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## **Offshoring and Changes in Firms' Domestic Employment**

*Evidence from the Danish Offshoring Survey*

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*Publication date:*  
2011

*Document Version*  
Early version, also known as pre-print

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*

Timmermans, B., & Østergaard, C. R. (2011). *Offshoring and Changes in Firms' Domestic Employment: Evidence from the Danish Offshoring Survey*. Paper presented at DRUID Summer Conference 2011 on Innovation, Strategy, and Structure: , Copenhagen, Denmark.

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Paper to be presented at the DRUID 2011

on

INNOVATION, STRATEGY, and STRUCTURE -  
Organizations, Institutions, Systems and Regions

at

Copenhagen Business School, Denmark, June 15-17, 2011

## **and Changes in Firms' Domestic Employment: Evidence from the Danish Offsho**

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### **Abstract**

In this paper, we investigate, by merging the Danish linked employer-employee database with a Danish offshoring survey, the difference in employment between offshoring and non-offshoring firms that are active in manufacturing industries and business services in Denmark. We measure the mean difference on a set of employment characteristics, i.e. employment growth, growth in high skilled employees, and growth in employees with a background in science and engineering, by using a partial propensity score matching approach. The findings of the analyses show that there are clear differences between Danish offshoring and non-offshoring firms in how the employee composition changes over time. The change in employment composition differ considerably between manufacturing industries and business services and on whether firms offshore administrative and technical business functions or other types of business functions.

# Offshoring and Changes in Firms' Domestic Employment: Evidence from the Danish Offshoring Survey

## Abstract

*In this paper, we investigate, by merging the Danish linked employer-employee database with a large scale Danish offshoring survey, the difference in employment between offshoring and non-offshoring firms that are active in manufacturing industries and business services in Denmark. The findings of the analyses show that there are clear differences between Danish offshoring and non-offshoring firms in employment growth and how the employee skill composition changes over time. The change in employment composition differ considerably between manufacturing industries and business services and on whether firms offshore administrative and technical business functions or other types of business functions.*

## INTRODUCTION

The interest in offshoring and outsourcing has over the last couple of years gained increasing attention in both the business press and within the academic literature (see e.g. Rasheed and Gilley, 2005; Maskell et al., 2007; Jensen and Pedersen, 2011; Bertrand, 2011). Offshoring decisions are regarded as of strategic importance for firms in order to (i) reduce costs of production and/or other efficiency gains to remain competitive, (ii) penetrate and strengthen the position in foreign markets, and (iii) to provide access to international pools of knowledge. Traditionally, offshoring involved to relocation of routinized production activities and standardized services (Mudambi, 2007). However, in the last 10 to 15 years, a shift has occurred since these activities move along a learning path leading the offshoring of additional more value added activities and related activities (Maskell et al., 2007). This is one of the reasons that might explain why we observe more frequently the offshoring of knowledge intensive activities, e.g. R&D.

Offshoring has been studied from various angles; however, one of the most debated issues related to offshoring is the impact on domestic employment. Most studies that investigate the impact of offshore outsourcing on the overall employment composition of the home country industries are inspired by the pioneering work of Feenstra and Hanson (1996). The point of departure in this study was to test whether offshoring could be an alternative explanation in the increased demand for skilled labor, which negatively influences the wage level of low-skilled workers and thus creates more wage inequality in an economy. Up to that point the majority of politicians and academics were of the opinion that international trade, including offshoring, hardly had any general employment impact and that the increased wage inequality was mainly attributed to the so-called skill-biased technological change (Berman et al. 1998). Feenstra and Hanson's findings spurred a line of studies that investigate the impact of offshore outsourcing on the demand of low-skilled labor in other non-US countries by using a variety of methods (e.g., Egger et al., 2001; Falk and Koebel, 2002; Strauss-Kahn, 2004; Hijzen et al. 2005). The majority of these studies confirmed that offshore outsourcing contributes significantly to a relative increase in the demand of high-skilled labor.

In this paper, we follow the existing work on offshoring and the overall effect on firms' domestic employment but move beyond the anecdotal evidence and the macro-economic perspective. Instead, we empirically investigate the micro-economic effects of offshoring on the change in domestic

employment by making a comparison between offshoring and non-offshoring firms in Danish manufacturing and business services. In addition to existing studies that focus on employment and the often-used low- and high- skill taxonomy we extend this investigation in two ways. First, when firms decide to offshore their activities it might change not only the demand from low to high-skilled labor but also the demand for specific type of skills. The relocation of activities might not necessarily have an impact on the overall demand for high-skilled labor but it affects the demand for types of skills. This can partly be explained by the impact of servitization where domestic manufacturing activities are being replaced by more developed integrated product solutions, which includes a high service component (Slepnirov et al., 2011). This change of focus most likely leads to the demand of another type of skills and not necessarily to a change in the overall level of skills. Second, firms engaged in offshoring often go through different stages of offshoring, where the company learns from initial offshoring of simple production and subsequently offshore a larger share of their productions; including other production related activities, e.g. the offshoring of more value added activities such as engineering and R&D (Maskell et al., 2007). Consequently, it can be expected that firms that offshore more value added activities experience a change in employment that is different compared to firms that offshore the more traditional production tasks. Therefore it is necessary to track changes in numbers of employees in more detail, rather than only looking at the aggregate wage bill.

To investigate these issues, we rely on an offshoring survey conducted by Statistics Denmark in 2007.<sup>1</sup> This survey was part of a wider European project with the purpose to gather information on several aspects of international offshoring, e.g. target countries, kind of activities that has been offshored, motivation factors, impact, barriers and also the consequences for domestic employment during the period 2001-2006. The survey was distributed among all Danish firms with more than 50 employees and a sample of firms with 20 - 50 employees. The benefits of using this survey are: (i) a more accurate measure of offshoring, the existing studies create a proxy for outsourcing and offshoring by looking at imports and exports while international outsourcing and offshoring is a much rarer phenomenon than international procurement and trade; (ii) existing research tends to focus on larger firms but the survey also provides insights on the offshoring activities, divided in different types of business functions, of small- and medium-sized enterprises; (iii) the large-scale survey allow the study of general offshoring trends and not only single cases.

This survey will be merged with the Danish Integrated Database for Labor Market Research (IDA). IDA is a universal and longitudinal database that provides detailed information on *all* establishments and *all* individuals in Denmark in the period 1980 and onwards. Due to the unique person and establishment identification number, it is possible to identify the human resource composition in each establishment, but also on the aggregated industry level. Because IDA provides detailed information on education it is possible to proxy the level of skills, and the type of skills. Consequently, in addition to the strengths offered by the survey, another strength is that in contrary to the majority of the studies that exists, it is possible to investigate the change in employment on the firm level (a notable exception within international economics is Görg and Hanley (2005) who investigated the labor demand effects of international outsourcing on plant level data).

The research conducted in this paper will contribute to the literature in the following three ways. First, this study will provide firm level evidence on the difference in the overall change of domestic

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<sup>1</sup> Statistics Denmark refers to this survey as an outsourcing survey. However, the definition they use refers more to offshoring than to outsourcing.

employment between offshoring and non-offshoring firms. In addition, it is possible to observe the trend during an economic recession. A crisis situation is often a motivation for firms to engage in offshoring (Larsen and Pedersen (2011) shows that this was the case for Lego). By following the trend in employment period 2000-2007 it is possible to identify how offshoring and non-offshoring firms reacted during and just after this recession in 2001. Such a recession results in lay-offs and the following economic recovery provides new jobs; nevertheless, the recovery might affect the re-hiring of employees differently in offshoring compared to non-offshoring firms, e.g. the crisis can lead to a restructuring on the allocation of labor. Second, the paper will investigate whether there can be observed a change in the type of skills between offshoring and non-offshoring firms in the various industries. Third, it will provide insights in how the employment changes depend on the type of business function that is being offshored.

In the next section, we provide more information on the offshoring phenomenon and how offshoring has moved from primarily production to other more valued added activities. Afterwards, we will discuss how offshoring has affected firms' domestic employment and based on this existing work we will identify the major shortcomings and formulate the research questions that will be addressed in this paper. After this theoretical exercise, we will move towards the empirical analysis by presenting the method of analyzing the difference in employment growth, the data and the empirical results. The paper will conclude with a discussion of the findings and suggestions for future research.

## **THEORY**

### **The Offshoring Phenomenon**

Offshoring refers to *"the process by which companies undertake some activities at offshore locations instead of their countries of origin"* (Kumar et al., 2009: p. 642). The term offshoring can refer to two type of relocation activities, i.e.: (i) when a firm offshores activities to a firm's own affiliate outside the home country, this is called internal or captive offshoring; and (ii) offshoring to an independent unaffiliated partner or supplier, which is referred to as offshore outsourcing (Kenney et al. 2009). In this paper we refer to offshoring as being any of these two activities. The offshoring phenomenon has been part of the corporate landscape for several decades and more than 30 year of research can be found on the topic (Lewin and Peeters, 2006; Maskell et al., 2007; Hätönen and Eriksson, 2009; Jensen and Pedersen, 2011). Nevertheless, only recently the offshoring phenomenon has received increased attention in the public media and academic literature (Rasheed and Gilley, 2005; Maskell et al., 2007; Jensen and Pedersen, 2011; Bertrand, 2011). This increasing interest can be attributed to the increased fragmentation of production processes and the associated rise in offshoring activities as a result of technological changes, e.g. lowering of transportation costs and the advancements in communication technologies, economic and competitive pressures to reduce costs and improve productivity, and institutional developments that are in favor of trade liberalization (Olsen, 2006; Bertrand, 2011). By offshoring, firms attempt to gain access to the comparative advantage of offshore locations (e.g. low cost of production and/or labor, access to skilled labor and new markets) in combination with their own resources and competencies (McCann and Mudambi 2005; Mudambi, 2008). These benefits are then weighted against the costs that are associated with having a geographical dispersed production network. Since offshoring primarily involved production, often also the most routinized production activities, combined with the decreasing costs of logistics and the often low cost of production factors in the offshore location, these benefits generally outweigh the cost of offshoring.

When firms started to engage in the relocation of firm activities, this primarily affected production and blue-collar jobs. Since the mid 1990s a shift occurred where offshoring has been moving up the value chain, not only affecting production and standardized services, but also activities such as R&D; a process that was mainly driven by advancements in communication technology (Lewin and Peeters, 2006). Up to that point it was difficult to imagine that firms would be offshoring administrative and technical business functions, including information technology, call centers, engineering tasks and R&D activities to non-OECD nations (Kenney et al. 2009). Nevertheless, this change from offshoring solely production to the offshoring of other, more value added, types of activities is not that easy. Maskell et al. (2007) identified this shift much more as a result of a learning process where firms started out with offshoring for cost reasons, but slowly moved into more differentiated offshoring strategies; including more innovation-based strategies (Kenney et al., 2009).

Arguably, depending on where firms are in this offshoring learning process, a different pattern in the demand of skilled labor might emerge. For example, firms that are exclusively engaged in the offshoring of core business functions, e.g. production. Instead of only losing domestic employees, firms might put their focus on other types of activities within the value chain close to their home base. The activities developed in the home market focus more on the provision of services related to the core business function; a process often referred to as servitization (Slepniov et al. 2011). It can be assumed that this process of servitization would require a different skill-set.

However, given the learning process of offshoring, firms will gradually offshore these value added activities which again will lead to a change in the demand of skills, i.e. the domestic demand of skills associated with the servitization process will be negatively affected due to the offshoring of other, more value added business functions. Consequently, treating offshoring as a general phenomenon when investigating the overall domestic employment effect would be inconclusive and it is necessary to consider the type of activities offshored in order to provide a more accurate picture on the change in employment.

### **Offshoring and Domestic Employment**

The topic of offshoring is closely related to the demand of labor. Early offshoring activities were mainly motivated by labor cost reduction but the access to talent in offshoring destination gained in importance as a motivation for offshoring (Florida, 1997). Nowadays, firms are actively engaged in getting access to pools of talent in countries like China, India, and Brazil (Couto et al., 2007; Lewin and Peeters, 2006; Manning et al., 2008); partly due to availability of cheap skilled labor in these countries and partly by the lack of trained personnel, in particular science and engineering graduates in the developed world (Manning et al. 2008).

Despite this changing offshoring pattern, there are hardly any studies on the firm level that have addressed the issue in how firms' domestic employment changes as a result of offshoring, which take into account the type of business function being outsourced and in what industry the outsourcing firm is active. An exception is Teirlinck et al. (2010), which addresses the issue of R&D outsourcing and R&D employment intensity. However, undisputedly, offshoring activities have a direct impact on the firms' employment as a result of plant closures, plant relocations, or large reductions in operations (Gregori et al., 2008) and offshoring of more value added activities might lead to a relative decrease in the demand of this more high-skilled type of labor.

Research conducted by Feenstra and Hanson (1996) is considered to be the pioneering work on the effect of offshoring and outsourcing on domestic employment has resulted in a number of macro-

based studies, which has mainly been the domain of international economics. This study, which adopts a broad definition of offshoring, despite calling it outsourcing, investigates the role of both skill-biased technological change and outsourcing, being the two most heavily cited explanations for, the relative decline in wages of low-skilled workers. Up to that point, the role of offshoring had hardly been investigated as most researchers and policy makers put emphasis on the impact of skill-biased technological change, i.e. the relative decrease in the demand of low-skilled labor is a result of investments in technology that can replace this type of labor, (see, e.g., Berman et al., 1994). Feenstra and Hanson, however, follow a comparative advantage perspective of outsourcing by stating that the import competition as a result of offshore outsourcing will result in a move of non-skilled activities abroad and a shift of employment towards skilled workers within these industries. To investigate this they use import data for all US manufacturing industries from the NBER trade database for the period 1972-1994 in combination with disaggregated data on input purchases from the Census of Manufacturing to estimate the industry-by-industry outsourcing for the period 1972-1992.<sup>2</sup> To make a distinction between low-skilled and skilled workers they use the non-production workers share of the industry wage bill to measure the relative demand for skilled labor. The result of their study was that skill-biased technological change played an important role in the wage gap between skilled and unskilled workers but approximately 15 percent of this gap could be explained by outsourcing (Feenstra and Hanson, 1999).

Following this pioneering work other studies have investigated the impact of offshoring on the employment structure in other non-US countries like Austria (Egger et al., 2001; Egger and Egger, 2003), Germany (Falk and Koebel, 2002; Geishecker, 2006), Sweden (Ekholm and Hakkala, 2008), France (Strauss-Kahn, 2004), Denmark (Munch and Skaksen, 2009), United Kingdom (Hijzen et al., 2005), Ireland (Görg and Hanley, 2005), and Japan (Head and Ries, 2002). Based on various types of methods, some more elaborate than others depending on the availability of data, and definitions, some follow a broad other more narrow definition, these studies all found a negative impact of offshoring on the low-skilled labor force.

These macro-based studies have, however, some major shortcomings. The first problem is their definition of offshoring and outsourcing. On their level of aggregation, there is hardly any data available that indisputably indicates offshoring; instead, they rely mainly on import and export data. Offshoring is, however, a rarer phenomenon than international trade. Second, these studies are based on country or industry aggregates and do not provide any insights in how offshoring firms perform in relation to non-offshoring firms. Finally, these studies all take the position where offshoring involves the relocation of low value added activities. Despite the fact that the majority of jobs that are offshored are low-skilled jobs, which adds to approximately two-thirds of all job losses (Munch and Skaksen, 2009), it disregards the effect of offshoring administrative and technical business functions.

For that reason, in this paper, we investigate the issue of change in domestic employment using three related research questions that are related to the effect of offshoring:

- First, how does the overall level of employment differ between Danish offshoring and non-offshoring firms, thereby focusing on the level of the firm but also making a distinction between manufacturing and business services?

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<sup>2</sup> They measure the extend of offshoring as the share of imported intermediate inputs in the total purchase of non-energy materials

- Second, how do offshoring and non-offshoring firms in Denmark differ in the change in high skilled workers, focusing on both the level of skills but also the types of skills?
- Third, is there a difference in the change in employment between firms whose offshoring includes administrative and technical business functions compared to firms that offshore other business functions?

## METHOD

The purpose of this study is to compare how offshoring firms differ in the growth of (high-skilled) employment compared to non-offshoring firms. A problem that arises is that some firms, based on their characteristics, are more likely to (not) engage in offshoring than others (e.g., based on size and industry characteristics). Consequently, there is a selection bias which makes it difficult to assess whether the difference in employment is a result of offshoring or another characteristic. This issue can be addressed by using matching estimators. In essence, it is possible to test what firm's that offshore business functions (a so-called treated firm), with a given set of characteristics had done if it had not offshored (received treatment). Thus, in order to evaluate how offshoring firms differ from non-offshoring firms, it is important that for each offshoring firm a match is found among the subsample of non-offshoring firms. This treatment effect is defined by the following equation:

$$E(\alpha_{TT}) = E(Y^T | S = 1) - E(Y^C | S = 1) \quad (1)$$

The variable  $Y^T$  is the outcome variable, which in the analysis is the change in number of (high-skilled) employees. The  $S$  stands for the status where:  $S = 1$  is the treatment group and  $S = 0$  is the group of untreated firms. The variable  $Y^C$  is the potential outcome that would have been realized if the treatment group ( $S = 1$ ) had not been treated. However, this counterfactual situation, i.e.  $E(Y^C | S = 1)$ , cannot be observed and needs to be estimated. To do so, this potential outcome for the treated firm is constructed from the control group of firms that did not engage in offshoring. Consequently, the assumption that follows is the following:

$$E(Y^T | S = 1, X) = E(Y^C | S = 0, X) \quad (2)$$

This equation states that, on the condition that there are no systematic differences, the untreated firms can be used to estimate the counterfactual outcome of the firms that were engaged in offshoring. By combining Equation 1 and Equation 2, the treatment effect can be estimated as follows:

$$E(\alpha_{TT}) = E(Y^T | S = 1, X = x) - E(Y^C | S = 0, X = x) \quad (3)$$

There is a choice between several matching approaches. In this study we will incorporate a partial propensity score matching method. It is a partial propensity score matching method because we use a

combination of covariate matching and propensity score matching. The first-mentioned matching technique matches treated and untreated firms based on a set of covariates on which they have to be similar. A problem of this approach is the so-called curse of dimensionality (Caliendo and Kopeinig, 2008), which occurs because conditioning on all relevant covariates is limited when the number of covariates is high; propensity score matching can solve this problem (Rosenbaum and Rubin, 1983) and this is the reason why we combine both matching methods. With this matching procedure we start by estimating, by using a logit model, the propensity that a firm engages in offshoring based on a set of variables that can explain a firm's decision to offshore. This propensity score is then used as a matching criterion. In our partial propensity score matching approach we take the point of departure in the propensity score but include two additional covariate-matching criteria that should be met, i.e. the firms should be active in the same industry class and be in the same size category. Thus, after we calculate the propensity scores and matched the treated and untreated firms on industry and size class, we will conduct caliper matching.<sup>3</sup> In this approach, we impose a tolerance level on the maximum propensity score distance, which we set at 5 percent point. All matches in this range will be included in the analysis.<sup>4</sup>

As a result of this matching procedure, those firms that are so unique that they cannot be matched with another firm will be removed from the sample. To illustrate the latter, Denmark has several national champions; large multinational companies that are active within a specific industry (e.g., Danfoss, Grundfos, Lego, Vestas, Novo Nordisk). It appears to be impossible, within the Danish context, to find a firm that matches any of these champions' characteristics and who at the same time did not engage in offshoring; similarly, some firms have such a low propensity to outsource that it is impossible to match it with a firm that has, given their characteristics, engaged in offshoring. For this reason, it is likely that these national champions, and those firms with a very low propensity score, will be excluded from the matched sample.<sup>5</sup>

A limitation of this matching approach is that it is only possible to select on observable covariates. Consequently, one assumes that there are no unobserved characteristics that explain whether a firm is engaged in offshoring. Despite the fact that it is impossible to observe all the determinants, we maintain the assumption that we observe all the important determinants of offshoring.

## DATA AND SAMPLE

To investigate the issue at hand we will investigate the change in employee composition in Danish manufacturing and business services. As indicated by Jensen and Pedersen (2011, pp.9), “[t]he Danish economy is closely tied to the international economy and is thus subject to global economic flows and trends, including offshoring trends.” The sample that will be used for the analysis is taken from a Danish survey on offshoring of business functions, which was conducted in 2007 and that was part of a wider European-based project. This project investigated different aspects of offshoring, e.g. target countries, kind of business activities the firm has offshored, motivation factors, impact, barriers and the consequences for domestic employment, in the period 2001-2006 in 13 EU Member States and

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<sup>3</sup> Other often-used matching techniques are: nearest neighbor matching, radius matching, stratification and interval matching, and kernel matching (Caliendo and Kopeinig, 2008).

<sup>4</sup> In other matching procedures, e.g. nearest neighbor matching, you often only include one match per treated firm.

<sup>5</sup> Due to the anonymity of the data it is not possible to identify whether that is the case for (all of) these Danish national champions.

EEA countries.<sup>6</sup> The survey was distributed among all Danish firms with more than 50 employees (with a response rate of approximately 97 percent). In addition, the survey was supplemented with a sample of firms in the size category 20-49. The total number of observations in the Danish offshoring survey is 4,161.

This survey provides a number of advantages over ways in which other studies have investigated this issue. First, this survey presents the possibility to identify firms that are actually engaged in offshoring; earlier studies provide proxies of both offshoring and outsourcing by defining it in terms of procurement activities, e.g. imported inputs, parts and components purchased abroad, etc. (Horgos, 2009). As mentioned by Gilley and Rasheed (2000), offshoring and outsourcing cannot be defined as simply a purchasing decision because all firms have some procurement element in their operations while offshoring and outsourcing are less common activities. In this survey offshoring is defined 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. 13).<sup>7</sup>

A second advantage of this survey is that it offers a broader perspective regarding offshoring. Many studies on offshoring focus on anecdotal evidence on strategies conducted by large firms. Nevertheless, globalization pressures and offshoring are not only present within large firms and are also part of the competitive landscape of small and medium sized enterprises. This survey includes small and medium sized firms, i.e. firms that in 2007 had at least 20 employees.

A final strength of the offshoring survey is the possibility to merge it with the Danish Integrated Database for Labor Market Research (IDA). IDA is a longitudinal linked employer- employee dataset constructed from government registers and maintained by Statistics Denmark; see Timmermans (2010) for a thorough description of this database and its use. The longitudinal character enables us to identify changes in employment structures and labor mobility flow by comparing employer-employee relationship in consecutive years. A change in this relationship would indicate a change in the employment composition. The education background (based on a detailed eight-digit education class) is the employee characteristic that has our main interest. This variable makes a distinction on higher and lower education and the type of background. In this study we are particularly interested in the divide between science and engineering, which has a strong manufacturing angle, and social sciences and administration, which can be linked more with the servitization perspective.

All the firms in the survey can be merged with IDA but before starting the analysis we set a number of criteria for the firms that are selected for our final sample. First, we will only select those firms that are active in manufacturing industries (NACE 15-37) and business services (NACE 72-74), which narrows the sample down to 2,631 observations. Furthermore, we are interested in the change in employment structure thus we select two years in which this change occurs. It would be ideal to evaluate the change in skill composition just before and shortly after offshoring has taken place; however, the survey does not allow for such an analysis since it asks about the outsourcing activities in the period 2001-2006. For this reason, we select those firms that were active in both years and analyze the subsequent change between these two years. In the survey, there are 2,098 firms that fulfill both criteria. Furthermore, it is possible to see how the general employment trend varies between offshoring

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<sup>6</sup> Countries that participated are: Czech Republic, Denmark, Germany, Ireland, Norway, Spain Italy, Portugal, Slovenia, Finland, Sweden, and the United Kingdom.

<sup>7</sup> Statistics Denmark refers to this survey as an outsourcing survey. However, the definition they use refers more to offshoring than to outsourcing. Furthermore, this definition is narrower compared to the definition provided by Kumar et al. (2009).

and non-offshoring firms during times of crisis. A crisis situation is often a motivation for firms to engage in offshoring (Larsen and Pedersen (2011) shows that this was the case for Lego). Denmark, as many other parts of Europe, was hit by an economic recession in early 2000s. This recession caused an increase in Danish unemployment. It is thus possible to identify how the different firms reacted during the upswing of the economy in the following years.

In addition to the above-mentioned advantages of the survey, there are, next to the general limitation of survey-based studies, some survey specific limitations. First, this offshoring survey asks only on whether firms offshore but not on the magnitude of offshoring. It is therefore not possible to identify if firms engage in large offshoring activities that affect the domestic operations to a large extend or whether it involves the relocation of a single job position. Second, we only observe whether firms have been engaged in offshoring over a five-year period (2001-2006). A more precise indication on the offshoring activity, e.g. the year of offshoring, is not available. Third, the indications of business functions, in particular core business functions, are not strictly defined. Firms might perceive any of the supporting business functions, i.e. IT, logistics, sales, R&D, etc., as they core activities. Finally, we only select on survival. This means that firms that engaged in offshoring in the period 2001-2006 but closed down in the same time period will not be observed.

### Treatment Variables

The treatment variable is a dummy variable that has the value 1 whenever the firm in the sample indicates that it was engaged in offshoring in the period 2001-2006 (OFFSHORE=1); otherwise the variable has the value 0 (OFFSHORE=0). A firm is considered active in offshoring when it has offshored one or more of the following business functions: (i) core business functions; (ii) distribution and logistics; (iii) marketing, sales, and after sales services; (iv) ICT services; (v) administrative and management functions; (vi) engineering and related technical services; (vii) research and development; and (viii) other functions. In total, 440 firms answer that they have offshored one or more business functions during the period 2001-2006.

**Table 1: Offshored functions of firms in the full sample**

Offshored functions	Offshoring (n=440)		
	#	%	% of offshoring firms
Core business functions*	268	12.77	60.90
Distribution and logistics	78	3.72	17.73
Marketing, sales, and after sales services	69	3.29	15.68
ICT services	83	3.96	18.86
Administrative and management functions	47	2.24	10.68
Engineering and related technical services	105	5.00	23.86
Research and development	74	3.53	16.82
Other functions	37	1.76	8.41

\* Statistics Denmark (2008: p.13) states that core business functions include the production of final goods or services intended for the market/for third parties carried out by the enterprise and yielding income. The core business function equals in most cases the primary activity of the enterprise. It may also include other (secondary) activities if the enterprise considers these to comprise part of their core functions.

Table 1 presents the distribution of the different types of functions that have been offshored. The majority of offshoring firms offshore only one business function (i.e. 265 firms), primarily the core business functions (i.e. 155 firms). The remaining 175 firms offshore a combination of business functions in the period 2001-2006.<sup>8</sup>

### **Control Variables**

The control variables are those observable characteristics of the firm that can be considered as important determinants of offshoring. Whenever possible, these variables are measured at the beginning of the period, i.e. all at the start of 2001. Due to the longitudinal nature of the IDA, it is possible to obtain various firm characteristics from the end of 2000, which is prior to the observation period 2001-2006.<sup>9</sup> It is crucial to include only variables that have a significant impact on the likelihood to offshore. Some variables are known to determine the likelihood of offshoring, e.g. industry and size.

For industry classes we applied a relative narrow industry definition based on the NACE (rev 1.1.) industry classification; i.e. manufacturing of food beverages and tobacco; manufacturing of textiles and leather; manufacturing of wood and paper products; publishing, printing and reproduction of recorded media; manufacturing of chemical products; manufacturing of plastics; manufacturing of other non-metallic mineral products; manufacturing of basic metals and fabricated metal products; manufacturing of machinery and equipment; manufacturing of electrical and optical equipment, manufacturing of transport equipment; manufacturing of furniture and other manufacturing; computer and related activities; research and development; business consultancy; technical consultancy; and other business services. As a measure of size, we identified the size of each firm in the sample in 2000. To control for the skewness in size the natural log is taken.

Table 2 presents how these firms are distributed based on the above-mentioned industry classification. In total 440 firms were engaged in offshoring during the period 2001-2006. There are clear differences based on industry and size on whether firms offshore. Offshoring appears to be a strategy primarily conducted by firms in manufacturing industries; however, some industries (e.g. manufacturing of textiles and leather, manufacturing of electrical and optical equipment, manufacturing of transport equipment, and computer and related activities) are more engaged in these activities than others (e.g. publishing and printing and business consultancy). Although the Danish Textile industry started outsourcing and offshoring in the 1970s the textile firms still offshore in the survey period. As expected, there is a clear size effect where large firms tend to be more active in offshoring compared to smaller firms.

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<sup>8</sup> It is likely that firms already offshored some of their business activities in the period before 2001. A limitation of this study is that we do not have the possibility to check which firms have done this.

<sup>9</sup> All information for the year 2000 is obtained in the end of the year (primarily in November). This would give a good estimation on the characteristics of the firm at the start of 2001.

**Table 2: Industries and size category distribution**

Industry	Total ( <i>n</i> =2,058)		Offshoring ( <i>n</i> =440)		
	#	%	#	%	% of industry
Manu. of food, beverages and tobacco	158	7.53	25	5.68	15.82
Manu. of textiles and leather	47	2.24	23	5.23	48.94
Manu. of wood and paper products,	107	5.10	12	2.73	11.21
Publishing, printing and reproduction of recorded media	107	5.10	11	2.50	10.28
Manu. of chemicals products	63	3.00	15	3.41	23.81
Manu. of plastics	102	4.86	19	4.32	18.63
Manu. of other non-metallic mineral products	74	3.53	8	1.82	10.81
Manu. of basic metals and fabricated metal products	283	13.49	47	10.68	16.61
Manu. of machinery and equipment	303	14.44	87	19.77	28.71
Manu. of electrical and optical equipment	154	7.34	64	14.55	41.56
Manu. of transport equipment	47	2.24	15	3.41	31.91
Manu. of furniture, manufacturing n.e.c.	109	5.20	24	5.45	22.02
Computer and related activities	126	6.01	45	10.23	35.71
Research and development	24	1.14	7	1.59	29.17
Business consultancy	128	6.10	5	1.14	3.91
Technical consultancy	124	5.91	23	5.23	18.55
Other Business Services	142	6.77	10	2.27	7.04
<b>Firm size categories</b>	<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>	<b>% of industry</b>
< 20 employees*	79	3.77	16	3.64	20.25
20-50 employees	668	31.81	95	21.59	14.22
51-100 employees	565	26.93	100	22.73	22.73
101-250 employees	479	22.83	120	27.27	25.05
251-500 employees	173	8.25	50	11.36	28.90
> 500 employees	134	6.39	59	13.41	44.03

\*The survey implemented the size criteria for firms in 2007; consequently, in the year 2000 some firms were smaller than the minimum requirement of 20 employees. In the partial propensity score matching method this category will be merged with 20-50 employees.

Other potential variables that characterize offshoring firms are relatively unknown. For that reason we rely on the statistical significance of a set of variables, both demographic characteristics and financial indicators, to find other variables that have an effect on the likelihood to offshore. This approach is common within propensity score matching when the specifications are unknown (Caleindo and Kopeinig, 2008). In this case, we started with a simple model including the size and industry variables and then test by iteratively adding variables into the specification. In this way, we can identify what other variables have a significant impact on the likelihood that a firm is engaged in offshoring; in the process, we also take into account the improvement in model fit statistics.

In addition to total size in employees (LN\_EMPL2000), we tested other employee characteristics, e.g. the number of highly educated workers (LN\_HEEMPL2000), the number of employees with a foreign citizenship (LN\_FOREIGN2000), and various age variables of the employees (i.e. MEAN\_AGE2000,

STD\_AGE2000, and Q3\_AGE2000). The number of employees with a foreign citizenship did not have any effect while the logarithm to the number of highly educated employees turned out to have a positive impact on the likelihood to offshore. However, this effect disappeared when we added the age characteristics, in particular the standard deviation in age (STD\_AGE2000). Since adding this variable improved the model considerably we kept this standard deviation variable to calculate the propensity scores. The average age did not have any significant effect while a high third quartile in age (Q3\_AGE2000) leads to a lower likelihood to engage in offshoring, although this effect disappears by adding STD\_AGE2000. It can be assumed that the significant negative impact of a higher standard deviation of age is strongly dependent on a deviation towards the older ages.

Various financial information of the firm is also included. The measures were exports, value added, turnover and wage cost. Exports (LN\_EXPORT2000) was included since it indicates to which extent the firm is engaged in international trade where we assume that a firm with high level of exports is more likely to engage in offshoring. Value added (LN\_VALUEADDED2000) and turnover (LN\_TURNOVER2000) indicate an overall performance measure of the firm, which might affect the likelihood to offshore, either positively or negatively depending on the motives of offshoring. Wage costs (LN\_WAGECOST2000) provide information on the firm's total expenses in wages and pension. It can be expected that high wage costs might have a positive impact on the likelihood to engage in offshoring. When including these variables in the model only two variables turn out to have a significant effect on the likelihood to offshore. First, there is the export variable. Firms with a high level of exports have a higher likelihood to engage in offshoring. On the other hand, value added has a negative relation with the likelihood to engage in offshoring. Other financial indicators, e.g. growth indicators of the above-mentioned variables in the period 1999-2000, did not have any significant effect.

Finally, we tested to impact on whether the firm is located in the Capital Region of Denmark (CPH=1) or in another region. (CPH=0) Our argument for including this control variable is that firms in the Capital Region are known to have a more international profile compared to firms in any of the other four regions, i.e. Region Zealand, Region of Southern Denmark, Central Denmark Region, and North Denmark Region.

### **Outcome Variables**

In this study, we want to investigate how offshoring affects a number of firm employment characteristics. First, we will measure the difference in growth in the overall employment (EMPL\_GROWTH) between offshoring and non-offshoring firms. To calculate this growth we identify the number of employees in 2000 (LN\_EMPL2000) and subtract this from the number of employees in 2007 (LN\_EMPL2007) to get the change in number of employees (on a logarithmic scale) between these two years.

Furthermore, we investigate the growth in high and low skilled employees. Previous studies that investigate the impact of offshoring on the skill composition have, in line with Berman et al. 1994 and Slaughter 2000, defined high and low skilled employees in terms of production and non-production workers. We will not make a distinction between production and non-production workers but take the education level of employees, which has been identified as a better method to proxy the level of skills within a firm (Anderson et al. 2001). Thus, we will investigate the change in respectively employees with a high education (HE\_GROWTH), employees with a medium-level education (ME\_GROWTH), and employees with a low-level of education (LE\_GROWTH). Highly educated employees are all the employees with a university or polytechnic degree. Employees with a medium-level education are

those with a certificate from the dual vocational training system. The remaining employees are classified as being low educated.

Finally, in addition to the effect of offshoring on the change of employment between high, medium and low level of education, we also test the difference in growth on specific high educational backgrounds. High-, medium- and low-level of education only accounts for part of the story, therefore, we make a distinction between people with a high-level education degree in science and engineering (S&E\_GROWTH), and social sciences and administration (ADM\_GROWTH).<sup>10</sup> All these variables will also be measured within the period to see the trend in the entire period 2001-2006.

## **EMPERICAL RESULTS**

As a first step to create the matched sample, we need to estimate the propensity scores. In order to do so we included all the control variables in a logit model with the dependent variable OFFSHORE, i.e. whether the firm was engaged in offshoring in the period 2001-2006. Table 3 presents some descriptive statistics on the full sample comparing offshoring and non-offshoring firms on their mean differences. The firms in the two sub-samples differ significantly on the variables that will be used to calculate the propensity scores. Regarding employment in offshoring and non-offshoring firms there are clear differences between these firms. First, the average growth in the number of employees is significantly different between offshoring and non-offshoring firms. Non-offshoring firms grow more compared to offshoring firms. The growth in both employees with low and high educational background is higher in non-offshoring firms (for offshoring firms there is a decline in low educated employees); nevertheless, there are no significant differences between the two sub samples. The growth in employees with a medium-level education differ is significantly higher in non-offshoring firms. When looking at the differences between offshoring and non-offshoring firms in the growth in employees with an academic background in science and engineering and social science and administration. Furthermore, Table 3 shows that there is no significant difference between these two types of firms on science and engineering but offshoring firms have a significant higher growth in employees with a social science and administration background. To start the matching procedure, we created a propensity score by running a logit model on the control variables presented earlier and also described in Table 3. The propensity scores for offshoring firms are, as expected, significantly higher compared to non-offshoring firms, by matching these propensity scores will be more similar.

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<sup>10</sup> By making a distinction on the level of education, there is the possibility that some firms have 0 employees in one or more of these categories. To solve this problem we apply a log transformation for the more detailed employment figures, i.e.  $\ln(x + 1)$ .

**Table 3: Descriptive Statistics (full sample)**

Variable	Offshoring=1	N <sup>1</sup> =433	Offshoring=0	N <sup>0</sup> =1,634	p-value of two tailed t-test on mean difference
	Mean	Std.dev.	Mean	Std.dev.	
Ln_empl2000	4.704	1.263	4.030	1.018	0.000
Std_age2000	10.471	1.785	11.118	2.149	0.000
Ln_export2000	15.313	6.163	11.277	7.597	0.000
Ln_value_added2000	17.488	1.847	16.884	1.451	0.000
Cph	0.333	0.472	0.282	0.450	0.040
Propensity Score	0.244	0.189	0.174	0.141	0.000
Empl_growth	0.013	0.639	0.121	0.753	0.006
He_growth	0.258	0.654	0.272	0.693	0.719
Me_growth	-0.033	0.678	0.094	0.730	0.001
Le_growth	-0.049	0.741	0.085	0.801	0.468
S&E_growth	0.174	0.655	0.173	0.655	0.987
Adm_growth	0.302	0.613	0.201	0.612	0.002

Note: the total number of observations and the number of offshoring firms has decreased due to missing observations in the financial data, i.e. export and value added.

After matching, which gives a sample of 367 treated (firms that offshore) and 1,399 untreated firms we observe some differences in the various employment figures compared to the full sample (see Table 4). Total growth in employment remains significantly positive for non-offshoring firms. Growth in the number of employees with an academic or polytechnic education was higher in non-offshoring firms but the difference remains not significant. Non-offshoring firms have a significant increase of employees with a medium and low level of education, for offshoring firms the number of firms with these two educational backgrounds decreases. Despite the slightly stronger increase in employees with an academic background in science and engineering in non-offshoring firms, the increase remains not significant while the offshoring firms experience a significant stronger increase (on the 10 percent level of significance) in employees with an academic background in social sciences and administration.

**Table 4: Mean difference in domestic employment change between offshoring and non-offshoring firms (matched sample)**

Variable	Offshoring=1	N <sup>1</sup> =367	Offshoring=0	N <sup>0</sup> =1,399	p-value of two tailed t-test on mean difference
	Mean	Std.dev.	Mean	Std. dev.	
Empl_growth	0.026	0.631	0.172	0.685	0.000
He_growth	0.259	0.675	0.301	0.660	0.277
Me_growth	-0.017	-0.086	0.140	0.104	0.000
Le_growth	-0.024	0.695	0.139	0.732	0.000
S&E_growth	0.171	0.662	0.180	0.641	0.797
Adm_growth	0.285	0.616	0.222	0.580	0.068

However, the results presented in Table 4 are based on the entire match sample. There might be some industry differences in the change in employment. For that reason, we look at the mean difference amongst firms in manufacturing (NACE 15-39) and business service (NACE 72-74). Table 6 presents the matched sample of firms that are active in manufacturing industries. In this manufacturing subsample there are 303 treated and 1,066 untreated firms. The results are very similar to results of the overall analysis. Non-offshoring firms in manufacturing experience significant higher growth in the number of employees compared to offshoring firms. There is no significant difference in the growth of employees with a higher education; however, the growth is slightly higher in offshoring firms, which is different compared to the full sample. The growth in employees with a low and medium level of education is significantly higher in non-offshoring firms. Non-offshoring firms experience a lower growth in employees with both science and engineering and social science and administration academic background but only the latter is significantly different.

**Table 5: Mean difference in domestic employment change between offshoring and non-offshoring firms in manufacturing (matched sample)**

Variable	Offshoring =1 N <sup>1</sup> =303		Offshoring =0 N <sup>0</sup> =1,066		p-value of two tailed t-test on mean difference
	Mean	Std.dev.	Mean	Std. dev.	
Empl_growth	0.013	0.588	0.127	0.598	0.003
He_growth	0.264	0.632	0.247	0.598	0.677
Me_growth	0.008	0.575	0.112	0.584	0.002
Le_growth	-0.037	0.684	0.119	0.639	0.000
S&E_growth	0.150	0.081	0.123	0.090	0.448
Adm_growth	0.302	0.578	0.182	0.533	0.001

Table 6 shows the mean differences between offshoring and non-offshoring firms in business services, which contains 63 treated and 333 untreated firms. Interestingly, the significance disappears for the majority of the employment growth variables. Nevertheless, non-offshoring firms experience a significant growth in the total number of employees compared to the offshoring firms. The other rather unexpected finding is that non-offshoring firms experience a significant stronger increase in the number of employees with an academic and polytechnic background.

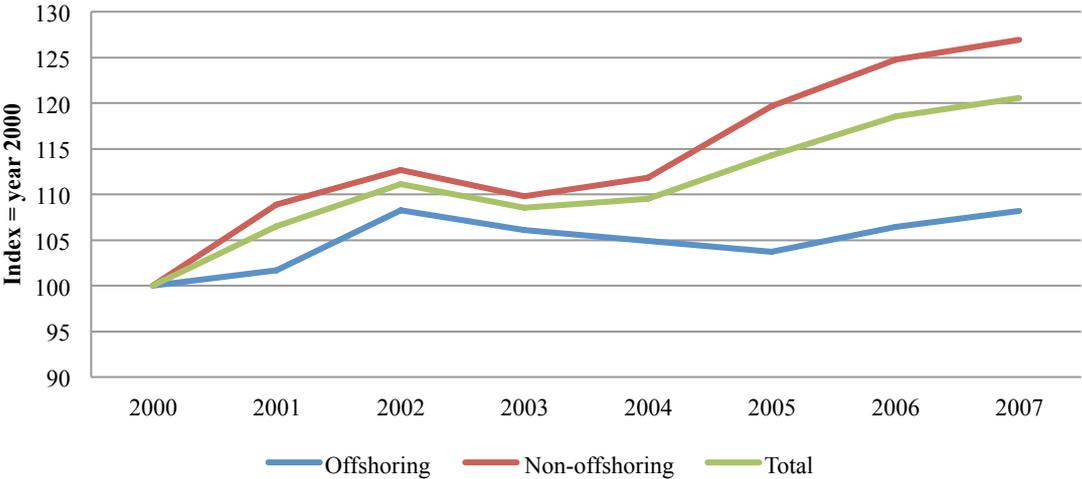
**Table 6: Mean differences in domestic employment change between offshoring and non-offshoring firms in business services (matched sample)**

Variable	Offshoring=1 N <sup>1</sup> =63		Offshoring =0 N <sup>0</sup> =333		p-value of two tailed t-test on mean difference
	Mean	Std.dev.	Mean	Std. dev.	
Empl_growth	0.087	-0.115	0.314	0.893	0.061
He_growth	0.023	0.086	0.471	0.806	0.032
Me_growth	-0.058	1.014	0.227	0.899	0.238
Le_growth	0.040	0.749	0.204	0.970	0.200
S&E_growth	0.269	0.879	0.357	0.866	0.414
Adm_growth	0.202	0.771	0.351	0.696	0.123

In the tables presented above, we only investigate whether there is a significant difference in the growth of domestic employees between offshoring and non-offshoring firms 2000 and 2007. From these tables, it is not possible to identify the difference in the overall trend in employment, which we will discuss in the following. Analyzing this trend can provide some interesting insights in how offshoring firms have changed their employment strategy as a result of economic crisis, Denmark experienced a recession in starting in 2001 followed by slow growth in 2002-2003 followed from 2004 by a period of economic prosperity and low, in particular given the overall pattern in which the overall employment of Danish firms has increased but a large share of this employment increase has not been realized within Danish borders.

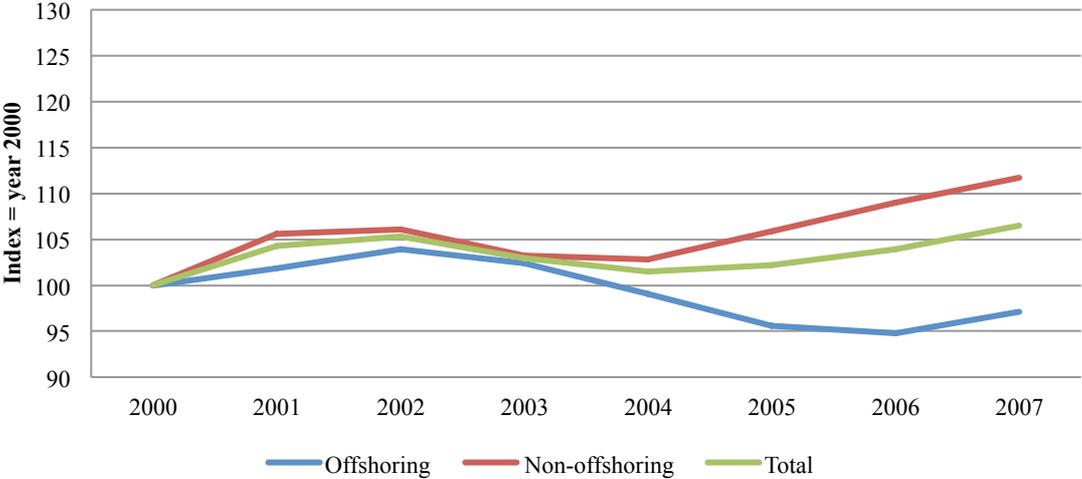
In Figure 1, we observe that there is an overall upward trend of employment with a small dip in employment as a result of the economic recession. Changes in employment usually lag the changes in the business cycle since firms want to keep their employees as long as possible to avoid costs related to hiring and firing. The recovery following this recession is only visible in non-offshoring firms. The domestic employment growth of offshoring firms is lagging behind and involves a slower rate of recovery, i.e. the peak that is visible in 2002 is reached in 2007 while non-offshoring firms surpass this peak already in 2005.

**Figure 1: Trend in employment 2000-2007 (matched sample)**



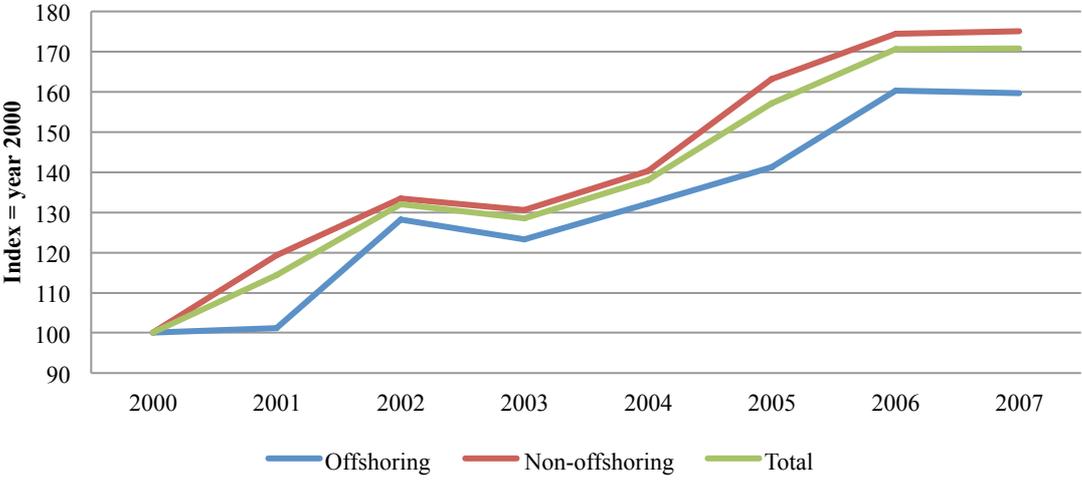
This pattern varies, again, considerably between manufacturing and services. In Figure 2 we present the numbers for manufacturing industries. In manufacturing, the “peak” of 2002 is reached in 2007 and it are the non-offshoring industries that are responsible for the overall recovery. Offshoring firms in this industry follow a similar decline in employees compared to non-offshoring firms during the recession but the recovery follows a more divergent path. The economic recovery does not lead to any form of employment growth for these firms, at least not within the Denmark.

**Figure 2: Trend in employment 2000-2007 in manufacturing (matched sample)**



In services, there is a strong growth visible for both offshoring and non-offshoring firms. Since the share of offshoring firms is relatively low, the pattern of non-offshoring firms resembles closely the pattern of the overall business service industry (not shown in the figure). Nevertheless, for both these type of firms the impact of the recession is visible in terms of declining employment levels but also here there is a slower rate of recovery for offshoring firms.

**Figure 3: Trend in employment 2000-2007 in business services (matched sample)**



The last table, Table 7, presents the mean differences in employment growth between firms that offshore administrative and technical business functions (ATBF=1) and other offshoring firms.<sup>11</sup> There is no significant difference between the growth-rates in overall employment. However, firms that offshore administrative and technical business functions have a significant lower growth in the number of highly educated employees. They have also a significant lower growth rate, which is on

<sup>11</sup> Those firms that offshore administrative and technical business function can also offshore other activities.

average decreasing, in the number of employees with a medium level of education (although significant on the 10 percent level of significance). Despite the fact that the average increase in the number of employees with a science and engineering degree is higher in those firms that do offshore technical administrative business functions, the mean differences is not statistical significant. Finally, firms that offshore administrative and technical business functions have a significant lower increase in employees with a social science or administration degree.

**Table 7: Mean differences in domestic employment change between firms that offshore administrative and technical business functions (ATBF) and other offshoring firms.**

Variable	ATBF=1 N <sup>1</sup> =135		ATBF =0 N <sup>0</sup> =232		p-value of two tailed t-test on mean difference
	Mean	Std.dev.	Mean	Std.dev.	
Empl_growth	-0.031	0.709	0.059	0.581	0.187
He_growth	0.127	0.800	0.335	0.579	0.004
Me_growth	-0.094	0.797	0.028	0.583	0.095
Le_growth	-0.077	0.697	0.007	0.694	0.264
S&E_growth	0.110	0.775	0.206	0.282	0.177
Adm_growth	0.159	0.703	0.358	0.547	0.003

## CONCLUSION

This paper has made an attempt to contribute to the offshoring literature by moving beyond the existing anecdotal and macro-economic evidence and providing micro-economic evidence on the role of offshoring on changes in employment. By making use of a Danish offshoring survey in combination with the Danish register data, our study provides strong evidence that the effect of offshoring on employment cannot be taken at face value but has to be considered in the light of the type of industry that and the type of activity that is being outsourced. To analyze the difference in growth rates we use a partial propensity score method where we identify multiple firms that can act as a comparable control group for the offshoring firm. We also identify firms that are unique in such a way that there is no non-offshoring counterpart will be removed from the analysis.

As expected, we found that the offshoring firms experience lower growth in the number of employees compared to non-offshoring firms. In addition, they experience a lower growth in the number of employees with a medium and low level of education, on average there is even a decrease. This picture changes, however, when taking into account the type of industry, i.e. manufacturing industries vs. business services, and when considering the type of activities being offshored. Manufacturing industries follow roughly the same overall pattern. The change in employment of business services presents a different picture. It appears from the analysis that non-offshoring firms have a higher increase in the number of employees with a higher education. This can potentially be explained by the fact that manufacturing firms are mainly involved in the offshoring of their core-activities while business services to a higher extend offshore other supportive business functions, i.e. sales and marketing, IT, administration and management functions, technical and engineering functions, and research and development.

When looking at offshoring of administrative and technical business functions it shows that this has a stronger impact on the change in employees with a higher education background in a way that those

firms that offshore experience a lower growth in the number of employees. Especially the growth in employees with a background in social sciences and administration; there is also a lower average growth in employees with a science and engineering background but there is no significant difference between the two subsamples. Furthermore, overall the number of employees with a background in social sciences and administration seems to increase more in offshoring firms.

Many issues remain left open. One topic is to investigate the broader employment issue; the labor effects of offshoring might be underestimated and relatively ambiguous due to the disregard of labor spillovers and feedback effects among firms and industries (Egger and Egger, 2005). What happens to those employees that leave the firms? Do they move out of the active labor force? Do they move to other firms in the same industry or are they ‘forced’ to take a job in other industries. Furthermore, what impact does offshoring have on the suppliers of the offshoring firms, i.e. what are the indirect employment effects? Another question that arises is what happens to overall performance of these firms and in particular focusing on innovation. Firms have traditionally offshored simple manufacturing tasks but when these tasks become more complex firms might lose the so-called “factory as a laboratory”. Lots of innovative activities occur on the work floor in relation to manufacturing tasks and when these activities disappear abroad this might hamper the innovative capacity of domestic firms. This problem might be enhanced when firms start to offshore activities like research and development (named ATBF in our study), which is why the OECD (2008) suggests to assess the impact of R&D offshoring on a country's innovative capacity. We believe that these and others questions would certainly increase our understanding of how offshoring affects the demand for labor and economic performance of firms, and to what extent this impacts the economy as a whole.

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