

Offshoring R&D

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Offshoring R&D

Abstract

This paper explores offshoring of firms' research and development functions. Our analysis employs a previously untapped and unique Eurostat International Sourcing Survey. The results are easy to summarize. First, the magnitude of R&D offshoring is small. Second, a large majority of R&D is offshored within the enterprise group, in contrast to offshoring outside of the enterprise group. Third, most of R&D offshoring from Europe is directed to high-income European countries, not so to low-cost countries in Europe, China, or India. Fourth, R&D jobs do have been lost from offshoring; however, the negative employment impact has been moderate. But the Eurostat International Sourcing Survey does not allow entangling the full net employment effect of R&D offshoring, which could be either negative or positive.

Key words: R&D, offshoring, outsourcing, innovation, product development

JEL: O3, O32, F0, F2, F16, L2, J44

Offshoring R&D

Tiivistelmä

Tämä tutkimus tarkastelee eurooppalaisten yritysten tutkimus- ja tuotekehitystoiminnan siirtämistä ulkomaille. Analyysimme pohjautuu aiemmin hyödyntämättömään ja ainutlaatuiseen Eurostatin ulkoistamista käsittelevään kyselyaineistoon. Tulokset ovat helppo tiivistää. (1) Suuri osa yrityksistä ei ole siirtänyt lainkaan T&K toimintojaan ulkomaille. (2) T&K toimintaa siirretään ulkomaille useimmiten saman yrityksen sisällä, ei toisiin yrityksiin ulkomailla. (3) T&K toiminnan siirtäminen Euroopasta suuntautuu pääosin korkean hintatason eurooppalaisiin maihin, ei alemman hintatason maihin Euroopassa, Kiinaan tai Intiaan. (4) T&K työpaikkoja on siirtynyt Suomesta ulkomaille, mutta negatiivinen työllisyysvaikutus on ollut maltillinen. Eurostatin kyselyaineisto ei mahdollista työllisyyden kokonaisvaikutuksen arvioimista, joka on voinut olla negatiivinen tai positiivinen.

Asiasanat: T&K, ulkoistaminen, innovaatiot, tuotekehitys, kansainvälistyminen

JEL: O3, O32, F0, F2, F16, L2, J44

1 Introduction

Firms in developed countries have moved—for a long time—low-skilled manufacturing tasks to developing countries (see, for example, Vernon 1966 and Autor et al. 2013). More recently, many scholars have observed that recent advances in technology, especially in transportation and communications, have allowed moving high-skilled tasks abroad as well (Acemoglu and Autor 2011; Lewin and Peeters 2006). A number of high-end R&D facilities are located in India (Dossani and Kenney 2007).

In the process, jobs, such as, R&D that formerly were believed to be those that would remain in the developed nations now appear to be at risk of being relocated offshore. It has been argued that the distinction between tradable and non-tradable activities made by David Ricardo (1817) in the early 19th century is being altered (see, for example, Spence 2011, for a review).

This paper explores offshoring of research and development functions in manufacturing firms from 15 European countries. This is one measure of the geography of innovation (see, for example, Florida 2012 for a review). In this study, we focus on Finland and Sweden but examine the results for the other European countries in our sample.

The analysis is based on the Eurostat International Sourcing Survey conducted in 2011. We describe the phenomenon and offer insights from previously untapped and large-scale official data. The data offers a novel analysis international sourcing and new measurement of the globalization of firms' R&D activities. The survey includes nearly 40,000 European firms with nearly 17 million employees.

In particular, this paper explores four aspects of European corporate R&D offshoring.

First, what percentage of manufacturing firms actually offshore R&D? We also explore some additional aspects of R&D offshoring.

Second, do manufacturing firms offshore their R&D through contracting to other firms or do they perform their R&D in offshore internally?

Third, does R&D offshoring impact domestic employment? It is clear that offshoring of manufacturing has meant manufacturing jobs have been lost (Autor et al. 2014; Autor et al. 2013). Undoubtedly, the manufacturing employment effects have been long lasting. But it is certain that offshoring is not a one-way process. At times, firms relocate activities back to the home market. Moreover, foreign international firms may also offshore their activities to domestic markets. Our goal is to provide estimates of the employment effect of manufacturing R&D offshoring through a direct firm-level survey. Our analysis describes only the amount of tasks lost from offshoring.

Fourth, is proximity important factor for manufacturing R&D offshoring? It is possible that being physically close to manufacturing facilities may reduce communication costs. Such an effect presumably would reduce incentives to offshore R&D functions. Conversely, an offshore manufacturing operation could induce offshoring of R&D functions as well, in order to those activities to be close to each other. We draw from a direct survey aimed to shed light on the motivation and barriers for offshoring decisions.

It is well known that most trade in the world happens between firms—not between firms and consumers (Caves et al. 2007). Firms trade tangible goods, such as coal or rear windows, but also intangible goods, for example, new ideas and blueprints. Furthermore, firms trade goods but also tasks (Baldwin and Robert-Nicoud 2014). Trade in tasks refers to fine-grained international division of labor to distinguish it from a more coarse trade in goods (Grossman and Rossi-Hansberg 2008). Small parts—fragments—of production processes are traded within or between firms and different locations (Timmer et al. 2014). A number of these tasks are intangible.

Firms' international organization decisions are described with a variety of vocabulary. A complex issue requires a nuanced framework. But many of the terms, including our main concept—offshoring—are used in several ways to describe several related activities. For brevity, we use the term offshoring as shorthand for both offshore outsourcing and insourcing. By offshoring we mean that a business function is totally or partially moved abroad and it was previously performed domestically, either in-house or outsourced. In relevant literature (see, for example, Grossman and Rossi-Hansberg 2008), offshoring refers to a decision by a firm to relocate a business function from one country to another. More broadly, offshoring describes breaking up an originally vertically connected production process internationally. Bits and pieces of production network are performed in various countries and the international division of tasks may change continuously.

This paper employs data from the Eurostat International Sourcing Survey. The target population is firms with 100 employees or more. We report country- and industry-level averages, unless otherwise stated. Our main concept, offshoring, is defined in the Eurostat International Sourcing Survey as total or partial movement of business functions (core or support business functions) currently performed in-house or currently domestically sourced by the resident enterprise out of the home country to enterprises within or outside of the enterprise group located abroad.

The International Sourcing Survey measures R&D activity jointly with engineering functions. That is, our measure includes both R&D and engineering activity. Although this may hide some of the role of innovation activity in a narrow view, it is the finest resolution available from the Eurostat International Sourcing Survey. On the other hand, R&D activity is hard to separate from other engineering functions. For example; same workers may divide their time between engineering and R&D tasks.

In the following four sections, we present descriptive evidence from International Sourcing Survey, intended for answering our questions.

2 What is the magnitude of R&D offshoring?

How many manufacturing firms offshore R&D compared to the total amount of firms? Figure 1 depicts the share of firms that offshore R&D by country. In our sample of 11 European countries, on average, 3.4 percent of firms offshore R&D. The share is highest in Denmark—9.0 percent—almost three times the average. Lithuanian and Bulgarian firms in the sample do not report any R&D offshoring.

We find that in Finland 6.1 percent and in Sweden 4.4 percent of manufacturing firms offshore some R&D. In both countries the share of manufacturing firms that offshore R&D is above the sample average. However, the numbers are low, too. In Finland, only one in sixteen and in Sweden one in twenty three manufacturing firms perform R&D activities abroad.

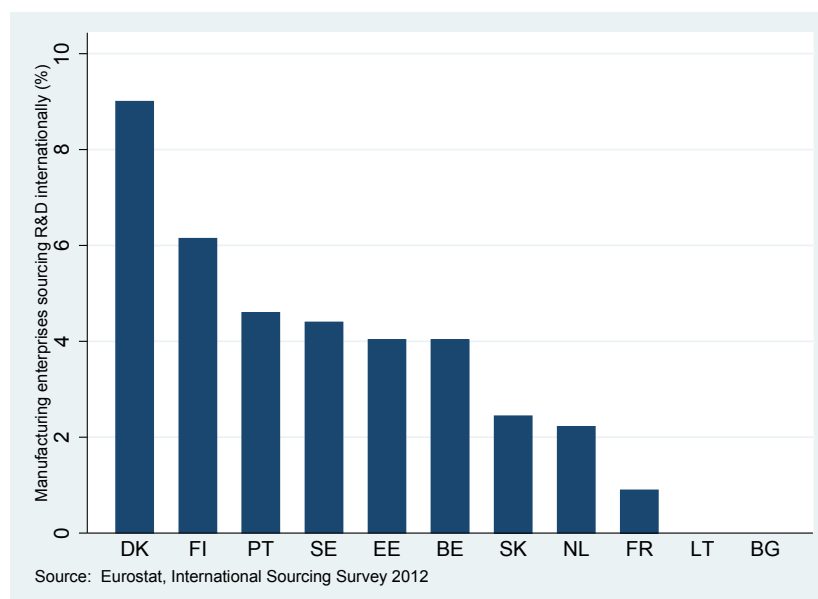
How many manufacturing firms offshore at least some part of their activities, not necessarily R&D, at the first place in comparison? On average, in our sample of European countries, 16.1 percent of firms were engaged in some type of offshoring.

The highest shares of firms that offshore any business functions are found in Denmark with 36.5 percent, Finland with 29.9 percent, and Belgium with 24.3 percent, while the lowest shares are in Latvia, Bulgaria and Romania with zero, 1.6, and 3.9 percent of firms offshoring any of their activities. Again, the numbers are 29.9 percent (a third) for Finland and 18.8 percent (a fifth) for Sweden. Most offshoring is not R&D offshoring; much of offshoring is in other business functions.

The perspective slightly changes when we look among firms that already have some offshoring activities—including other than offshoring R&D. Within firms that already offshore at least one business function, on average, 17.9 percent also offshore some R&D. Estonia leads with a share of 26.5 on this measure, and Denmark and Portugal take the second and third place with 24.7 and 24.3 percent shares.

When we look at firms that offshore part of their activities 20.6 percent in Finland and 23.4 percent in Sweden offshore their R&D functions as well. We get a similar change for figures in most other European countries in our sample. Furthermore, the previously reported difference between Finland and Sweden in R&D offshoring vanishes from this viewpoint. The ex-

Figure 1 Share of manufacturing enterprises that offshore R&D



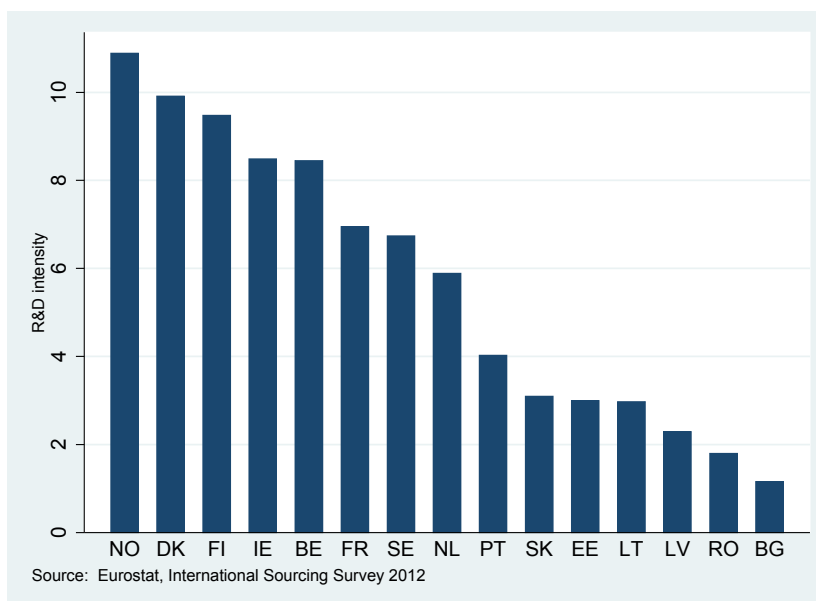
planation is that Finland has a higher share of firms that offshore at the first place than Sweden has, but out of firms that are engaged in any kind of international sourcing, the share is similar in both countries. We see that within firms that already offshore any activities—that is within global firms by this measure—it is not uncommon to offshore R&D functions as well.

We have noticed that not many European firms in our sample—not even Finnish or Swedish manufacturing firms—offshore R&D. To give a broader picture on the size of the issue, how much employment there is in manufacturing R&D compared to the total employment in manufacturing? This measure includes both domestic and international R&D activity within the firm.

Figure 2 compares the R&D intensity in selected European countries covered in the International Sourcing Survey. The R&D intensity—employment in R&D functions as a fraction of the total employment—within Finnish manufacturing firms is 9.5 percent and in Swedish firms 6.7 percent. It is evident from the Figure 2 that the R&D intensity is higher in high-income countries. However, R&D intensity varies between selected high-income countries.

In volumes, according to the Eurostat International Sourcing Survey, manufacturing firms with more than 100 employees have total employment of 193,000 and in Sweden 251,000—7.1 percent and 5.0 percent of the labor force.¹ From Finnish and Swedish perspective, our interest in this paper is focused on 18,300 Finnish and 16,900 Swedish manufacturing employees working in R&D functions. These numbers are slightly different from the conventional Labor Force Survey figures because we use a different survey.

Figure 2 R&D intensity in selected EU countries



¹ Source: World Bank, Labor force total and Eurostat International Sourcing Survey.

As we said earlier, the overall picture from our analysis is that the magnitude of R&D offshoring is small—in the sample of 11 European countries, according to the Eurostat survey. Has this changed recently in a meaningful way? The answer is no. According our analysis drawing from the previous International Sourcing Survey published by Eurostat in 2007, on average, 4.9 percent of firms in the same pool of countries were offshoring R&D functions internationally from 2001 to 2006, compared to 3.4 percent from 2007 to 2011. If anything, the magnitude has become even smaller.

The decrease from 2007 data to 2011—from 4.9 to 3.4 percent on average—may be explained by the actual changes in firm's behavior. One plausible explanation is that the 2008 economic crisis may have reduced investment in R&D and amount of R&D offshoring. But the decrease may also reflect changes in measurement. More than the average, the order of the countries with respect to the share of R&D offshoring has changed with increases and decreases back and forth.

We acknowledge that although not many European firms do offshore R&D, the number of firms is not the only measure for offshoring's magnitude. For example, we do not possess data on the transaction volumes on offshoring. Furthermore, we only measure the number of firms, and it may give a different picture of the magnitude than other measures, such as employment in those firms. But it seems fair to say that not many firms in our sample offshore R&D in Finland, Sweden, or Europe.

3 What is the mechanism through which R&D is offshored?

Our survey data allows disentangling whether offshoring of R&D activities happens within the same multinational enterprise group or is directed outside the enterprise. This helps shed light on the channel through which firms offshore their activities. Previously in Finland, Deschryvere and Ali-Yrkkö (2013) emphasize the importance of the distinction between the two different, internal and external, channels of offshoring. Different channels may be used for different types of R&D activity, and this may entail different impacts (Deschryvere and Ali-Yrkkö 2013).

Our analysis suggests that firms offshore R&D more often within the firm, for example, to their own plant or R&D center outside the country, than they do outside the firm. Out of those firms that had offshored their R&D functions, on average 67.7 percent stated they had done it within their enterprise group and, in turn, 24.8 percent reported R&D offshoring outside the enterprise group.

Note that these percentages do not need to add up as some firms offshore both within and outside their enterprise group, and, on the other hand, the lowest percentages are not necessarily reported due to a privacy threshold in the data. Moreover, the non-response rate—that Eurostat, however, does not report—appears to be high for this question.

Figure 3 presents the share of firms that offshore R&D within and outside enterprise group by country. Countries differ by this respect. Firms in several countries—Sweden, France, and Finland—report that they only offshored R&D within the enterprise group, while in Denmark and Portugal the shares of internal and external offshoring are more even. In only a one country, Estonia, firms report offshoring more outside than within their enterprise group. We also find that the channel of offshoring—inside or outside the company—is only weakly if at all

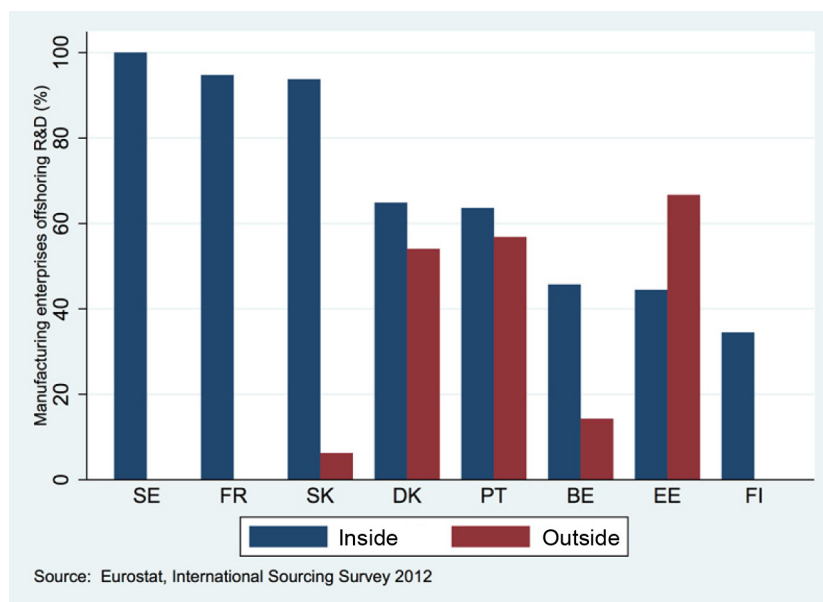
correlated with the magnitude of R&D offshoring in that country. However, country-level observations may hide firm-level associations.

The observation that offshoring happens in many cases internally is not completely specific to R&D. When we look at any offshoring activity we see that in most, that is nine out of twelve European countries, more offshoring is performed inside rather than outside the enterprise group. On average, 61.2 percent of firms in our sample reported they had offshored any business functions within the enterprise group. On the other hand, 41.0 percent of firms had offshored activities outside their enterprise group. However, it appears that in most countries R&D activities are more often offshored internally than other activities in general are.

Where is R&D offshoring directed to from our sample of European countries? Figure 4 presents the geographical destinations of R&D offshoring from 12 countries covered in the survey. We measure popularity of destinations as a percentage of firms that told they had offshored to that destination among the firms that had offshored R&D to any destination. It is equivalent to asking: if you offshored R&D, where did you offshore it?

Contrary to a belief common both in academic literature as well as in the popular press, we find that majority of R&D offshoring from Europe is directed to high-income countries in Europe. 37.4 percent of the firms that had offshored R&D at the first place reported they had done so to high-income EU-15² countries. In comparison with high-income—and high cost—EU-15 countries, only 5.6 percent of firms accounted they had offshored R&D to low-income

Figure 3 Share of firms that offshore R&D within and outside enterprise group by country



² EU-15: Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, Sweden, and the United Kingdom.

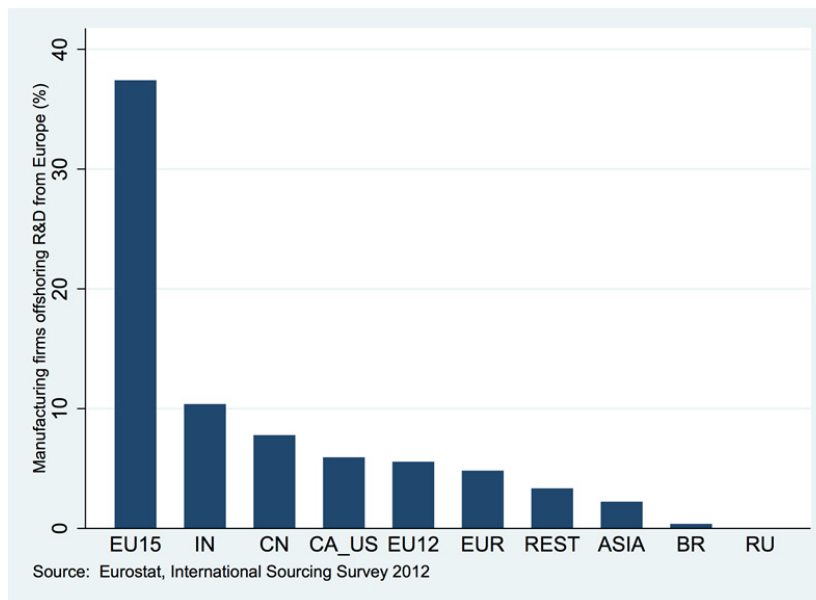
EU-12³ countries.⁴ At least in Europe, firms offshore R&D to high-income countries such as Germany and France rather than to low-income countries, such as Bulgaria and Romania.

We think that this is an important observation. Our analysis, based on the large-scale firm-level survey, suggests that R&D offshoring from Europe does not seem to send jobs out of Europe. The jobs appear to stay, to a large extent, within the EU. In specific, the data suggests that high-income European countries are trading tasks (Grossman and Rossi-Hansberg 2008) between other high-income European countries.

However, the second most popular destination for R&D offshoring from 2009 to 2011 was India with 10 percent of firms locating R&D activities there. China was the third largest destination for offshoring R&D functions. Among the firms that had offshored R&D functions, 7.8 percent of firms had located those functions to China. But at the first place, the Figure 4 shows, the R&D offshoring does not appear to be directed to China or India.

Are these destinations different from where offshoring is directed in general? Yes, and no. For all types of offshoring, the most popular destinations were the high-income EU-15 countries, with 34.6 percent of firms moving any of their function to these countries. The twist comes at the second place. The percentage of firms that accounted they had offshored any activities to low-income EU-12 countries was considerably high, 24.6 percent, in contrast with only 5.6

Figure 4 Geographical destination of R&D offshoring from selected European countries, % of the firms that had offshored R&D*



* EU-15 and EU-12 are defined in the footnotes. EUR refers to other European countries: Switzerland, Norway, Turkey, Belo Russia, Ukraine and the Balkan states. ASIA includes other Asian countries than China and India.

³ EU-12: the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovak Republic, Bulgaria, and Romania.

⁴ Volumes of EU15 and EU12 exclude the country of origin itself.

percent in R&D. On the third place is China, which 15.9 percent of firms that were engaged in offshoring chose for being their offshoring location. We also see that the United States and Canada are not common destinations for European based offshoring in general but are common for offshoring R&D in particular.

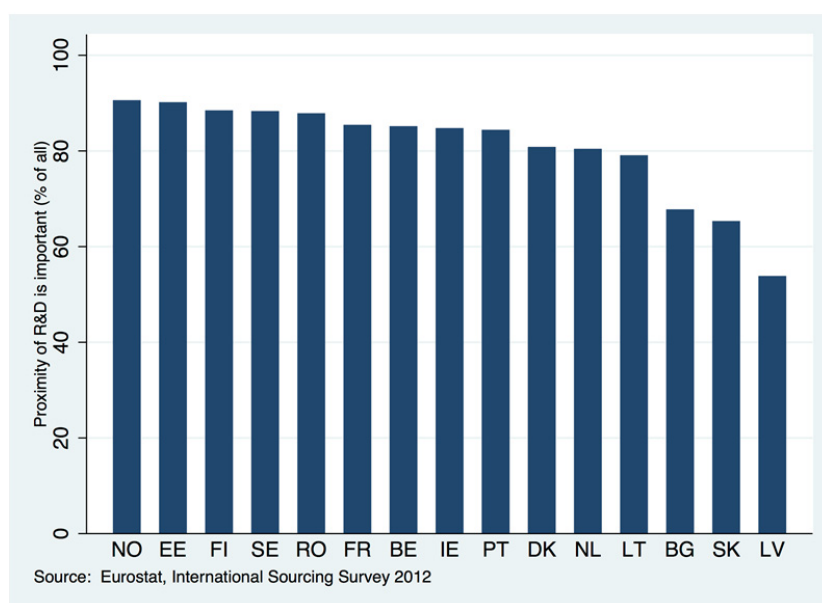
The point becomes clearer when we look at the share of R&D offshoring by destination. That is, we ask how many firms offshore R&D to these locations compared to the number of firms that offshore any activity to the same location. By this measure, R&D is comparatively directed to the United States and Canada and to high-income European countries. Within the firms that had offshored to the US and Canada, 17.0 percent had offshored R&D to either or both of the countries. It is the highest percentage among our destinations. In Europe, among those firms that had offshored to high-income EU-15 countries, 15.9 percent had offshored R&D. In contrast, in low-income EU-12 countries the number was much smaller: 3.3 percent.

The difference between China and India as offshoring locations also becomes apparent. The R&D offshoring share to China was 7.2 percent while to India it was 15.1 percent—over two times larger. China is a major destination for manufacturing offshoring in general, as noted in many previous studies including Autor et al. (2013) and Autor et al. (2014), but R&D offshoring is more typically directed to India (Dossani and Kenney 2007).

To explain the mechanism, is physical distance an important factor for firms' R&D offshoring decisions? Data on the Figure 5 show that most firms report proximity as an important factor for their offshoring decisions. This could explain why only a few firms offshore R&D.

A plausible explanation is that offshoring manufacturing activities may induce offshoring R&D functions as well. Firms may need to have these functions to be close to each other (Dossani and Kenney 2007).

Figure 5 Share of firms that report proximity is an important factor for offshoring decisions



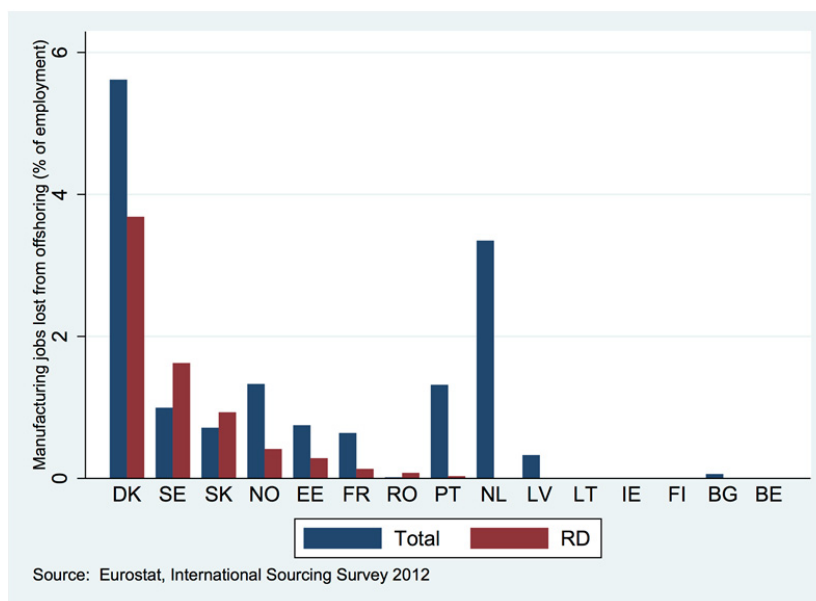
4 What is the impact of R&D offshoring on domestic employment?

What has been the impact of R&D offshoring on domestic employment in Europe? Departing from the majority of previous literature (see, for example, Liu and Trefler 2008, Becker et al. 2013, and Hummels et al. 2014), we provide an assessment on the employment effects by using a direct firm-level survey. The manufacturing firms were asked how many R&D jobs had been lost as a result of any offshoring activities from 2009 to 2011.

We do not claim that our approach is superior to that of the previous studies (Becker et al. 2013; Hummels et al. 2014) that use register-based data, but it complements the earlier analysis by providing evidence from a novel data source. We measure direct job losses from offshoring that the firms report but there might also be other effects. The reported amounts of jobs lost by country are presented in Figure 6. Despite the fact that a small proportion of firms offshore R&D, the firms do report negative employment effects. One possibility for this is that it may be large firms offshoring R&D.

How do the reported first-order negative employment effects in R&D compare to the overall impact of offshoring on employment? In every country, except for Sweden and Slovakia, firms reported less R&D jobs lost as a result of offshoring than they did in total when adjusted for the employment in R&D. In other words, the employment effects have been less negative for R&D jobs than for manufacturing jobs in general. A potential reason for this is the lower magnitude of R&D offshoring. But, in total, our findings imply that we would need to take other aspects into account as well. The findings on employment effects are confirmed by earlier studies including Deschryvere and Ali-Yrkkö (2013).

Figure 6 Manufacturing jobs lost as a result of offshoring from 2009 to 2011 in selected European countries



	<i>Moving other jobs abroad (%)</i>		<i>Creating high skilled jobs (%)</i>	
	<i>Some impact</i>	<i>Substantial impact</i>	<i>Some impact</i>	<i>Substantial impact</i>
Finland	46.3	9.1	29.7	3.0
Ireland	27.5	7.6	27.1	3.4
UK	7.4	8.6	23.0	2.9
Denmark	34.3	12.7	20.8	5.7
Norway	19.4	15.7	16.7	9.3
Germany	28.7	39.7	31.3	15.6

Source: European Labour Force Survey and Mitrunen (2013).

Other sources than the Eurostat International Sourcing Survey provide information on offshoring activities as well. According to the European Labour Force Survey in 2007, 28.5 per cent of manufacturing firms in Finland offshored at least part of their activities. 46.3 percent of the firms that did offshore told that offshoring displaced less skilled tasks from home to abroad. On the other hand, 29.7 percent of the firms reported that offshoring of less skilled tasks contributed to increase in high-skill task employment within their company. Offshoring caused skill upgrading or polarization within firms—according to the firms' self-assessment. The reported numbers are larger for Finland than they are for several other countries. Table 1 (abridged from Mitrunen 2013) provides descriptive evidence for Finland and several other European countries that while offshoring moves jobs abroad at the same time it helps to create high-skilled jobs domestically.

5 Conclusions

This paper has explored offshoring of firms' research and development functions. Our analysis was based on unique and previously untapped Eurostat International Sourcing Survey. The results are easy to summarize. First, the magnitude of R&D offshoring is small. Second, a large majority of R&D is offshored within the enterprise group, in contrast to offshoring outside of the enterprise group. Third, most of R&D offshoring from Europe is directed to high-income European countries, not so to low-cost countries in Europe, China, or India. Fourth, R&D jobs have been lost from offshoring; however, the negative employment impact has been moderate. But the Eurostat International Sourcing Survey does not allow entangling the full net employment effect of R&D offshoring, which could be either negative or positive.

More generally, no longer only low-skilled work, such as call center positions, is subject to offshoring or moved abroad. We document that high-value R&D work also is, in part, moving offshore. But offshoring of R&D functions is still a small phenomenon.

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