ETLA
ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 358-9-609 900
Telefax 358-9-601 753 World Wide Web: http://www.etla.fi/

Keskusteluaiheita – Discussion papers

No. 1163

Jyrki Ali-Yrkkö* – Matthias Deschryvere*

DOMESTIC R&D EMPLOYMENT EFFECTS OF OFFSHORING R&D TASKS: SOME EMPIRICAL EVIDENCE FROM FINLAND

* ETLA, The Research Institute of the Finnish Economy – Lönnrotinkatu 4B, FIN-00120 Helsinki, Finland. Tel: (+) 358-9-609 900, Fax: (+) 358-9-601 753, e-mail: jyrki.ali-yrkko@etla.fi and matthias.deschryvere@etla.fi

ACKNOWLEDGEMENTS: Financial support from the Finnish Funding Agency for Technology and Innovation (TEKES) is gratefully acknowledged.

ISSN 0781-6847 05.11.2008

ALI-YRKKÖ, Jyrki & **DESCHRYVERE,** Matthias. **DOMESTIC R&D EMPLOYMENT EFFECTS OF OFFSHORING R&D TASKS: SOME EMPIRICAL EVIDENCE FROM FINLAND.** Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2008, 31 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; No. 1163).

ABSTRACT: This study empirically explores whether R&D offshoring affects the domestic R&D employment at the firm level. Overall, the Finnish survey data suggest that the impact of R&D internationalization on domestic R&D employment depends on the mode of internationalization (in-house offshoring vs. offshore outsourcing vs. in-house expansion of R&D abroad). Moreover, manufacturing and service firms are found to be different when it comes to R&D internationalization and its domestic employment effects. In the manufacturing sector, especially in-house offshoring of R&D has a significant negative impact on the plan to increase R&D employment. But the relationship between the in-house expansion of R&D abroad and domestic R&D employment turns out to be complementary. In the service sector, it is in the first place offshore outsourcing of R&D that has a significant negative impact on the plan to increase R&D employment. A final result supports the view that R&D does not always follow production but that a strong location link between production and R&D does have a significant negative effect on the domestic R&D employment.

KEYWORDS: globalization, internationalization, outsourcing, offshoring, job loss, R&D, spillovers, research, relocation, domestic, home-country

JEL Codes: J6, J3

ALI-YRKKÖ, Jyrki & **DESCHRYVERE,** Matthias. **T&K-TOIMINTOJEN KANSAINVÄLISTYMISEN VAIKUTUKSET KOTIMAAHAN – EMPIIRINEN TUTKIMUS SUOMEN AINEISTOLLA.** Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2008, 31 s. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; No. 1163).

TIIVISTELMÄ: Tässä tutkimuksessa tarkastellaan yritysten tutkimus- ja tuotekehitystoiminnan (t&k) kansainvälistymisen vaikutuksia kotimaahan. Aineisto koostuu Suomessa toimivista yrityksistä. Ekonometristen analyysien tulosten mukaan sillä, että yrityksellä on t&k-toimintaa ulkomailla ei ole vaikutusta t&k-henkilöstön määrään kotimaassa. Tulokset muuttuvat, kun otetaan huomioon t&k-toiminnan kansainvälistymisen muoto ja yritysten toimiala. Teollisuudessa erityisesti konsernin sisäisellä t&k-toiminnan siirrolla ulkomaille on selvä negatiivinen vaikutus niiden aikomuksiin lisätä t&k-henkilöstöä kotimaassa. Toisaalta t&k-toiminnan laajentamisella ulkomailla on positiivinen yhteys kotimaisen t&k-henkilöstön kanssa. Palvelualoilla puolestaan t&k:n ulkoistaminen ulkomaille vähentää todennäköisyyttä, että yritys lisää t&k-henkilöstöä kotimaassa. Kaiken kaikkiaan tulokset osoittavat, että t&k:n kansainvälistymisen muodolla on vaikutusta siihen, onko koti- ja ulkomainen t&k toisiaan täydentäviä vai korvaavia.

AVAINSANAT: globalisaatio, kansainvälistyminen, t&k, tutkimus, tuotekehitys, ulkoistus, työllisyys, siirto, kansainvälistymismuoto, kotimaa

JEL-KOODIT: J6, J3

Table of contents

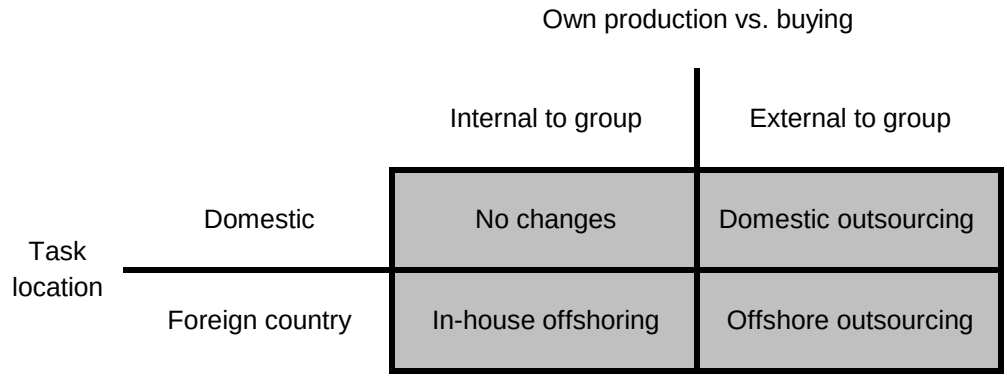
1. Introduction

Offshoring practices have been moving up the value chain, affecting production, services, and R&D. An increasing number of firms have internationalized their R&D, and a major concern to the home countries is that R&D abroad starts to replace domestic R&D and that this hollows out the National Innovation System and threatens the human capital accumulation (UNCTAD 2005). However, empirical research on the home-country consequences of R&D internationalization and offshoring is scarce.

This paper addresses the impact of R&D offshoring on the future domestic R&D employment plans[1]. The analysis focuses on the following three questions: (1) Does overseas R&D replace domestic R&D? (2) Does the industry matter for R&D offshoring and its domestic R&D employment effects? (3) Does R&D follow production? The empirical analysis is based on a representative cross-section of 428 firms with R&D expenses. The data sample used was collected in 2006 as part of ETLA's (The Research Institute of the Finnish Economy) project conducted for the Office of the Finnish Prime Minister.

Because the terms outsourcing and offshoring are often confused, a clear definition is needed (cf. OECD, 2007). Any task no longer produced within the firm (or group of firms) is outsourced. Any task no longer being conducted in the originating country is offshored. Figure 1 categorizes both outsourcing, offshoring, and their combinations.

Figure 1 Outsourcing (horizontal), offshoring (vertical), and their combinations (the figure refers to a group of companies or various establishment locations of the firm).



Source: Secretariat of the Economic Council (2006, Figure 2.1).

Based on the above figure firms can be regrouped in several categories: (1) firms that did not outsource and offshore R&D, (2) firms that carried out domestic outsourcing of R&D, (3) firms that are characterized by in-house offshoring of R&D, (4) firms that undertook offshore outsourcing of R&D, and (5) firms that are characterized by a combination of categories (2)-(4).

The paper proceeds as follows. The next section offers a selection of relevant literature. Part 3 clarifies the methodology. Section 4 describes the data and summarizes the sample properties. Section 5 presents the econometric results and finally, Section 6 concludes.

[1] Our sample of 428 firms consists of 334 domestic owned firms and 94 foreign owned firms. Therefore, robustness tests will take into account the dimension of foreign ownership.

2. Relevant literature on offshoring R&D and its domestic effects

2.1. Economic theory

Outsourcing and offshoring have both been studied in the context of the theory of the firm and the theory of international trade. The theory of the firm pays attention to the firm's decision to engage in outsourcing and offshoring. The main idea is that the firm has boundaries and has to make a choice between making and buying. In addition the firm can engage in several types of partnerships and joint-ventures with other firms, institutions, and universities. The current analysis specifically focuses on in-house **offshoring** (via FDI) and offshore outsourcing to subcontractors.

Spencer (2005) summarizes the four basic approaches explaining the firm's decision to outsource or integrate vertically (either at home or abroad). (1) property rights model, according to which outsourcing is more favorable the less important the final good providers are in creating surpluses; (2) an incentives model, where high incentives to offshore offset integration advantages (3) a delegation of authority model, where an agent's effort increases under offshoring while total control over the project by the principle is lost, and (4) a transaction cost approach, where the trade off is between the costs of finding an offshoring partner and the high fixed cost of vertical integration. According to Antras (2005) the decision to outsource depends on the maturity of the technological product. Transfer of younger technology should be in-house offshored so as to minimize incomplete contracts. Additional to the two latter studies LTT (2007) also referred to other studies concluding that more complex and less codifiable technologies are less frequently offshore outsourced and more frequently in-house offshored.

Originally influenced by the international trade literature, a category of studies focuses specifically on the effects of service offshoring on relative labor demand for skilled white collar workers. Crinò (2007) recently summarized this stance of literature. He concludes that the theory consists of two main approaches, a traditional one based on trade theory and a new one based on the theory of firm organizations and hierarchies. The latter approach stresses that the nature of service offshoring is an "international trade of tasks". Hence, the key point is that in addition to firm-by-firm and sector-by-sector basis, global competition occurs also on a task-by-task basis (Baldwin 2006, Grossman & Rossi-Hansberg 2006a, Grossman & Rossi-Hansberg 2006b).

According to the traditional theory, service offshoring leads developed countries to specialize in high skill intensive service tasks, in line with the standard law of comparative advantages. For the new theory it is not the skill intensity of the tasks that matters but the ease in the tradability of the services. The risk of services being offshored depends on the tradability not on the skill intensity. In practice, the tasks that show tradability characteristics are mostly routinized and low-skill intensive. As such both approaches lead to the same conclusion that in developed countries service offshoring will shift relative labor demand in favour of high-skilled white collar workers (Antras et al., 2006). Based on the above conclusions and based on the fact that R&D activities are a special form of services it could be expected that firms will offshore the R&D tasks that are tradable. Whereas the expected effect of the offshoring of R&D would be that it will shift relative demand for domestic R&D employees to the most skilled - demanding or important - R&D tasks.

Based on a two-country model, the relocation of R&D activities increases domestic welfare since relocation only occurs if intra-firm communication is well developed and therefore knowledge generated and obtained abroad flows back to the domestic country (Gersbach & Smutzler, 2006). When countries are asymmetric, the small country firm is more likely to offshore its R&D activities into the large country than conversely. This firm migration accelerates productivity gains in the big-nation while reducing productivity gains in the small nation (Baldwin & Okubo, 2006).

2.2. Heterogeneity of R&D

Bardhan (2006) illustrates that firms with a cellular form organization can offshore different R&D tasks to one or more competence clusters around the world. This leads to much heterogeneity in the R&D that has been offshored and to a dispersed location of technology development. The composition of offshored R&D depends on two main dimensions: the type of technology (familiar technology versus new technology) and the category of market (familiar markets versus new markets).

Most of the literature on the motivation to offshore R&D focuses on large multinational firms. The home-country effects of R&D offshoring depend on what kind of R&D is involved. According to the empirical firm perspective literature, overseas R&D activities can either be motivated by *support-oriented R&D* or *knowledge sourcing R&D*. The first and conventional type involves the adaptation of the home-made technology and products to the host country. The second type combines both local and worldwide R&D resources so as to generate new technological knowledge. The expansion of support oriented R&D depends on the size of the market in which the firm supplies products. Firms with a higher share of sales in a certain market were found to be more likely to conduct R&D for that market. But other studies found that foreign R&D activities are explained by the foreign affiliate's higher propensity to export products. It is not completely clear if a higher ratio of sales to the host country or the higher propensity to export of the affiliate in the host country pushes R&D expansion. The expansion of knowledge sourcing R&D is influenced by country specific factors like the availability and costs of R&D resources (human resources and the technological knowledge in specific industries). The fact that the globalization of R&D and innovation is simultaneously driven by low costs, access to new markets, and the availability of skilled scientific talent explains the direction of offshoring towards the skilled labor pools of China, India, and Russia, as well as to the EU-10 countries. A final crucial factor for the expansion of overseas R&D activities is the strength of protection of IPRs. Mostly the two types of R&D have been analyzed separately. In those studies the focus was on the explanation of the expansion of overseas R&D while the choice between both types of R&D has rarely been analyzed.

But a recent contribution of Ito & Wkasugi (2007) did take into account the choice between the two types of overseas R&D. They found that the export propensity of the affiliated firms has a positive effect on the overseas expansion of R&D. Knowledge sourcing R&D is expanded because of the relative abundance of human resources and the high level of technological accumulation in the host country. The stronger enforcement of IPRs in the host countries expands the knowledge sourcing R&D. Both firm and country specific factors are important for the expansion of R&D of multinationals.

The motivation behind the offshoring of R&D affects the composition and the mode of R&D offshoring. In-house offshoring and offshore outsourcing could be motivated both by support-oriented R&D and knowledge sourcing R&D. Different modes of R&D offshoring have dif-

ferent domestic implications. The domestic R&D employment effects have therefore to be assessed by R&D type and offshoring mode. The general view in the literature is that most of the R&D work is still carried out in-house (domestically or abroad) and major firms only use offshore outsourcing for the more marginal aspects of innovation and for the more routine elements in R&D projects.

The R&D intensity is found to affect the internationalization intensity of R&D and the offshoring mode of R&D. In a study of the European Commission that was based on a sample of 110 European firms carrying out industrial R&D investment, it was found that high R&D intensity sectors are the most internationalized (European Commission, 2006). Despite the worries about R&D offshoring to Asia, work carried out there is less than one percent of the total R&D investment. However, those firms reported also that the expected growth of their R&D investments is highest in China and India.

According to Leiponen (2008) the sources of knowledge for innovation between the service sector and the manufacturing sector differ. R&D investments or permanent R&D teams are not very strongly statistically associated with the introduction of new services. Service firms tend to rely more than manufacturing firms on consulting companies as inputs for innovation. In-house training may compensate for formal R&D activities in many service firms. Service innovators utilize formal intellectual property rights much less intensively than good innovators. Service firms tend to rely on confidentiality agreements, lead time, trademarks, and secrecy rather than patents. Based on the above findings it seems appropriate to study the R&D offshoring between the manufacturing and service sector separately.

2.3. Employment effects of R&D offshoring

In this section we summarize the literature on the domestic employment effects of offshoring. Studies in this field are still very scarce and the majority of the empirical analyses are based on US data. In most of the contributions the focus is not always on R&D, but often on the broader categories science and engineering or services.

Jaffee (2004) analyzes the US employment and wage effects of offshoring. He argues that job losses are transitory and that service sector job losses do not lead to measurable and sustainable increases in macroeconomic unemployment rates. The author stresses that this flexibility of service workers can also be seen in the results of Amiti & Wei (2004) who find that service offshoring lead to employment losses at a disaggregated level, but that these effects disappear when higher aggregation is concerned. However, Jaffee notes that if in the long-term the comparative advantage shifts or offshoring of initially non-tradable goods and services increases, adverse effects could rise.

Based on the R&D location decision data of 200 multinational companies, roughly 17% of the companies anticipate decreasing R&D employment in Western Europe (Thursby & Thursby 2006). But as much as 35% (20%) of the companies anticipate an increase in technical employment in China (India). Although some companies plan to expand R&D in emerging countries with some contraction in developed countries, more recent or planned facilities central to the firm's R&D strategy seem to be located in developed countries. Their results show that the recent or planned facilities central to the firm's current R&D strategy on average make up 15 % of all technical employees worldwide. Facility employment is highly skewed and a majority of new or planned facilities have less than 50 employees.

According to LTT (2007), locating offshore R&D in developing Asia is associated with a higher degree of domestic R&D replacement than offshoring to other locations. Their more general study looks at the implications of R&D offshoring on the innovation capacity of EU firms. *In extremis* the effects of R&D on employment should indeed be analyzed within a broader context. According to the OECD (2008, p.20) one should rather assess the effect of R&D offshoring on the technological potential of the country. Offshoring R&D may indeed lead to a possible decline of capacity for innovation. The scale of this effect depends on the nature and composition of the R&D.

If R&D is done for in-house foreign affiliates, the negative impact may be more modest due to spill-over effects (OECD, 2007, p. 37). When assessing the implications of R&D offshoring one has indeed to take into account the international spill-over effects. Typically innovations and new findings developed abroad spill back domestically. International diffusion of technology can affect productivity through three channels. (1) The domestic R&D sectors openness to information flows and its ability to absorb information from abroad, (2) International trade of intermediate goods and services that are more advanced than those domestically, and (3) FDI and international trade are both ways to learn new product technologies and processes. Kiyota (2005) found that the positive effect of FDI-related (in-house offshoring) R&D spill-over effects last longer than import-related R&D (offshore outsourcing) spill-over effects, though both accelerate productivity growth.

Freeman (2005) argues that the fact that populous low income countries have many science and engineering specialists threatens to undo the North-South trade pattern in which advanced countries dominate high-tech while developing countries specialize in less skilled manufacturing. The diminished comparative advantage in high-tech will create a long period of adjustment for US workers, of which multinational R&D facilities in developing countries, is one of the harbingers. To ease the adjustment to a less dominant position in science and engineering, the US will have to develop a new labor market and R&D policies that build on existing strengths and develop new ways of benefiting from scientific and technological advances in other countries.

In addition to direct job displacement, R&D offshoring potentially redirects job growth to lower cost developing nations (Kenny & Dossani 2005). Not only big firms engage in offshoring, but also high technology start-ups may early in their life start to offshore so as to be more competitive. According to them Kenny and Dossani it is worrying that if a large number of new jobs continue to be relocated, entrepreneurship as such may also be relocated.

Most of the contributions do not analyze the domestic employment effects of R&D offshoring in depth. Assessing the implications of R&D offshoring on the domestic job-market needs more empirical research. The empirical analysis in this paper is a step towards a better understanding of the domestic effects of R&D internationalization.

3. Methodology

In order to investigate the impact of the R&D internationalization on the domestic R&D employment , we formulated an observable model, taking into account the data availability:

$$y_{i\ 2006-2009} = \begin{cases} 1 \ \ if \ \ y_i^* > 0 \\ 0 \ \ if \ \ y_i^* \le 0 \end{cases}$$

with the measure of domestic R&D employment $y_{i\ 2006-2009}$ equaling 1 if the firm *i* plans to increase domestic R&D employment in the period 2006 to 2009 or 0 if this is not the case.

The empirical latent model with latent metric $y^*_{i\,2006-2009}$ (propensity to plan to increase domestic R&D employment) becomes:

$$y^*_{i\,(2006-2009)} = \beta_1 \left(Internationalization\ of\ R\,\&\,D \right)_{i\,(2001-2006)} + \beta_2 X_{i2006} + \varepsilon_{i2006}$$

with ε_{i2006} following an extreme value distribution.

So the unit of analysis in the above logit model is the firm. The right hand side of the equation contains variables that capture if the firm internationalized its R&D in the period 2001-2006. The most general variable that belongs to this category is a dummy that tells if the firm has R&D abroad or not. A second available dummy summarizes if the firm relocated R&D activities in the above period or not. On a more detailed level dummies do make a difference between offshore outsourcing of R&D and in-house offshoring of R&D. A last dummy variable tells if the firm expanded in-house R&D abroad in that period.

The vector *X* refers to 2006 and contains a number of other variables identified in the literature as affecting R&D activity. As a proxy for firm size, two dummies are used that tell if the firm is either large or small, and where the reference category is the medium sized firm. As export active firms may also be more R&D intensive a variable is used that represents the export intensity. R&D intensity is supposed to have a positive significant effect on the plans to increase R&D employment. As profitability is supposed to have a positive impact on R&D employment a variable return on investment is used. To capture information from the plant level, a dummy is used that tells if a firm has more than one establishment or not. Nationality of the ownership has been found to affect R&D activities and, therefore, a foreign ownership dummy could be introduced in the specification. Domestic outsourcing of R&D could give information on the difference in effects between domestic and international outsourcing on R&D employment. Finally, the equation also includes a full set of industry dummies to control for any sector specific effects that are unobserved in this econometric specification.

In the above set-up having internationalized R&D in the period 2001-2006 can affect an anticipated increase in R&D employment for the period 2006-2009. Ideally one would allow for both shorter and longer lags but this is not possible as the data are limited. All firm level control variables give information on the year 2006 and lag, therefore, behind the plans to increase R&D employment in Finland in the 2006-2009 period. This set-up helps to minimize potential endogeneity problems. The effects of offshoring have to be interpreted as short to medium term effects, as they are based on an average of 1 to 8 year time lags.

4. Data description and sample properties

Data description

The questionnaire was designed and data collected as part of ETLA's (The Research Institute of the Finnish Economy) project conducted for the Prime Minister's Office in Finland[2]. The target population consists of firms with at least 10 employees in manufacturing and private services. The stratified random sample and associated weights were determined in association with the Statistic Finland's Register of Enterprises and Establishments, which has the statutory duty to maintain a complete and continuous record of all businesses in the country. The strata and other details are discussed in the Appendix (Table A.1). The survey was conducted in summer 2006 (with some retrospective and forward-looking questions) and it yielded 653 usable observations; the response rate was 40%. Unless otherwise mentioned, all results reported in this paper employ the sampling weights. As with any general firm population, the sample also includes foreign-owned companies and subsidiaries with parent companies abroad. As the focus of this analysis is on R&D offshoring, only firms which reported to have R&D expenses in 2005 are taken into account, this leaves us with a sample of 428 firms.

Sample properties

Table 1 shows the descriptive statistics of the data consisting of 428 manufacturing and private services businesses with 10 or more employees operating in Finland and having reported R&D expenses. In the first two numerical columns the mean and standard deviation refers to the whole sample. Since we are investigating the relationship between R&D offshoring and the intention to raise R&D employment in Finland, it is useful to list the same information across the group of firms who have no R&D activities abroad and those who have. The last three columns report the means of firms with R&D abroad and those without, as well as the statistical significance of the difference between these means (a two-sided *t*-test without assuming equal variances across the two groups).

The first line of Table 1 lists our dependent variable, "*planning to increase R&D employment in Finland in the next three years*". As can be seen, on average about 39% of the firms plan to increase their R&D employment in Finland in 2006-9. That share is slightly higher for firms that already have R&D activities abroad but the difference is not statistically significant. A very limited number of firms (roughly 1 %) anticipate a decrease in R&D employment in Finland. Firms who do plan a decrease almost all belong to the manufacturing sector (roughly 4%).

The second section of Table 1 refers to the set of non-categorical explanatory variables, as well as a couple of indicator explanatory variables. Roughly 9.5% of the firms had R&D activities abroad in 2001–6[3]. About 7.5% of the firms relocated R&D employment from Finland during that time. But about three times more firms, 22.6%, outsourced R&D activities domestically. On average less than 2% internationalized R&D through in-house offshoring while almost 6% did that through offshore outsourcing. During the same period about 3% of the firms engaged in the expansion of R&D activities abroad (within their group). Less than 1%

[2] Some properties of the data, as well as some basic results, are reported in Secretariat of the Economic Council (2006).

[3] All means presented here are weighted and, therefore, they do not correspond but are in line with the means published in table 2.2 of the publication "*Secretariat of the Economic Council*" (2006).

relocated R&D activities back to Finland but as much as 9% of the firms that had R&D activities abroad relocated (a part of) their R&D activities back to Finland.

Table 1 Descriptive statistics (two-tailed *t*-tests in means)

	Mean	S.D.	R&D Abroad Mean	No R&D Abroad Mean	Signif.
Planning to increase the firm's R&D empl. in Finland	0.389	0.049	0.437	0.384	
Planning to decrease the firm's R&D empl. in Finland	0.011	0.003	0.039	0.007	*
Firm: Has R&D abroad	0.095	0.020	.	.	
Firm: Relocated R&D from Finland	0.074	0.020	0.781	0.000	***
Firm: Offshore outsourcing of R&D	0.058	0.017	0.610	0.000	***
Firm: In-house offshoring of R&D	0.020	0.012	0.205	0.000	*
Firm: In-house expansion of R&D abroad	0.031	0.012	0.328	0.000	***
Firm: Relocated R&D back to Finland	0.008	0.002	0.087	0.000	***
Firm: Domestic outsourcing of R&D	0.226	0.043	0.608	0.186	***
Firm: Has production abroad	0.155	0.026	0.629	0.105	***
Firm: Relocated production from Finland	0.127	0.026	0.513	0.086	***
Firm: Offshore outsourcing of production	0.103	0.024	0.332	0.079	**
Firm: In-house offshoring of production	0.038	0.012	0.262	0.014	**
Firm: In-house expansion of production abroad	0.050	0.013	0.323	0.021	***
Firm: Domestic outsourcing of production	0.206	0.031	0.309	0.195	
Firm: Age (years)	17.611	1.313	14.008	17.990	*
Firm: Age (log of years)	2.516	0.096	2.245	2.545	**
Firm: Infant	0.284	0.044	0.396	0.272	
Firm: Mid-Age (Reference)	0.381	0.053	0.380	0.381	
Firm: Old	0.335	0.047	0.224	0.347	+
Firm: Size (Finnish empl.)	199.471	21.849	529.996	164.703	***
Firm: Size (log of Finnish empl.)	3.904	0.106	4.726	3.818	**
Firm: Small	0.569	0.043	0.390	0.587	'
Firm: Mid-size (Reference)	0.291	0.038	0.269	0.294	
Firm: Large	0.140	0.028	0.341	0.119	***
Firm: Multi-establishment	0.305	0.040	0.502	0.285	*
Firm: Profitability (ROI)	0.123	0.021	0.115	0.124	
Firm: Foreign owner	0.124	0.033	0.170	0.119	
Firm: Export propensity	0.613	0.053	0.924	0.580	***
Firm: Export intensity	0.176	0.020	0.314	0.162	***
Firm: R&D intensity	0.047	0.007	0.064	0.045	
Firm: High educ. empl. sh.	0.177	0.019	0.206	0.174	
Firm: Med. educ. empl. sh., (Reference)	0.270	0.022	0.235	0.274	
Firm: Low educ. empl. sh.	0.553	0.025	0.559	0.552	
Firm: Missing educ. sh.	0.028	0.012	0.069	0.024	+
Region: Metropolitan area (Reference)	0.254	0.045	0.232	0.256	
Region: North	0.073	0.025	0.048	0.076	
Region: South	0.199	0.045	0.130	0.206	
Region: East	0.086	0.034	0.027	0.092	+
Region: West	0.387	0.048	0.550	0.370	+
Ind.: Foods, textiles, apparel (15-19)	0.090	0.026	0.024	0.097	**
Ind.: Wood, pulp, paper (20-21)	0.076	0.024	0.023	0.081	**
Ind.: Chemicals (23-25)	0.055	0.020	0.047	0.055	
Ind.: Metals (27-28)	0.110	0.027	0.067	0.115	'
Ind.: Machinery, equip. (29, 34-35)	0.086	0.020	0.255	0.068	*
Ind.: Electronics, electr. eq. (30-33)	0.049	0.017	0.208	0.032	*
Ind. Other manuf.(22, 26, 36-37), Reference	0.044	0.012	0.067	0.042	
Ind.: Trade (50-52)	0.145	0.035	0.022	0.158	***
Ind.: Transportation (60-64, ex. 642)	0.044	0.028	0.011	0.047	
Ind.: Knowledge intensive business services (KIBS)	0.214	0.019	0.241	0.211	
Ind.: Other services (55, 65-74, ex. KIBS)	0.088	0.033	0.036	0.093	'

Notes: Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; mid-education level is the reference level of education; and other manufacturing is the reference industry. Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20.

As can be seen, firms with no R&D abroad are on average older (18 vs. 14 years) and smaller (the average number of employees in Finland: 165 vs. 530). Firms with R&D abroad are, on average, more likely to have many establishments (50% vs. 28%). There is no statistically significant difference in terms of profitability.

Important, but not surprising, is that the firms which have R&D activities abroad have a significantly higher export intensity than firms who have no R&D abroad (31% versus 16%). For firms with more exports it may be worthwhile to relocate R&D activities away from Finland

for reasons of favorable access to local markets (right shoring). While the sizable difference in the means would seem to suggest that firms with R&D abroad are more R&D intensive (6.4%) than firms without R&D abroad (4.5%), the difference is not statistically significant due to the large variance.

The above results suggest that there may be much variation across industries and firm-size, therefore, the next table takes into account these two dimensions (Table 2).

Table 2. R&D internationalization by industry and firm-size (shares of firms)

	All Industries			Manufacturing			Services		
	All	Large	SMEs	All	Large	SMEs	All	Large	SMEs
Planning to increase the firm's R&D empl. in Finland	38.86 %	38.42 %	38.94 %	27.56 %	46.45 %	24.64 %	50.58 %	32.12 %	54.55 %
Planning to decrease the firm's R&D empl. in Finland	1.05 %	2.86 %	0.71 %	1.17 %	4.91 %	0.59 %	0.92 %	1.25 %	0.85 %
Has R&D abroad	9.52 %	25.42 %	6.60 %	12.89 %	38.78 %	8.89 %	6.02 %	14.94 %	4.11 %
Relocated R&D from Finland	7.43 %	14.37 %	6.16 %	9.89 %	21.85 %	8.04 %	4.88 %	8.50 %	4.11 %
Offshore outsourcing of R&D	5.80 %	12.09 %	4.65 %	7.03 %	17.48 %	5.42 %	4.53 %	7.85 %	3.81 %
In-house offshoring of R&D	1.95 %	4.37 %	1.51 %	3.15 %	6.55 %	2.63 %	0.71 %	2.66 %	0.29 %
In-house expansion of R&D abroad	3.12 %	9.80 %	1.90 %	5.34 %	16.38 %	3.64 %	0.82 %	4.63 %	0.00 %
Relocated R&D back to Finland	0.83 %	4.63 %	0.13 %	0.95 %	5.45 %	0.25 %	0.70 %	3.98 %	0.00 %
Domestic outsourcing of R&D	22.58 %	25.34 %	22.07 %	26.17 %	37.17 %	24.47 %	18.85 %	16.06 %	19.45 %
R&D intensity	4.71 %	3.84 %	4.87 %	3.30 %	3.05 %	3.34 %	6.18 %	4.46 %	6.55 %

Table 2 shows that the share of the service sector (50.6%) planning to increase R&D employment is almost twice as big as that of the manufacturing sector (27.6%). In the manufacturing sector recruitment plans are mainly driven by large firms, whereas the recruitment dynamics in the service sector are more driven by SMEs. Roughly 5% of the large manufacturing firms anticipate a decrease in R&D employment in Finland.

R&D internationalization along firm size and industry: The above table shows that: (1) Large firms are on average two to three times more involved in R&D relocation than SMEs. (2) The share of manufacturing firms involved in R&D offshoring is two to three times higher than that of the service sector. (3) When looking at the modes of internationalization, offshore outsourcing (5.8% of firms) is two to three times more common than in-house offshoring (1.95% of firms).

Reasons for offshoring R&D: The reasons for offshoring R&D vary. Table A.2 shows that on average in-house offshoring is mainly driven by cost savings, entry to market, or improved consideration of customer needs and increasing flexibility. Offshore outsourcing is mainly driven by acquiring technology or know-how, acquiring additional capacity, and cost savings. The first conclusion is that offshoring is not just driven by the rationale for cost savings (see also Secretariat of the Economic Council, 2006, p.63-68). The second conclusion is that on average in-house offshoring is potentially more motivated by support-oriented R&D whereas offshore outsourcing seems to be more motivated by knowledge sourcing R&D. R&D offshoring seems to be also motivated by the need for increasing flexibility. The latter motivation fits perfectly into the picture of the cellular form organization (see Bardhan, 2006).

Correlations: Table A.3 lists the non-weighted correlations between the plan to increase R&D employment (dependent variable) and the R&D offshoring variables so as to understand the relationship better and gain information on the optimal specification of the multivariate analysis. The correlation between the dependent variable and the R&D offshoring variables turns out to be rather weak. The correlation between having R&D abroad and planning to increase R&D employment in Finland is 0.14. The correlation between the dependent variable and the in-house offshoring of R&D variable is very weak since only 15 companies have in-house offshored R&D. Looking at the correlation between the different variables of R&D offshoring, it becomes clear that certain variables correlate significantly and that this must be taken into account when specifying the multivariate equations. Domestic outsourcing has a relative high correlation (0.53) with offshore outsourcing. This suggests that domestic outsourcing and offshore outsourcing are complementary to each other. Possibly many firms first outsourced domestically and then abroad. In-house offshoring of R&D correlates strongly (0.45) with '*In-house expansion of R&D abroad'*. '*In-house expansion of R&D abroad'* correlates significantly (0.43) with the '*In-house expansion of production abroad'*.

This section had a simple look at the data without controlling for the potential impact of any other variable. This will be tackled in the next section.

5. Econometric results

Based on our representative recent cross section of firms from Finland some clear results can be deduced. It is however important to stress that results should be interpreted with care. The first reason that asks for a careful interpretation is the relative small absolute number of firms with R&D abroad. The previous sections showed that based on our sample of 428 firms with R&D only 9.5% already have R&D activities abroad. The second reason for a cautious interpretation of the results evolves from the possible endogeneity problems. The problem of endogeneity has been reduced because in our set up (see section 3) the explanatory offshoring variables and other control variables lag behind the forward-looking employment variable. The final reason for cautious interpretation relates to the multicollinearity between certain variables. In what follows the main results are discussed.

5.1. Does overseas R&D replace domestic R&D?

All tables with the results of our logit model list the marginal effects (ME's). The results of the base line regression are tabulated in column (*a*) in Table 3. As described in Section 3, the specification controls for variables that turned out to be important for the level of R&D activities.

Table 3 Estimation results of the baseline regression, all sectors

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years; Sample with all sectors; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)	(f)
Has R&D abroad (d)	-0.123					
Relocated R&D from Finland (d)		-0.148 '				
Offshore outsourcing of R&D (d)			-0.035			-0.035
In-house offshoring of R&D (d)				-0.365 ***		-0.374 ***
In-house expansion of R&D abroad (d)		-0.209 +			-0.256 **	0.174
Infant (d)	0.123	0.145	0.113	0.179 +	0.146	0.175 '
Old (d)	-0.054	-0.054	-0.048	-0.041	-0.042	-0.044
Small (d)	0.185 '	0.205 +	0.176	0.229 +	0.195 '	0.23 +
Large (d)	0.168 +	0.181 +	0.145 '	0.177 +	0.17 +	0.171 +
Multi-establishment (d)	0.129	0.13	0.119	0.122	0.118	0.124
Profitability (ROI)	0.172	0.161	0.168	0.123	0.158	0.123
Export intensity	0.458 ***	0.467 ***	0.447 ***	0.463 ***	0.469 ***	0.46 ***
R&D intensity	1.826 **	1.904 **	1.759 **	1.82 **	1.849 **	1.813 **
High educ. empl. sh.	-0.163	-0.2	-0.15	-0.251	-0.192	-0.249
Low educ. empl. sh.	0.062	0.063	0.074	0.069	0.061	0.076
Firm: Missing educ. sh. (d)	0.451 ***	0.452 ***	0.45 ***	0.431 ***	0.453 ***	0.428 ***
North (d)	-0.165	-0.179	-0.159	-0.196 '	-0.173	-0.197 '
South (d)	-0.208 +	-0.217 *	-0.205 +	-0.226 *	-0.22 *	-0.223 *
East (d)	0.146	0.132	0.155	0.12	0.14	0.12
West (d)	0.289 **	0.298 **	0.283 **	0.302 **	0.292 **	0.301 **
Foods, textiles, apparel (d)	-0.003	-0.035	0.001	-0.038	-0.016	-0.04
Wood, pulp, paper (d)	0.238	0.231	0.231	0.25	0.244	0.244
Chemicals (d)	0.172	0.142	0.17	0.132	0.157	0.13
Metals (d)	-0.098	-0.116	-0.098	-0.116	-0.104	-0.12
Machinery, equip. (d)	-0.145	-0.156	-0.159 '	-0.163 '	-0.162 '	-0.161 '
Electronics, electr. eq. (d)	0.268	0.343 +	0.218	0.448 ***	0.327 '	0.442 **
Trade (d)	0.398 **	0.386 **	0.402 ***	0.408 ***	0.402 ***	0.406 ***
Transportation (d)	0.093	0.088	0.089	0.116	0.098	0.114
KIBS (d)	0.411 ***	0.401 ***	0.412 ***	0.428 ***	0.403 ***	0.433 ***
Other services (d)	0.31 *	0.297 *	0.317 *	0.322 **	0.304 *	0.327 **
Observations	428	428	428	428	428	428
Adjusted Wald test (Model)	2.8 ***	2.766 ***	2.759 ***	3.19 ***	2.987 ***	2.938 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	4.538	5.184	3.876	8.247	5.764	7.871

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other manufacturing is the reference industry. Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20.
(d) dy/dx is for discrete change of dummy variable from 0 to 1. A&L: for more information on this test see Archer & Lemeshow (2006).

Having R&D abroad (dummy variable) has a negative impact on 'planning to increase the R&D employment in Finland', but the effect is statistically non-significant. This implies that the evidence that having R&D abroad is combined with a decrease in domestic R&D employment is weak. Hence, this does not support the substitution hypothesis between foreign and domestic R&D.

Column (*b*) uses two alternative dummies to capture R&D internationalization, namely a dummy that captures if the firm relocated R&D activities abroad from Finland (in-house or outsourced) and a dummy that shows if a firm expanded their R&D activities abroad or not (in-house). Both dummies have a negative sign but their statistical significance is rather weak (20% resp. 15%).

When looking at the mode of relocating R&D activities abroad two major categories of modes can be distinguished namely offshore outsourcing and in-house offshoring. Column (*c*) shows that firms undertaking offshore outsourcing are less likely to raise their domestic R&D employment but the effect turned out to be non-significant. Columns (*d*) and (*f*) show that another picture arises when the internationalization of R&D via in-house offshoring is concerned. In-house offshoring has a negative and statistically significant impact on 'planning to raise domestic R&D employment'. Columns (d) and (f) also show that the marginal effect of the dummy variable in-house offshoring turns out to be roughly -0.37. That number represents the difference between the probabilities to increase R&D employment in 2006-2009 of (1) a firm with "typical" characteristics[4] that did in-house offshore R&D in the period 2001-2006 and (2) of a firm with the same characteristics that did not in-house offshore R&D in the period 2001-2006.

In sum, these results indicate that different modes of R&D internationalization have different impacts on the domestic R&D employment. In addition those results have implications for the National Innovation System. In section 2.2 attention was paid to the heterogeneity of R&D tasks and one should analyze in more detail what tasks are more prone to in-house offshoring than others.

5.2. Does industry matter?

This section reassesses the results by analyzing a sample of manufacturing firms and a sample of service firms. In a first step the same specification is used as in Table 1. In a second step the regression for the manufacturing sample will also include information on the relocation of production so as to be able to assess the effects between the offshoring of R&D and production.

Manufacturing versus Services

Findings from the literature (Leiponen, 2008) and the fact that the manufacturing and service sector displayed on average different shares of R&D internationalization (see Table 2), suggest that it is useful to analyze the two industries apart. Do manufacturing and service businesses display different effects when it comes to R&D internationalization and offshoring?

[4] Holding all other variables at some fixed values by setting all dummy variables to their modal values and all other variables to their mean values.

Table 4. Estimation results for the manufacturing sector

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years; Manufacturing sample; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)	(f)
Has R&D abroad (d)	-0.065					
Relocated R&D from Finland (d)		-0.133 *				
Offshore outsourcing of R&D (d)			-0.044			-0.057
In-house offshoring of R&D (d)				-0.227 ***		-0.243 ***
In-house expansion of R&D abroad (d)		-0.01			-0.09	0.219 *
Infant (d)	0.138	0.148	0.128	0.182 '	0.145	0.177
Old (d)	0.121 '	0.123 '	0.118 '	0.137 +	0.125 '	0.133 '
Small (d)	-0.229 **	-0.215 *	-0.234 **	-0.187 +	-0.228 **	-0.178 +
Large (d)	0.14 '	0.143 +	0.125 '	0.143 +	0.131 '	0.134 '
Multi-establishment (d)	-0.039	-0.042	-0.039	-0.04	-0.037	-0.042
Profitability (ROI)	0.661 **	0.669 **	0.667 **	0.57 *	0.632 **	0.594 *
Export intensity	0.085	0.085	0.083	0.079	0.083	0.079
R&D intensity	1.07	1.045	1.074	0.71	1.083	0.576
High educ. empl. sh.	-0.239	-0.264	-0.237	-0.311	-0.249	-0.315
Low educ. empl. sh.	0.062	0.063	0.063	0.059	0.066	0.063
Missing educ. sh. (d)	0.269	0.27	0.262	0.238	0.276	0.225
North (d)	-0.126	-0.139	-0.124	-0.152 '	-0.126	-0.156 '
South (d)	-0.064	-0.077	-0.057	-0.086	-0.065	-0.085
East (d)	-0.065	-0.078	-0.057	-0.086	-0.063	-0.085
West (d)	0.143 '	0.137 '	0.145 +	0.144 '	0.148 +	0.141 '
Foods, textiles, apparel (d)	0.111	0.083	0.113	0.074	0.111	0.063
Wood, pulp, paper (d)	0.327	0.303	0.324	0.32	0.334	0.3
Chemicals (d)	0.148	0.12	0.149	0.121	0.153	0.107
Metals (d)	-0.014	-0.033	-0.015	-0.025	-0.008	-0.041
Machinery, equip. (d)	-0.054	-0.06	-0.063	-0.057	-0.06	-0.059
Electronics, electr. eq. (d)	0.317 +	0.334 *	0.285 '	0.449 **	0.334 *	0.432 **
Observations	284	284	284	284	284	284
Adjusted Wald test (Model)	3.91 ***	3.909 ***	3.814 ***	3.945 ***	3.851 ***	3.898 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	13.792	10.718	6.272	17.003	853.723	14.226

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other manufacturing is the reference industry. Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20.
(d) dy/dx is for discrete change of dummy variable from 0 to 1. A&L: for more information on this test see Archer & Lemeshow (2006).

In the manufacturing sector, the ME of '*Has R&D abroad'* does not differ statistically significantly from zero echoing the result in Table 3. Not surprisingly, the relocation of domestic R&D has a negative (ME -0.13) and statistically significant impact on the domestic R&D employment plans (column *b*). The results reported in columns (c) – (f) reveal that this result is driven by in-house offshoring (ME's -0.23 resp. -0.24). Interestingly, in column (f) the ME of '*In-house expansion of R&D abroad'* is positive (+0.22) and statistically significant at 10% level indicating that '*In-house expansion of R&D abroad'* and domestic R&D are complementary.

The next table (5) reports the results of regressions for the service sector.

Table 5. Estimation results, service sector

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years; Sample of service sector; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)	(f)
Has R&D abroad (d)	-0.42 ***					
Relocated R&D from Finland (d)		-0.449 ***				
Offshore outsourcing of R&D (d)			-0.485 ***			-0.486 ***
In-house offshoring of R&D (d)				-0.503 **		-0.422 *
In-house expansion of R&D abroad (d)		-0.481 ***			-0.488 **	-0.375 +
Infant (d)	0.356 **	0.362 **	0.335 *	0.315 *	0.31 *	0.35 **
Old (d)	-0.32 *	-0.33 *	-0.312 *	-0.277 +	-0.272 +	-0.333 *
Small (d)	0.836 ***	0.846 ***	0.853 ***	0.816 ***	0.815 ***	0.854 ***
Large (d)	0.341 ***	0.338 ***	0.316 **	0.314 **	0.324 **	0.331 ***
Multi-establishment (d)	0.597 ***	0.611 ***	0.611 ***	0.552 ***	0.542 ***	0.62 ***
Profitability (ROI)	-0.145	-0.125	-0.158	-0.148	-0.129	-0.122
Export intensity	1.356 ***	1.352 ***	1.33 ***	1.208 ***	1.228 ***	1.413 ***
R&D intensity	3.968 **	4.216 **	4.07 **	3.609 **	3.668 **	4.472 **
High educ. empl. sh.	-1.071 **	-1.092 **	-1.074 **	-0.933 **	-0.914 **	-1.102 **
Low educ. empl. sh.	0.225	0.257	0.309	0.289	0.319	0.281
Missing educ. sh. (d)	-0.061	-0.05	-0.069	0.016	0.033	-0.014
North (d)	-0.55 ***	-0.549 ***	-0.553 ***	-0.516 ***	-0.512 ***	-0.558 ***
South (d)	-0.551 ***	-0.542 ***	-0.534 ***	-0.552 ***	-0.555 ***	-0.541 ***
East (d)	0.026	0.032	0.006	0.027	0.028	0.023
West (d)	0.205	0.213	0.186	0.195	0.194	0.198
Trade (d)	-0.269	-0.288	-0.334 '	-0.224	-0.22	-0.325 '
Transportation (d)	-0.52 ***	-0.53 ***	-0.547 ***	-0.512 ***	-0.515 ***	-0.543 ***
KIBS (d)	-0.113	-0.121	-0.138	-0.095	-0.099	-0.129
Observations	144	144	144	144	144	144
Adjusted Wald test (Model)	2.673 ***	2.845 ***	2.653 ***	3.261 ***	3.465 ***	2.672 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	4993.871	29.698	6758.556	436.072	13.850	342.555

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other services is the reference industry.
Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20. (d) dy/dx is for discrete change of dummy variable from 0 to 1.
A&L: for more information on this test see Archer & Lemeshow (2006).

Table 5 shows that the internationalization of R&D in the service sector seems to have an overall negative significant effect on the probability to plan to increase domestic employment (column *a* in Table 5). Moreover, R&D relocation has a statistically significant ME (-0.45). However in contrast to the manufacturing sector, this result is mainly driven by offshore outsourcing (columns *c* – *f*). The ME of offshore outsourcing is -0.49 and significant at a 1% level whereas the ME of in-house offshoring amounts to -0.42 and is significant at a 10% level. Another difference compared to the manufacturing sector concerns the ME of '*In-house expansion of R&D abroad'*. In the service sector, this ME becomes negative and statistically insignificant (ME: -0.37).

Overall we can conclude that the domestic impacts of the internationalization of R&D in the service sectors and the manufacturing sectors seem to be different. In the manufacturing sector only in-house offshoring of R&D has a significant negative effect on 'planning to increase domestic R&D employment' whereas in the service sector offshore outsourcing, in particular, has a negative significant impact.

5.3. Does R&D follow production?

This section looks at the effect of both the internationalization of production and the internationalization of R&D on the domestic R&D employment plans. The aim is to study the link between production and R&D offshoring (Table 6).

Table 6 Estimation results for the manufacturing sector with production variables

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years; Manufacturing sample; Specification with production variables; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)
Off-shore outsourcing of R&D (d)	-0.062	-0.092	-0.05	-0.057	-0.089
In-house off-shoring of R&D (d)	-0.243 ***	-0.237 ***	-0.237 ***	-0.242 ***	-0.227 ***
In-house expansion of R&D abroad (d)	0.212 +	0.206 +	0.252 *	0.246 *	0.261 *
Has production abroad (d)	0.015				
Off-shore outsourcing of production (d)		0.147			0.159
In-house off-shoring of production (d)			-0.09		-0.099 '
In-house expansion of production abroad (d)				-0.042	-0.027
Infant (d)	0.177	0.186 '	0.179	0.172	0.185 '
Old (d)	0.132 +	0.124 '	0.135 '	0.13 '	0.121 '
Small (d)	-0.18 +	-0.206 *	-0.184 +	-0.181 +	-0.215 *
Large (d)	0.131	0.125	0.138 '	0.145 +	0.134 '
Multi-establishment (d)	-0.045	-0.057	-0.037	-0.039	-0.051
Profitability (ROI)	0.599 *	0.628 *	0.591 *	0.592 *	0.627 *
Export intensity	0.076	0.053	0.085	0.081	0.06
R&D intensity	0.588	0.603	0.536	0.564	0.552
High educ. empl. sh.	-0.322	-0.37	-0.328	-0.313	-0.402
Low educ. empl. sh.	0.055	0.032	0.062	0.066	0.018
Missing educ. sh. (d)	0.213	0.203	0.224	0.231	0.19
North (d)	-0.154 +	-0.147 '	-0.15 '	-0.158 '	-0.14 '
South (d)	-0.085	-0.096	-0.08	-0.086	-0.089
East (d)	-0.082	-0.08	-0.088	-0.09	-0.086
West (d)	0.142 '	0.139 '	0.144 '	0.14 '	0.143 '
Foods, textiles, apparel (d)	0.066	0.088	0.061	0.064	0.089
Wood, pulp, paper (d)	0.302	0.311	0.291	0.301	0.3
Chemicals (d)	0.107	0.124	0.107	0.109	0.125
Metals (d)	-0.04	-0.04	-0.044	-0.042	-0.045
Machinery, equip. (d)	-0.062	-0.09	-0.06	-0.06	-0.095
Electronics, electr. eq. (d)	0.431 **	0.415 **	0.441 **	0.435 **	0.424 **
Observations	284	284	284	284	284
Adjusted Wald test (Model)	3.95 ***	3.987 ***	3.754 ***	3.754 ***	3.687 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	4.814	10.171	10.016	4.542	9.973

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other manufacturing is the reference industry. Statistical significance: *** p<0.01, ** p<0.05, * p<0.10 , + p < 0.15, ' p<0.20. (d) dy/dx is for discrete change of dummy variable from 0 to 1. A&L: for more information on this test see Archer & Lemeshow (2006).

Adding production variables to the specification does not alter the main result of the previous section. The ME's of offshore outsourcing of R&D do not differ statistically significantly from zero whereas those of in-house offshoring are negative (at a 1% level) repeating the results reported in Table 4.

The internationalization of production variables has no statistically significant effects on the domestic R&D employment plans (see columns *a* to *e* in Table 6). Therefore, these results do not support the view that R&D always follows production (see also Ketokivi & Ali-Yrkkö, 2007). This result is in line with the results of qualitative research of Finnish firms' R&D in China (Ali-Yrkkö & Tahvanainen 2008). However, the results in Table A.4 underline that the

condition of a strong location link between production and R&D (large share of R&D has to be done in the same premises with production) has a significant negative effect (ME -0.24) on an anticipated increase of domestic R&D employment.

5.4. Robustness tests

A number of robustness test were carried out. Below we briefly summarize the results.

Robustness test 1: Take into account domestic R&D outsourcing

Domestic R&D outsourcing was not included in our baseline regressions. However, domestic as well as foreign outsourcing impacts potentially on plans to increase or decrease future R&D employment. Moreover, the correlation matrix (presented in table A.3) shows domestic R&D outsourcing clearly correlates with R&D offshoring. Based on these two observations, it is possible that our basic results suffer from omitted-variable bias. To take this into account, we re-run our models by including a dummy variable equaling 1 if a firm has outsourced R&D domestically, or zero otherwise.

For the sample, with all sectors taken into account, domestic R&D does not alter our main results (see Table A.5). But results do slightly vary when the manufacturing and service sectors are looked at separately (Table A.6 versus Table A.7). The main differences in the manufacturing sector are that the significant negative impact of in-house offshoring becomes less significant (in column f the ME changes from -0.24 to -0.21) and the negative effect of offshore outsourcing becomes significant and more than doubles (in column f the ME changes from 0.06 to -0.16). The ME of the domestic outsourcing dummy is positive and statistically significant at the 1% to 5% level (in column f its ME is +0.34). In the service sector the positive effect of the domestic outsourcing dummy is not significant and the results are in line with those of the baseline regression. The above findings show that it is important to take into account the domestic outsourcing dummy in our specification as it may alter the estimated effects of offshoring on employment. However, including the dummy leads to multicollinearity and shows us that the magnitude and significance of certain effects have to be interpreted with care.

Robustness test 2: Take into account the foreign ownership dimension

Some previous studies suggest that foreign multinationals are more likely to shut down operations compared to national firms (Görg and Strobl 2003; Van Beveren 2007). However, in the basic specifications we did not control for foreign ownership. Hence it is possible that the negative correlation between in-house offshoring and the plan to increase domestic R&D employment does not result from any direct relation between them but from their relation to foreign ownership. In other words, it is possible that there is a spurious correlation.

In a first step we checked if adding a foreign ownership dummy to the baseline specification alters our results. Table A.8 shows that the foreign ownership dummy has a significant negative effect on plans to increase R&D employment in Finland. However, our main results remain robust when controlling for foreign ownership. In a second step the baseline regression was run solely on a sample of domestic-owned firms (Table A.9). In that reduced sample the main results also turn out to be robust.

We also ran the regressions separately for the manufacturing and service sectors. The results (not reported) suggest that particularly in the manufacturing sector, the foreign ownership dummy turns out to have a negative and statistically significant (at a 1% level) impact on the plan to raise domestic R&D employment (ME is -0.17). This is an important message for Finnish policy makers. It signals that foreign-owned firms in manufacturing will not expand jobs in Finland as often as domestic-owned firms. In the service sector the ME of the foreign ownership dummy turns out to be not statistically significant.

Robustness test 3: Use different dependent variable

The sample contains a variable that shows if a firm is planning to decrease, increase, or leave the R&D employment equal in the 2006-2009 period. Table 1 shows that a big share of firms plan to increase employment but that only a very small share of firms plan to decrease employment. Because of that lack of observations the focus of this robustness test will be shifted to the manufacturing sector where nevertheless still 4% of the firms were planning to decrease employment. As described in Section 3, in our basic model the dependent dummy variable equals 1 if a firm plans to INCREASE domestic R&D employment and zero otherwise. Based on this dependent variable, our main results for the manufacturing sector suggest that in-house offshoring of R&D has a substitutive relationship with the plan to increase domestic R&D employment. To test the robustness of this result, we re-define our dependent variable so that it equals 1 if a firm plans to DECREASE domestic R&D employment and zero otherwise.

The major results of these estimations for the manufacturing sector (Table A.10) are in line with the results of our basic estimations. In-house offshoring has a positive impact on the probability of planning to DECREASE domestic R&D employment (column *f* in Table A.10), but the effect turns out to be insignificant. The ME of 'In-house expansion of R&D abroad' is negative and statistically significant at 10% level. However, it should be noted that the results in table A.10 have to be interpreted with care as even in the manufacturing sector only a limited number of firms were planning to reduce their R&D employment in Finland.

6. Conclusions

The internationalization of R&D has picked up pace. This evolution has been led by large multinational firms. In this study, we have considered the question of what are the home-country employment effects of the internationalization of R&D? This depends both on the composition of R&D that stays and leaves and on the mode of internationalization (in-house offshoring, offshore outsourcing and in-house expansion of R&D abroad).

Based on our Finnish sample of 428 firms with R&D activities, we find that on average 39% of the firms anticipate to increase their R&D employment in Finland in the coming 3 years. (2006-2009). Roughly 9.5% of the firms had R&D activities abroad in 2001-6. About 7.5% of the firms relocated R&D employment from Finland during that time but three times more firms (22.6%) outsourced R&D activities domestically. Less than 2% internationalized R&D through in-house offshoring while almost 6% engaged in offshore outsourcing.

Our econometric analysis focused on the effect of R&D internationalization on the domestic R&D employment. It was found that having overseas R&D did not have a statistically significant impact on future domestic R&D employment plans. However, when the different modes of R&D internationalization were screened, it was revealed that in-house offshoring of R&D had a significant robust negative impact on the domestic R&D employment plans. Offshore outsourcing of R&D had a negative impact but this effect turned out not to be significant.

Analyzing the employment effects of R&D offshoring for the manufacturing sector and the service sector separately, revealed that the effect of the offshoring modes of R&D differs between the sectors. Especially manufacturing firms with in-house offshoring had a lower probability to increase domestic employment. But in the service sector we primarily found a significant negative effect of offshore outsourcing. The offshoring effects in the service sector are at least the double of those in manufacturing. Furthermore, our findings suggest that manufacturing firms that have expanded their in-house R&D abroad, also plan to increase their domestic R&D indicating that in this sense, domestic and foreign in-house R&D are complementary. Further results support the view that R&D does not always follow production but that the condition of a strong location link between production and R&D does have a negative effect on the domestic R&D employment. The impact of domestic outsourcing turns out to be significant and positive for the manufacturing sector but lacks significance for the service sector. Our analysis also showed that the multicollinearity between domestic outsourcing and offshoring underlines caution in the interpretation of the results.

In the manufacturing sector, foreign ownership has a significant negative effect on the probability to raise R&D employment in Finland. This result signals that foreign-owned firms in the manufacturing sector are not planning to increase employment in Finland as often as domestic-owned firms.

In sum, we found evidence that the impact of R&D internationalization on domestic R&D depends on internationalization mode. Moreover, our empirical evidence supports the idea by Kenney and Dossani (2005) that offshoring does not only mean current displacement but also to some extent redirects job growth to overseas.

7. References

Ali-Yrkkö, J., & Tahvanainen, A. (2008). R&D operations in Developing Country – Case China. *ETLA* ,forthcoming, The Research Institute of the Finnish Economy.

Antras, P. (2005). Incomplete Contracts and the Product Cycle. *The American Economic Review*, 25 (4), 1054-1073.

Antras, P., Garicano, L., Rossi-Hansberg, E. (2006). Offshoring in a Knowledge Economy. *Quarterly Journal of Economics*, 121(1), 31-77.

Baldwin, R. (2006). Globalisation: The Great Unbundling(s). In VNK (2006): *Globalisation challenges for Europe*. Report by the Secretariat of the Economic Council – Part I, Prime Minister's Office Publications 18/2006. Helsinki, Finland.

Baldwin, R. & Okubo, T. (2006). Agglomeration, Offshoring and Heterogenous Firms. *CEPR Discussion Paper*, 5663, Centre for Economic Policy Research, London, UK.

Bardhan, A.D. (2006). Managing globalization of R&D: Organizing for offshoring innovation. *Human Systems Management*, 25, 103-114, IOS Press.

Bardhan, A.D., & Jaffee, D. (2005). Innovation, R&D and offshoring. Research Report of the Fisher Center for Real Estate and Urban Economics, University of California, Berkely, Fall 2005.

Cochran, W.G. (1977). Sampling Techniques (3 ed.). New York, John Wiley & Sons.

Crinò, R. (2007). Offshoring, Multinationals and Labor Market: A Review of the Literature. *CESPRI Working Paper Series*, 196, Centre of Research on Innovation and Internationalization, Università Bocconi.

European Commission (2006). The 2006 EU Survey on R&D Investment Business Trends. Joint Research Centre, Directorate General Research, 33 p.

Freeman, R.B. (2005). Does Globalization of the Scientific/Engineering Workforce Threaten US Economic Leadership? Paper for Innovation Policy and the Economy Conference, April 19, 2005, Washington DC.

Gersbach, H., & Schmutzler. A. (2006). Foreign Direct Investment and R&D offshoring. CEPR Discussion Paper Series, 5766, Centre for Economic Policy Research, London, UK.

Grossman, G. M., & Rossi-Hansberg, E. (2006a). Trading Tasks: A Simple Theory of Offshoring. *NBER Working Paper*, 12721, National Bureau of Economic Research.

Grossman, G. M., & Rossi-Hansberg, E. (2006b). The Rise of Offshoring: It's Not Wine for Cloth Anymore. *The New Economic Geography: Effects and Policy Implications*, Jackson Hole Conference Volume, Federal Reserve Bank of Kansas City.

Görg, H., & Strobl, E. (2003). 'Footloose' Multinationals? *The Manchester School*, 71 (1), 1-19.

Ito, B., & Wakasugi, R. (2007). What factors determine the mode of overseas R&D by multinationals? Empirical evidence. *Research Policy*, 36, 1275-1287.

Ito, B., Tomiura, E., Wakasugi, R. (2007). Dissecting Offshore Outsourcing and R&D: a Survey of Japanese Manufacturing Firms. *RIETI Discussion Paper Series*, 60, Research Institute of Economy, Trade and Industry, Japan.

Jaffee, D., (2004). Globalization, offshoring, and Economic Convergence: A Synthesis. For presentation at the Conference Understanding Global Outsourcing, Stern School of Business, New York University, December 10, 2004.

Kenny, M., & Dossani, R. (2005). Offshoring and the Future of U.S. Engineering: An Overview. *The Bridge*, 35 (3).

Ketokivi, M., & Ali-Yrkkö, J. (2007). Determinants of Manufacturing-R&D Co-location. *ETLA Discussion Papers*, 1082, The Research Institute of the Finnish Economy.

Kiyota, K. (2005). Reconsidering the Effects of Intranational and International R&D Spillovers: Firm Level Evidence from Japan. Manufacturing Management Research Center, The University of Tokyo.

Leiponen, A. (2008). Is Service Innovation Different? *ETLA Discussion Paper Series*, 1151, The Research Institute of the Finnish Economy.

LTT (2007). The implications of R&D offshoring on the innovation capacity of EU firms. Helsinki School of Economics.

OECD (1998). Internationalisation of Industrial R&D, Patterns and Trends. November 1998.

OECD (2007). Offshoring and Employment, Trends and Impacts. July 2007.

OECD (2008). The Internationalisation of Business R&D: Evidence, Impacts and Implications. June 2008.

Secretariat of the Economic Council (2006). Finland's response to the Challenge of Globalisation: Report by the Secretariat of the Economic Council – PART II. Prime Minister's Office Publications, 19, Helsinki.

Spencer, B. (2005). International outsourcing and incomplete contracts. *Canadian Journal of Economics*, 38 (4), 1107-1135.

Thursby, J., & Thursby M. (2006). Here or There, a survey of factors in multinational R&D location. Ewing Marion Kauffman Foundation, Washington DC.

UNCTAD (2005). World Investment Report, Transnational Corporations and the Internationalization of R&D. United Nations Conference on Trade and Development.

Van Beveren, I. (2007). Footloose Multinationals in Belgium? *Review of World Economics*, 143 (3), 483-507.

Van Welsum, D., & Reif, X. (2005). Potential offshoring: Evidence from Selected OECD Countries. OECD, Directorate for Science, Technology and Industry.

8. Appendix

Description of the survey

The field evidence for the study comes from a Finnish cross-sectional survey carried out by ETLA, the Research Institute of the Finnish Economy. The survey was nation-wide and the target population consisted of firms with at least 10 employees in manufacturing and private services[5]. The stratified random sampling without replacement or clustering was used as a sampling technique (see Cochran, 1977, Chapter 5). There were nine strata in the sample, determined by the industry and size of firms. It was decided to include all large firms (with at least 250 employees) in all focused sectors in the sample, and comprehensive random samples were drawn in other strata. The stratified random sample and associated weights were determined in association with Statistic Finland's Register of Enterprises and Establishments, which has the statutory duty to maintain a complete and continuous record of all businesses in the country. Table A.1 describes the strata and the execution of the survey in more detail.

The questionnaire was initially designed and data collected as part of the project conducted for the Prime Minister's Office in Finland to study the challenges of globalization (some properties of the data, as well as some basic results are also reported in Secretariat of the Economic Council, 2006). The respondents of the survey represented the companies' top management. The core questions in the survey asked respondents about their firms' international activities and views on Finland as their host country.

The survey focused especially on domestic and offshore outsourcing and in-house offshoring conducted by companies in the new millennium, and on their motivating factors. The survey was conducted by computer assisted telephone interviews. The interviews were completed between 9 June and 24 August 2006, and were carried out by Tietoykkönen Oy, which specializes in research and marketing information services, fieldwork, and statistical data analysis and has over 15 years experience in the field. Its specifically trained staff regularly carries out similar surveys for the Bank of Finland, various ministries, and other clients. The number of completed interviews was 653, with a response rate of 40%.

The (non-weighted) number of global staff in the respondent companies at the end of 2005 was 625,000. In Finland, these companies had 375,000 employees (un-weighted), which accounted for a quarter of the staff in the Finnish business sector, and 44% of the domestic employment in the target population firms in 2005.

[5] NACE Rev. 1.1 codes 15–37, 50–74. "Private services" is a short name for industries not dominated by public provision.

Table A.1. How the survey was carried out.

A. Number of firms in the target population in June 2006

	Firm size category (# of employees)			
	Small 10-49 empl.	Medium 50-249 empl.	Large at least 250 empl.	Total
Manufacturing (15-37)	2,832	870	244	3,946
Services 1 (50-71)	5,369	726	213	6,308
Services 2 (72-74)	1,784	364	70	2,218
Total	9,985	1,960	527	12,472

B. Number of firms in the random sample to be interviewed

	Firm size category (# of employees)			
	Small 10-49 empl.	Medium 50-249 empl.	Large at least 250 empl.	Total
Manufacturing (15-37)	200	400	244	844
Services 1 (50-71)	150	200	213	563
Services 2 (72-74)	150	200	70	420
Total	500	800	527	1,827

C. Number of contacts reached during the interviewed period

	Firm size category (# of employees)			
	Small 10-49 empl.	Medium 50-249 empl.	Large at least 250 empl.	Total
Manufacturing (15-37)	192	364	213	769
Services 1 (50-71)	139	185	184	508
Services 2 (72-74)	134	180	59	373
Total	465	729	456	1,650

D. Number of completed interviews

	Firm size category (# of employees)			
	Small 10-49 empl.	Medium 50-249 empl.	Large at least 250 empl.	Total
Manufacturing (15-37)	51	162	137	350
Services 1 (50-71)	41	53	86	180
Services 2 (72-74)	33	64	26	123
Total	125	279	249	653

Notes: NACE Rev. 1.1 Industry codes are in parentheses. Data for determining the strata were acquired from the Statistics Finland's register of Enterprises and Establishments

Table A.2. Reasons for the internationalization of R&D by offshoring mode

Ranking the reasons to offshore R&D		
	A. In-house Offshoring*	
1	Cost savings	89 %
2	Entry to market or improved consideration of customer needs	88 %
3	Increasing flexibility	84 %
4	Need to locate R&D closer to our production units	75 %
5	Need to move R&D operations closer to our R&D partners	69 %
6	Taking advantage of a target country's tax benefits or company subsidies	13 %
7	Better technological or other expertise in target country	13 %
8	Focusing Finnish operations on another activity	11 %
	B. Offshore Outsourcing**	
1	Acquiring technology or know-how	87 %
2	Acquiring additional capacity	81 %
3	Cost savings	68 %
4	Increasing flexibility	55 %
5	Focusing	38 %
6	Entry to market or customer needs	35 %

* Ranking based on the firms that have in-house offshored in the years 2000

** Ranking based on the firms that have offshore outsourced in the years 2000

Table A.3. Non-weighted correlations between the outsourcing and offshoring variables (dummies) of R&D and production

All Sectors (N=428)	Planning to increase the firm's R&D empl. in Finland	Firm has R&D abroad	Relocated R&D from Finland	Offshore outsourcing of R&D	IH offshoring of R&D	IH expansion of R&D abroad	Domestic outsourcing of R&D
Planning to increase the firm's R&D employment in Finland	1.000						
Has R&D abroad	0.145	1.000					
Relocated R&D from Finland	0.053	0.738	1.000				
Offshore outsourcing of R&D	0.053	0.674	0.912	1.000			
In-house offshoring of R&D	-0.004	0.345	0.468	0.163	1.000		
In-house expansion of R&D abroad	0.123	0.549	0.286	0.171	0.446	1.000	
Domestic outsourcing of R&D	0.110	0.322	0.473	0.529	0.027	0.061	1.000
Has production abroad	0.065	0.476	0.290	0.260	0.147	0.342	0.181
Relocated production from Finland	0.045	0.402	0.322	0.271	0.186	0.325	0.223
Offshore outsourcing of production	0.065	0.334	0.298	0.288	0.126	0.237	0.238
In-house offshoring of production	0.017	0.325	0.269	0.194	0.262	0.357	0.179
In-house expansion of production abroad	0.074	0.377	0.160	0.103	0.188	0.431	0.096
Domestic outsourcing of production	0.049	0.095	0.044	0.053	0.001	0.124	0.112

Manufacturing (N=284)	Planning to increase the firm's R&D empl. in Finland	Firm has R&D abroad	Relocated R&D from Finland	Offshore outsourcing of R&D	IH offshoring of R&D	IH expansion of R&D abroad	Domestic outsourcing of R&D
Planning to increase the firm's R&D employment in Finland	1.000						
Has R&D abroad	0.208	1.000					
Relocated R&D from Finland	0.084	0.718	1.000				
Offshore outsourcing of R&D	0.082	0.650	0.906	1.000			
In-house offshoring of R&D	-0.004	0.332	0.463	0.136	1.000		
In-house expansion of R&D abroad	0.150	0.579	0.312	0.161	0.456	1.000	
Domestic outsourcing of R&D	0.174	0.288	0.431	0.508	-0.046	0.054	1.000
Has production abroad	0.122	0.538	0.353	0.318	0.190	0.349	0.225
Relocated production from Finland	0.080	0.451	0.378	0.316	0.232	0.321	0.263
Offshore outsourcing of production	0.096	0.366	0.349	0.338	0.156	0.221	0.282
In-house offshoring of production	0.056	0.360	0.307	0.220	0.308	0.367	0.209
In-house expansion of production abroad	0.140	0.418	0.181	0.115	0.227	0.434	0.115
Domestic outsourcing of production	0.112	0.060	0.024	0.039	-0.004	0.080	0.125

Non-Manufacturing (N=144)	Planning to increase the firm's R&D empl. in Finland	Firm has R&D abroad	Relocated R&D from Finland	Offshore outsourcing of R&D	IH offshoring of R&D	IH expansion of R&D abroad	Domestic outsourcing of R&D
Planning to increase the firm's R&D employment in Finland	1.000						
Has R&D abroad	0.050	1.000					
Relocated R&D from Finland	0.010	0.791	1.000				
Offshore outsourcing of R&D	0.009	0.734	0.928	1.000			
In-house offshoring of R&D	0.005	0.378	0.478	0.230	1.000		
In-house expansion of R&D abroad	0.119	0.424	0.174	0.194	0.430	1.000	
Domestic outsourcing of R&D	-0.0004	0.398	0.572	0.579	0.200	0.069	1.000

Table A.4 Estimation results, manufacturing sector with a dummy that shows if a large portion of R&D has to be done in the same premises with the production

Dependent variable in logit model: Planning to increase R&D employment in Finland in the next three years;
Manufacturing sample; Specification with dummy showing if large share of R&D is done at production site; Table lists the marginal effects

	(a)	(b)	(c)	(d)	(e)	(f)
Large R&D share done at production site (d)	-0.238 ***	-0.238 ***	-0.239 ***	-0.236 ***	-0.237 ***	-0.243 ***
Has R&D abroad (d)	-0.041					
Relocated R&D from Finland (d)		-0.127 *				
Offshore outsourcing of R&D (d)			-0.024			-0.035
In-house offshoring of R&D (d)				-0.209 ***		-0.227 ***
In-house expansion of R&D abroad (d)		0.033			-0.057	0.309 **
Infant (d)	0.135	0.141	0.129	0.177 +	0.139	0.166 +
Old (d)	0.085	0.087	0.083	0.1	0.087	0.096
Small (d)	-0.212 **	-0.2 **	-0.216 **	-0.169 *	-0.211 **	-0.158 +
Large (d)	0.114	0.12 '	0.103	0.128 '	0.109	0.114
Multi-establishment (d)	-0.015	-0.019	-0.015	-0.017	-0.014	-0.018
Profitability (ROI)	0.864 ***	0.874 ***	0.869 ***	0.775 **	0.846 ***	0.803 **
Export intensity	0.062	0.063	0.06	0.054	0.061	0.051
R&D intensity	1.404 *	1.337 +	1.408 +	1.012 '	1.406 *	0.806
High educ. empl. sh.	-0.169	-0.196	-0.166	-0.247	-0.173	-0.253
Low educ. empl. sh.	0.106	0.103	0.108	0.103	0.111	0.11
Firm: Missing educ. sh. (d)	0.396	0.385	0.396	0.371	0.405	0.342
North (d)	-0.077	-0.09	-0.075	-0.107	-0.077	-0.113
South (d)	0.044	0.033	0.048	0.016	0.042	0.021
East (d)	-0.046	-0.061	-0.041	-0.072	-0.044	-0.069
West (d)	0.15 +	0.139 +	0.151 +	0.15 +	0.154 +	0.145 +
Foods, textiles, apparel (d)	0.223	0.188	0.227	0.174	0.224	0.165
Wood, pulp, paper (d)	0.355 '	0.318	0.357 '	0.341 '	0.363 '	0.319
Chemicals (d)	0.167	0.132	0.17	0.13	0.171	0.119
Metals (d)	0.017	-0.009	0.019	0	0.022	-0.017
Machinery, equip. (d)	0.001	-0.009	-0.004	-0.002	-0.003	-0.005
Electronics, electr. eq. (d)	0.296 +	0.299 +	0.277 '	0.439 **	0.309 +	0.413 **
Observations	284	284	284	284	284	284
Adjusted Wald test (Model)	5 ***	5.182 ***	5.003 ***	4.827 ***	4.786 ***	4.984 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	363.961	1.830	3.538	29.144	2.150	239.617

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other manufacturing is the reference industry.
Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p < 0.15, ' p<0.20. (d) dy/dx is for discrete change of dummy variable from 0 to 1.
A&L: for more information on this test see Archer & Lemeshow (2006).

Table A.5. Estimation results, all sectors with domestic outsourcing of R&D dummy

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years; Sample with all sectors; Specification with domestic outsourcing of R&D dummy; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)	(f)
Domestic outsourcing of R&D (d)	0.175 '	0.189 +	0.182 '	0.117	0.135	0.148
Has R&D abroad (d)	-0.164 +					
Relocated R&D from Finland (d)		-0.218 **				
Offshore outsourcing of R&D (d)			-0.142			-0.126
In-house offshoring of R&D (d)				-0.357 ***		-0.365 ***
In-house expansion of R&D abroad (d)		-0.144			-0.239 **	0.183
Infant (d)	0.115	0.129	0.096	0.168 '	0.134	0.156 '
Old (d)	-0.077	-0.081	-0.076	-0.053	-0.057	-0.066
Small (d)	0.193 '	0.212 +	0.183 '	0.229 +	0.196 '	0.232 +
Large (d)	0.197 *	0.205 *	0.173 +	0.19 *	0.184 *	0.192 *
Multi-establishment (d)	0.093	0.093	0.086	0.094	0.087	0.095
Profitability (ROI)	0.079	0.063	0.079	0.061	0.084	0.054
Export intensity	0.469 ***	0.469 ***	0.457 ***	0.465 ***	0.47 ***	0.466 ***
R&D intensity	1.762 **	1.795 **	1.727 **	1.736 ***	1.764 **	1.762 **
High educ. empl. sh.	-0.228	-0.262	-0.211	-0.282	-0.231	-0.29
Low educ. empl. sh.	0.034	0.039	0.049	0.053	0.044	0.058
Firm: Missing educ. sh. (d)	0.438 **	0.434 **	0.44 ***	0.417 **	0.442 ***	0.417 **
North (d)	-0.184	-0.198 '	-0.178	-0.206 +	-0.184	-0.21 +
South (d)	-0.244 **	-0.25 **	-0.239 **	-0.246 **	-0.244 **	-0.249 **
East (d)	0.114	0.097	0.124	0.102	0.12	0.094
West (d)	0.266 *	0.274 **	0.26 *	0.283 **	0.273 **	0.279 **
Foods, textiles, apparel (d)	-0.018	-0.059	-0.021	-0.041	-0.019	-0.056
Wood, pulp, paper (d)	0.231	0.209	0.213	0.247	0.242	0.226
Chemicals (d)	0.2	0.162	0.193	0.155	0.185	0.149
Metals (d)	-0.105	-0.13	-0.111	-0.118	-0.105	-0.131
Machinery, equip. (d)	-0.169 '	-0.184 +	-0.183 +	-0.182 +	-0.183 +	-0.182 +
Electronics, electr. eq. (d)	0.242	0.292 +	0.166	0.417 **	0.291 '	0.392 **
Trade (d)	0.398 **	0.376 **	0.393 **	0.411 ***	0.408 ***	0.396 **
Transportation (d)	0.102	0.088	0.089	0.121	0.107	0.111
KIBS (d)	0.423 ***	0.412 ***	0.422 ***	0.439 ***	0.419 ***	0.439 ***
Other services (d)	0.262 +	0.242 '	0.264 +	0.292 *	0.275 *	0.282 *
Observations	428	428	428	428	428	428
Adjusted Wald test (Model)	2.784 ***	2.684 ***	2.81 ***	3.144 ***	2.932 ***	2.86 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	2.306	4.713	7.135	5.492	13.076	5.348

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other manufacturing is the reference industry.
Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20. (d) dy/dx is for discrete change of dummy variable from 0 to 1.
A&L: for more information on this test see Archer & Lemeshow (2006).

Table A.6. Estimation results, manufacturing sector with domestic outsourcing of R&D dummy

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years; Manufacturing sample; Specification with domestic outsourcing of R&D dummy; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)	(f)
Domestic outsourcing of R&D (d)	0.31 **	0.368 ***	0.367 ***	0.257 **	0.282 **	0.338 **
Has R&D abroad (d)	-0.1 +					
Relocated R&D from Finland (d)		-0.191 ***				
Offshore outsourcing of R&D (d)			-0.16 ***			-0.162 ***
In-house offshoring of R&D (d)				-0.191 ***		-0.211 ***
In-house expansion of R&D abroad (d)		0.143			-0.049	0.239 *
Infant (d)	0.171	0.166	0.154	0.189 '	0.163	0.175
Old (d)	0.085	0.069	0.067	0.103	0.091	0.079
Small (d)	-0.268 ***	-0.255 **	-0.281 ***	-0.239 **	-0.271 ***	-0.238 **
Large (d)	0.142 '	0.135 '	0.131 '	0.126 '	0.116	0.129 '
Multi-establishment (d)	-0.105 +	-0.125 *	-0.12 *	-0.093	-0.095 '	-0.118 +
Profitability (ROI)	0.532 **	0.562 **	0.574 **	0.467 *	0.507 **	0.536 **
Export intensity	0.079	0.08	0.076	0.069	0.071	0.075
R&D intensity	0.702	0.438	0.708	0.486	0.736	0.306
High educ. empl. sh.	0.015	0.041	0.072	-0.074	-0.017	0.009
Low educ. empl. sh.	0.214	0.246	0.234	0.19	0.197	0.236
Missing educ. sh. (d)	0.475	0.497 '	0.498 '	0.423	0.449	0.467
North (d)	-0.106	-0.125	-0.11	-0.125	-0.102	-0.132 '
South (d)	-0.05	-0.051	-0.045	-0.062	-0.041	-0.059
East (d)	-0.106	-0.121 +	-0.111 '	-0.106	-0.089	-0.122 +
West (d)	0.142 '	0.135 '	0.135 '	0.144 '	0.152 +	0.132 '
Foods, textiles, apparel (d)	0.145	0.093	0.13	0.122	0.158	0.088
Wood, pulp, paper (d)	0.352 +	0.289	0.325 '	0.35 +	0.37 +	0.29
Chemicals (d)	0.21	0.148	0.186	0.196	0.229	0.146
Metals (d)	-0.01	-0.055	-0.031	-0.01	0.004	-0.053
Machinery, equip. (d)	-0.069	-0.086	-0.082	-0.075	-0.077	-0.082
Electronics, electr. eq. (d)	0.262 +	0.207 '	0.172	0.353 *	0.259 +	0.263 +
Observations	284	284	284	284	284	284
Adjusted Wald test (Model)	4.758 ***	5.027 ***	5.101 ***	4.559 ***	4.562 ***	4.903 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	3.656	5.711	4.910	15.084	16.904	4.520

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other manufacturing is the reference industry.
Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20. (d) dy/dx is for discrete change of dummy variable from 0 to 1.
A&L: for more information on this test see Archer & Lemeshow (2006).

Table A.7. Estimation results, service sector with domestic outsourcing of R&D dummy

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years; Sample of service sector; Specification with domestic outsourcing of R&D dummy; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)	(f)
Domestic outsourcing of R&D (d)	0.126	0.165	0.192 '	0.05	0.035	0.2 +
Has R&D abroad (d)	-0.457 ***					
Relocated R&D from Finland (d)		-0.51 ***				
Offshore outsourcing of R&D (d)			-0.546 ***			-0.554 ***
In-house offshoring of R&D (d)				-0.51 **		-0.46 *
In-house expansion of R&D abroad (d)		-0.49 ***			-0.49 **	-0.368 '
Infant (d)	0.345 **	0.354 **	0.322 *	0.309 *	0.306 *	0.338 **
Old (d)	-0.318 *	-0.332 *	-0.315 *	-0.274 +	-0.27 +	-0.336 **
Small (d)	0.832 ***	0.845 ***	0.854 ***	0.815 ***	0.814 ***	0.855 ***
Large (d)	0.348 ***	0.346 ***	0.325 ***	0.315 **	0.324 **	0.34 ***
Multi-establishment (d)	0.586 ***	0.601 ***	0.6 ***	0.546 ***	0.537 ***	0.61 ***
Profitability (ROI)	-0.139	-0.123	-0.151	-0.148	-0.13	-0.117
Export intensity	1.357 ***	1.348 ***	1.338 ***	1.202 ***	1.223 ***	1.417 ***
R&D intensity	4.047 **	4.327 **	4.253 **	3.621 **	3.674 **	4.666 **
High educ. empl. sh.	-1.082 **	-1.124 **	-1.115 **	-0.934 **	-0.915 **	-1.146 **
Low educ. empl. sh.	0.192	0.211	0.262	0.283	0.315	0.228
Missing educ. sh. (d)	-0.052	-0.06	-0.074	0.02	0.034	-0.022
North (d)	-0.555 ***	-0.558 ***	-0.565 ***	-0.518 ***	-0.513 ***	-0.571 ***
South (d)	-0.56 ***	-0.552 ***	-0.546 ***	-0.555 ***	-0.557 ***	-0.553 ***
East (d)	0.011	0.012	-0.021	0.021	0.025	-0.004
West (d)	0.181	0.184	0.147	0.184	0.187	0.16
Trade (d)	-0.227	-0.24	-0.291	-0.208	-0.208	-0.273
Transportation (d)	-0.489 **	-0.489 **	-0.51 **	-0.503 ***	-0.508 ***	-0.496 **
KIBS (d)	-0.064	-0.058	-0.07	-0.074	-0.085	-0.054
Observations	144	144	144	144	144	144
Adjusted Wald test (Model)	2.681 ***	2.867 ***	2.657 ***	3.09 ***	3.306 ***	2.716 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	103.088	28.630	11.750	30.050	74.638	19.395

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other services is the reference industry.
Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20. (d) dy/dx is for discrete change of dummy variable from 0 to 1.
A&L: for more information on this test see Archer & Lemeshow (2006).

Table A.8. Estimation results, baseline regression with foreign ownership dummy

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years;
Sample with all sectors; Specification with foreign ownership dummy; Table lists the marginal effects

	(a)	(b)	(c)	(d)	(e)	(f)
Foreign owner (d)	-0.155 *	-0.157 *	-0.153 *	-0.158 *	-0.158 *	-0.156 *
Has R&D abroad (d)	-0.126					
Relocated R&D from Finland (d)		-0.149 '				
Offshore outsourcing of R&D (d)			-0.033			-0.03
In-house offshoring of R&D (d)				-0.367 ***		-0.375 ***
In-house expansion of R&D abroad (d)		-0.215 +			-0.261 **	0.151
Infant (d)	0.124	0.147	0.114	0.181 '	0.148	0.178 '
Old (d)	-0.074	-0.073	-0.067	-0.061	-0.062	-0.063
Small (d)	0.174	0.194 '	0.165	0.219 +	0.184 '	0.22 +
Large (d)	0.162 '	0.176 +	0.139	0.174 +	0.166 +	0.168 +
Multi-establishment (d)	0.141	0.142	0.13	0.134	0.129	0.135
Profitability (ROI)	0.124	0.114	0.121	0.074	0.11	0.075
Export intensity	0.502 ***	0.511 ***	0.49 ***	0.505 ***	0.514 ***	0.501 ***
R&D intensity	1.886 **	1.964 **	1.811 **	1.858 **	1.912 **	1.847 **
High educ. empl. sh.	-0.154	-0.192	-0.142	-0.243	-0.184	-0.241
Low educ. empl. sh.	0.016	0.016	0.028	0.021	0.015	0.027
Firm: Missing educ. sh. (d)	0.419 **	0.419 **	0.418 **	0.392 **	0.42 **	0.391 **
North (d)	-0.153	-0.167	-0.146	-0.185	-0.16	-0.186
South (d)	-0.198 +	-0.207 +	-0.194 '	-0.214 *	-0.209 +	-0.212 +
East (d)	0.14	0.125	0.149	0.113	0.133	0.114
West (d)	0.277 **	0.286 **	0.273 **	0.291 **	0.28 **	0.29 **
Foods, textiles, apparel (d)	0.008	-0.025	0.011	-0.032	-0.006	-0.034
Wood, pulp, paper (d)	0.214	0.205	0.206	0.222	0.218	0.217
Chemicals (d)	0.182	0.15	0.179	0.135	0.164	0.133
Metals (d)	-0.085	-0.104	-0.087	-0.106	-0.094	-0.11
Machinery, equip. (d)	-0.144	-0.157	-0.159 '	-0.166 '	-0.163 '	-0.165 '
Electronics, electr. eq. (d)	0.266	0.342 +	0.214	0.445 **	0.325 '	0.439 **
Trade (d)	0.409 ***	0.396 **	0.412 ***	0.414 ***	0.411 ***	0.412 ***
Transportation (d)	0.077	0.071	0.072	0.094	0.08	0.092
KIBS (d)	0.388 ***	0.376 **	0.389 ***	0.401 ***	0.379 **	0.405 ***
Other services (d)	0.292 *	0.278 +	0.299 *	0.299 *	0.285 *	0.304 *
Observations	428	428	428	428	428	428
Adjusted Wald test (Model)	2.758 ***	2.753 ***	2.716 ***	3.235 ***	2.933 ***	3.002 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	7.381	42.870	5.761	8.543	9.911	7.145

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other manufacturing is the reference industry.
Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20. (d) dy/dx is for discrete change of dummy variable from 0 to 1.
A&L: for more information on this test see Archer & Lemeshow (2006).

Table A.9. Estimation results, baseline regression based on the sample of domestic-owned firms

Dependent variable in logit model: Planning to INCREASE R&D employment in Finland in the next three years; Sample with all sectors but with only Finnish owned firms; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)	(f)
Has R&D abroad (d)	-0.143					
Relocated R&D from Finland (d)		-0.157				
Offshore outsourcing of R&D (d)			-0.005			0.015
In-house offshoring of R&D (d)				-0.394 ***		-0.401 ***
In-house expansion of R&D abroad (d)		-0.259 *			-0.301 **	0.157
Infant (d)	0.099	0.126	0.089	0.162	0.126	0.159
Old (d)	-0.155 '	-0.151	-0.146	-0.142	-0.14	-0.142
Small (d)	0.2	0.224 '	0.187	0.253 +	0.213 '	0.253 +
Large (d)	0.242 *	0.261 *	0.21 +	0.257 *	0.253 *	0.249 *
Multi-establishment (d)	0.149	0.15	0.135	0.145	0.137	0.144
Profitability (ROI)	0.006	0.004	-0.004	-0.036	-0.002	-0.043
Export intensity	0.378 **	0.407 **	0.36 **	0.424 ***	0.405 **	0.419 **
R&D intensity	1.807 **	1.949 **	1.72 **	1.899 **	1.876 **	1.856 **
High educ. empl. sh.	-0.249	-0.292	-0.236	-0.36	-0.283	-0.36
Low educ. empl. sh.	-0.219	-0.208	-0.206	-0.183	-0.217	-0.176
Firm: Missing educ. sh. (d)	0.281	0.29	0.278	0.273	0.292	0.265
North (d)	-0.277 **	-0.287 **	-0.275 *	-0.3 **	-0.283 **	-0.302 **
South (d)	-0.146	-0.164	-0.142	-0.173	-0.165	-0.17
East (d)	0.141	0.116	0.155	0.102	0.13	0.105
West (d)	0.318 **	0.326 **	0.312 **	0.335 **	0.324 **	0.334 **
Foods, textiles, apparel (d)	0.053	0.014	0.056	-0.002	0.03	-0.001
Wood, pulp, paper (d)	0.364 *	0.354 *	0.356 *	0.359 *	0.364 *	0.357 *
Chemicals (d)	0.222	0.186	0.217	0.155	0.197	0.153
Metals (d)	0.026	-0.005	0.021	-0.02	0.004	-0.022
Machinery, equip. (d)	-0.068	-0.094	-0.093	-0.129	-0.106	-0.132
Electronics, electr. eq. (d)	0.343	0.432 **	0.28	0.513 ***	0.413 *	0.508 ***
Trade (d)	0.465 ***	0.451 ***	0.467 ***	0.463 ***	0.461 ***	0.464 ***
Transportation (d)	0.057	0.06	0.047	0.085	0.059	0.082
KIBS (d)	0.295 +	0.286 +	0.295 +	0.324 *	0.279 +	0.331 *
Other services (d)	0.183	0.171	0.19	0.204	0.17	0.211
Observations	334	334	334	334	334	334
Adjusted Wald test (Model)	2.765 ***	2.606 ***	2.84 ***	2.893 ***	2.838 ***	2.719 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	5.948	9.158	4.979	9.218	14.290	6.391

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; other manufacturing is the reference industry.
Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20. (d) dy/dx is for discrete change of dummy variable from 0 to 1.
A&L: for more information on this test see Archer & Lemeshow (2006).

Table A.10 Estimation results, manufacturing sector, baseline regression with alternative dependent variable (planning to DECREASE employment in Finland in the 2006-2009 period).

Dependent variable in logit model: Planning to DECREASE R&D employment in Finland in the next three years; Manufacturing sample; Table lists the marginal effects	(a)	(b)	(c)	(d)	(e)	(f)
Has R&D abroad (d)	0.002					
Relocated R&D from Finland (d)		0.007				
Offshore outsourcing of R&D (d)			0.008 '			0.009
In-house offshoring of R&D (d)				0.006		0.013
In-house expansion of R&D abroad (d)		-0.002 *			-0.001	-0.002 **
Infant (d)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
Old (d)	0.001	0.001	0.001	0.001	0.002	0.001
Large (d)	0.002	0.003	0.002	0.003	0.004	0.003
Multi-establishment (d)	0.011 '	0.01 '	0.009 '	0.011 '	0.01 '	0.009
Profitability (ROI)	-0.009	-0.008	-0.008	-0.007	-0.007	-0.007
Export intensity	0.003	0.003	0.003	0.004 +	0.004 +	0.003
R&D intensity	0.007	0.005	0.004	0.01	0.01	0.006
High educ. empl. sh.	0.001	0.003	0	0.002	0.003	0.002
Low educ. empl. sh.	-0.003	-0.001	-0.003	-0.003	-0.002	-0.002
Firm: Missing educ. sh. (d)	-0.001	0	-0.001	0	0	0
North (d)	0.001	0.001	0.001	0.001	0.001	0.001
South (d)	-0.003 +	-0.003 +	-0.003 *	-0.003 '	-0.003 +	-0.003 +
West (d)	-0.001	-0.001	-0.001	0	-0.001	0
Observations	284	284	284	284	284	284
Adjusted Wald test (Model)	14.967 ***	12.637 ***	13.206 ***	16.682 ***	14.035 ***	12.382 ***
Goodness-of-fit (F-adjusted test statistic of A&L)	279.217	829.409	207.256	392.543	1274.954	620.433

Notes: Mid-age is the reference category of age; Mid-size is the reference category of size; Mid-education level is the reference level of education; Greater Helsinki Metropolitan area is the reference area, it includes Helsinki, Espoo, and Vantaa; This specification does not include industry dummies due to a lack of variation in the data. Statistical significance: *** p<0.01, ** p<0.05, * p<0.10, + p<0.15, ' p<0.20.
(d) dy/dx is for discrete change of dummy variable from 0 to 1. A&L: for more information on this test see Archer & Lemeshow (2006).

E L I N K E I N O E L Ä M Ä N T U T K I M U S L A I T O S (ETLA)

THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, FIN-00120 HELSINKI

Puh./Tel. (09) 609 900 Telefax (09) 601753
Int. 358-9-609 900 Int. 358-9-601 753
http://www.etla.fi

KESKUSTELUAIHEITA - DISCUSSION PAPERS ISSN 0781-6847

Julkaisut ovat saatavissa elektronisessa muodossa internet-osoitteessa:
http://www.etla.fi/finnish/research/publications/searchengine

No 1131 DEREK C. JONES – PANU KALMI – TAKAO KATO – MIKKO MÄKINEN, The Incidence and Determinants of Employee Involvement – Evidence from the Finnish Manufacturing Sector. 28.03.2008. 24 p.

No 1132 JUKKA JALAVA – ILJA KRISTIAN KAVONIUS, Durable Goods and ICT: The Drivers of Euro Area Productivity Growth? 18.04.2008. 18 p.

No 1133 ANTTI-JUSSI TAHVANAINEN – RAINE HERMANS, Agglomeration and Specialisation Patterns of Finnish Biotechnology – On the Search for an Economic Rationale of a Dispersed Industry Structure. 18.04.2008. 43 p.

No 1134 PEKKA ILMAKUNNAS – EDVARD JOHANSSON – MIKA MALIRANTA, Työolot ja tuottavuus – Työpaikkavirtojen nosteessa vai puristuksessa? 21.04.2008. 37 s.

No 1135 ELAD HARISON – HELI KOSKI, Does Open Innovation Foster Productivity? Evidence from Open Source Software(OSS) Firms. 07.07.2008. 23 p.

No 1136 FRANCESCA VALENTINI, Unemployment Insurance Savings Accounts: An Overview. 08.05.2008. 44 p.

No 1137 JUKKA LASSILA – TARMO VALKONEN, Suomen työeläkejärjestelmän stokastinen kestävyysanalyysi. 26.05.2008. 62 s.

No 1138 MIKA PAJARINEN – PEKKA YLÄ-ANTTILA, Large Corporations in the Finnish Economy. 04.06.2008. 23 p.

No 1139 HEIKKI MARJOSOLA, Säänneltyä joustavuutta: Hankemekanismit kansainvälisessä ilmastopolitiikassa. 06.06.2008. 66 s.

No 1140 MIKA MALIRANTA – PETRI ROUVINEN – AARNO AIRAKSINEN, It Outsourcing in Finnish Business. 04.06.2008. 16 p.

No 1141 NIKU MÄÄTTÄNEN – TARMO VALKONEN, Ikääntyneiden varallisuus ja sen muuntaminen kulutukseksi. 10.06.2008. 40 s.

No 1142 HELI KOSKI, Public R&D Funding and Entrepreneurial Innovation. 07.07.2008. 28 p.

No 1143 HELI KOSKI, Public R&D Subsidies and Employment Growth – Microeconomic Evidence from Finnish Firms. 11.08.2008. 24 p.

No 1144 MATTHIAS DESCHRYVERE, High Growth Firms and Job Creation in Finland. 27.06.2008. 31 p.

No 1145 ELIAS OIKARINEN, Interaction between Housing Prices and Household Borrowing in Finland. 11.08.2008. 26 p.

No 1146 VESA HARMAAKORPI – RAINE HERMANS – TUOMO UOTILA, Suomen alueelliset innovaatiostrategiat. 13.08.2008. 111 s.

No 1147 TOPIAS LEINO, Koulutus työmarkkinasignaalina. Kirjallisuuskatsaus ja empiirinen tarkastelu Suomen peruskoulu-uudistuksen valossa. 18.08.2008. 78 s.

No 1148 ANTTI-JUSSI TAHVANAINEN – RAINE HERMANS, Value Creation in the Interface of Industry and Academia. – A Case Study on the Intellectual Capital of Technology Transfer Offices at US Universities. 22.09.2008. 39 p.

No 1149 TERTTU LUUKKONEN, Different Types of Venture Capital Investors and Value-added to High-tech Portfolio Firms. 20.10.2008. 24 p.

No 1150 MIKA MALIRANTA, Kilpailun kehitys ja kannattavuuden mikrodynamiikka Suomen yrityssektorilla. 07.10.2008. 23 s.

No 1151 AIJA LEIPONEN, Is Service Innovation Different? 22.08.2008. 24 p.

No 1152 ANNI NEVALAINEN, Labour Productivity and Firm Entry and Exit in Manufacturing. 25.08.2008. 25 p.

No 1153 EDVARD JOHANSSON, Does Finland Suffer from Brain Drain? 01.09.2008. 26 p.

No 1154 ANNU KOTIRANTA – SARIANNA LUNDAN – PEKKA YLÄ-ANTTILA, Yritysten kansainvälistymisen vaikutukset kotimaan talouteen ja työllisyyteen – katsaus kirjallisuuteen. 22.08.2008. 25 s.

No 1155 SUSANNA STÉN, Mapping of the PhDs in the Private Sector. A Literature Review. 19.09.2008. 50 p.

No 1156 KARI E.O. ALHO – VILLE KAITILA – MIKA WIDGRÉN, Offshoring, Relocation and the Speed of Convergence in the Enlarged European Union. 01.10.2008. 25 p.

No 1157 MIKA PAJARINEN – PETRI ROUVINEN, Verkostosta alueellista elinvoimaa? Havaintoja yrityskyselystä. 07.10.2008. 93 s.

No 1158 JYRKI ALI-YRKKÖ – ANNU KOTIRANTA – TUOMO NIKULAINEN – MIKA PAJARINEN – PETRI ROUVINEN, Kuluttajat ja yritykset rahoitusmarkkinakriisissä – Reaktioita ja näkemyksiä tulevasta. 29.10.2008. 86 s.

No 1159 TUOMO NIKULAINEN, A Historical Perspective on Patents and Industry Growth in Finland – Connections and Lags. 03.11.2008. 22 p.

No 1161 HEIKKI KAUPPI – MIKA WIDGRÉN, Do Benevolent Aspects Have Room in Explaining EU Budget Receipts? 04.11.2008. 26 p.

No 1162 MIKA WIDGRÉN, The Impact of Council Voting Rules on EU Decision-Making. 04.11.2008. 26 p.

No 1163 Jyrki Ali-Yrkkö – Matthias Deschryvere, Domestic R&D Employment Effects of Offshoring R&D Tasks: Some Empirical Evidence from Finland. 05.11.2008. 31 p.

Elinkeinoelämän Tutkimuslaitoksen julkaisemat "Keskusteluaiheet" ovat raportteja alustavista tutkimustuloksista ja väliraportteja tekeillä olevista tutkimuksista. Tässä sarjassa julkaistuja monisteita on mahdollista ostaa Taloustieto Oy:stä kopiointi- ja toimituskuluja vastaavaan hintaan.

Papers in this series are reports on preliminary research results and on studies in progress. They are sold by Taloustieto Oy for a nominal fee covering copying and postage costs.