Backward and forward linkages, specialization and concentration in Finnish manufacturing in the period 1995-1999

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Abstract

This study focuses on industrial concentration and regional specialization in Finland in the late 1990s. Our results show increasing specialization and at least for some industries increased geographical concentration. Thus, there was no single process driving all industries in the same direction. Our results are in line with previous studies reporting increased regional specialization and industrial concentration in Europe (see e.g. Puga, 1999; Monfort and Nicolini (2000); Amiti, 1998; Niiranen, 1997 and 1999; and Koutaniemi, 2003). In addition, our results suggest that the most concentrated industries benefit from high economies of scale or a high level of technology. We also examine the linkages in Finnish manufacturing industries. The most interesting outcome of the study is that the most concentrated industries were found to be more reliant on imports from other countries than on intra or inter industry linkages. This indicates that there was no 'home-market effect', meaning that upstream firms are located in areas where there are a relatively high number of downstream firms. This is a particularly interesting result, because linkages are at the centre of location theory (Venables, 1996; Krugman and Venables, 1995; and Tervo, 1999). It may however be that technological change and a shift in economic policy thinking towards research and development, with a focus on technology, and the gravitation towards international trade and collaboration played a more important role than industrial linkages in shaping industrial concentration patterns in Finland during the 1990s.

Key words: Specialization, concentration, manufacturing industries.

Introduction

Many economic activities show a marked geographical concentration. New economic geography theory argues that although flexibility in location decisions exists *a priori*, once the agglomeration process has begun, spatial differences become quite rigid[2]. Krugman and Venables (1995) and Venables (1996) have shown how this feature can be explained by backward and forward linkages[3]. These linkages may give rise to the agglomeration of activity in a few locations. This prompts the question: If spatial economic structures are rigid, what are the forces that can change the status quo? On the one hand international integration affects the spatial distribution of economic activities and on the other, exogenous shocks such as recessions, may change prevailing geographical specialization and concentration patterns. Finland became a member of European Union in 1995. Only a couple of years earlier during the period 1990-1993, Finland experienced a severe recession. This shock proved to be a remarkable watershed in Finnish economic performance. The recession broke up the traditional Finnish economic structure and made space for new growth (see e.g. Ottaviano and Pinelli, 2004). Business closures were common while the decline in profits induced entrepreneurs to innovate[4].

Interest in location problems and in the issues of regional specialization and industrial concentration have grown along with the rise of globalization and the integration of national economies within the context of trading blocks such as the European Union. Integration is characterized by common markets where trade costs are lowered, facilitating the free movement of the factors of production. This in turn could favour the emergence of economic concentrations and clusters. The proximity of customers (forward linkages) and of suppliers (backward linkages) may generate positive externalities for entrepreneurial clustering. As firms cluster (and employees too), local markets grow up. These market-size effects foster geographical concentration.

There appear to be forces inherent in the process of European integration that tend to strengthen specialization and concentration. Regional policy (both at the national and European Union regional policy levels) aims at balanced regional development, i.e., the equitable and independent development of different parts of the country or Union, including special support to less developed areas. Notwithstanding this, national regional policy and the measures taken to implement it also contain elements that might tend to strengthen specialization and concentration. These include the Centre of Expertise Programme, the Regional Centre Development Programme and urban policy. Puga (1999) and Monfort and Nicolini (2000) argued that around the end of 1990s[5] economic activities were more likely to become concentrated within each European country. This makes an individual country study of partition all the more interesting.

Amiti (1998) argues that economic integration within the European Union has led to changing patterns of production and specialization among European countries. Thus, European integration contains forces that tend to strengthen specialization and concentration. During Finland's membership of the European Union, specialization has become a central regional development strategy. Regions have evaluated their most important sectors of industry and defined their focus areas of development.

Ottaviano and Pinelli (2004) argue that the main tenet of the new economic geography (NEG) is that the evolution of the economic landscape is mainly driven by pecuniary externalities. The mechanism creating those externalities is linkages between firms through

the input-output structure (Krugman and Venables, 1995) or linkages between firms and workers/customers (Krugman, 1991). Ottaviano and Pinelli (2004) have studied the economic future of Finland within the context of a global scenario of deeper economic integration and knowledge-intensive production processes[6]. This paper analyses developments in Finland during the period 1995-1999[7]. Finland as a whole (all regions) underwent a severe recession in the early 1990s. In some regions, the recession lasted for four years, while in others it continued for longer. The recession was followed by a boom where GDP growth rose to nearly five per cent for several years. This boom coincided with Finland's accession to the EU, a shift in policy thinking towards research, development and technology, and a gravitation towards international trade and collaboration (Tervo, 2003). The rise in the significance of the electronics sector occurred during the post-recession period and was also enabled by rising migration (see e.g. Pekkala, 2000). We believe however that Finnish economic performance has been driven by the recession and post recession boom rather than by EU membership *per se*. As backward and forward linkages can give rise to the agglomeration of economic activity in the Finnish case it is worthwhile studying the connections between regional input-output structures and specialization and concentration patterns as well as high-growth firms.

The paper has four objectives: 1) to determine whether specialization took place in the Finnish regions between 1995 and 1999; 2) to determine whether the spatial concentration of Finnish manufacturing industry took place between 1995 and 1999; 3) to find out whether specialization and geographical concentration is higher in regions and industries whose products depend on the supply of intermediate goods; and 4) to determine whether manufacturing industries with high economies of scale/ high level of technology are more geographically concentrated than other industries in Finland. We formulate the following research hypotheses pertaining to the above objectives: 1) specialization has increased in Finnish regions since Finland joined the EU in 1995[8]; 2) the concentration of Finnish manufacturing has increased since Finland joined the EU; 3) the proportion of intermediate goods used in the production of final goods is higher in more specialized regions; 4) the proportion of intermediate goods used in the production of final goods is higher in industries where geographical concentration is higher; 5) economies of scale affect the concentration of manufacturing in Finland; and 6) the level of technological sophistication affects the concentration of manufacturing in Finland.

Our study concentrates on manufacturing because our hypotheses (numbers 3 to 6) are connected with economies of scale, level of technology and use of intermediate goods. These aspects are typical of manufacturing and less apparent in services. Giving our undivided attention to manufacturing also allows us to compare our results with those of other European studies on manufacturing.

The main aim of this paper is to examine whether specialization (and geographical concentration) is higher in regions (industries) that are more intensive users of intermediate inputs in their final production. Although linkages are at the centre of location theories (new economic geography) it is, however, surprising how few empirical studies have been conducted to test the significance of these linkages[9]. The studies of Midelfart-Knarvik et al. (2000, 2002), Paluzie et al. (2001) and Alonso-Villar et al. (2004) come closest to our approach. Instead of ranking industries into three groups according to the intensity of the use of intermediate inputs in their final products after Midelfart-Knarvik et al. (2000 and 2002), we apply input-output relations between industries, making the variable continuous. Paluzie et al. (2001) also use input-output tables but they only measure intra-industry linkages. In

our analysis we use input-output tables in measuring both intra- and inter-industry linkages as well as imports from other regions[10] and other countries. Alonso-Villar et al. (2004) pairs each industry with its main customer and with its main seller. The analysis of these linkages is based on the last input-output matrix of the Spanish economy in 1995. Cases where the main customers and suppliers represent higher values of output are analysed at the national level and compared with a sectoral co-agglomeration index, based on Maurel and Sedillot (1999), constructed at the provincial level. In our study Herfindahl indexes are calculated for regions and industries and compared with backward and forward linkages, which are also analysed at the regional and industrial levels. Because input-output relations (backward and forward) are widely viewed as a valid way of describing structural relationships, we believe that our perspective could enrich the empirical literature of the new economic geography.

Head and Mayer (2004) argue that the increasing returns to scale that are internal to the firm are one of the essential insights that distinguish NEG models from other approaches to understanding the geography of economic activity. Various studies (Midelfart-Knarvik et al., 2000, 2002; Brülhart, 1998a,b; Alonso-Villar et al., 2004) have found that agglomeration is more common (and more persistent) in sectors that are characterized by economies of scale and tighter input-output relations, and that are technology intensive as well as science-based.

This study is divided into three parts. In the first part of the study we seek to determine whether patterns of specialization in Finland have changed since the country joined the European Union. Specialization in Finland during the period 1995-1999 is measured by Herfindahl indices using employment data. The second part concerns manufacturing concentration in Finland during the period 1995-1999. Geographical concentration is measured by Herfindahl indices using employment, export and 'value added' data, and data that is based on the employment of fast growing firms. In the third part of this study we examine whether specialization and geographical concentration is higher among regions and industries that are more intensive users of intermediate inputs in their final production. In 2000, Statistics Finland published regional input-output tables for Finnish regions in 1995. The tables were compiled at the NUTS-3 level, which divides Finland into 20 provinces. This made it possible to examine how intensive industries and regions are as users of intermediate inputs in final production. The manufacturing industries are also characterised by their level of increasing returns and their level of technology.

The data used in this study allows analysis of the years 1995-1999. This period could be characterized as one of very rapid economic development (see e.g. Kangasharju and Pekkala, 2004; and Ottaviano and Pinelli, 2004). For example, along with growth in GDP regional convergence ended (see e.g. Kangasharju et al., 2001). The regional input-output tables for Finnish regions used in this study are for the year 1995. So far these are the only regional input-output tables ever to be published in Finland. Although our data for fast-growing firms is restricted to the period 1995-1999, we are able to examine regional economic differences utilising the regional input-output structure constructed for 1995, the year, which saw the beginning of this era of economic boom and rapid structural change.

Review of empirical earlier studies on specialization and concentration patterns in Europe

Amiti (1998), Maskell and Malmberg (1995), Niiranen (1997), Midelfart-Knarvik et al. (2000), Hallet (2000), Gorter (2002) and Koutaniemi (2003) have studied the specialization and concentration of industries in the Nordic countries (table 1).

These empirical studies show evidence of increasing specialization and increased geographical concentration in the Nordic countries over recent decades. In the Nordic countries growing similarity in the 1980s was replaced by slowly increasing specialization in the 1990s. These studies also found that in the Nordic countries some branches of manufacturing were becoming more geographically concentrated while others were becoming more dispersed, i.e., there was no single process driving all industries in the same direction. Midelfart-Knarvik et al. (2000) found that within the EU 15 (Luxembourg excluded) high returns-to-scale industries have remained concentrated. Hallet (2000) also found that manufacturing industries with high economies of scale were concentrated in a few locations. Gorter (2002) argued that both specialization and concentration declined (nine industries moved towards, while eight moved away from, greater concentration) between 1980 and 1995.

In Finland, as in the other Nordic countries, patterns of specialization at the national as well as the regional level were quite stable in the 1970s and 1980s, which may be explained by reference to the localised and 'sticky' nature of some forms of knowledge and knowledge creation (Maskell et al., 1998). In general, the concentration of manufacturing in the Nordic countries increased in the 1990s, i.e., a larger proportion of output or employment in many industries was increasingly concentrated in a smaller number of regions.

Table 1. Studies of industrial specialization and concentration in Europe

Compari-son/Study	Amiti (1998)	Niiranen (1997)	Maskell and Malm-berg (1995)	Midelfart-Knarvik et al. (2000)
	EU 12 countries in 1968-1990	**Finland 1974-1993, Norway 1977-1986, Sweden 1970-1990 and Denmark 1972-1992**	**Denmark 1972-1990 and Sweden 1970-1990**	**The EU 15 excluding Luxembourg 1970-1997**
Industries studied	27 manufacturing industries	80 manufacturing industries	84 manufacturing industries	Manufacturing data for 36 industries, manufac-turing trade data for 104 sectors and service data for 5 service sectors
Finland	Excluded	Included	Excluded	Included
Specialization	Significant increase in specialization bet-ween 1980 and 1990 in all countries	-	Decentralisation in Sweden 1970-1990 and in Denmark 1972-1990	Growing similarity in 1980s was replaced by slowly increasing spe-cialization in 1990s
Concentration increased	in 17/27 industries	In Finland 62.5%, Nor-way 64.4%, Sweden 77.2% and Denmark 94.4% of industries	In Sweden 64/84 and In Denmark 79/84 industries	High returns-to-scale industries have re-mained concentrated
Most concentrated industries	Leather, transport equipment and tex-tiles industries	**Finland**: Carpet and fur industries	**Denmark**: Tanneries and leather finishing, other mining and quarrying and manu-facture of engines and turbines **Sweden**: Manufacture of watches and clocks, tanneries and leather finishing and fur dressing and iron ore mining	Motor vehicles, aircraft, pottery and china and petroleum and coal products
Compari-son/Study	Koutaniemi (2003)	Hallet (2000)	Gorter (2002)	
	Finland 1975-2000	**119 regions in EU 1980-1995**	**119 regions in EU 1980-1995**	
Industries studied	14 manufacturing industries	17 branches	17 industries	
Finland	Included	Included	Included	
Specialization	Decentralization in 1970s and 1980s. Increasing spe-cialization in 1990s	34 regions (including Finland) moved towards more specializa-tion and 85 moved away from it	34 regions moved towards more specialization and 85 moved away from it. Groningen and Ceuta y Melilla were the most specialised	
Concentration increased	in 9/14 industries from 1995 to 2000	Agriculture as well as day-to-day services are spatially dispersed whereas manufacturing industries with high economies of scale are concentrated in few locations.	9/17 moved towards more concen-tration	
Most concentrated industries	Petroleum, electronics and publishing industries	Traded goods (including fuel and power products, almost all manufacturing goods, credit and insurance services and other market services)	Ferrous and non-ferrous ores and metals, textiles and clothing, leather and footwear, agricultural, forestry and fishery products and transport equipment	

Backward and forward linkages and geographical concentration

Many economic activities show marked geographical concentration, i.e., economic activity tends to concentrate regionally into a conglomeration of enterprises and population (Krugman, 1991). The centripetal forces affecting geographical concentration include 1) market-size effects (linkages), 2) thick labour markets and 3) pure external economies (see e.g. Fujita et al., 1999; Fujita, 2003; and Krugman, 1998). A large local market creates backward and forward linkages, i.e., a large local market supports locally produced intermediate goods, giving a comparative advantage to those goods, subject to economies of scale in their production, while lowering costs for downstream producers.

Amiti (1998) argues that the home-market effect means that upstream firms are drawn to locations where there are relatively many downstream firms (Marshallian externalities). Downstream firms gain by obtaining their intermediate goods more cheaply (lower transport costs[11] or more intense competition) and having a larger variety of differentiated inputs to use in production. Upstream firms located in a region use these backward and forward linkages and produce intermediate goods, i.e. creating forward and backward linkages to customers and suppliers. The linkages (forward and backward) make it more attractive for firms to set up in the location, and so on (Krugman, 1998; and Tervo, 1999). In such a set-up the interaction between trade costs, increasing returns to scale and linkages creates the possibility of cumulative causation, leading to the formation of new centres of activity (Venables, 1996 and 1998). Thus these linkages may give rise to an agglomeration of activity.

The concentration of economic activity may create beneficial externalities via information spillovers. Regions that have an important stock of R&D and experience-based 'know-how', a specialised labour-force or infrastructure etc., are usually in a better position to make innovations and add to their existing stock of knowledge than regions with small initial endowments of such factors (Maskell and Malmberg, 1995). In fact, technological change follows in its own footsteps, i.e., the ability to innovate is dependent on past innovation, so that much of the innovative activity becomes even more associated with high-tech innovative regional clusters (Kautonen and Tiainen, 2000; and Lovio, 1990). Hence, innovative activity contains forces that tend to promote geographical concentration.

Methods

In this study, which seeks to discover whether or not Finnish regions have become more specialized in their manufacturing structure, the analysis is based on Herfindahl indices. The Herfindahl index is defined as follows:

$$H = \Sigma_i^n X_i^2, \qquad (1)$$

where X_i^2 denotes the sum of the square of the share of employment of each industry of total employment across all industries. The Herfindahl index measures the extent to which the distribution of, for example, the share of employment (exports, value added) deviates from a uniform distribution.
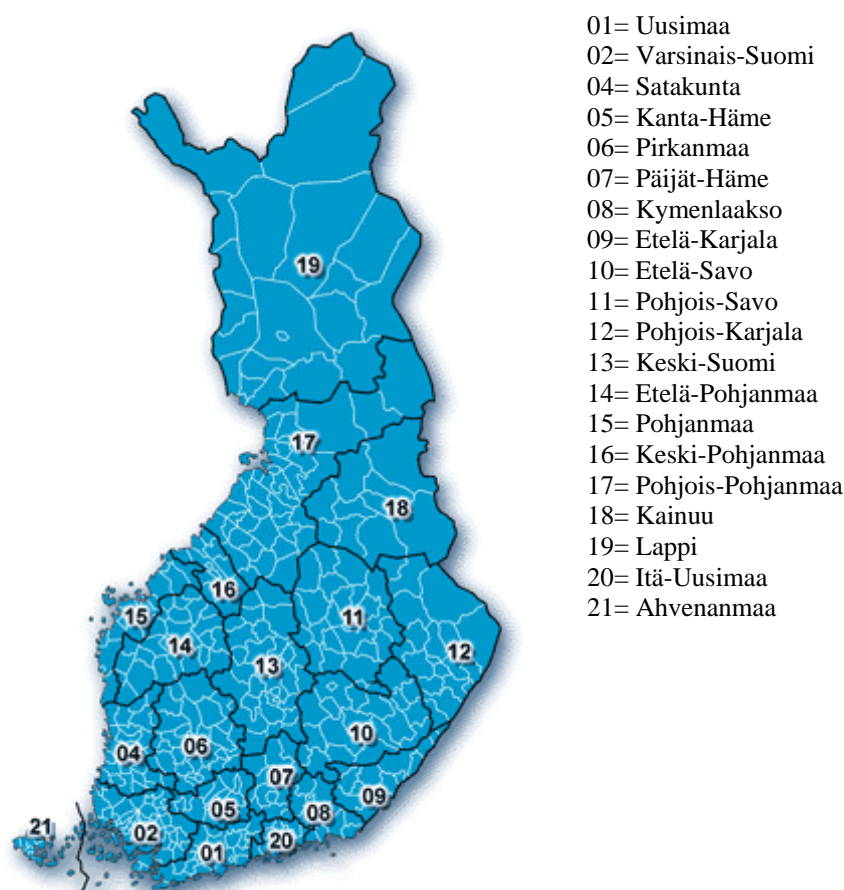
In this study the geographical concentration of Finnish manufacturing industries is examined by Herfindahl indices[12]. Whenever an industry is more concentrated then a larger proportion of that industry's employment (exports, value added) will be concentrated over

time in a smaller number of regions. The Herfindahl indices for Finnish manufacturing are based on employment, 'value added' and export[13] data as well as data which is based on employment in fast growing firms[14].

Regional specialization 1995-1999

Next we examine the specialization patterns in Finland during 1995-1999. The specialization of Finnish regions (figure 1) is measured by Herfindahl indices. The main objective is to offer new information on regional specialization in Finland by showing what changes took place during the study period. Has specialization changed during Finland's membership of the European Union? Did specialization (and concentration) change during the post recession economic boom? Do specialized regions use a high proportion of intermediate inputs?

Figure 1. Finnish regions. Source: Statistics Finland

01= Uusimaa
02= Varsinais-Suomi
04= Satakunta
05= Kanta-Häme
06= Pirkanmaa
07= Päijät-Häme
08= Kymenlaakso
09= Etelä-Karjala
10= Etelä-Savo
11= Pohjois-Savo
12= Pohjois-Karjala
13= Keski-Suomi
14= Etelä-Pohjanmaa
15= Pohjanmaa
16= Keski-Pohjanmaa
17= Pohjois-Pohjanmaa
18= Kainuu
19= Lappi
20= Itä-Uusimaa
21= Ahvenanmaa

Kymenlaakso and Etelä-Karjala were the most specialized manufacturing regions in Finland and, as figure 2 shows, specialization increased markedly between 1995 and 1999. The paper industry is the manufacturing mainstay of Kymen-laakso and Etelä-Karjala. Moreover, in Pohjois-Pohjanmaa, Ahvenanmaa, Lappi, Kainuu, Keski-Pohjanmaa, Keski-Suomi and Uusimaa the degree of specialization can be considered to be high. The Herfindahl index gives evidence of a significant change in specialization between 1995 and 1999 in Pohjois-Pohjanmaa and Uusimaa. Electronics manufacturing is a major industry

in Pohjois-Pohjanmaa and in Uusimaa, while the growth of electronics is reflected in the increase in specialization in these two regions. Lappi, Kainuu and Keski-Suomi are home to large-scale private and state-owned enterprises. The paper industry is a important in Kainuu. In Keski-Suomi the paper and machinery and equipment industries are the most concentrated industries. In Lappi the main strengths are the paper and metal industries. Keski-Pohjanmaa has high small-business activity and many manufacturing concentrations (metals, chemicals and textiles). Specialization in Lappi, Kainuu, Keski-Suomi and Keski-Pohjanmaa decreased between 1995 and 1999. Ahvenanmaa specializes in services (transport and tourism). However there is some manufacturing industry in Ahvenanmaa, especially in the food sector.

In 1999 the degree of specialization was lowest in Finland in the region of Pohjanmaa. Itä-Uusimaa also had quite a low degree of specialization, as measured by the Herfindahl index.

Specialization in the EU countries has increased in recent decades as has the geographical concentration of different industries (Amiti, 1997, 1998). Evidence of specialization in manufacturing in the Finnish regions, obtained on the basis of the Herfindahl index, suggest that in nine regions, specialization increased. However, the most highly specialized regions (Kymenlaakso, Etelä-Karjala and Pohjois-Pohjanmaa) also experienced a significant increase in specialization between 1995 and 1999. Specialization was due either to the high growth of the electronics industry or to the paper industry.

Figure 2. Herfindahl indices for Finnish regions based on employment data for Finnish manufacturing in 1995 and 1999
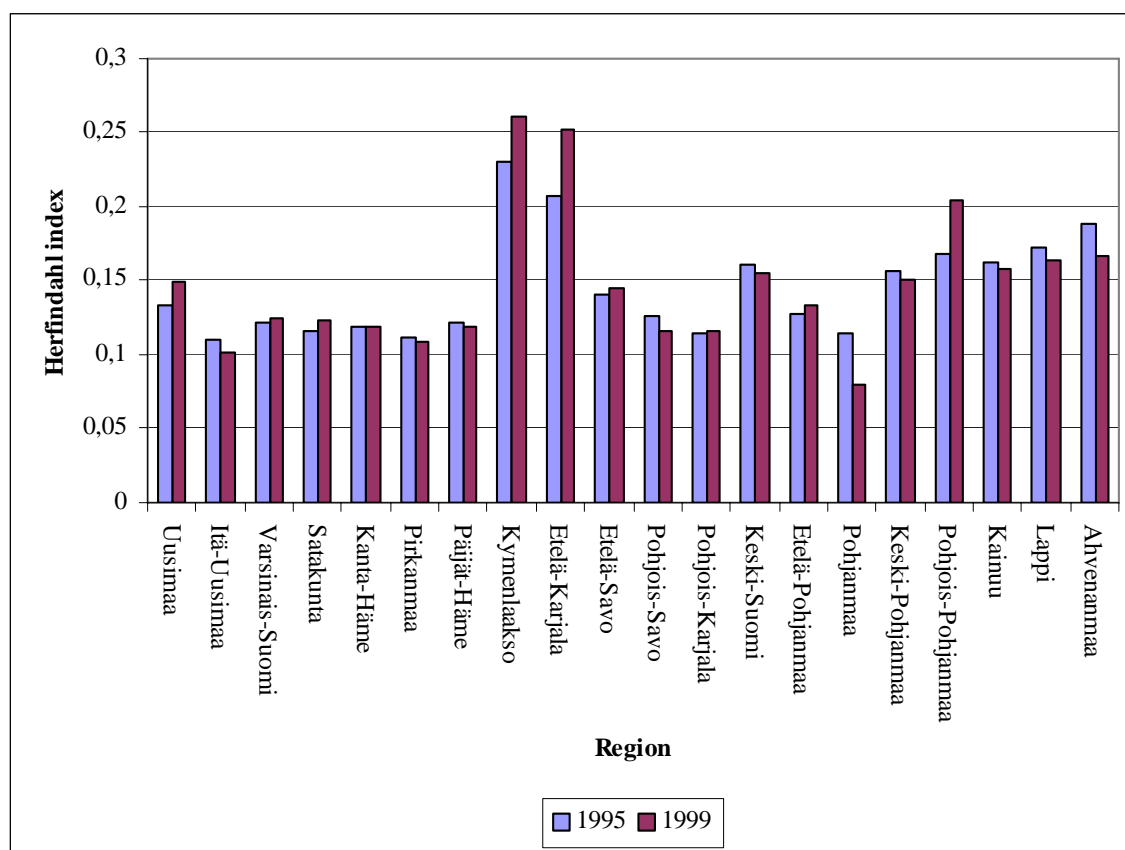
Kymenlaakso, Etelä-Karjala and Pohjois-Pohjanmaa were the most highly specialized regions in the Finland in 1990s on the basis of the employment data, indicating that there are marked similarities between industrial location patterns in these regions. The output of these regions were strongly reliant on inter-industry linkages, i.e., the share of intermediate inputs from other sectors, as a share of the value of production, was high (appendix 1, figure 3). Ahvenanmaa, Keski-Suomi, Kainuu, Lappi and Keski-Pohjanmaa are also regions where the share of intermediate inputs as a share of the value of production are high, and they too were rather specialized at the end of the 1990s. This supports the assumption that when the proportion of intermediate goods used in the production of final goods is higher, the level of specialization can be expected to be higher. Overall, the combination of backward and forward linkages creates the possibility of the clustering of vertically related industries (Amiti, 1998).

Figure 3. Total use of intermediate inputs (weighted means) and Herfindahl indices for Finnish regions based on employment data for Finnish manufacturing in 1995
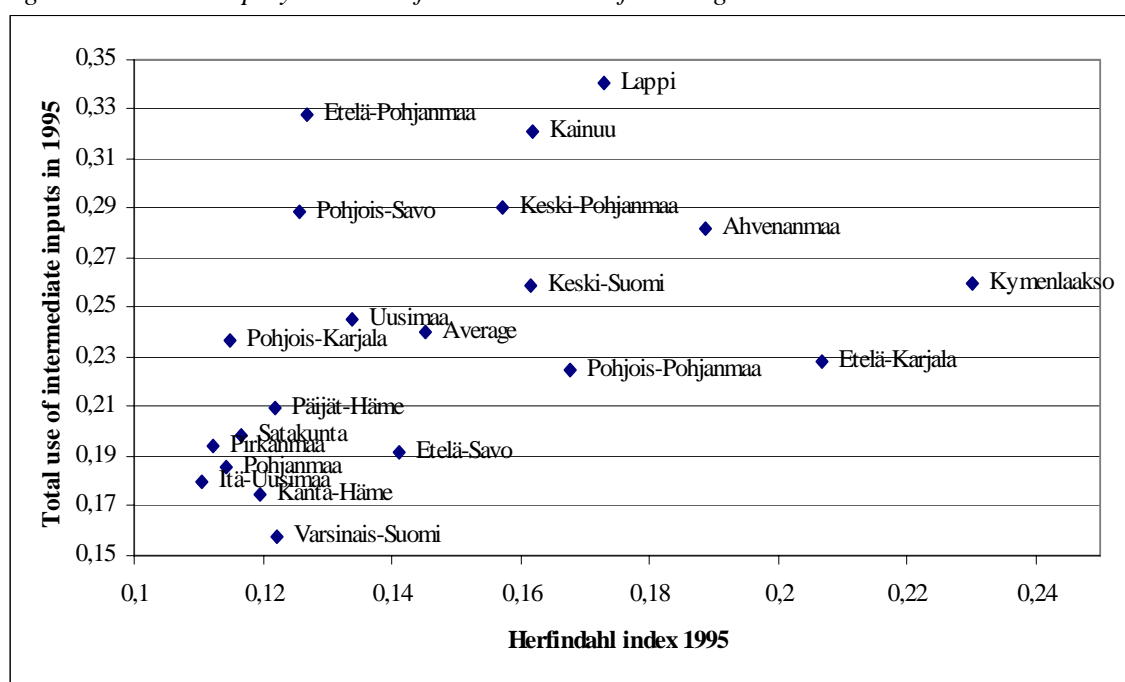
Itä-Uusimaa and Pohjanmaa were the least specialized regions in Finland at the end of 1990s. They were also less reliant on inter- industry linkages, i.e., the share of intermediate inputs as a share of the value of production are low. Instead these regions were more reliant on imports from other regions and other countries[15]. There was a strong linkage to imports, i.e., no home-market effect was in evidence, meaning that in the cases of Itä-Uusimaa and Pohjanmaa upstream firms are located in areas where there are many downstream firms.

We compared the Herfindahl indices for Finnish regions in 1995 and 1999 with their total use of intermediate inputs and imports and found a statistically significant correlation between the Herfindahl index in 1995 and total use of intermediate inputs as a share of the value of output in 1995 (Pearson= 0,448, p=0,048). This supported the assumption that when the proportion of intermediate goods used in the production of final goods is higher, the level of specialization can be expected to be higher. We also found a statistically significant negative correlation between the Herfindahl index in 1995 and use of imports as a

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share of the value of output in 1995 (Pearson= -0,486, p=0,030). This negative correlation tells us that in these regions there was considerable overlap between the specialization of regions and imports from other countries, i.e., the most highly specialized regions use imports of intermediate goods from other countries less than others.

In studying the total use of intermediate inputs and imports we were analyzing so- called backward linkages from the point of view of the Finnish regions. We also analyzed the so-called forward linkages (appendix 2) of the Finnish regions, i.e., the share of the use of intermediate consumption of total supply in 1995. Overall, we compared the Herfindahl indices of Finnish regions in 1995 with their forward linkages on average (weighted means) and found a statistically significant correlation between the Herfindahl index in 1995 and the average share of forward linkages in 1995 (Pearson= 0,456, p=0,0432). The positive correlation tells us that in these regions there was considerable overlap between the specialization of regions and forward linkages, i.e., the most specialized regions had more forward linkages on average than the others.
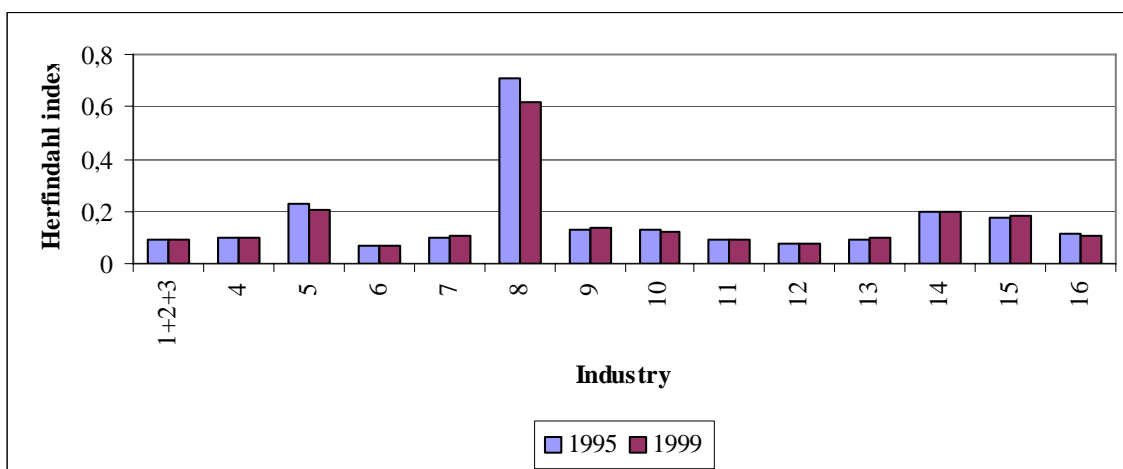
Geographical concentration of Finnish manufacturing in 1995-1999

In the previous section we examined the patterns of specialization in Finland. The results suggest that the most specialized regions experienced a significant increase in specialization between 1995 and 1999. From the description of specialization patterns in Finland after joining EU, we cannot conclude that the changes in specialization patterns are due to membership of the European Union. Next we examine the geographical concentration and changes in concentration patterns in the structure of Finnish manufacturing during 1995-1999. The measures are performed using employment, export, 'value added' and employment data on fast growing firms.

Employment and exports
According to the employment and export data, the most highly concentrated manufacturing industries at the end of the 1990s were petroleum, electronics, leather and transport equipment (see figure 4 for employment data). The least concentrated were the wood and wood products industries.

Figure 4. Herfindahl indices for Finnish manufacturing industries[16] based on employment data in 1995 and 1999

The employment data indicates that the geographical concentration of Finnish manufacturing increased between 1995 and 1999 in the textile, wood, paper, chemical, machinery and equipment and transport equipment industries. The food, leather, petroleum, rubber, mineral products, electronics and furniture industries became more dispersed in the study period. The structure of manufacturing industry was fairly stable, i.e., industries that were most concentrated in 1995 remained in the same category in 1999. We compared the Herfindahl indices for industries in 1995 with those for 1999 and found a statistically significant correlation (Pearson=0,999, p=0,000).

The biggest change in geographical concentration patterns were in the petroleum industry. The petroleum industry is located in Finland in three regions, namely, Itä-Uusimaa, Varsinais-Suomi and Uusimaa. Investment and the hiring of new employees in one region may change the concentration of the industry as a whole. Petroleum is a typical example of an industry that is located in places that offer good access to markets and consumers, i.e., locations where transportation routes intersect, or a major port (sea, river or lake ports) through which goods flow in and out of the country. These transportation hubs naturally generate lock-in for firms, and economic activity and agglomeration take place in such locations, often continuing to prosper even after the initial advantage (for example access to water) has become irrelevant. Fujita and Mori (1996) explain this as being due to the lock-in effect of self-reinforcing agglomeration forces generated by the interaction of increasing returns and transport costs. The petroleum industry in Finland has the historical advantage of being located in close proximity to Russia/Soviet Union (oil), but in recent years this advantage has become weaker.

In Finland the most geographically concentrated industries have high economies of scale (petroleum and transport equipment) or a high level of technology (electronics). Only the leather industry has low increasing returns and low technology (table 2). The leather industry exemplifies a traditional low-tech industry with low economies of scale[17]. In the EU, leather and transport equipment were traditionally among the most dispersed industries in Europe, but by the end of the 1990s they had become increasingly concentrated (Midelfart-Knarvik et al., 2002). At the EU level (see Midelfart-Knarvik et al., 2002) disaggregated data showed that the subgroups of electronics were initially very concentrated but have become more dispersed over time. They also found that small countries (Austria, Finland, Ireland and Sweden) and some southern European countries (Italy, Portugal and Spain) strengthened their position in some of these subgroups. In Finland electronics underwent dispersion between 1995 and 1999 on the regional level.

We compared the Herfindahl indices of the industries in 1995 and 1999 against their levels of economies of scale and technology (table 2) and found quite a high, although not statistically significant, correlation with economies of scale (Pearson=0,463 in 1995 and 0,490 in 1999). This corroborates the above finding that a positive relation exists between a high geographical concentration of industries and high economies of scale[18].

The geographical concentration of exports[19] decreased between 1995 and 1999 in nearly all manufacturing areas. The highest decreases were in the food, petroleum and electronics industries.

Petroleum, electronics and transport equipment manufacturing were the most concentrated industries at the end of the 1990s according to the employment and export data. The share of intermediate inputs from their own sector in the production of these industries was

rather low. Moreover these industries were less reliant on inter industry linkages, i.e., the shares of intermediate inputs from other sectors as a share of the value of production were low. Overall, the combination of backward and forward linkages creates the preconditions for the clustering of vertically related industries (Amiti, 1998). When the proportion of intermediate goods used in the production of final goods is higher, the level of geographical concentration can also be expected to be higher.

In Finland the most concentrated manufacturing industries were less reliant on intra- and inter- industry linkages, i.e., the shares of intermediate inputs from their own sector and other sectors as a share of the value of production were low (appendix 3). Instead they were more reliant on imports from other countries. There was a strong linkage to imports, i.e., no home-market effect existed, meaning that upstream firms are located in areas where there are relatively many downstream firms. The food and paper industries are more intensive users of intermediate inputs in their final products, i.e., they are more reliant on intra- and inter-industry linkages. Amiti (1998) argue that downstream firms obtain their intermediate goods more cheaply (saving transport costs) and benefit from a larger variety of differentiated inputs or more intense competition among the industries upstream.

Additionally, in Finland the most concentrated manufacturing industries are characterized, as shown in table 2, by high increasing returns (petroleum and transport equipment) or a high level of technology (electronics). Leather manufacture was also quite highly concentrated. The leather industry was less reliant on intra- and inter-industry linkages and had low increasing returns and low level technology.

Table 2. Level of economies of scale and of technology in Finnish manufacturing. Source: Statistics Finland, 1995; Midelfart-Knarvik et al., 2000; and Ritsilä, 1997.

Manufacturing	Economics of scale	Techlological level
1+2+3= Meat, fish and their products; other food products	L	L
4= Textiles, wearing apparel	L	L
5= Leather and leather products	L	L
6= Manufacture of wood and wood products	L	L
7= Manufacture of pulp, paper and paper products	M	L
8= Manufacture of coke, refined petroleum products	H	L
9= Chemicals, chemical products	H	M
10= Rubber and plastic products	L	M
11= Manufacture of other non-metallic mineral products	M	L
12= Manufacture of basic metals and metal products	M	L
13= Manufacture of machinery and equipment	M	M
14= Manufacture of office machinery and computers	M	H
15= Manufacture of transport equipment	H	M
16 = Manufacture of furniture, recycling	L	L

Overall we compared the economies of scale and technological level of Finnish industries with their share of intermediate consumption as a share of total supply (forward linkages) and found a statistically significant correlation between technological level and forward linkages (Pearson= 0,59, p=0,016). The positive correlation tells us that there was considerable overlap between the technological level of industries and their share of intermediate consumption as a share of total supply on average.

***Regional growth[20] and industry 'value added'***
Figure 5 shows that in 1999 the most concentrated growth industries in Finnish manufacturing were the leather, paper, chemicals, rubber, electronics and transport equipment industries. The Herfindahl indices imply that the growth of manufacturing in Finland at the end of 1990s was not evenly spread regionally, that is, a larger proportion of manufacturing industrial employment was increasingly concentrated in a smaller number of regions. This supports the hypothesis that firms with an important stock of R&D- and experience-based 'know-how', a specialised labour-force or infrastructure etc., are usually in a better position to make innovations and add to their existing stock of knowledge. The concentration of economic activity can create beneficial externalities via information spillovers.

Figure 5. Herfindahl indices for Finnish manufacturing industries[16] based on employment of fast growing firms in 1999
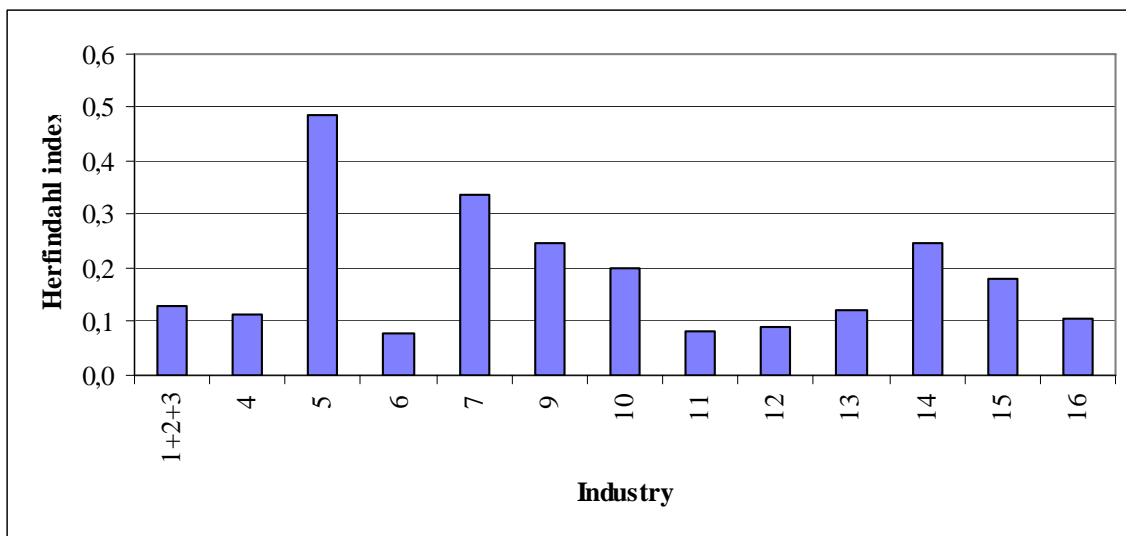
The geographical concentration in the growth of the electronics, paper, chemicals, rubber and leather industries was reflected in an increasing concentration of 'value added' in these industries between 1995 and 1999. The transport equipment industry experienced a significant decrease in the concentration of 'value added' in 1999 compared to 1995. However the concentration of employment and exports in transport equipment increased over the study period.

Figure 6. Herfindahl indices for Finnish manufacturing industries[16] based on value added in 1995 and 1999
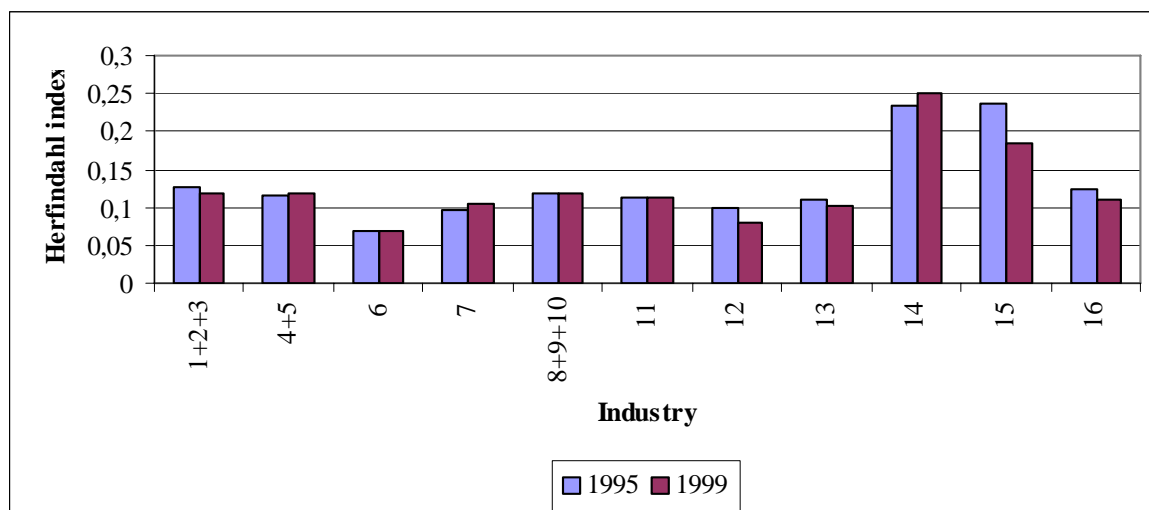
Conclusions

The Finnish economy experienced an exogenous shock, namely a recession, in the period 1991-1993. The recession meant that the traditional Finnish economic structure collapsed, making way for new innovations and growth. Finland also became a member of the European Union in 1995. Thus two notable events in recent Finnish economic history changed the prevailing rigid economic structure and spatial distribution of economic activity, deepening economic integration and recession.

Specialization in the EU countries has increased in recent decades, as has the geographical concentration of different industries (Amiti, 1997 and 1998). The Economic Council of Finland (2000) argues that, from the middle of the 1990s, Finland's economic dynamics have been dominated by high technology and marked geographical concentration. In this study the Herfindahl indices imply that there was a notable increase in specialization between 1995 and 1999. The most specialized regions (Kymenlaakso, Etelä-Karjala and Pohjois-Pohjanmaa) experienced a significant increase in specialization between 1995 and 1999, caused by either the high growth of the electronics industry or the paper industry. The overall Herfindahl index suggests that in nine of the regions specialization increased and in 11 there was dispersion.

This paper provides evidence for increasing specialization in Finland between 1995 and 1999, i.e., at least some industries showed increased geographical concentration. On the basis of the employment data the geographical concentration of six manufacturing industries increased between 1995 and 1999. Eight industries (food, leather, petroleum, rubber, mineral products, metal, electronics and furniture) experienced a fall in concentration, i.e. showed an increase in dispersion. Thus there was no single process driving all industries in the same direction. The export data suggest that Finnish manufacturing industries were very concentrated. The fact remains, however, that overall concentration decreased between 1995 and 1999.

Our assumption was that when the proportion of intermediate goods in the production of final goods is higher, the level of geographical concentration will also be higher. In

Finland the most concentrated manufacturing industries (petroleum, electronics and transport equipment) were found to be less reliant on intra- and inter-industry linkages, i.e., the share of intermediate inputs from an industry's own sector and from other sectors as a share of the value of its production was low. Instead they were more reliant on imports from other countries. Thus there was a strong linkage to imports, i.e., there was no home-market effect, meaning that upstream firms are located in areas where there are relatively many downstream firms. We believe that, for example, the changing technology and a shift in economic policy thinking towards research and development and technology and a gravitation towards international trade and collaboration played a more important role than industrial linkages in moulding industrial concentration patterns in Finland in the 1990s. On the regional level however, our findings support the assumption that when the proportion of intermediate goods used in the production of final goods is higher, the level of specialization will also be higher. This is due to the industrial structure of the most specialized regions, characterized by powerful paper, wood and metal industries using a high share of intermediate inputs in their final products.

Midelfart-Knarvik et al. (2000 and 2002), Hallet (2000) and Brülhart (1998) found that increasing-returns industries and technology-intensive industries tend to be more agglomerated than the average. In Finland, the most geographically concentrated industries have high economies of scale (petroleum and transport equipment) or a high level of technology (electronics). Only the leather industry has both low increasing returns and low technology.

In the post-recession period, characterized by high growth, industries with high returns to scale and with a high level of technology have remained concentrated. Moreover, our study indicates that growth has not been even in regional terms, that is to say, a larger proportion of manufacturing employment has become increasingly concentrated in a smaller number of regions. In Finland in 1999 the most concentrated growth industries were leather, paper, chemicals, rubber, electronics and transport equipment. The geographical concentration in the growth of electronics, rubber, paper, chemicals and leather manufacturing is reflected in an increasing concentration of 'value added'. The transport equipment industry experienced a significant decrease in the concentration of 'value added' when 1999 is compared with 1995. However the concentration of employment and of exports in the transport equipment industry increased over the study period.

On the regional policy level, attempts could be made to influence the development of industries (and firms) via industry specific policies, as concentration and agglomerations seem to rely on economies of scale and high technology. On the national level a timely shift in policy thinking focusing on research and development and technology seems to have been implemented.

Notes

[1] We would like to thank Hannu Tervo for helpful comments on this paper. This study is a part of project no. 200856, financed by the Academy of Finland.

[2] E.g. Dumais, Ellison and Glaeser (2002) found that the level of agglomeration of industries is very stable over time (correlation of 0.92 between 1972 and 1992 indexes), while Kim (1995) found a correlation of 0.64 between 1980 and 1987 values.

[3] The Krugman (1991) model is based on footloose labour, where labour mobility fosters regional agglomeration, i.e., immigration flow causes local expenditures to expand, making cumulative causation more likely.

[4] In Schumpeter's view the engine of economic development is entrepreneurial innovation.

[5] Cultural and linguistic barriers partially prevent factor mobility on the country level.

[6] They found that successful regions are characterized by highly educated people, firms that are active in dynamic sectors, and good access to national and international markets.

[7] Input-output tables for the Finnish regions used in this study are for 1995, and 1999 is the last year for which we have data. Statistics Finland are constructing regional input-output tables for 2000, which will give us opportunity in the future to study how rigid the industrial structure is after an exogenous shock (recession) and the deepening integration process, and whether industries are recovering differently.

[8] We are not arguing that the consequences of economic integration can be separated from overall development. Movements in specialization and concentration patterns cannot be seen as confirmation of theories constructed to explain the phenomenon in question, i.e., the indication of concentration itself cannot be interpreted as evidence for external economies (this is also a concern of other studies describing the specialization patterns of countries or regions). Furthermore we have no data with which to run regressions and hereby study the explanatory variables and causality behind the patterns of specialization and concentration that we find. Our interest is in specialization and concentration in Finland, post EU membership. We calculate concentration and specialization indexes in order to answer our main questions, namely hypotheses three to six.

[9] Ellison and Glaeser (1997); Rosenthal and Strange (2001); Amiti (1998); Midelfart-Knarvik et al. (2000 and 2002); and Paluzie et al. (2001) have studied input-output linkages. The foundation of these papers is a fairly robust relationship between concentration and input-output linkages.

[10] With imports from other regions we try to capture possible cluster effects harmed by administrative regional frontiers.

[11] It is unclear if it is more costly to transport intermediate inputs than final goods.

[12] We have also calculated regional *gini* coefficients. Regional *ginis*, however, measure relative, not absolute, concentration.

[13] The export data is based on statistics on the manufacturing and construction industries published by Statistics Finland.

[14] Statistics Finland took samples of high-growth firms by regions and industries (SIC 95). The high-growth firms were identified on the basis of two criteria: 1) rapid growth and 2) significant size by 1999. A firm's growth is rapid if its sales turnover more than doubled in real terms over the period 1995-1999. Firms that did not reach a minimum sales turnover of FIM 500 000 were thus discarded (Smallbone et al., 1995; and Littunen and Tohmo, 2003). If the firm had business in more than one region in 1995 or 1999, it was discarded for practical reasons.

[15] Tables concerning imports from other regions and other countries are not shown in this study. They are available from the authors on request.

[16] 1+2+3= Meat, fish and their products; other food products, 4= Textiles, wearing apparel, 5= leather and leather products, 6= Manufacture of wood and wood products, 7= Manufacture of pulp, paper and paper products, 8= Manufacture of coke, refined petroleum products, 9= Chemicals, chemical products, 10= Rubber and plastic products, 11= Manufacture of other non-metallic mineral products, 12= Manufacture of basic metals and metal products, 13= Manufacture of machinery and equipment, 14= Manufacture of office machinery and computers, 15= Manufacture of transport equipment, 16= Manufacture of furniture, recycling.

[17] The phenomenon is not restricted to the leather industry (see e.g. Devereux et al. (2004). For example, the UK lace industry is centred in Nottingham, the US carpet industry in Dalton and the UK ceramics industry around Stoke-on Trent ("The Potteries").

[18] We also conducted multiple comparisons (oneway Anova) between groups (low, medium and high) of economies of scale (the test was not performed for the technological level of industries because at least one group has fewer than two cases) and found no significant differences between groups in the Herfindahl indices. Nonetheless the mean of the Herfindahl index of the industries with high economies of scale were higher (mean=0,3394 in 1995) than the mean of the industries with medium (mean=0,1125 in 1995) or low economies of scale (mean=0,1204 in 1995) This is parallel with the above finding that industries with a high geographical concentration also have high economies of scale.

[19] The figures concerning Herfindahl indices for manufacturing industries are based on export data in 1995 and 1999 is not shown in this study. It is available from the authors on request.

[20] This analysis is based on the sample of high-growth firms.

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Appendix 1. Total use of intermediate inputs as a share of the value of production in 1995. Source: Statistics Finland

In-dustry	Total use of intermediate inputs in 1995									
	Uusi-maa	Itä-Uusi-maa	Varsi-nais-Suomi	Sata-kunta	Kanta-Häme	Pir-kan-maa	Päijät-Häme	Ky-men-laakso	Etelä-Kar-jala	Etelä-Savo
1	0.1916	0.2140	0.0000	0.2858	0.1318	0.2148	0.6175	0.5801	0.6132	0.3658
2	0.3256	0.1785	0.3925	0.4576	0.2945	0.6399	0.3107	0.3608	0.3693	0.3131
3	0.2649	0.0866	0.2553	0.2921	0.2138	0.2039	0.2988	0.1626	0.1598	0.1534
4	0.1544	0.1341	0.1096	0.0783	0.3300	0.2093	0.1196	0.0875	0.1462	0.1691
5	0.1984	0.1253	0.1315	0.1749	0.2634	0.1773	0.1021	0.0873	0.0533	0.1094
6	0.2600	0.1252	0.4173	0.3765	0.3329	0.3959	0.2869	0.2086	0.2625	0.4088
7	0.2653	0.1790	0.2559	0.2632	0.2446	0.2451	0.2119	0.1948	0.2558	0.2750
8	0.3561	0.1045	0.1350	0.2577	0.1199	0.2013	0.1905	0.2740	0.2161	0.1010
9	0.2374	0.1944	0.1208	0.1564	0.1002	0.1648	0.1793	0.1731	0.2907	0.1039
10	0.2374	0.1157	0.3096	0.1661	0.1498	0.2063	0.1559	0.1403	0.2539	0.1934
11	0.2004	0.0907	0.1045	0.1360	0.1437	0.2485	0.1165	0.1238	0.2158	0.1035
12	0.2729	0.1139	0.1659	0.2035	0.1320	0.1127	0.2642	0.2094	0.1712	0.1528
13	0.1835	0.1713	0.0991	0.1239	0.0806	0.1303	0.1327	0.1586	0.1051	0.0778
14	0.1768	0.1304	0.1341	0.1438	0.0753	0.1669	0.1547	0.1284	0.1195	0.1175
15	0.1477	0.0823	0.1737	0.2030	0.1494	0.1090	0.1140	0.1913	0.1832	0.1238
16	0.1905	0.1894	0.1522	0.2118	0.1695	0.2259	0.1695	0.2143	0.1882	0.1703
Weig-hted mean	**0.2457**	**0.1799**	**0.1573**	**0.1988**	**0.1749**	**0.1939**	**0.2099**	**0.2602**	**0.2285**	**0.1915**

1= Production, processing, preserving of meat and fish, 2= Processing and preserving of other food products, 3= Manufacture of other food products, beverages and tobacco products, 4= Textiles, wearing apparel, 5= Leather and leather products, 6= Sawmilling and planing of wood, impregnation of wood, 7= Manufacture of other wood products, 8= Manufacture of pulp, paper and paper products, 9= Manufacture of coke, refined petroleum products, chemicals, chemical products, rubber and plastic products, 10 = Manufacture of other non-metallic mineral products, 11= Manufacture of basic metals and metal products, 12= Manufacture of machinery and equipment, 13= Manufacture of electrical machinery and apparatus, 14= Manufacture of medical and optical instruments, clocks, 15= Manufacture of transport equipment, 16= Manufacture of furniture, recycling

Appendix 1 (continues). Total use of intermediate inputs as a share of the value of production in 1995

Indust-ry	Total use of intermediate inputs in 1995									
	Poh-jois-Savo	Poh-jois-Kar-jala	Keski-Suomi	Etelä-Poh-jan-maa	Poh-jan-maa	Keski-Poh-jan-maa	Pohjois-Poh-janmaa	Kai-nuu	Lappi	Ahve-nan-maa
1	0.5899	0.6859	0.3916	0.3547	0.4784	0.3979	0.6515	0.1669	0.6448	0.5273
2	0.4864	0.6322	0.6329	0.6739	0.4950	0.8298	0.8066	0.5912	1.0169	0.3298
3	0.2603	0.2065	0.2006	0.3285	0.2243	0.1438	0.2148	0.1557	0.2734	0.1656
4	0.1240	0.0889	0.0945	0.2146	0.1100	0.1673	0.1375	0.2803	0.1792	0.1434
5	0.1810	0.0938	0.1305	0.0973	0.1536	0.1688	0.1116	0.0912	0.2905	0.1051
6	0.5034	0.4970	0.4031	0.3952	0.2729	0.3913	0.3384	0.4907	0.3922	0.4113
7	0.2958	0.2144	0.2772	0.3104	0.2098	0.3720	0.2754	0.4494	0.1980	0.2427
8	0.2354	0.1727	0.2982	0.1963	0.1745	0.1854	0.2454	0.3322	0.4517	0.2024
9	0.2502	0.0909	0.2147	0.1353	0.0984	0.1519	0.1834	0.1561	0.1799	0.0667
10	0.2525	0.1818	0.2081	0.2195	0.1220	0.1776	0.2734	0.3092	0.2431	0.2221
11	0.2427	0.0897	0.1332	0.1667	0.1430	0.2259	0.1789	0.0893	0.2262	0.1356
12	0.1046	0.0843	0.1347	0.1690	0.1236	0.0776	0.1542	0.1081	0.1239	0.2146
13	0.0818	0.0810	0.0926	0.1090	0.1603	0.0892	0.1393	0.0600	0.0715	0.0920
14	0.1953	0.0457	0.0885	0.1671	0.1460	0.1236	0.1669	0.1246	0.1633	0.1819
15	0.1747	0.1270	0.1145	0.1306	0.1444	0.1683	0.2533	0.0834	0.1187	0.1702
16	0.2126	0.1204	0.1628	0.2310	0.2063	0.2805	0.2808	0.3144	0.2121	0.0597
Weigh-ted mean	**0.2885**	**0.2365**	**0.2591**	**0.3278**	**0.1854**	**0.2908**	**0.2251**	**0.3208**	**0.3405**	**0.2821**

1= Production, processing, preserving of meat and fish, 2= Processing and preserving of other food products, 3= Manufacture of other food products, beverages and tobacco products, 4= Textiles, wearing apparel, 5= Leather and leather products, 6= Sawmilling and planing of wood, impregnation of wood, 7= Manufacture of other wood products, 8= Manufacture of pulp, paper and paper products, 9= Manufacture of coke, refined petroleum products, chemicals, chemical products, rubber and plastic products, 10= Manufacture of other non-metallic mineral products, 11= Manufacture of basic metals and metal products, 12= Manufacture of machinery and equipment, 13= Manufacture of electrical machinery and apparatus, 14= Manufacture of medical and optical instruments, clocks, 15= Manufacture of transport equipment, 16 = Manufacture of furniture, recycling

Appendix 2. Intermediate consumption (forward linkages) of Finnish regions as a share of value of total supply in 1995

In-dustry	Intermediate consumption (forward linkages) of Finnish regions									
	Uusi-maa	Itä-Uusi-maa	Varsi-nais-Suomi	Sata-kunta	Kanta-Häme	Pir-kan-maa	Päijät-Häme	Ky-men-laakso	Etelä-Kar-jala	Etelä-Savo
1	0,0142	0,1456	0,0678	0,0612	0,0054	0,1097	0,0434	0,4035	0,0371	0,3124
2	0,0707	0,0376	0,3007	0,1949	0,1582	0,1497	0,0267	0,2870	0,1095	0,0256
3	0,1576	0,0196	0,0907	0,1603	0,0709	0,0417	0,2319	0,0672	0,0820	0,0618
4	0,0727	0,0470	0,0355	0,0403	0,3841	0,1330	0,0095	0,0509	0,0078	0,0610
5	0,0198	0,0051	0,0354	0,0743	0,0759	0,0508	0,0275	0,0217	0,0022	0,0126
6	0,0136	0,1453	0,0909	0,1595	0,2790	0,0769	0,0591	0,0889	0,1305	0,0427
7	0,0720	0,0164	0,0781	0,0605	0,0978	0,0413	0,0924	0,0405	0,0247	0,1205
8	0,5040	0,1742	0,1664	0,2370	0,1667	0,3059	0,3776	0,6377	0,5015	0,1527
9	0,1149	0,7112	0,2153	0,1829	0,1218	0,2703	0,2561	0,2488	0,2018	0,0166
10	0,0422	0,0352	0,2191	0,0506	0,0590	0,1110	0,0364	0,0286	0,3017	0,1263
11	0,1214	0,0642	0,0667	0,2243	0,2828	0,3226	0,0915	0,2169	0,3422	0,0469
12	0,2349	0,0447	0,1964	0,2202	0,0670	0,0592	0,3191	0,2814	0,1271	0,1379
13	0,1898	0,1195	0,1063	0,0669	0,0142	0,0633	0,0512	0,0248	0,0235	0,0129
14	0,0165	0,0187	0,0071	0,0090	0,0067	0,0650	0,0084	0,0195	0,0249	0,0033
15	0,0210	0,0033	0,0787	0,0944	0,0366	0,0197	0,0103	0,0314	0,0076	0,0215
16	0,0317	0,0107	0,0385	0,0116	0,0180	0,0611	0,0552	0,0412	0,0125	0,0294
Weig-hted mean	**0,2108**	**0,5573**	**0,1382**	**0,1889**	**0,1604**	**0,1773**	**0,1850**	**0,5091**	**0,4027**	**0,1128**

1= Production, processing, preserving of meat and fish, 2= Processing and preserving of other food products, 3= Manufacture of other food products, beverages and tobacco products, 4= Textiles, wearing apparel, 5= Leather and leather products, 6= Sawmilling and planing of wood, impregnation of wood, 7= Manufacture of other wood products, 8= Manufacture of pulp, paper and paper products, 9= Manufacture of coke, refined petroleum products, chemicals, chemical products, rubber and plastic products, 10= Manufacture of other non-metallic mineral products, 11= Manufacture of basic metals and metal products, 12= Manufacture of machinery and equipment, 13= Manufacture of electrical machinery and apparatus, 14= Manufacture of medical and optical instruments, clocks, 15= Manufacture of transport equipment, 16= Manufacture of furniture, recycling

Appendix 2 (continues). Intermediate consumption (forward linkages) of Finnish regions as a share of the value of total supply in 1995

In-dustry	Intermediate consumption (forward linkages) of Finnish regions									
	Poh-jois-Savo	Poh-jois-Kar-jala	Keski-Suomi	Etelä-Poh-jan-maa	Poh-jan-maa	Keski-Poh-jan-maa	Poh-jois-Poh-jan-maa	Kai-nuu	Lappi	Ahve-nan-maa
1	0,3393	0,0282	0,1100	0,0794	0,1692	0,0743	0,1137	0,0320	0,0194	0,2163
2	0,1815	0,2629	0,4752	0,5180	0,4207	0,3866	0,2528	0,1728	0,1095	0,1649
3	0,0996	0,0450	0,0925	0,0693	0,0521	0,0385	0,0622	0,0252	0,0944	0,0148
4	0,0517	0,0315	0,0110	0,1081	0,0419	0,0972	0,0075	0,0083	0,2582	0,0659
5	0,0342	0,0122	0,0045	0,0221	0,0197	0,0462	0,0399	0,0024	0,0072	0,0008
6	0,1219	0,0901	0,0731	0,1632	0,1714	0,2015	0,1269	0,4645	0,1291	0,1293
7	0,0766	0,0372	0,1142	0,1352	0,0757	0,3612	0,0848	0,0945	0,0425	0,0340
8	0,3524	0,1709	0,9038	0,1853	0,3105	0,2067	0,2333	0,4027	0,8724	0,2156
9	0,3083	0,0677	0,0967	0,0721	0,0638	0,1335	0,2343	0,0019	0,0756	0,0106
10	0,1504	0,0610	0,0723	0,1121	0,0893	0,0473	0,1181	0,1918	0,1333	0,0659
11	0,4458	0,0509	0,1815	0,3423	0,2052	0,1216	0,2712	0,0249	0,3510	0,2499
12	0,0362	0,1103	0,1413	0,1294	0,0173	0,1005	0,1183	0,0562	0,0541	0,1380
13	0,0042	0,0135	0,0271	0,0413	0,1583	0,0089	0,1343	0,0580	0,0151	0,0250
14	0,0242	0,0069	0,0187	0,0421	0,0498	0,0007	0,0635	0,0283	0,0404	0,0370
15	0,0195	0,0069	0,0067	0,0396	0,0174	0,0133	0,0242	0,0614	0,0098	0,0279
16	0,0501	0,0237	0,0334	0,0633	0,0193	0,0140	0,0387	0,0185	0,0101	0,0230
Weig-hted mean	**0,2651**	**0,1099**	**0,5076**	**0,2114**	**0,1824**	**0,1630**	**0,1992**	**0,2786**	**0,5314**	**0,2651**

1= Production, processing, preserving of meat and fish, 2= Processing and preserving of other food products, 3= Manufacture of other food products, beverages and tobacco products, 4= Textiles, wearing apparel, 5= Leather and leather products, 6= Sawmilling and planing of wood, impregnation of wood, 7= Manufacture of other wood products, 8= Manufacture of pulp, paper and paper products, 9= Manufacture of coke, refined petroleum products, chemicals, chemical products, rubber and plastic products, 10= Manufacture of other non-metallic mineral products, 11= Manufacture of basic metals and metal products, 12= Manufacture of machinery and equipment, 13= Manufacture of electrical machinery and apparatus, 14= Manufacture of medical and optical instruments, clocks, 15= Manufacture of transport equipment, 16= Manufacture of furniture, recycling

Appendix 3. Use of intermediate inputs and imports as a share of the value of production by manufacturing sector in 1995. Source: Statistics Finland

Manufacturing	Total use of intermediate inputs 1995 Mean	Use of intermediate inputs from own sector 1995 Mean	Import from other regions 1995 Mean	Import from other countries 1995 Mean
1=Production, processing, preserving of meat and fish	0.4052	0.0847	0.4288	0.0530
2=Processing and preserving of other food products	0.5069	0.0948	0.3424	0.0812
3=Manufacture of other food products, beverages and tobacco products	0.2132	0.0219	0.2501	0.1071
4=Textiles, wearing apparel	0.1539	0.0327	0.1710	0.2336
5=Leather and leather products	0.1423	0.0164	0.1631	0.2432
6=Sawmilling and planing of wood, impregnation of wood	0.3585	0.0092	0.3362	0.0407
7=Manufacture of other wood products	0.2618	0.0347	0.2887	0.0789
8=Manufacture of pulp, paper and paper products	0.2225	0.0713	0.2851	0.0985
9=Manufacture of coke, refined petro-leum products, chemicals, chemical products, rubber and plastic products	0.1624	0.0333	0.2146	0.2372
10=Manufacture of other non-metallic mineral products	0.2069	0.0420	0.2235	0.1343
11=Manufacture of basic metals and metal products	0.1557	0.0545	0.2899	0.1819
12=Manufacture of machinery and equipment	0.1547	0.0526	0.2107	0.2377
13=Manufacture of electrical machinery and apparatus	0.1120	0.0246	0.2246	0.2483
14=Manufacture of medical and optical instruments, clocks	0.1375	0.0196	0.1758	0.2133
15=Manufacture of transport equipment	0.1481	0.0148	0.2063	0.2820
16=Manufacture of furniture, recycling	0.1981	0.0138	0.2594	0.1294
Average	**0.2278**	**0.0383**	**0.2483**	**0.1594**