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International Production Networks in the Nordic/ Baltic Region

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INTERNATIONAL PRODUCTION NETWORKS IN THE NORDIC/BALTIC REGION

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ABSTRACT

The Nordic countries are characterized by relatively compressed wage structures, implying that the incentives to offshore activities intensive in low-skilled labour might be particularly strong in these countries. In this paper, we document the recent changes in measures of offshoring and find that there has been an overall increase since the mid 1990s but that the experience varies considerably across sectors. We also document the recent trends in wage-bill shares of workers with different levels of educational attainment. As in most industrialized countries, there has been an overall increase in the wage-bill share of highly educated workers, a development that is relatively uniform across sectors.

In an econometric analysis we estimate the relationship between offshoring of intermediate input production and labour demand in Sweden, Finland and Norway, distinguishing between workers with different educational attainments. We only find weak relationships. In this sense, the results suggest that the gains from an increased specialisation due to fragmentation of production and the emergence of production networks involving low-wage countries are reaped without any large adverse effects on income distribution. For Sweden, we find that offshoring to low-income countries is associated with a shift in demand towards workers with a relatively high level of education. For Finland, however, it is rather offshoring to high-income countries that is associated with such a shift. Moreover, in the Swedish case the shift is away from workers with upper secondary education whereas in the Finnish case it is away from workers with lower secondary education.

Keywords: Outsourcing, labour demand, skill upgrading, Baltic, Nordic, manufacturing

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EXECUTIVE SUMMARY

One of the most distinctive features of recent globalisation is the increased fragmentation of production, leading to the creation of international production networks. This paper deals with the emergence of such international production networks in the Nordic/Baltic region as it manifests itself through trade in intermediate inputs and foreign direct investment. It addresses the question how an increased tendency to source intermediate inputs from abroad affect the demand for workers with different levels of educational attainment in the Nordic countries.

The Nordic countries constitute a particularly interesting group of countries since they are characterized by relatively compressed wage structures, implying that the incentives to move activities intensive in low-skilled labour might be particularly strong in these countries. Moreover, they are geographically close to some of the Eastern European countries that have been successful in terms of attracting foreign direct investment. Since geographical proximity is an important factor for trade flows as well as investment flows, we would expect that firms originating in the Nordic countries, in particular, might take the opportunity of using low-cost suppliers in the Baltic States and Poland.

The paper starts by documenting recent changes in the import pattern and offshoring of intermediate inputs production in the four Nordic countries: Denmark, Finland, Norway and Sweden. Offshoring is taken to mean a shift from domestic to foreign suppliers. In spite of the many similarities between the Nordic countries regarding institutions and – to some extent – industrial structure, they exhibit diverse patterns with respect to changes in their import patterns. Overall, the share of imported inputs in output within industries (a measure of offshoring) has increased for all countries for which we have data (Finland, Norway and Sweden), but the industry pattern differs substantially. In Finland, the largest increases are found in textiles and other transport equipment while in Sweden the largest increases are found in medical, precision and optical instruments. In Norway there have been large increases in pulp and paper.

The paper then proceeds to present estimates of the relationship between offshoring of intermediate input production and demand for workers with different levels of educational attainment in the Nordic countries. The analysis, which is carried out for Sweden, Finland and Norway (Denmark is dropped from the analysis on account of lack of data), a distinction is made between workers with lower secondary education, upper secondary education and tertiary education.

Quantitatively the estimated relationships between offshoring and demand for different types of labour are weak, implying that, on average, we only find a weak relationship. For Norway, we do not find a significant relationship at all, but this may be due to the fact that we have observations for only a few years. For Sweden, we find that offshoring to low-income countries is associated with a shift in demand towards workers with a relatively high level of education. For Finland, however, it is rather offshoring to high-income countries that is associated with such a shift. Moreover, in the Swedish case the shift is away from workers with upper secondary education whereas in the Finnish case it is away from workers with lower secondary education. The results for Sweden, but not necessarily for Finland, are in line with what we would expect on the basis of theoretical predictions. Imports from low-income countries are expected to be intensive in low-skilled labour and thus effectively reduce the relative demand for low-skilled labour.

Ultimately, the issue of how offshoring and the creation of production networks affect the labour market is a question about the possible negative side of globalisation. If offshoring were associated with a strong shift in labour demand away from workers with low education towards workers with high education, there would be reason for concern about the consequences of offshoring on the income distribution. From this perspective, our finding of only weak relationships might be viewed as a positive thing. In neither of our estimations we find a statistically significant effect of offshoring to low-income countries on the wage-bill share of workers with at most lower secondary education. In this sense, the results suggest that the gains from an increased specialisation due to fragmentation of production and the emergence of production networks involving low-wage countries indeed are reaped without any large adverse effects on the income distribution.

Low-skilled labour may nevertheless be on the losing end of the overall trends and changes in the Nordic countries. Technical change, in particular, may very well have such an effect, and our results regarding R&D intensity to some extent support that hypothesis (especially for Sweden). However, we do not find any evidence that the narrower phenomenon of using suppliers of intermediate inputs in low-wage countries is associated with a relative decline in the demand for low-skilled workers.

1 Introduction

1. One of the most distinctive features of recent globalisation is the increased fragmentation of production. By most accounts, a large part of the recent surge in international trade is related to trade intermediate inputs (e.g. Hummels et al., 2001, Yi, 2003). The increased fragmentation of production – and the resulting creation of production networks – enable a stronger international specialisation and are likely to bring large economic gains. At the same time, increased specialisation creates the need for structural adjustment; a process involving adjustment costs as well as possible changes in the income distribution. In many industrialised countries, concern has been voiced over the effect on low-skilled workers of an increased tendency of firms to move jobs to low-wage countries in Asia and Central and Eastern Europe.

2. In this context, the Nordic countries constitute a particularly interesting group of countries. They are characterized by relatively compressed wage structures, implying that the incentives to move activities intensive in low-skilled labour might be particularly strong in these countries. Moreover, they are geographically close to some of the more successful Eastern European countries in terms of attracting foreign direct investment. Since geographical proximity is an important factor for trade flows as well as investment flows, we would expect that firms originating in the Nordic countries, in particular, might take the opportunity of using low-cost suppliers in the Baltic states and Poland.

3. In this paper, we document the recent changes in the import pattern and the share of imported inputs to the four Nordic countries Denmark, Finland, Norway, and Sweden, and find that there has been an overall increase since the mid 1990s, but that the experience varies considerably across sectors. We also document the development of wage-bill shares of workers with different levels of educational attainment. There has been a clear overall increase in the wage-bill share of highly educated workers, a development that is relatively uniform across sectors.

4. In an econometric analysis we estimate the relationship between offshoring of intermediate input production and demand for labour demand in Sweden, Finland and Norway, distinguishing between workers with different educational attainments (Denmark had to be dropped from the analysis on account of lack of data). By offshoring we mean a shift from domestic to foreign suppliers of intermediate inputs and services. We find differences as well as similarities across countries. In particular, while Swedish offshoring to low-income countries is associated with a shift in demand towards workers with a relatively

high level of education, for Finland it is rather offshoring to high-income countries that is associated with such a shift. Moreover, in the Swedish case the shift is away from workers with upper secondary workers whereas in the Finnish case it is away from workers with lower secondary workers. The results for Sweden, but not necessarily for Finland, are in line with what we would expect on the basis of theoretical predictions. Imports from low-income countries are expected to be intensive in low-skilled labour and thus effectively reduce the relative demand for low-skilled labour. We discuss briefly reasons for why this may mainly affect workers with an intermediate level of education and not workers with the lowest level of education.

5. The remaining part of the paper is organized as follows: We first discuss what kind of production networks we expect to emerge in the Nordic/Baltic region. Then we document the trends in first imports and then wage-bill shares in the Nordic countries, touching briefly on the evolvement of multinational activity related to the creation of production networks. We proceed to explain the basis for the econometric analysis and to present the results. In the final section we draw some conclusions from the analysis.

2 Production Networks and Vertical Specialisation

6. The recent reductions in trade costs – partly due to trade liberalisation but perhaps mostly due to technical progress in the area of information and communication technology – is generally believed to have altered the nature of the globalisation process. In the words of Richard Baldwin (2006), what was before mainly an "unbundling" of production and consumption – creating trade in final goods – is now more and more turning into an "unbundling" of production itself.

7. There are a number of theoretical analyses of what might cause such unbundling and the likely consequences for welfare and income distribution (see e.g. Jones, 2000, Arndt and Kierzkowski, 2003, Feenstra and Hanson, 2003). The key factors creating incentives for splitting up different production stages are differences in production costs and the costs associated with trading intermediate inputs. A recent literature on export platform foreign direct investment (FDI) also emphasises that regional integration between countries with different levels of production costs may affect the firms' strategies vis-à-vis the location of production networks (e.g. Ekholm et al., 2007). According to this theory, the Eastern enlargement of the European Union may induce not only Western European but also non-European firms to locate final production in countries in Central and Eastern Europe. For non-European firms these countries provide low-cost locations with good access to the large consumer markets in Western Europe.

8. A reason why Nordic firms might prefer to use the Baltic countries as a production base for intermediate inputs to countries such as China and India – countries with substantially lower wages – is that the costs associated with trading intermediates are lower. Pure transport costs are of course generally lower, but also less tangible costs created by cultural differences and language barriers are likely to be lower. These less tangible costs may very well be more important than transportation costs. Furthermore, as emphasized by e.g. Harrigan and Venables (2004), low-cost locations close by may be preferred over even lower-cost locations farther away for items for which timeliness plays an important role. Examples would be products that are seasonal and whose product design must change quickly, such as various types of fashion items.

9. Vertical specialisation brings additional gains from trade, but may also have adverse effects on the income distribution. To the extent that Western firms source inputs from abroad because of cheap labour, it seems reasonable to expect that this practice leads to a reduced relative demand for low-skilled labour and possibly a decreased relative wage of this low-income group. As discussed by Jones (2000) and Jones and Kierzkowski (2001), this is however not the only possible outcome. Offshoring of inputs – be

they components or services – tends to increase productivity of the factors of production employed domestically. A country that loses an unskilled labour intensive fragment of production might nonetheless see the wage rate of unskilled labour rising if this productivity increase is biased towards the relatively unskilled labour intensive part of the economy. It has also been pointed out that the main driving force behind vertical specialisation – if we take that to be technical change rather than trade liberalisation – is such that the level of skills may be secondary to other workforce characteristics in determining the outcome in the labour market (e.g. Blinder, 2006 and Grossman and Hansi-Rossberg, 2006). Whether it is easy to offshore a job may not depend primarily on the skill content of the job, but instead on the nature of tasks carried out by the person holding the job. It is easier to offshore a task such as computer programming – a task requiring a high level of formal education – than tasks such as maintenance and cleaning – tasks which do not require any formal training. Because of this, the expected effects of offshoring on the composition of labour demand is not at all straightforward.

10. Our analysis of offshoring focuses mainly on observed changes in imports of intermediate inputs. Much of the concern surrounding potential job losses stemming from offshoring has centred on the activities of multinational firms. When multinational firms originating in small countries, such as the Nordic ones, invest abroad this does not necessarily lead to any import flows back to the home countries since the output of the foreign affiliates may be destined for other markets, even in the case when they are producing intermediate inputs. However, many studies of multinational activity reach the conclusion that a large part of these activities are motivated by market access reasons rather than factor cost reasons (see e.g. Markusen, 2002). This seems to imply that a large part of the activities of multinationals are really motivated by remaining barriers for "unbundling" production and consumption. These activities are likely to have very different labour market consequences than the emergence of production networks. To some extent this conclusion is supported by the empirical evidence. The reported estimates of the relationship between in-house offshoring (that is, foreign direct investment) and the relative demand for skills have been lower than for the relationship between trade-based measures of offshoring and relative demand for skills (see e.g. Head and Ries, 2002, Hansson, 2005).

11. A drawback with focusing on trade-based measures of offshoring, however, is that the analysis by necessity only deals with the manufacturing sector (due to a lack of detailed data on trade in services). Considering that the technical improvements in information and communication has made many services tradable in a way they were not 10-15 years ago, focusing on the manufacturing sector may mean missing important developments and effects. We will here only touch briefly on multinational activities but will otherwise stick with trade-based measures of offshoring.

3 Patterns of Trade and Offshoring in the Nordic/Baltic Region

Imports from Baltic countries

12. During the last decade, trade has increased in a trend-wise fashion for most industrialised countries, including the Nordic ones. In order to investigate whether there is a tendency of a shift in trading patterns we will look at the country distribution of imports to the Nordic countries. In particular, we are interested in finding out whether there is any evidence of a shift towards the Baltic countries regarding sourcing of imports, which might indicate the use of the Baltic countries as a production base for intermediate inputs used by Nordic companies in their production at home.

13. Table 1 shows the share of imports from all four Baltic states in total imports of each of the four Nordic countries in 1995 and 2004. The last column shows the change between these two years. The Baltic share of overall imports and of overall manufacturing imports has increased for all four Nordic countries during this period. For all of them the percentage point increase in Baltic imports was larger for manufacturing products than for all sectors together (which includes the primary sector and services). The

magnitude of the increase in the share of Baltic imports differs somewhat across countries. It is the smallest in Denmark and the highest in Sweden. It is somewhat larger in Norway than in Finland.

Table 1A. Share of imports from Baltic States in total Danish imports (percent)

Industry	1995	2004	Change 95-04
All sectors	2.07	3.05	0.98
Total manufacturing	1.79	3.04	1.25
Food products, beverages and tobacco	1.75	2.36	0.61
Textiles, textile products, leather and footwear	7.90	6.86	-1.04
Wood and products of wood and cork	6.82	15.91	9.09
Pulp, paper, paper products, printing and publishing	0.26	0.63	0.37
Chemical, rubber, plastics and fuel products	1.74	2.04	0.29
Other non-metallic mineral products	2.62	3.52	0.90
Basic metals and fabricated metal products	1.25	4.35	3.10
Machinery and equipment	0.39	1.31	0.92
Transport equipment	0.25	1.86	1.61
Manufacturing nec	2.76	10.26	7.50

Source: OECD, STAN

Table 1B. Share of imports from Baltic States in total Finnish imports (percent)

Industry	1995	2004	Change 95-04
All sectors	2.58	3.87	1.30
Total manufacturing	2.18	4.08	1.90
Food products, beverages and tobacco	1.54	2.67	1.13
Textiles, textile products, leather and footwear	9.08	10.49	1.41
Wood and products of wood and cork	18.61	34.83	16.22
Pulp, paper, paper products, printing and publishing	0.37	1.53	1.16
Chemical, rubber, plastics and fuel products	0.70	1.00	0.30
Other non-metallic mineral products	3.00	4.77	1.77
Basic metals and fabricated metal products	2.02	2.82	0.80
Machinery and equipment	1.37	4.98	3.61
Transport equipment	2.79	1.19	-1.60
Manufacturing nec	6.71	15.02	8.31

Source: OECD, STAN

Table 1C. Share of imports from Baltic States in total Norwegian imports (percent)

Industry	1995	2004	Change 95-04
All sectors	0.98	2.82	1.84
Total manufacturing	0.77	2.79	2.02
Food products, beverages and tobacco	0.85	1.63	0.78
Textiles, textile products, leather and footwear	1.67	6.23	4.56
Wood and products of wood and cork	4.27	10.95	6.67
Pulp, paper, paper products, printing and publishing	0.16	1.47	1.31
Chemical, rubber, plastics and fuel products	1.48	2.92	1.45
Other non-metallic mineral products	1.62	3.80	2.18
Basic metals and fabricated metal products	0.58	3.43	2.84
Machinery and equipment	0.17	1.40	1.24
Transport equipment	0.62	1.65	1.03
Manufacturing nec	1.00	7.15	6.15

Source: OECD, STAN

Table 1D. Share of imports from Baltic States in total Swedish imports (percent)

Industry	1995	2004	Change 95-04
All sectors	2.22	4.49	2.27
Total manufacturing	1.55	4.41	2.86
Food products, beverages and tobacco	1.28	1.67	0.39
Textiles, textile products, leather and footwear	5.15	8.19	3.04
Wood and products of wood and cork	14.03	26.12	12.08
Pulp, paper, paper products, printing and publishing	0.85	2.54	1.69
Chemical, rubber, plastics and fuel products	1.55	3.39	1.84
Other non-metallic mineral products	2.48	4.69	2.21
Basic metals and fabricated metal products	2.00	2.51	0.51
Machinery and equipment	0.70	4.85	4.15
Transport equipment	0.40	2.69	2.29
Manufacturing nec	4.57	14.01	9.45

Source: OECD, STAN

14. It is evident from Table 1 that the sector in which the increase in the Baltic share of imports to the Nordic countries is the largest is wood and wood products. In particular, this is true for Finland and Sweden, whose Baltic shares of imports in this industry in 2004 were 35 and 26 percent, respectively. The fact that Finland and Sweden themselves are large net exporters of wood products suggests that this may be due to the establishment of production networks in the Nordic/Baltic region. In the Danish case, the Baltic share of imports in the textile industry fell between 1995 and 2004, whereas in the Norwegian and Swedish cases it increased significantly. In transport equipment, there was a decrease in the Baltic share of imports to Finland but an increase to the other three Nordic countries (the decrease stemming from a reduced import share of Poland).

15. Table 2 shows a breakdown of import shares in total manufacturing across the four Baltic countries. It shows that all four Baltic countries have increased their shares of manufacturing imports in all four Nordic countries. However, whereas the increase 1995 – 2004 was considerably larger for imports

from Poland than from the other Baltic countries in the case of Norway as well as Sweden, it was instead considerably larger for imports from Estonia in the case of Finland. Denmark looks somewhat different from the other Nordic countries in that the increase in the share of Baltic imports has been relatively small for all four Baltic countries. The increase in Estonia's share of Finnish imports in the wood and wood products industry was almost 13 percentage points during this period. For Sweden the increase in the Baltic share of imports of wood and wood products mainly came from Latvia and Poland (a 5 and 4 percentage point increase, respectively).

Table 2A. The share of Danish imports in total manufacturing (percent)

Sending country	1995	2004	Change 95-04
Estonia	0.14	0.32	0.19
Latvia	0.11	0.33	0.22
Lithuania	0.21	0.56	0.35
Poland	1.33	1.83	0.50

Source: OECD, STAN

Table 2B. The share of Finnish imports in total manufacturing (percent)

Sending country	1995	2004	Change 95-04
Estonia	1.20	2.87	1.67
Latvia	0.10	0.20	0.10
Lithuania	0.12	0.15	0.03
Poland	0.76	0.86	0.10

Source: OECD, STAN

Table 2C. The share of Norwegian imports in total manufacturing (percent)

Sending country	1995	2004	Change 95-04
Estonia	0.09	0.41	0.32
Latvia	0.13	0.30	0.17
Lithuania	0.05	0.45	0.39
Poland	0.50	1.64	1.13

Source: OECD, STAN

Table 2D. The share of Swedish imports in total manufacturing (percent)

Sending country	1995	2004	Change 95-04
Estonia	0.41	0.92	0.52
Latvia	0.15	0.32	0.18
Lithuania	0.09	0.49	0.40
Poland	0.91	2.67	1.76

Source: OECD, STAN

16. Looking at the level of the import shares in Table 2 it is evident that the Baltic countries still are relatively small suppliers of imported goods to the Nordic countries. Estonia, Latvia and Lithuania are very small economies and therefore we would not expect them to have high import shares even in their major

export destinations. Still, Poland, which is a fairly large economy in terms of population, make up only 2.5 percent of Swedish imports and even less of the other Nordic countries' imports.

17. The experience across industries and across countries thus seems to differ in significant ways. There are similarities between Finland and Sweden with respect to the industry profile of the increases in Baltic imports while there are similarities between Norway and Sweden with respect to the country profile of these increases

Offshoring of intermediate inputs

18. Let us now look specifically at imports of intermediate inputs. We follow Feenstra and Hanson (1999) in defining measures of offshoring of intermediate inputs based on the amount of inputs that are imported. We use information from the input-output tables to find out how much inputs are imported and we then put this amount in relation to industry output. This measure will capture the inputs that are imported from independent suppliers as well as foreign affiliates of multinational firms. In principle, we can distinguish between narrow and broad offshoring (Feenstra and Hanson, 1999). Narrow offshoring only includes imported intermediate inputs from the importing industry, i.e. an industry's purchases of imported intermediate inputs produced in the same industry. Broad offshoring also includes imported non-energy intermediate inputs from all other industries. The narrow measure may be considered closer to the phenomenon of fragmentation and the creation of production networks since it captures the amount of inputs that is imported from within the same industry. This is especially likely to be the case when we carry out the analysis based on a relatively aggregated industry level. In the following analysis we will therefore concentrate on the narrow measure.

19. Information about industry use of imported inputs from symmetric input-output tables is only available for certain years. Table 3-5 show the change over time in the share of imported inputs in total inputs within different manufacturing industries for Finland, Norway and Sweden. We choose as start and end year the first and last year for which input-output tables are available on a consistent basis. For Norway, we are able to calculate the changes over a ten year period between 1992 and 2002. For the other two countries, however, we only have symmetric input-output tables for 1995 and 2000.

Table 3. Share of imported inputs within industries in Finland (percentage)

Industry	1995	2000	Change 95-00
Food products and beverages	13.58	21.29	7.72
Tobacco products	3.71	47.75	44.04
Textiles	57.62	80.68	23.06
Wearing apparel; furs	40.73	42.39	1.66
Leather and leather products	46.67	63.42	16.75
Wood and wood products	54.48	12.68	-41.80
Pulp, paper and paper products	6.63	8.16	1.53
Printed matter and recorded media	0.25	0.43	0.18
Coke, refined petroleum products and nuclear fuels	26.97	67.24	40.27
Chemicals and chemical products	56.67	73.82	17.14
Rubber and plastic products	41.33	50.64	9.31
Other non-metallic mineral products	38.65	26.88	-11.77
Basic metals	25.92	36.58	10.65
Fabricated metal products	15.64	18.96	3.31
Machinery and equipment n.e.c.	38.11	41.07	2.97
Office machinery and computers	78.67	100.00	21.67
Electrical machinery and apparatus n.e.c.	65.00	75.26	10.26
Radio, television and communication equipment	80.75	41.86	-38.89
Medical, precision and optical instruments	55.99	75.73	19.74
Motor vehicles, trailers and semi-trailers	71.55	92.05	20.50
Other transport equipment	69.26	92.66	23.40
Furniture; other manufactured goods n.e.c.	35.32	37.04	1.72

Source: OECD, STAN

Table 4. Share of imported inputs within industries in Norway (percentage)

Industry	1992	2002	Change 92-02
Food products, beverages and tobacco	11.37	14.82	3.44
Textiles	66.38	66.32	-0.07
Wearing apparel; furs	87.50	58.33	-29.17
Leather and leather products	71.79	84.00	12.21
Wood and wood products	21.61	27.04	5.43
Pulp, paper and paper products	18.32	38.90	20.57
Printed matter and recorded media	1.47	3.52	2.05
Chemicals and chemical products	55.93	63.87	7.95
Rubber and plastic products	66.00	71.35	5.35
Other non-metallic mineral products	26.30	36.51	10.21
Basic metals	76.41	80.19	3.78
Fabricated metal products	43.32	31.39	-11.93
Machinery and equipment n.e.c.	70.61	59.68	-10.92
Office machinery and computers	98.10	100.00	1.90
Electrical machinery and apparatus n.e.c.	61.85	60.13	-1.72
Radio, television and communication equipment	66.09	68.50	2.41
Medical, precision and optical instruments	72.43	81.63	9.20
Motor vehicles, trailers and semi-trailers	71.76	66.80	-4.96
Other transport equipment	20.94	23.34	2.41
Furniture; other manufactured goods n.e.c.	46.33	44.56	-1.77

Source: Statistics Norway

Table 5. Share of imported inputs within industries in Sweden (percentage)

Industry	1995	2000	Change 95-00
Food products and beverages	19.80	28.53	8.73
Textiles	61.87	53.13	-8.75
Wearing apparel; furs	84.91	92.86	7.95
Leather and leather products	77.40	80.95	3.55
Wood and wood products	15.74	18.15	2.41
Pulp, paper and paper products	22.20	26.51	4.31
Printed matter and recorded media	4.55	4.48	-0.07
Coke, refined petroleum products and nuclear	53.11	53.99	0.88
Chemicals	76.13	74.09	-2.04
Rubber and plastic products	49.89	51.11	1.22
Other non-metallic mineral products	32.76	35.24	2.48
Basic metals	47.49	58.16	10.66
Fabricated metal products	14.59	12.75	-1.83
Machinery and equipment n.e.c.	64.56	63.02	-1.54
Office machinery and computers	95.85	95.05	-0.80
Electrical machinery and apparatus n.e.c.	80.02	80.76	0.73
Radio, television and communication equipme	82.79	92.01	9.22
Medical, precision and optical instruments	70.39	81.62	11.23
Motor vehicles, trailers and semi-trailers	57.61	53.54	-4.07
Other transport equipment	64.83	58.31	-6.52
Furniture; other manufactured goods n.e.c.	38.35	43.19	4.84

Source: Statistics Sweden

20. Although the share of imported inputs on average increases in all three countries during this time period, the changes across industries vary substantially. In terms of magnitudes, increases as well as decreases seem to be the largest in Finland. Interestingly, there is a large decrease in the share of imported inputs within the wood and wood products sector between 1995 and 2000. There is an overall increase in imports in this sector between 1995 and 2000, so it may be that a large part of this increase is in final rather than intermediate goods. Large increases in the share of imported inputs are found in textiles and other transport equipment.

21. For Norway the largest increase in the share of imported inputs is in pulp and paper while the largest decrease is in wearing apparel. For Sweden the largest increase is in medical, precision and optical instruments while the largest decrease is in textiles. Taken together, there is thus no clear pattern whereby certain industries seem to offshore intermediate input production and others inshore them.[1]

22. If the relatively compressed wage structure in the Nordic countries created strong incentives for Nordic firms to offshore low-skilled jobs, we might expect to see disproportionately large increases in offshoring from industries intensive in low-skilled workers. However, since there may be low-skilled segment within otherwise high-skill intensive sectors, it is difficult to assess the relevance of this argument based on the industry distribution of offshoring measures. The fact that the industry distribution looks so

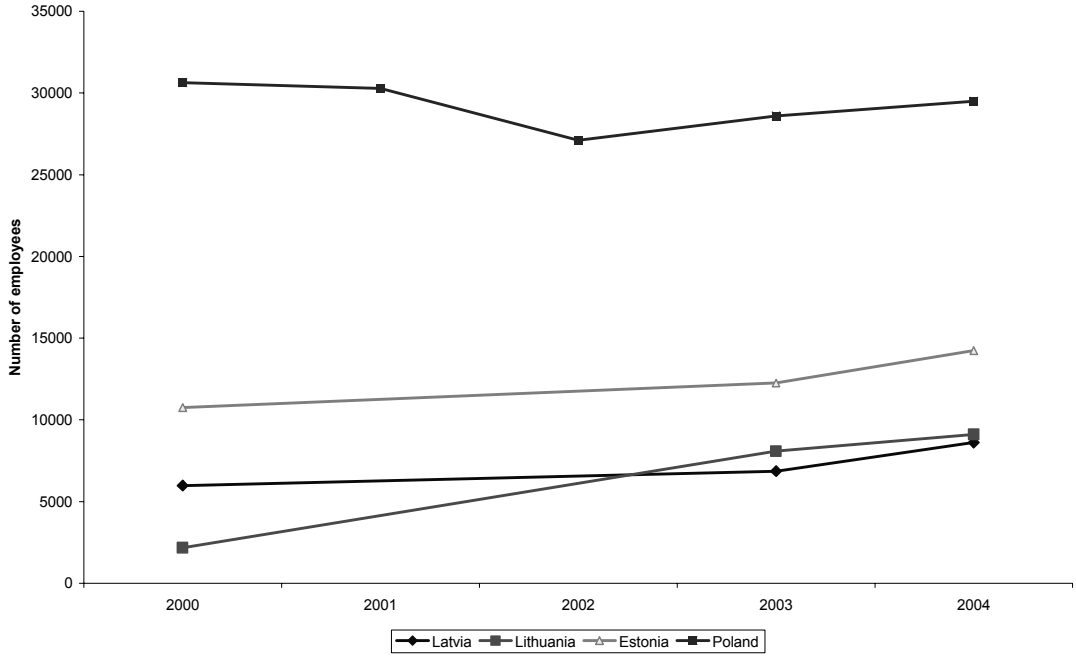
[1] It seems to matter somewhat for the picture whether the imported inputs are put in relation to overall inputs or to output. As a share of output, for instance, the imported inputs increased considerably in the electronics industry. As a share of total input, however, the increase is very modest, suggesting that domestic outsourcing of component production has been important in the electronics industry.

different for the three countries for which we have data, however, casts some doubt on the idea that a common feature of the labour market should be a driving factor behind offshoring.

Multinational Activity

23. Due to a lack of data, it is difficult to assess the recent changes in multinational activity in the Nordic/Baltic region. Looking at Sweden, a country for which information about the foreign employment of multinational firms is publicly available, we find that affiliate employment has increased somewhat in the Baltic states and decreased somewhat in Poland since early 2000 (see Figure 1). In 2000 there were about 49 500 people employed by Swedish multinationals throughout the Baltic region (i.e. in either Estonia, Latvia, Lithuania or Poland). This number had increased to about 61 500 in 2004; an increase by about 24 percent. In terms of the share of total affiliate employment, the Baltic region increased its share with about one percentage point; from 5.4 percent to 6.4 percent (Institutet för Tillväxtpolitiska Studier, 2002, 2006).

Figure 1. Affiliate employment at Swedish multinationals in the Baltic states and Poland 2000-2004.

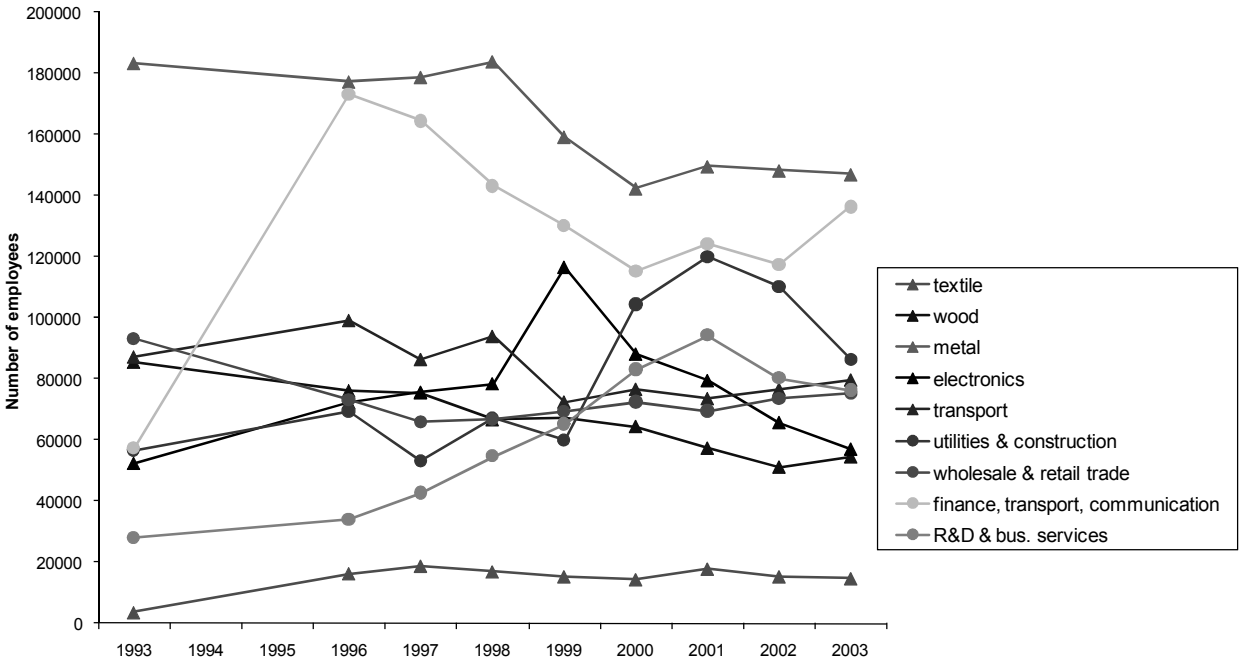


Source: Institutet för Tillväxtpolitiska Studier (ITPS)

24. We would like to study how the part of multinational activity that is related to vertical specialisation has evolved over time across industries. However, the available data do not permit a distinction between affiliate activities that are part of a production network in the sense of carrying out upstream or downstream activities vis-à-vis the parent firm and other affiliate activities. What we can look at is the extent of affiliate activities carried out in low-income rather than high-income regions. Such affiliates are likely to be located abroad at least partly because of low production costs and their production may therefore to a larger extent be exported to other markets.

25. Figure 2 shows how the number of employees of affiliates of Swedish multinationals that are located outside Western Europe and North America has evolved across broad sectors during the ten year period 1993-2003. As is clear from this figure, there is no uniform pattern across sectors. In fact, the number of affiliate employees has decreased in several sectors, such as in the metal industry, wood and wood products and electronics. It is mainly in the service industries that we see significant increases in the number of affiliate employees in the low-income region, in particular in the R&D and business service sector.

Figure 2. Affiliate employment at Swedish multinationals outside Western Europe and North America.



Source: Institutet för Tillväxtpolitiska Studier (ITPS)

26. Data on foreign direct investment can tell us how financial flows related to the activities of multinationals have evolved. A drawback with these data, however, is that financial flows may arise even without any change in real activities, at the same time as real activities may change without any accompanying financial flows. Thus, foreign direct investment data make up noisy proxies for the real activities funded by such investment. Nevertheless, it may be instructive to see how the Baltic region's share of the outward FDI stock of the Nordic countries has evolved over time.

27. Table 6 presents such information based on the information on FDI stocks collected by UNCTAD.[2] The time period for which information is available is relatively short and varies somewhat across countries. From the available information, it appears as if it is only for Sweden that there has been a consistent upward trend in the share of the FDI stock located in the Baltic region. For the other Nordic countries, this share decreased 1999-2000. By most accounts, year 2000 was the peak year for cross-border

[2] The data stem from the FDI Country Profiles which can be downloaded at http://www.unctad.org/Templates/Page.asp?intItemID=3198&lang=1.

mergers and acquisitions, mainly involving the advanced industrialized countries. This may explain the fact that the share of transition economies such as the Baltic states and Poland in the total outward FDI stock went down during the late 1990's. At the latest year for which data are available, the Baltic region's share of the outward FDI stock was a few percentages (around 2 for Finland and Norway, around 3 for Sweden and around 4 for Denmark).

Table 6. The Baltic region's share of the total outward FDI stock (Baltic region = Estonia, Latvia, Lithuania and Poland)

	Denmark	Finland	Norway	Sweden
1998	4.40	0.74	0.95	.
1999	3.72	2.14	1.33	1.61
2000	2.70	1.68	1.24	2.09
2001	2.98	2.03	1.76	2.58
2002	3.60	2.00	.	3.22
2003	3.85	.	.	3.24

Source: UNCTAD Foreign Direct Investment Database

Note: "." indicates missing information

28. Taken together, the information on multinational activity and foreign direct investment indicates that affiliate activities of Nordic firms in the Baltic region have increased, but the increase seems to be relatively modest.

4 Shifts in Demand for Workers with Different Levels of Education

29. Shifts in the relative demand for different skill categories may lead to shifts in relative employment, relative wages or a combination of both. In countries with relatively rigid relative wages, we would expect demand shifts to be mainly expressed in changes in employment shares, whereas in countries with relatively flexible wages we would expect demand shifts to affect relative wages more. Changes in wage-bill shares should capture both margins of adjustment.

30. We distinguish between three different skill groups based on educational attainment: (*i*) workers with at most lower secondary education, (*ii*) workers with at most upper secondary education, and (*iii*) workers with tertiary education. Lower secondary education corresponds to about 9 years of schooling while upper secondary education corresponds to about 11-13 years of schooling.

31. There has been a clear upward trend in the wage-bill share of workers with tertiary education and downward trend in the wage-bill share of workers with lower secondary education. The wage-bill share of workers with upper secondary education has remained fairly constant (see Figure 3-5).

Figure 3. Wage-bill share of workers with different levels of educational attainment in Finland 1995-2004.

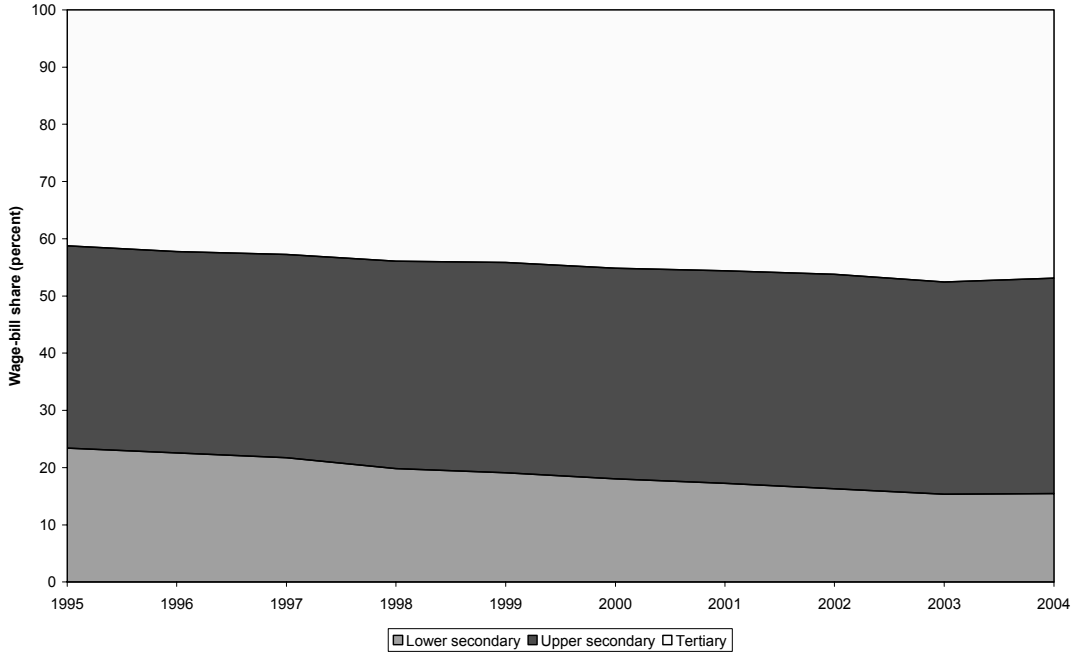


Figure 4. Wage-bill share of workers with different levels of educational attainment in Norway 2000-2005.

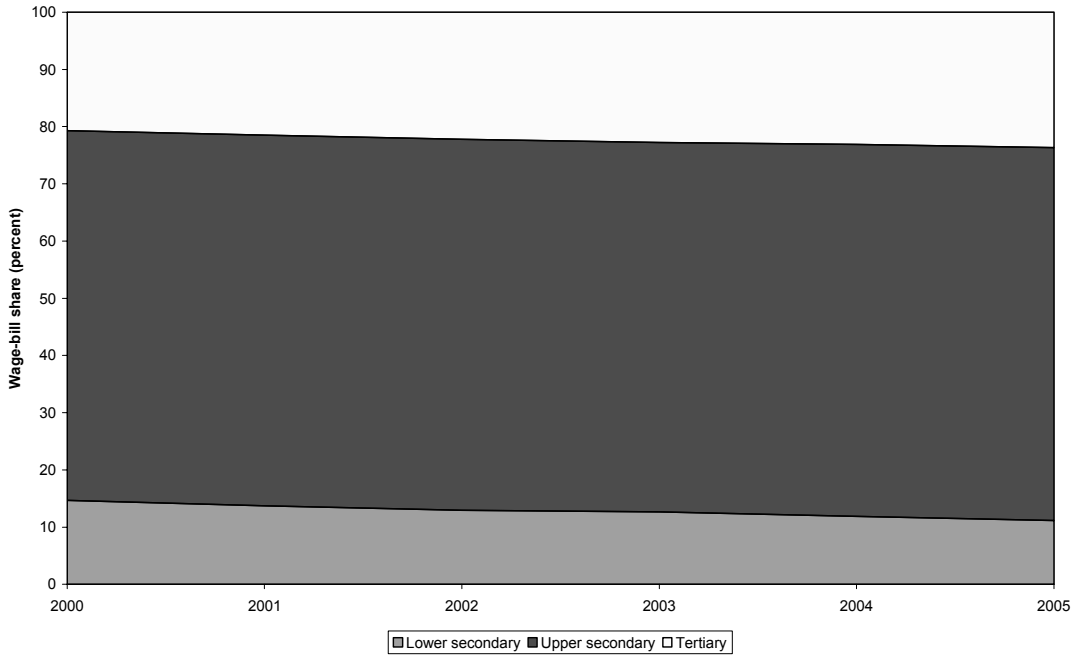
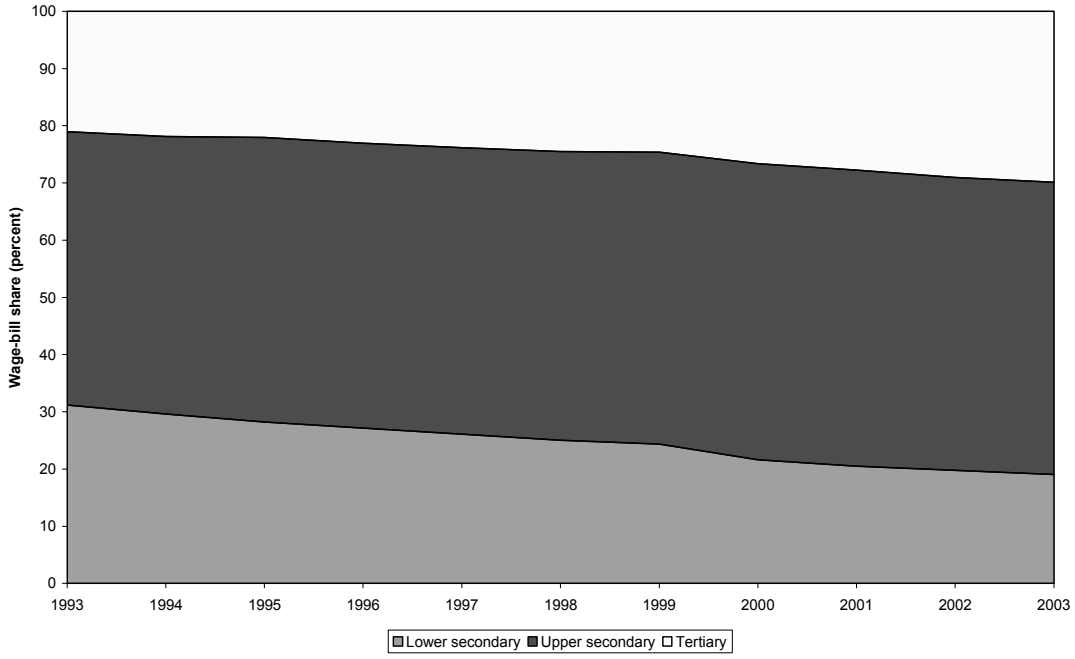


Figure 5. Wage-bill share of workers with different levels of educational attainment in Sweden 1993-2003.



32. Table 7-9 show the percentage point changes in the wage-bill shares of workers with different levels of educational attainment across industries. As suggested by Figure 3-5, most industries exhibit increasing wage-bill shares of workers with tertiary education. For Norway, the information is only available at a relatively high level of industry aggregation (the manufacturing sector is divided into eight industries) and at this aggregated level all industries exhibit an increase in the wage-bill share of workers with tertiary education and a decrease in the wage-bill share of workers with lower secondary education. For Finland and Sweden, the information is available at a more disaggregated industry level (the data cover the period 1995-2004 for Finland and 1993-2003 for Sweden). As is clear from Table 7 and 9, the increase in the wage-bill for workers with tertiary education and decrease in the wage-bill for workers with lower secondary education is more or less uniform across industries. There are some exceptions; the coke and petroleum products industry in Finland and the office, accounting and computing machinery industry in Sweden; but these are very small industries in terms of employment.[3]

[3] We do not report numbers for the office, accounting and computing machinery industry in Finland on account of missing information on employment and earnings of workers with lower secondary education towards the end of the period.

Table 7. Changes in wage-bill shares across industries 1995-2004 in Finland (percentage points)

Industry	Lower secondary	Upper secondary	Tertiary
Food products and beverages	-9.15	7.14	2.01
Tobacco products	3.94	-16.81	12.87
Textiles	-10.33	6.37	3.95
Wearing apparel	-9.14	-3.30	12.44
Leather	-15.22	9.38	5.84
Wood and products of wood and cork	-8.49	6.08	2.42
Pulp	-11.97	10.15	1.82
Printing and publishing	-16.95	4.10	12.85
Coke, refined petroleum products and nuclear fuel	-4.52	8.67	-4.15
Chemicals and chemical products	-7.93	3.58	4.35
Rubber and plastics products	-5.97	2.18	3.78
Other non-metallic mineral products	-4.55	4.59	-0.04
Basic metals	-9.77	7.49	2.28
Fabricated metal products	-7.69	6.70	0.98
Machinery and equipment	-8.19	-4.57	12.75
Electrical machinery and apparatus	-9.73	4.06	5.67
Radio	-8.53	-4.37	12.90
Medical	-11.81	-4.12	15.93
Motor vehicles	-4.80	2.94	1.86
Other transport equipment	-3.41	3.35	0.06
Furniture; manufacturing n.e.c.	-6.07	3.22	2.85

Source: Statistics Finland, own calculations

Table 8. Changes in wage-bill shares across industries 2000-2005 in Norway (percentage points)

Industry	Lower secondary	Upper secondary	Tertiary
Food products, beverages and tobacco	-2.06	0.81	1.25
Textiles, textile products, leather and footwear	-2.54	1.23	1.31
Wood and wood products	-1.71	1.24	0.47
Pulp, paper, paper product and printing	-1.22	-1.41	2.63
Chemical, rubber and plastics	-1.97	0.85	1.12
Basic metals	-2.36	1.17	1.19
Metal products and machinery	-1.50	0.28	1.22
Other manufacturing	-1.05	-0.47	1.51

Source: Statistics Norway, own calculations

Table 9. Changes in wage-bill shares across industries 1993-2003 in Sweden (percentage points)

Industry	Lower secondary	Upper secondary	Tertiary
Food products, beverages and tobacco	-12.93	7.57	5.36
Textiles	-16.03	8.80	7.23
Wearing apparel	-20.69	9.51	11.18
Leather	-10.89	7.28	3.61
Wood and products of wood and cork	-11.74	14.39	-2.65
Pulp	-11.58	5.57	6.01
Printing and publishing	-10.67	0.49	10.18
Chemicals and chemical products	-10.15	-1.94	12.08
Rubber and plastics products	-12.83	7.78	5.05
Other non-metallic mineral products	-15.11	8.46	6.66
Basic metals	-11.87	6.16	5.71
Fabricated metal products	-14.61	10.58	4.03
Machinery and equipment	-10.85	0.65	10.20
Office, accounting and computing machinery	-0.89	4.41	-3.52
Electrical machinery and apparatus	-12.96	-2.50	15.46
Radio	-12.68	-10.50	23.18
Medical	-6.91	-6.63	13.54
Motor vehicles	-11.48	3.65	7.82
Other transport equipment	-7.75	-3.26	11.01
Furniture; manufacturing n.e.c.	-13.96	9.13	4.83

Source: Statistics Sweden, own calculations

33. There are of course many possible reasons for a trendwise increase in the wage-bill share of highly educated workers. There have been considerable increases in the relative supply of workers with tertiary education that might affect the employment shares. At many workplaces there have also been large increases in the extent to which the jobs involve work with computers. Because computers tend to be complementary to high-skilled workers this may lead to an increased relative demand for highly educated workers (see e.g. Berman, Bound and Griliches, 1994). In order to investigate whether the observed increase in the wage-bill share of highly educated workers can be related to offshoring, it is thus important to control for other possible effects.

34. A few studies have addressed the issue of how offshoring has affected the demand for different types of labour in the Nordic countries. Ekholm and Hakkala (2006) carry out an econometric analysis for Sweden and find that offshoring 1995-2000 in the manufacturing sector was associated with a shift away from workers with an intermediate level of education, but that the quantitative importance of this was small. Ali-Yrkkö (2006) report results based on a survey of Finnish firms and conclude that offshoring firms are more prone to shift employment away from workers with a low level of education, towards workers with a university degree, than other firms.

5 Econometric Analysis

35. In the econometric analysis we will estimate the relationship between observed offshoring at the industry level and the wage-bill shares of workers with different levels of educational attainment. We use a

cost function approach similar to Ekholm and Hakkala (2006), where the impact of offshoring on labour demand is modelled in a similar way as for factor-biased technological change (FBTC).

Econometric specification

36. We carry out the analysis based on a translog cost function, treating offshoring as a factor that changes the technology with which the domestic industry operates and not necessarily in a way that affects all domestic input factors uniformly. For instance, offshoring of certain parts of the production process could raise productivity for certain domestic workers more than others, leading to a shift in relative demand. To control for any FBTC induced by domestic innovation, we also include the industry's R&D intensity. We apply Shephard's lemma to the cost function to arrive at an equation where the cost share of a variable factor is a function of factor prices, output levels and technical change (see Ekholm and Hakkala, 2006, for a more detailed account).

37. By assuming a common short-run cost function for the manufacturing industries where capital is treated as a quasi-fixed factor, we get the following estimating equation

$$\theta_{ij} = \alpha_j + \sum_{s=1}^{S} \gamma_{js} \ln w_s + \phi_j \ln Q_i + \delta_j \ln K_i + \lambda_{jz} z_i + \lambda_{jr} r_i$$

(j=1,...S, s=1,...S),

38. where $\theta_{ij} \equiv w_j L_{ij} / \sum w_s L_{is}$ is the wage-bill share of workers belonging to skill group j, w_s the wage of workers belonging to skill group j, K_i is the capital stock, Q_i value added, z_i a measure of offshoring, and r_i a measure of R&D intensity. According to the cost-function approach, the value of the parameters γ_{js} depend on whether different types of labour tend to be substitutes for or complements to one another, while the value of δ_j depends on whether capital tends to substitute or complement labour belonging to skill group j. The value of parameter λ_{jz} depends on whether offshoring tends to bias factor demand towards or away from the usage of labour belonging to skill group j.

39. R&D intensity is defined as R&D expenditure divided by gross output. Offshoring is measured as the share of imported inputs within the industry put in relation to industry output. It may be preferable to put the imported inputs in relation to output rather than total inputs since otherwise outsourcing of activities across industries may confound the measure (outsourcing being defined as a situation where a firm chooses to purchase an input from an independent supplier instead of producing it itself). Our measure capture in-house offshoring to the extent it concerns a relocation of the firm's own intermediate input that is imported back for further processing.

40. As mentioned previously, information about imported inputs from symmetric input-output tables is only available for certain years. However, by interpolating information from the input-output tables, we can construct time series for offshoring. We then use the observed share of intermediate inputs in total imports in industry *i* in those years in which we have information from the input-output tables and interpolate this share for intermittent years. We observe imports in relation to domestic output every year and multiply this ratio with the interpolated ratio between imported inputs and total imports. This gives us a proxy measure of imported inputs as a share of output in intermittent years. For some countries, yearly

information on imported inputs is available through supply tables which are not symmetric. Alternatively, time series of offshoring can be constructed from these supply tables.[4]

41. We are left with a system of equations; one wage-bill share equation for each skill group. One of the three wage-bill equations can be derived from the other two, implying that we have two independent equations to be estimated for each country. Homogeneity in prices implies $\sum\gamma_{js}=0$ and symmetry of the underlying translog cost function that $\gamma_{st}=\gamma_{ts}$; restrictions imposed in the analysis.

42. There are a number of well-known econometric problems associated with estimating a system of equations such as these ones. One obvious problem is the endogeneity of the offshoring variable as well as wages. In previous studies it has been customary to not include wages but instead letting time dummies pick up changing relative wages over time. The endogeneity of the offshoring variable is difficult to do anything about without a plausible instrument, which is hard to find in this context. We will therefore not attempt instrumenting for offshoring, but acknowledge that this means that our estimates should be viewed as partial correlations rather than causal effects.

43. We estimate the system of equations using iterated seemingly unrelated regression (ISUR). We include industry dummies in order to control for time-invariant industry-specific effects and we run a number of different specifications: (*i*) equations that do not include wages, (*ii*) equations that include industry-distributed wages, and (*iii*) equations in which offshoring is divided into offshoring from high-income and low-income countries. High-income and low-income country groups are defined according to World Bank classification (World Development Indicators). For robustness we also estimate separate relationships between the wage-bill shares and the share of imported inputs from different low-income regions (such as Central and Eastern Europe and Asia).

Results

44. As was evident in the previous section, information about imported intermediate inputs from input-output tables is available 1992-2002 for Norway. However, information about wage bills across skill groups is only available 2000-2005. This implies that an econometric analysis of the effects of offshoring on the demand for different skill groups can only be made based on information for 2000-2002; most likely too short a time span to be able to disentangle the relationship between wage-bill shares and offshoring. In neither of the specifications that we have run the estimated coefficient of the offshoring variable is significant. In fact very few of the other estimated coefficients turn out significant. We therefore do not to report any econometric results for Norway.[5]

45. For Finland offshoring measures based on the use tables can be created for every year 1995-2003. For Finland as well as Sweden we can create measures for 1995 and 2000 based on information from the symmetric input-output tables. By interpolating the input share of total imports we then impute values for each intermittent year. The regressions are run at a level of industry aggregation with 22 industries for Finland and 20 industries for Sweden. The total number of observations is 132 (196 when using information from the use tables) for Finland and 120 for Sweden. We present the elasticities of the included variables based on our estimations. These elasticities show the estimated relationship between a percentage change in the right hand side variable of the estimating equation (percentage point change in the case of the offshoring variables) and the percentage change in the demand for workers belonging to a particular skill group.

[4] For Finland, we construct offshoring measures based on information about imported inputs from use tables 1995-2003 (see Appendix A).

[5] The results are available from the authors upon request.

46. Table 10 shows the estimated elasticities for Finland and Table 11 the estimated elasticities for Sweden based on regressions using offshoring measures computed from the symmetric input-output tables (results based on regressions using offshoring measures computed from use tables for Finland are presented in Appendix B). Panel A shows results for specifications with total offshoring whereas panel B shows results for specifications where we distinguish between offshoring to high-income and low-income countries. In the case of Finland, the estimated elasticity of total offshoring is mostly insignificant, with the exception of a negative elasticity significant at the five percent level for workers with lower secondary education in one of the specifications (the one including industry-specific wages). Similarly, in the case of Sweden, the estimated elasticity of total offshoring is mostly insignificant with one exception, but in the Swedish case the exception is a negative elasticity significant at the 10 percent level for workers with upper secondary education. Thus, we do not find any robust evidence that total offshoring is associated with shifts in labour demand across educational groups for either country.

47. For Sweden, the estimated elasticities of R&D intensity are significant and have the sign pattern one would expect – R&D seems quite clearly to be associated with a shift away from the least educated workers and towards the most educated workers.[6] For Finland, the sign pattern is similar, but none of the estimated elasticities of R&D intensity are significantly different from zero.

Table 10A. Elasticities calculated from estimations of translog cost functions for Finland. Total offshoring

		Changes in:						
Demand for labor with:	*Spec.*	**Capital**	**Value added**	**R&D**	**Off-shoring**	**lower sec.**	**Wages upper sec.**	**tertiary**
Lower sec. education	*(1)*	0.021	-0.206	0.148	-0.730			
		(0.130)	(0.113)*	(2.002)	(0.654)			
	(2)	0.120	-0.222	-1.251	-1.097	0.110	-0.122	-0.168
		(0.121)	(0.102)**	(1.787)	(0.551)**	(0.292)	(0.292)	(0.198)
Upper sec. education	*(1)*	-0.069	-0.067	-0.984	0.282			
		(0.101)	(0.082)	(1.740)	(0.630)			
	(2)	0.001	-0.123	-0.728	-0.107	0.304	-0.023	0.150
		(0.178)	(0.144)	(2.550)	(0.546)	(0.289)	(0.371)	(0.309)
Tertiary education	*(1)*	0.085	0.300	1.378	0.263			
		(0.153)	(0.146)**	(2.733)	(1.012)			
	(2)	-0.117	0.402	2.319	1.214	-0.108	-0.164	0.157
		(0.216)	(0.195)**	(3.005)	(1.097)	(0.197)	(0.310)	(0.432)

Note: Specification (1) is without wages on the assumption that wages are set economy-wide, whereas specification (2) includes industry-distributed wages. Standard errors in parenthesis are based on bootstrapping. Significance at the 1, 5, and 10 percent level is indicated by ***, **, and *, respectively.

[6] The results for Sweden are consistent with results from Machin and Van Reenen (1998), Haskel and Heden (1999), Hansson (2005) and Hijzen et al. (2005).

Table 10B. Elasticities calculated from estimations of translog cost functions for Finland. Offshoring to high-income (HI) and low-income (LI) countries

		Changes in:							
Demand for			**Value**		**Offshoring**			**Wages**	
labor with:	*Spec.*	**Capital**	**added**	**R&D**	**HI**	**LI**	**lower sec.**	**upper sec.**	**tertiary**
Lower sec.	*(1)*	0.022	-0.181	0.310	-0.572	-1.849			
education		(0.137)	(0.128)	(2.158)	(0.715)	(3.573)			
	(2)	0.125	-0.241	-1.373	-1.227	-0.370	0.114	-0.105	-0.189
		(0.143)	(0.131)*	(2.024)	(0.691)*	(2.708)	(0.328)	(0.340)	(0.218)
Upper sec.	*(1)*	-0.067	-0.019	-0.670	0.589	-1.894			
education		(0.108)	(0.086)	(1.703)	(0.699)	(2.433)			
	(2)	-0.006	-0.092	-0.563	0.098	-1.230	0.292	-0.067	0.183
		(0.121)	(0.107)	(1.775)	(0.700)	(2.237)	(0.211)	(0.256)	(0.202)
Tertiary	*(1)*	0.083	0.203	0.737	-0.362	4.690			
education		(0.167)	(0.175)	(2.898)	(1.148)	(5.290)			
	(2)	-0.110	0.373	2.181	1.021	2.252	-0.156	-0.112	0.125
		(0.193)	(0.195)*	(2.726)	(1.041)	(4.064)	(0.208)	(0.264)	(0.343)

Note: Specification (1) is without wages on the assumption that wages are set economy-wide, whereas specification (2) includes industry-distributed wages. Standard errors in parenthesis are based on bootstrapping. Significance at the 1, 5, and 10 percent level is indicated by ***, **, and *, respectively.

Table 11A. Elasticities calculated from estimations of translog cost functions for Sweden. Total offshoring

		Changes in:						
Demand for			**Value**		**Off-**		**Wages**	
labor with:	*Spec.*	**Capital**	**added**	**R&D**	**shoring**	**lower sec.**	**upper sec.**	**tertiary**
Lower sec.	*(1)*	0.143	-0.067	-0.853	0.531			
education		(0.078)*	(0.042)	(0.442)*	(0.328)			
	(2)	0.149	-0.068	-0.774	0.487	-0.520	0.244	0.277
		(0.082)*	(0.045)	(0.408)*	(0.337)	(0.445)	(0.461)	(0.227)
Upper sec.	*(1)*	-0.124	0.030	-0.086	-0.574			
education		(0.067)*	(0.028)	(0.194)**	(0.332)*			
	(2)	-0.131	0.038	-0.218	-0.422	0.239	-0.010	-0.229
		(0.072)*	(0.028)	(0.207)	(0.334)	(0.262)	(0.257)	(0.150)
Tertiary	*(1)*	0.090	0.017	1.197	0.573			
education		(0.078)*	(0.045)	(0.448)**	(0.386)			
	(2)	0.097	0.002	1.381	0.306	0.330	-0.269	-0.060
		(0.078)	(0.053)	(0.457)***	(0.383)	(0.251)	(0.285)	(0.272)

Note: Specification (1) is without wages on the assumption that wages are set economy-wide, whereas specification (2) includes industry-distributed wages. Standard errors in parenthesis are based on bootstrapping. Significance at the 1, 5, and 10 percent level is indicated by ***, **, and *, respectively.

Table 11B. Elasticities calculated from estimations of translog cost functions for Sweden. Offshoring to high-income (HI) and low-income (LI) countries

		Changes in:							
Demand for			**Value**		**Offshoring**		**Wages**		
labor with:	*Spec.*	**Capital**	**added**	**R&D**	**HI**	**LI**	**lower sec.**	**upper sec.**	**tertiary**
Lower sec.	*(1)*	0.138	-0.069	-0.841	0.425	1.144			
education		(0.081)*	(0.046)	(0.439)*	(0.522)	(2.095)			
	(2)	0.146	-0.072	-0.681	0.248	1.661	-0.320	0.035	0.284
		(0.079)*	(0.045)	(0.400)*	(0.511)	(2.360)	(0.481)	(0.487)	(0.236)
Upper sec.	*(1)*	-0.102	0.039	-0.146	-0.046	-3.631			
education		(0.068)	(0.030)	(0.193)	(0.441)	(1.570)**			
	(2)	-0.112	0.046	-0.308	0.095	-3.398	0.237	0.069	-0.190
		(0.072)	(0.029)	(0.225)	(0.436)	(1.752)*	(0.276)	(0.259)	(0.156)
Tertiary	*(1)*	0.049	0.001	1.310	-0.410	6.263			
education		(0.082)	(0.048)	(0.477)***	(0.543)	(2.239)***			
	(2)	0.062	-0.010	1.458	-0.494	5.157	0.339	-0.187	-0.152
		(0.079)	(0.051)	(0.476)***	(0.528)	(2.731)*	(0.271)	(0.307)	(0.286)

Note: Specification (1) is without wages on the assumption that wages are set economy-wide, whereas specification (2) includes industry-distributed wages. Standard errors in parenthesis are based on bootstrapping. Significance at the 1, 5, and 10 percent level is indicated by ***, **, and *, respectively.

48. Panel B of Table 10 and 11 show the corresponding estimated elasticities when we distinguish between offshoring to high-income and low-income countries. Once more, the estimated elasticities are mostly insignificant for Finland, but in the case of Sweden there are several significant estimates of demand elasticities with respect to offshoring to low-income countries. The results suggest a difference in results for the two countries regarding why there is a (weak) tendency for total offshoring to be associated with a demand shift away from workers with secondary education. In the case of Finland, this tendency appears to stem from offshoring to high-income countries. The estimated elasticity of demand for workers with lower secondary education with respect to offshoring to high-income countries is negative in all specifications (including those presented in Appendix B) and significant at the 10 percent level in the specification including industry-specific wages.

49. In the case of Sweden, on the other hand, the tendency for total offshoring to be associated with a demand shift away from workers with upper secondary education appears to be related to offshoring to low-income countries. The estimated elasticities of the demand for workers with upper secondary education with respect to offshoring to low-income countries are negative and significant at 5 or 10 percent level depending on specification. Furthermore, the estimated elasticity of offshoring to low-income countries with respect to demand for workers with tertiary education is positive and significant at the 10 or 1 percent level. For Sweden the results thus indicate that offshoring to low-income countries is associated with a demand shift away from workers with an intermediate level of education and towards workers with a high level of education. Offshoring to high-income countries, on the other hand, does not appear to be associated with any shift in the relative demand for workers.

50. The results for Sweden are perhaps more in line with what we would expect based on theory. Imports from low-wage countries are expected to be relatively intensive in unskilled labour and thus effectively reduce the relative demand for such labour. Arguably, we would expect that such imports would shift demand away from the group of workers with the lowest level of education rather than from the group of workers with an intermediate level of education, but there are a number of reasons why the latter group might be more strongly affected. To begin with, there could be an age effect stemming from a tendency for imported inputs to substitute disproportionately for younger workers on account of the practice of letting the most recently hired workers go first in situations where firms are downsizing (see Ekholm and Hakkala, 2006). There is a positive correlation between age and the average level of

education, i.e. young workers tend to have a higher education than old workers. Furthermore, it could be that the types of tasks that are easily offshorable are to a larger extent carried out by people with an intermediate level of education than by people with a low level of education. Workers with a low level of education may be to a greater extent carrying out tasks such as maintenance and cleaning; tasks which are not easily offshorable.

51. In the case of Finland, the results suggest that offshoring to high-income countries has been associated with the kind of shift in labour demand we would expect from offshoring to low-income countries, i.e. away from workers with the lowest level of education. In order to investigate whether the result is driven by offshoring to a particular group of countries, we divide the high-income countries into Western Europe and other high-income countries (see Table B3 in appendix B). It turns out that the negative demand elasticity significant at the 10 percent level for workers with lower secondary education is driven by offshoring to Western European countries. The signs of the estimated elasticities for other high-income countries are in line with what we would expect from theory; positive for workers with lower and secondary education and negative for workers with tertiary education. However, none of them are significantly different from zero.

52. One might speculate about the underlying mechanisms behind these results. For instance, offshoring to high-income countries might induce a form of skill-biased technical change that is not captured by the R&D variable. This might be the case if Finnish firms access new technology through their interactions with suppliers in other high-income countries. Ultimately, such speculations may not be very useful since the main result emanating from this analysis is still that most of the estimated demand elasticities of offshoring are not significantly different from zero. Moreover, in those instances where the estimated elasticities are significant, their magnitudes are relatively small.

53. The elasticities should be interpreted with reference to a percentage point change in the offshoring measure. On average, this measure is well below 10 percent for Finland and Sweden, implying that a one percentage point increase would represent a very large change from the current situation. The largest significant estimated elasticity is found for the demand for Swedish workers with upper secondary education with respect to offshoring to low-income countries. This negative elasticity of -3.6 implies that a 10 percent increase in our measure of offshoring to low-income countries from its average value in 2000 (when imported inputs from low-income countries made up 0.84 percent of output), would be associated with a reduction in the demand for workers with upper secondary education by only about 0.3 percent (0.084×-3.6).

54. Having looked at the descriptive evidence of changes in measures of offshoring and wage-bill shares across sectors it is perhaps not very surprising that our estimates turn out small and mostly insignificant. We are restricting the relationship to be one and the same across industries that apparently have evolved very differently. There is no indication that groups of industries share similar experiences across countries, implying that there is no obvious reason for letting the estimated parameters vary across sectors at the same time as restricting them to be the same across countries. It should also be emphasized that our estimates capture the partial correlation between offshoring and the demand for different types of labour when we control for factors such as capital stocks, output and R&D intensities. We are thus focusing on whether offshoring tends to bias labour demand towards a particular type of labour, not on whether it tends to bias factor demand away from labour altogether.

6 Conclusions

55. In spite of the many similarities between the Nordic countries regarding institutions and – to some extent – industrial structure, they exhibit diverse patterns with respect to offshoring. Overall, offshoring has increased for all countries for which we have data (Finland, Norway and Sweden), but the industry pattern differs substantially. In Finland, there have been large increases in the share of imported inputs in textiles and other transport equipment while the share of imported inputs within the wood and wood products sector decreased between 1995 and 2000. During the same period, there were large decreases in the share of imported inputs in textiles for Sweden and large increases in medical, precision and optical instruments. In Norway there were large increases in the share of imported inputs in pulp and paper and large decreases in wearing apparel between 1992 and 2002.

56. Finland and Sweden have relatively similar industry structures. They are both net exporters of paper and pulp and of electronics. They also both faced severe downturns in the early 1990's although for different reasons; in Finland it was related to the demise of the Soviet union and drastic decline of Soviet demand for Finnish products whereas in Sweden it was related to sharply increased real interest rates in connection with speculative attacks against the Swedish krona. Their trade structures, however, differ somewhat in that Sweden's trade is more heavily geared towards Western Europe than Finland, which has substantial trade with Russia. The estimated relationship between offshoring and the wage-bill shares of workers with different levels of educational attainment are also different for these two countries. Offshoring to low-income countries seems to be associated with a shift in labour demand for Sweden while it is offshoring to high-income countries that seem to be associated with a shift in labour demand for Finland. In the Swedish case, the shift seems to have been away from workers with upper secondary education and towards workers with tertiary education. In the Finnish case, however, it seems to have been away from workers with the lowest level of education (lower secondary education) towards workers with tertiary education.

57. It should be noted that quantitatively the estimated relationships between offshoring and demand for different types of labour are weak. This is of course not to say that offshoring cannot have dramatic effects on labour demand in narrowly defined sectors or regions. On average, however, we only find weak relationships for the two countries for which have sufficient data to carry out econometric analysis; Finland and Sweden.

58. Ultimately, the issue of how offshoring and the creation of production networks affect the labour market is a question about the possible negative side of globalisation. If offshoring were associated with a strong shift in labour demand away from workers with low education towards workers with high education, there would be reason for concern about the consequences of offshoring on the income distribution. From this perspective, our finding of only weak relationships might be viewed as a positive thing. In neither of our estimations we find a statistically significant effect of offshoring to low-income countries on the wage-bill share of workers with at most lower secondary education. In this sense, the results suggest that the gains from an increased specialisation due to fragmentation of production and the emergence of production networks involving low-wage countries indeed are reaped without any large adverse effects on the income distribution.

59. This study thus finds similar results as many other studies in this area; a lack of empirical evidence in support of the view that increased trade with low-wage countries hurt low-skilled workers. The main message of the study in terms of policy implications is that the lack of evidence for offshoring to low-wage countries hurting low-skilled labour holds for Finland and Sweden as well. Low-skilled labour may nevertheless be on the losing end of the overall trends and changes in the Finnish and Swedish economy. Technical change, in particular, may very well have such an effect, and our results regarding R&D

intensity to some extent support that hypothesis (especially for Sweden). However, we do not find any evidence that the more narrow phenomenon of using suppliers of intermediate inputs in low-wage countries is associated with a relative decline in the demand for low-skilled workers.

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APPENDIX A. DATA

FINLAND

60. In the case of Finland, there are symmetric input-output tables with information on imports for 1995 and 2000. There are also use tables with information on demand for imports for each year 1995-2004. In the econometric analysis, we use both types of tables to construct the offshoring measures (in the case where we use the symmetric input-output tables we interpolate the share of intermediate inputs in total imports for intermittent years). An advantage with using the use tables (which are not symmetric but industry times product) is that the used imports is classified at the product rather than industry level, which makes it more consistent with the classification used in the trade statistics. A possible disadvantage is that narrow offshoring is not necessarily imports from the same industry, since a particular product may be produced by several industries and a particular industry may produce several products. In practice, however, this problem is likely to be small since most industries produce only their own product (as is evident from the supply tables).

61. Information on employment and earnings across educational groups as well as R&D expenditures has been provided by Statistics Finland. There was a change in the classification of different types of education into secondary and tertiary education in the official statistics in 1997. The data used here have been classified according to the new classification scheme. Wages are defined as annual earnings and are expressed in euro. They have been deflated using CPI

62. Data on capital stocks, output and value added have been collected from the STAN database. Values are expressed in millions of euro, 2000 prices.

Table A1. Descriptive statistics for Finland (1995-2003)

Variable	Obs	Mean	Std. Dev.	Min	Max
Wage-bill share					
primary education	132	0.2884434	0.0837487	0.1078234	0.5220993
secondary education	132	0.4342733	0.0746108	0.2357454	0.5977176
tertiary education	132	0.2772833	0.1194023	0.0802121	0.6504231
Wages of workers with					
primary education	132	21634.41	3351.277	14826.1	32984.34
secondary education	132	21848.48	3277.2	14616.2	30205.21
tertiary education	132	28512.64	3979.375	17756.61	41327.81
Capital stock	132	3774.151	5.11E+03	119	24536
Value added	132	1125.242	1212.065	4	6044
R&D	132	0.0185267	0.0224246	0.0003311	0.1132124
Total offshoring	132	0.0852153	0.0783168	0.0004173	0.5136788
Offshoring HI	132	0.0730256	0.0719023	0.0003993	0.4935186
Offshoring LI	132	0.0121897	0.0139912	5.54E-06	0.0665284

NORWAY

63. Information about imported intermediate inputs from the input-output table is available 1992-2002. However, information about earnings and employment across skill groups is only available for the period 2000-2005, and only at a relatively aggregated level. An econometric analysis of the effects of offshoring on the demand for different skill groups thus can only be made based on information for 2000-2002. Wages are defined as annual earnings in NOK and have been deflated using CPI.

64. Data on output and value added have been collected from the STAN database and are expressed in million NOK, 2000 prices. Information about capital stocks is available from the input-output tables, but not from the STAN database. In order to get capital stocks in fixed (2000) prices, we have used the industry-distributed value added deflator implicit in STAN. Trade data used to construct offshoring measures are from Statistics Norway.

Table A2. Descriptive statistics for Norway (2000-2002)

Variable	Obs	Mean	Std. Dev.	Min	Max
Cost share of workers with					
primary education	57	0.1440363	0.0551857	0.0967505	0.2622819
secondary education	57	0.6422509	0.0315958	0.5870191	0.7172905
tertiary education	57	0.2137128	0.0727203	0.0826208	0.2932511
Wages of workers with					
primary education	57	252599.1	19150.45	214152	279275.9
secondary education	57	273230.7	22953.03	229512	306408
tertiary education	57	401374.8	46177.07	321024	488808.1
Capital stock	57	13872.11	20613.54	174	110419.3
Value added	57	7418.159	6570.463	40.74778	26341.32
R&D	57	0.024627	0.0322755	0.0010056	0.1492855
Total offshoring	57	0.0677692	0.0945759	0	0.4398093
Offshoring HI	57	0.0544607	0.0739613	0	0.358469
Offshoring LI	57	0.0133085	0.0235594	0	0.1172496

SWEDEN

65. Information about imported intermediate inputs from the input-output table is available for 1995 and 2000.

66. The trade data along with input-output tables, price deflators and other industry-specific variables have been provided by Statistics Sweden. Data on the number of employees, wages and educational attainment have been collected from the RAMS database (Regional Arbetsmarknadsstatistik). The information is available for the 1993-2003 period. There is a change in the classification of source country for imports in 1995 (prior to 1995 it was based on country of origin while after it has been based on sending country), which makes the country distribution of trade for the pre-1995 period non-comparable with the one for the post-1995 period.

67. Information about capital stocks is available at a about the two-digit level of NACE. Wages have been defined as montly earnings and are expressed in million SEK. They have been deflated using CPI. Capital stocks, output and value added have been deflated using PPI.

Table A3. Descriptive statistics for Sweden (1995-2000)

Variable	Obs	Mean	Std. Dev.	Min	Max
Cost share of workers with					
primary education	120	0.2776942	0.1061974	0.0781685	0.4919746
secondary education	120	0.4893342	0.051693	0.3777223	0.6080354
tertiary education	120	0.2329716	0.1276619	0.0711407	0.5441092
Wages of workers with					
primary education	120	182631.2	28779.27	111295.7	237366.7
secondary education	120	198042.4	35071.99	99341.92	254637.6
tertiary education	120	275720.7	54804.21	117078.6	362483.1
Capital stock	120	23177.07	20261.1	978.9582	84988.02
Value added	120	18041.11	14188.64	373.5778	53591
R&D	120	0.0408362	0.0478182	0.0001802	0.275262
Total offshoring	120	0.0754609	0.0558101	0.0064883	0.1998517
Offshoring HI	120	0.0680506	0.0521611	0.0062085	0.1815548
Offshoring LI	120	0.0074103	0.0084363	0.0002427	0.037315

APPENDIX B. RESULTS FOR FINLAND BASED ON MEASURE OF OFFSHORING CONSTRUCTED FROM USE TABLES

Table B1. Elasticities calculated from estimations of translog cost functions for Finland. Total offshoring

		Changes in:						
Demand for labor with:	*Spec.*	**Capital**	**Value added**	**R&D**	**Off-shoring**	**lower sec.**	**Wages upper sec.**	**tertiary**
Lower sec. education	*(1)*	-0.043	-0.014	-3.180	-0.529			
		(0.161)	(0.107)	(3.065)	(0.377)			
	(2)	-0.004	-0.004	-3.736	-0.586	-0.035	0.126	-0.272
		(0.175)	(0.115)	(2.712)	(0.364)	(0.478)	(0.525)	(0.313)
Upper sec. education	*(1)*	-0.064	-0.031	-2.125	0.247			
		(0.113)	(0.066)	(1.861)	(0.269)			
	(2)	-0.037	-0.041	-1.661	0.171	0.439	-0.122	0.095
		(0.189)	(0.101)	(2.421)	(0.360)	(0.519)	(0.668)	(0.342)
Tertiary education	*(1)*	0.140	0.061	6.318	0.125			
		(0.155)	(0.135)	(4.233)	(0.521)			
	(2)	0.061	0.067	6.133	0.297	-0.040	-0.248	0.341
		(0.185)	(0.151)	(4.054)	(0.725)	(0.311)	(0.341)	(0.324)

Note: Specification (1) is without wages on the assumption that wages are set economy-wide, whereas specification (2) includes industry-distributed wages. Standard errors in parenthesis are based on bootstrapping. Significance at the 1, 5, and 10 percent level is indicated by ***, **, and *, respectively.

Table B2. Elasticities calculated from estimations of translog cost functions for Finland. Offshoring to high-income (HI) and low-income (LI) countries

		Changes in:							
Demand for			**Value**		**Offshoring**			**Wages**	
labor with:	*Spec.*	**Capital**	**added**	**R&D**	**HI**	**LI**	**lower sec.**	**upper sec.**	**tertiary**
Lower sec.	*(1)*	-0.041	-0.006	-3.088	-0.471	-0.889			
education		(0.111)	(0.113)	(2.935)	(0.443)	(1.712)			
	(2)	-0.010	-0.029	-4.174	-0.785	0.678	0.053	0.060	-0.294
		(0.103)	(0.108)	(2.499)*	(0.430)*	(1.308)	(0.254)	(0.271)	(0.238)
Upper sec.	*(1)*	-0.054	0.012	-1.634	0.551	-1.671			
education		(0.072)	(0.055)	(1.539)	(0.291)*	(1.381)			
	(2)	-0.031	-0.010	-1.259	0.403	-1.270	0.423	-0.113	0.127
		(0.066)	(0.050)	(1.424)	(0.281)	(1.180)	(0.168)**	(0.181)	(0.175)
Tertiary	*(1)*	0.122	-0.012	5.473	-0.400	3.429			
education		(0.156)	(0.150)	(4.100)	(0.636)	(2.595)			
	(2)	0.058	0.043	5.931	0.127	1.312	-0.256	-0.199	0.313
		(0.138)	(0.132)	(3.454)*	(0.557)	(1.971)	(0.206)	(0.240)	(0.371)

Note: Specification (1) is without wages on the assumption that wages are set economy-wide, whereas specification (2) includes industry-distributed wages. Standard errors in parenthesis are based on bootstrapping. Significance at the 1, 5, and 10 percent level is indicated by ***, **, and *, respectively.

Table B3. Elasticities calculated from estimations of translog cost functions for Finland. Offshoring to Western Europe (WE), other high-income countries (HI) and low-income (LI) countries

		Changes in:								
Demand for			**Value**		**Offshoring**		**Other**		**Wages**	
labor with:	*Spec.*	**Capital**	**added**	**R&D**	**WE**	**Other HI**	**LI**	**lower sec.**	**upper sec.**	**tertiary**
Lower sec.	*(1)*	0.024	-0.053	-3.228	-0.828	2.423	-0.653			
education		(0.095)	(0.089)	(0.000)	(0.577)	(2.403)	(1.619)			
	(2)	0.054	-0.073	-4.267	-1.075	2.224	0.933	0.038	0.091	-0.312
		(0.086)	(0.088)	(2.470)	(0.646)*	(2.277)	(1.477)	(0.262)	(0.263)	(0.246)
Upper sec.	*(1)*	-0.061	0.001	-1.772	0.435	0.046	-1.131			
education		(0.073)	(0.054)	(1.654)	(0.410)	(1.365)	(1.289)			
	(2)	-0.036	-0.022	-1.424	0.289	0.076	-0.695	0.397	-0.120	0.116
		(0.073)	(0.051)	(1.507)	(0.365)	(1.283)	(1.223)	(0.163)	(0.184)	(0.181)
Tertiary	*(1)*	0.073	0.049	5.820	0.116	-2.381	2.374			
education		(0.138)	(0.118)	(4.549)	(0.797)	(3.211)	(2.344)			
	(2)	0.004	0.103	6.271	0.577	-2.237	0.188	-0.271	-0.220	0.348
		(0.124)	(0.108)	(3.571)	(0.790)	(2.864)	(2.021)	(0.217)	(0.241)	(0.387)

Note: Specification (1) is without wages on the assumption that wages are set economy-wide, whereas specification (2) includes industry-distributed wages. Standard errors in parenthesis are based on bootstrapping. Significance at the 1, 5, and 10 percent level is indicated by ***, **, and *, respectively.