards to the impact of offshoring on innovation, the competence level of offshore location makes difference as the firms that are offshoring to advanced

economies are more likely to innovate than non-offshoring firms while the positive impact of offshoring is not found in the firms that are offshoring to developing countries. However, these two locational factors do not have any influence on the level of codification in offshoring implementation.

Secondly, what kind of activities firms relocate matters in explaining the level of codified knowledge transfer and the relation between dynamic capabilities and offshoring. Offshoring firms codify knowledge to a higher degree when they offshore more advanced activities regardless of the functional division of the activities. The typical association of codifiability and administrative service activities is not apparent in the results in the thesis. Rather, the functional division of activities has implications for the association between dynamic capabilities and offshoring. The negative association between adaptive capabilities and offshoring exists for the offshoring of production activities and the offshoring of development activities, but not for the offshoring of administrative service activities. This suggests that managing administrative service activities do not necessarily become more complex as distance increases.

The strategic driver for offshoring is related to the level of codification while it does not have influence on the impact of offshoring on innovation. Strong efficiency-seeking motivation is positively related to the intense codification of knowledge in offshoring firms, and the mechanism behind this association is the necessity to replicate the home operations as well as possible so that the firms do not compromise the quality in the output and the productivity in operations.

Lastly, the governance mode is found to be critical for innovation performance as there is no positive impact of offshoring on innovation when the activities are outsourced to independent suppliers. This suggests that international knowledge sourcing across the organizational boundary is not as efficient as knowledge sourcing within the organization.

7.2. PART II

The two chapters in part II have the empirical setting of a regional cluster that once had hosted several 'knowledge-seeking' FDI activities by big MNCs in the growing phase and then experienced the closure of these MNCs when it started to go into the declining phase. With this empirical setting, *Chapter 5* studies the evolution of the cluster over time and the factors that have influenced the evolution. *Chapter 6* describes knowledge-intensive entrepreneurship that was observed after a multinational firm exited the cluster. Although the two chapters have distinctive research questions on their own, they both illustrate how the globalization activities of multinational firms influence a cluster in an advanced economy in different phases of its evolution. In this section, the points that are relevant for the research question for part II are discussed.

Chapter 5 deals with the factors that led a high-tech cluster to decline following several periods of disruption. Among the factors, the existence of MNCs is discussed as a factor that has had some opposite effects on the cluster. When the cluster experienced the first disruption in the late 80s and the early 90s, several MNCs entered the cluster by acquiring troubled local firms. By taking over local firms, the foreign firms contributed to the stability and the further development of the cluster by bringing financial and knowledge resources into the cluster. However, the activities of MNCs in the cluster were largely influenced by strategic decision in the headquarters of the MNCs, which often were not interested in participating actively in cluster-wide activities. There were also some occasions in which some development projects initiated in a subsidiary in the cluster were not supported by the headquarters, which indicates that the competition among the various development centers of MNCs around the world can influence the development of a regional cluster. Thus, the existence of foreign firms had a negative influence on common competence building in the growing phase of the cluster and later on joint action to overcome disruptions. When the new generation of communication technology emerged, the competitive landscape among the major mobile device manufacturers changed, which affected the activities of MNCs in the

cluster. Some MNCs lost their competitive advantage during the technological disruption and had to reorganize their global activities. Furthermore, the cluster had also lost its leading role in technology development within wireless communications domain with the emergence of new generation of technologies, and the foreign firms with 'knowledge-seeking' activities could not see the advantage of staying in the cluster. All these changes led some of the subsidiaries of foreign firms to retract their activities from the cluster, which played a part in the process of decline of the cluster.

Based on the observation on the same regional cluster, *Chapter 6* demonstrates that there is a positive aspect of the activities of MNCs in a declining cluster. This chapter describes knowledge-intensive entrepreneurship incurred by the closure of a multinational firm in the cluster. The main message is that the closure of a R&D unit of a foreign firm can lead to the birth of knowledge-intensive start-ups and that the entrepreneur's knowledge from former employment (in this case, a multinational firm) is passed on to new firms. The knowledge from 'the global pipeline' stays in the region and contributes to the new firm creation. In some cases, the entrepreneurs were pressured into entrepreneurship as they created new firms to avoid long-term employment, but in some other cases, the exit of MNC gave the entrepreneurs a timely opportunity to realize the business idea that they have developed while they were still working in the former workplace. A case on a specific start-up shows that the insights that the entrepreneur gained from working in a multinational company allowed him to come up with new business idea.

Another interesting observation is that the new firms are established based on the expertise area of the entrepreneurs from the former workplace, but they are not necessarily founded in the same industry. As they are established in different, but related industries, they seem to have broadened the industry composition in the region. This pattern is also found for the new jobs that the former employees of the closed-down firm find as they are absorbed in diverse, related industries based on their specialized competences. This illustrates that

the knowledge from the global pipe is spread outside the boundary of the cluster and therefore impact other related industries in the region.

All in all, the results show that a regional cluster in an advanced economy has been influenced by MNC activities in both positive and negative ways depending on the phase of the evolution of the cluster and industry. One of the implications that also can be drawn from this part of thesis is that, as KIE examples show, a strong regional innovation system based on the collaboration of various actors such as supporting organizations, firms in related industries and universities can overcome unfavorable circumstances like the closure of a large foreign firm.

7.3. CONTRIBUTION AND FUTURE RESEARCH

Firstly, the results of the thesis contribute to the literature on the consequences of offshoring on firm performance (Görg and Hanley, 2005, Mol et al., 2005, Di Gregorio et al., 2009, Jabbour, 2010, Bertrand, 2011). Specifically, the thesis provides evidence that there is a positive impact of offshoring on innovation performance. While previous studies focus on the impact of relocation of certain type of activities (Nieto and Rodríguez, 2011, Mihalache et al., 2012, Bertrand and Mol, 2013), this thesis investigates overall impact of offshoring regardless of activities and shows under which settings of offshoring implementation this positive impact is evident, aiming at providing more comprehensive picture. The strength of this thesis is the combination of various sources of data from three different time periods, which makes it possible to control for the firm's innovation performance prior to offshoring.

Although the level of the analysis was on firm-level, some macro-economic implications can also be drawn based on the results. As the findings suggest that the offshoring firms are more likely to innovate compared to non-offshoring firms, at least in the short run, the fear of losing innovative capabilities in the home country in relation to offshoring, which is prevalent in the current public discussion in advanced economies, may be misleading. It is

found that offshoring firms are likely to have strong innovative capabilities, and it can be assumed that they also possess strong capabilities in managing knowledge. As the offshored activities support the remaining operations in the home country in the majority of cases, the firms will put effort in keeping and developing knowledge related to the offshored activities through various channels of knowledge transfer. To complement the results of this thesis, the long-term effects of offshoring on innovation performance and the detailed underlying mechanisms for positive relation between offshoring and innovation will be worth investigating in future studies.

Secondly, the thesis directs focus on offshoring firms and identifies certain characteristics and capabilities of these firms in comparison with non-offshoring firms. Identifying the characteristics of the offshoring firms helps understand the phenomenon of offshoring, which has already been studied through diverse lenses such as motives (Couto et al., 2006, Lewin and Peeters, 2006, Manning et al., 2008,), location (Graf and Mudambi, 2005, Kedia and Mukherjee, 2009, Jensen and Pedersen, 2011), and performance outcomes (Görg and Hanley, 2005, Mol et al., 2005, Di Gregorio et al., 2009, Jabbour, 2010, Bertrand, 2011). What the results of the thesis imply is that offshoring firms have certain abilities to implement organizational changes and manage knowledge efficiently. As it is discussed above, these capabilities may help offshoring firms manage knowledge that is dispersed geographically and maintain the innovativeness despite the increasing complexity of operations due to the relocation of activities. However, the finding also shows that offshoring firms are not likely to have strong adaptive capabilities and therefore will not be as responsive to changes as non-offshoring firms. This suggests that firms in the industry with fast-changing customer needs or trends may have more to lose than gain by offshoring.

In line with this, offshoring can also be conceptualized as a capability building process, through which firms realize what kind of knowledge they possess and what they are capable of. The decision making process for offshoring and the consequent codification of knowledge in relation to offshoring allow firms to

assess and reconfigure their organizational setting, which is beneficial for strategy and competence development. The more process oriented view of offshoring in relation to the capabilities of firms will be an interesting area to explore in future studies.

Thirdly, the findings in the part II of the thesis contribute to the vast literature on the impact of FDI in the host country, which have had a contentious debate for a long time (Narula and Driffield, 2012). The last two chapters of the thesis show how MNC activities with 'knowledge-seeking' purpose influence a region in an advanced economy over time, thereby providing evidence to balance out the studies with country-level quantitative analysis in the context of the 'efficiency-seeking' activities of MNCs, mostly in developing countries. The longitudinal case study analysis demonstrates that there have been both positive and negative effects of MNC activities on innovation dynamics and the evolution of the regional cluster. One implication that can be drawn from the results is that the effort to get MNCs embedded in the local activities is crucial for the cluster in overcoming market and technological disruptions. By addressing the potential negative aspects of the existence of foreign firms, the host regions will be able to enjoy the resources and the spillover effects that these firms bring in.

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SUMMARY

Firms are increasingly relocating diverse activities in the value chain abroad to reap the locational advantage available in other countries. One of the issues raised in this context is that, as global operations can function as channels for knowledge flows, the involved firms and locations may gain or lose knowledge associated with the activities that are being globalized. Since knowledge is a critical input for innovation, this has some implications for the capability of firms to create new products and services. At the macro level, it may have an influence on the competitiveness of the involved regions and countries. The purpose of this thesis is to study these issues with a broad research question, “What implications does the globalization of value chain activities have on innovation in firms and locations?” Four articles and a case study included in the thesis present empirical results from quantitative and qualitative data on Denmark.