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The location of Norwegian manufacturing industry

by

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Contents

1. Introduction

2005 has been a year of parliamentary elections in Norway, and the focus on the deindustrialisation of the country (between 2000 and 2004, as many as 32,000 jobs in manufacturing have been lost[1]) has been strong. Discussions of the subject are vivid and the disputes many. Sceptics fear that substantial closures in the manufacturing industry will leave already vulnerable rural districts without a proper basis of existence, and lead to a pattern of concentration of the manufacturing industry in the more central regions.

To be able to take part in such discussions it may be valuable to clarify answers to the questions: Of what does this deindustrialisation consist? Has this trend resulted in a reorganisation of the localisation pattern of manufacturing industries within Norway? It is also useful to establish to what extent the Norwegian manufacturing industry has shown a tendency to concentrate in particular regions, and, similarly, if there has been a tendency for some regions to specialise in any particular industries. The two last questions will be the main topic of this report.

Several factors make the location of Norwegian manufacturing interesting; first of all, the Norwegian geography is different from that of most other countries; over time, a long-stretched coastline, deep fjords and the many mountains have ensured spatial dispersion of societies, with their respective population and production. Based on this geography, a tradition has developed for interventional economic policy in order to maintain a minimum of regional employment and income in some of the most geographically isolated regions of Norway. This tradition has implications for policymakers, and the study of different factors of regional manufacturing will provide vital knowledge for policymakers dealing with industrial policies as well as regional employment policies.

Since the nineteen-seventies, the Norwegian economic development has been closely connected to the development of activities related to fossil fuels. The strong reliance on this particular sector is said to have taken away the attention from forming a comprehensive industry policy for the whole of the Norwegian industry. A descriptive analysis of the location

[1] Statistics Norway.

of Norwegian industries and the specialisation of Norwegian regions will provide some information about whether there is any substance in this argument or not. Such an analysis may also point out some of the factors that seem to be important for location and investment decisions.

Arguments over different approaches to a policy for vitalisation of the Norwegian industry have been many; some maintain that industry neutrality is important in order to encourage the most vital activities and enterprises, while others argue that externalities make direct intervention or earmarked support to certain industries or regions necessary. Among the supporters of more neutral instruments there is also disagreement on whether the authorities should contribute by providing tax relieves and simpler rules and regulations or whether they should invest more actively in infrastructure and large R&D projects.

Independent of political opinions and intentions, it is likely that the authorities will be able to form a better industrial policy if they have adequate information about the basics of both the development and the present situation of the Norwegian industrial location. Such information will hopefully provide better understanding of some of the driving forces behind the location of Norwegian manufacturing industry, and may finally help to structure the debate about the development and the future of the Norwegian manufacturing industry.

The paper is organised as follows: In section 2, the data material is presented. The regional specialisation of Norway is discussed in section 3, while the industrial concentration is examined in section 4. Section 5 sums up and concludes.

2. Data

The following analysis is based on data from the Manufacturing Time-series database provided by Statistics Norway. The database consists of plant level data for all Norwegian manufacturing firms, and in this paper, the data are aggregated for each NUTS4 region[2], the so-called economic regions, and for 25 manufacturing industries.

Hallet (2002) points out that: *"location and relocation of production involve high investment and are therefore long-term processes with a high sluggishness once a certain pattern of specialisation and concentration has developed"*. Hallet only had data for 15 years. Data for 28 years, 1973 - 2000, make it possible to compare the results over time and hopefully also to identify some trends in the development of the location patterns of the Norwegian industry sector. The data are smoothed by a symmetric five year moving average in order to prevent the results from becoming affected by incidental events. Throughout the paper, all results are presented by four year averages calculated on basis of the smoothed data series.

An employment measure, number of employees, represents the activity level in a region or in an industry. Employment data have the interesting quality of displaying quite explicitly an important political decision variable. Due to the relatively rigid Norwegian labour market, the employment data are moreover probably less affected by cyclical fluctuations in the level of economic activity than activity measures such as value added and gross production value.

The sources and treatment of variables applied in the analysis are described in detail in Appendix A, thus only a short introduction is provided here; statistics of value added, manufacturing employment, man hours, investment in capital, wage costs and gross production value are taken from the Manufacturing Time-series database from Statistics Norway. Also labour-tax zones are extracted from this database and used in order to examine the importance of governmental subsidies for location of the industry. Employment data (by main economic sectors) and data on regional aid as well as education are extracted from different databases and provided for the years 1989, 1991, 1993, 1995, 1997 and 1999 by Statistics Norway. Data on research and development are the official numbers reported from Statistics Norway to the OECD OFFBERD database.

[2] See Appendix 1 for further information concerning the sources and preparations of the data.

3. Specialisation (the specialisation of regions)

3.1 Theory and former findings on regional specialisation.

Traditional economic theories and trade theories predict that economies will specialise according to their comparative advantage, based on factor endowments or technology or both. Integration usually implies more trade (lower transaction costs), and will accordingly lead to increased specialisation according to such theories. Growth theories, on the other hand, predict less specialisation in the long run due to equalisation of factor productivities and income convergence. The new growth theories incorporating externalities do, however, predict ever increasing specialisation. All in all, economic theory seems to be quite inconclusive with regard to which effects one should expect on specialisation from globalisation and increased integration of economic activity.

In line with the reasoning above, it is often assumed that increased globalisation leads to increased specialisation, see for example Krugman (1993). Over the period between 1973 and 2000, Norway has extended the access to parts of its markets for the rest of the world. Parallel to this development, there has been a closer social, economic and juridical integration, particularly with the EU. One might therefore expect a more specialised industrial structure in Norway by the end of the period compared to that of 1973. However, another problem related to the ability of economic theory to predict effects of globalisation, is the fact that the theories apply only to the national level. We do not have a theory that actually tells us what to expect at the regional level when globalisation takes place, although there has been several attempts to establish empirically a relationship between national and regional integration. Due to this lack of theoretical explanation, the adaptation of theory in this particular report will restrict itself to the results from increased integration between the different regions in Norway. Over the three decades that are studied, there has been a steady process of regional integration in Norway, and especially the infrastructure has been strengthened substantially in this period. Theory leads us mainly to expect more regional specialisation as a consequence of such a development, but before we explore the location of Norwegian manufacturing industry, it may also be valuable to seek empirical evidence from other regions, like for instance the ones in EU.

There exist several studies of the regions of the EU[3], which cast a light on the relation between integration and specialisation. Redding & Vera-Martin (2001) analysed data on a panel of 14 industries in 45 regions from 7 European countries since 1975 up to 1995, and found that there was no evidence that the process of increasing economic integration in Europe had weakened the relationship between patterns of production and factor endowments across regions within countries. They also found that factor endowments served well as an explanation of European regional production patterns, although more successful at explaining specialisation in aggregate industries than in disaggregate industries within the manufacturing sector. A study by Midelfart-Knarvik and Overman (2002) observes a slight movement towards increased specialisation in the NUTS2 regions of Europe on average between 1983 and 2000. The increase was not as high as could be expected, however; over the period between 1980 and 1995 only 53% of the regions actually became more specialised while 47% of the regions became less specialised. The evidence of increased specialisation is ambiguous; others, like Marelli (2002), argue that more equal structural systems and more liberal markets point in the direction of convergence rather than increased specialisation. He supports his view with specialisation indexes based on employment data from European NUTS2 regions between 1983 and 2000, which indicate a slow but steady structural convergence over the period in question. Hallet (2000) on the other hand, finds a slight tendency of decreasing specialisation, especially between 1981 and 1984 and between 1989 and 1993, but suspects this to be partly the result of a transition from manufacturing to services[4].

In the following, an empirical examination of the specialisation pattern in Norway has been carried out in order to provide more knowledge about the factors and forces affecting the specialisation of Norwegian regions.

[3] An introduction to empiric research on this subject is provided in Krieger-Boden (2002).

[4] The NACE17 classification is much more detailed on manufacturing than on services, and a structural change from several manufacturing industries to a few services implies a higher specialisation in *all* regions (a higher structural similarity of regions).

3.2 How specialised are the economic regions in Norway?

The specialisation of economic regions is measured by the activity level of industry k in region i at time t, denoted $x_i^k(t)$. The basic unit of the analysis is, however, industry k's share of the total activity in region i at time t, here expressed by $v_i^k(t)$.

$$v_i^k(t) \equiv \frac{x_i^k(t)}{\sum_k x_i^k(t)}$$

This measure gives quite an extensive matrix of results. A more "handy" measure of specialisation, namely the Krugman specialisation index, is therefore introduced, and this measure forms the basis of the following analysis of specialisation.

The Krugman Specialisation Index

The Krugman specialisation index[5], in the following called K-spec, is a more comprehensible and suitable measure for comparing the specialisation levels of the different economic regions than the specialisation index referred to above. The K-spec index allows comparison of the specialisation level of a region with that of the rest of the country, and is defined by the equation below:

$$K_i(t) = \sum_k abs\left(v_i^k(t) - \bar{v}_i^k(t)\right)$$

where:

$$\bar{v}_i^k(t) \equiv \frac{\sum_{j \neq i} x_i^k(t)}{\sum_k \sum_{j \neq i} x_i^k(t)}$$

The index is formed by taking the absolute difference between industry k's share of the total activity in region i at time t, and the share of the same industry of the total activity in all other regions at time t, and finally summing up these differences over all industries. The index can take values between 0 and 2. 0 suggests that a region has an identical industrial structure to

[5] For more information about this index, see Krugman (1990).

the rest of Norway, while 2 indicates that the region has no industries at all in common with the rest of the economic regions of Norway[6].

Table B.1 in Appendix B reports the 4 year average Krugman Specialisation Indexes for all economic regions in Norway for the periods 1973-1976, 1977-1980, 1981-1984, 1985-1988, 1989-1992, 1993-1996 and 1997-2000. There are actually more regions with index values higher than one (a relatively high degree of specialisation), than regions with index values below 0.6 (a relatively low degree of specialisation) for all 4 year averages. Apparently, it is more normal for a Norwegian economic region to be relatively specialised than not. Compared to results in a study by Midelfart-Knarvik et al. (2000), describing the specialisation pattern of regions in Europe, the K-spec values of the Norwegian economic regions are high. The current study is based on a higher regional classification level (NUTS4) than the study on Europe (NUTS2), however, and it seems only reasonable that a large region is less specialised than a smaller one. This view is shared in Marelli (2004) where employment data are used in order to study regional specialisation in the EU.

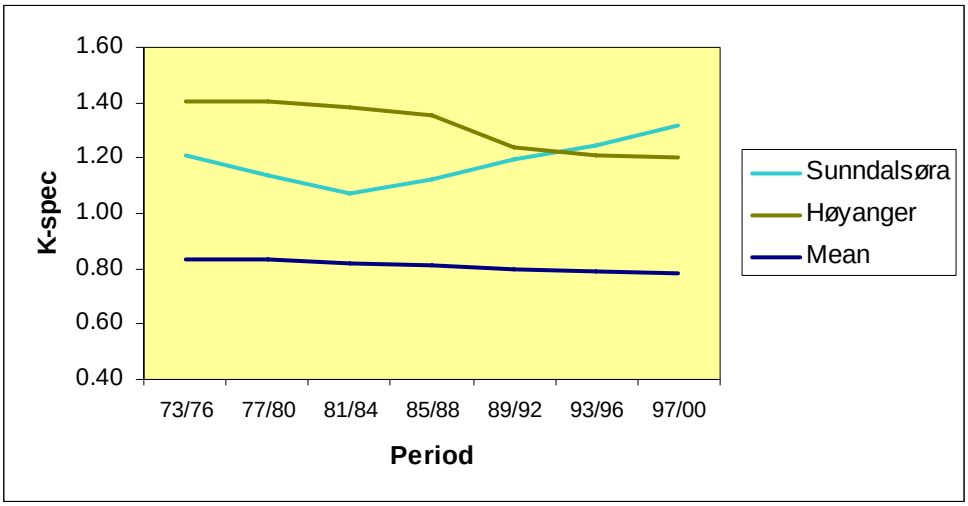
Of the economic regions with a high degree of specialisation, shown in Figure 3.1, Høyanger and Sunndalsøra do in particular stand out. Both regions are small economic regions in terms of population, and their respective societies are very much based on Hydro Aluminium's production of aluminium. Sunndalsøra was among the three most specialised economic regions in all 4 year averages, with an index value of 1.21 in 1973/1976. In this period, 60.5% of the production at Sunndalsøra would, in other words, have to change industry in order to get in line with the rest of Norway[7]. The tendency of Sunndalsøra has been to reinforce the high specialisation level and become less similar to the rest of Norway. The region had a positive change of 8.8% in the index values between 1973 and 2000, but especially the years 1985-2000 were marked by increasing specialisation (as much as 17%). Høyanger on the other hand, started off, according to our calculations, with an index value of 1.4 in 1973/1976 and ended up with an index value of 1.2 in 1997/2000. By the end of the analysis period,

[6] Note that this way of measuring the specialisation level, gives an impression of the relative specialisation of regions within Norway, but it is not suitable for direct comparisons with other countries.

[7] That is: 1.41 divided by 2, as our measure counts both positive and negative deviations for all sectors and the absolute differences between the regions thereby were counted twice.

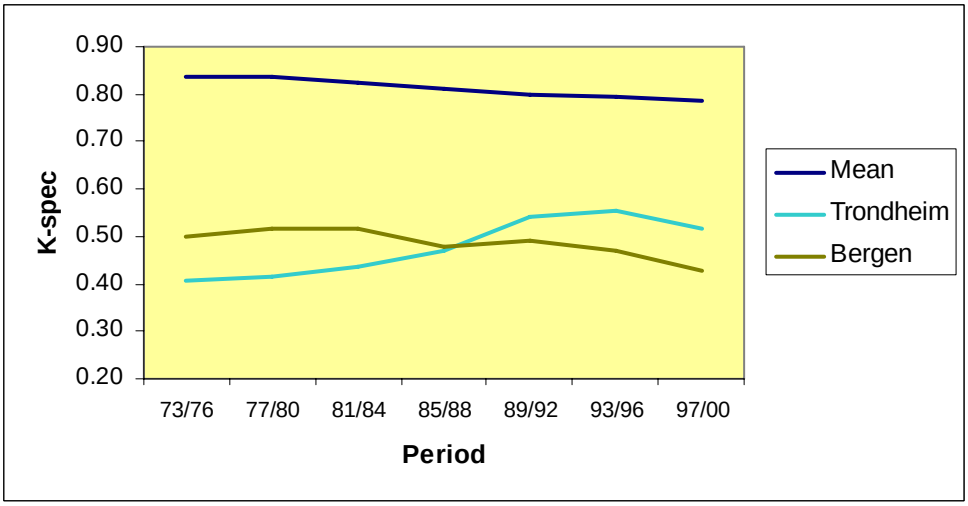
Høyanger had decreased its index value by 14.2%, and, at that time, 60% of the production would have to change industry in order to get in line with the rest of Norway.

Figure 3.1: The most specialised regions



Among the economic regions with an especially low degree of specialisation are some of the larger cities in Norway. Bergen and Trondheim, the second and fourth largest cities in Norway respectively, stand out as economic regions with a continuous low degree of specialisation. The development of these regions is shown graphically in Figure 3.2. Bergen had an index value of 0.50 in 1973/1976; only 25% of the region's industry was out of line with that of the rest of Norway, while the industry of Trondheim was even more similar to the rest of the country with only 20% of its industry out of line with the rest of Norway.

Figure 3.2: The least specialised regions

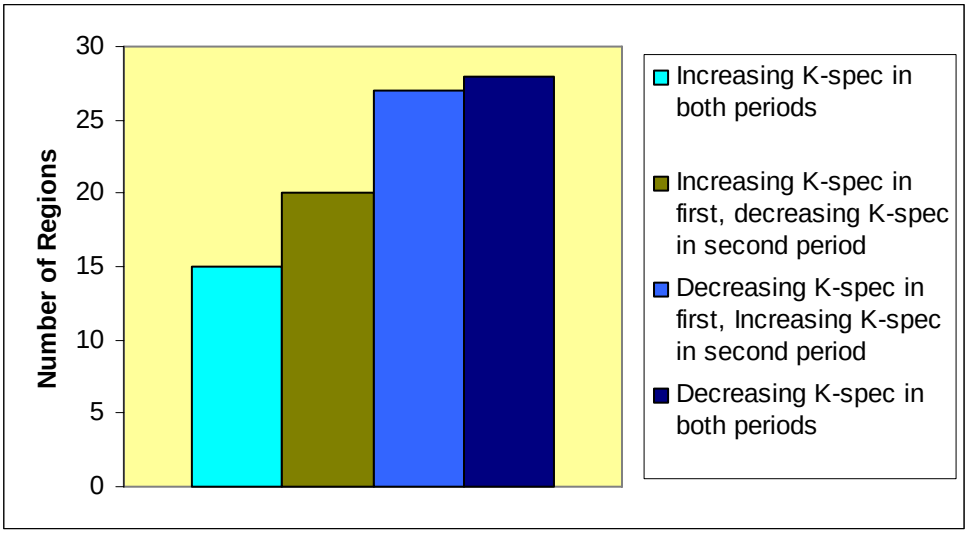


However, the subsequent development of Bergen and Trondheim has taken different paths. Since 1973/1976 Bergen has experienced a decline in the specialisation level in both sub-periods[8]. The index value decreased by as much as 13% from the beginning to the end of the whole period covered by our data, and ended up at 0.43 in 1997/2000. For Trondheim, on the other hand, the same periods were characterised by increased specialisation. In 1997/2000, Trondheim's index value was 0.51, an increase of 32 % from 1973/1976.

In order to make a simple analysis of the development of the specialisation profiles of the economic regions over time, the changes in the specialisation index in two sub-periods, 1973/1976 - 1985/1988 and 1985/1988 - 1997/2000, have been calculated for all economic regions, and results are presented in Figures 3.3 and 3.4.

Figure 3.3: Changes in Regional Specialisation

1973/1976 - 1985/1988 and 1985/1988 - 1997/2000



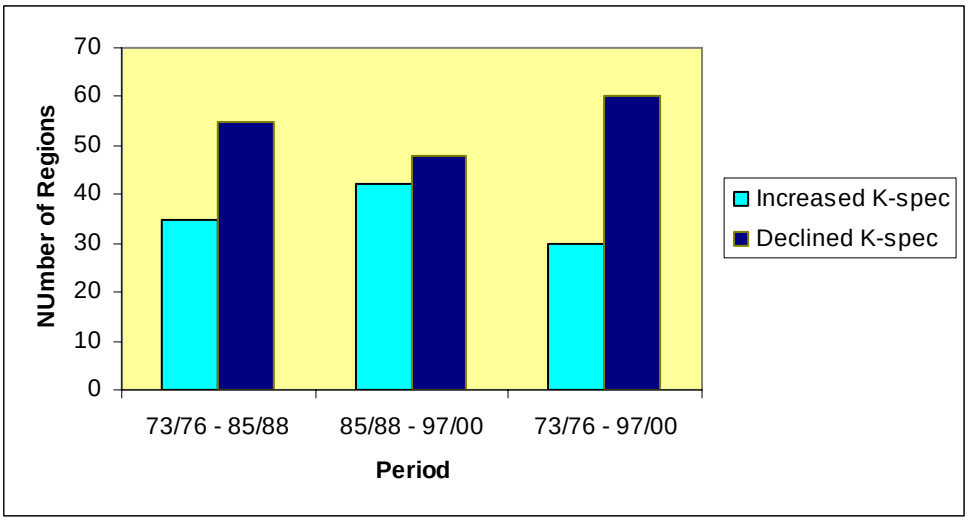
Over the time span studied, 17% of the economic regions reinforced their tendency to specialise; while as many as 31% reinforced their tendency to converge with the industrial structure of the rest of the economic regions. 22% of the economic regions experienced increased specialisation in the first period, while this tendency was turned to convergence towards the rest of Norway between 1985/1988 and 1997/2000. However, 30% of the economic regions experienced a decline in specialisation between 1973/1976 and 1985/1988, but thereafter increased specialisation.

[8] 1973/1976 – 1985/1988 and 1985/1988 – 1997/2000, see the next paragraph.

Figure 3.4 confirms the impression of convergence from Figure 3.2. In both sub-periods there was a dominant tendency of decreasing specialisation levels. Especially in the first period, this tendency was strong. This impression is further confirmed when calculating the change of the whole period, i.e. the change from 1973/1977 to 1997/2000. Over the whole period, only 33%, or put differently, 30 of the 90 economic regions, experienced increased specialisation. 67% of the economic regions experienced increased convergence of their industrial structure with that of the rest of Norway. The changes are not dramatic, however; on average the specialisation index has decreased by 2.8% in both periods, a result well in accordance with the observation of a "sluggish development" in Hallet (2000). In sum, there has been a continuous, but modest decline in specialisation between 1973 and 2000. These results do in some aspects differ from the results of the formerly mentioned study of European regions between 1983 and 2000 by Marelli (2004). While Marelli, in line with our results, finds a slow but steady structural convergence over the period in question, his results are less ambiguous than ours. In Marelli's study, all specialisation indexes decreased between 1983 and 2000. He also found persistence in his results; the industries that were initially most specialised, were also the most specialised by the end of the period.

Figure 3.4: Changes in Regional Specialisation

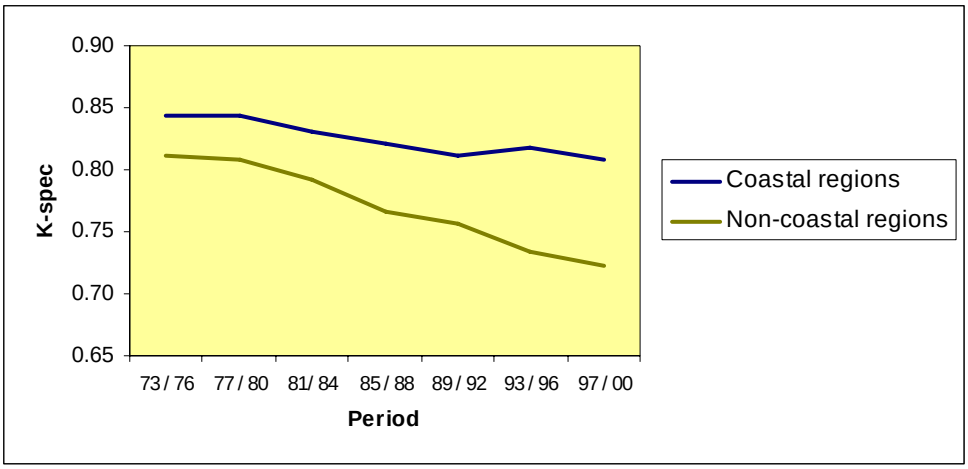
1973/1976 - 1985/1988, 1985/1988 - 1997/2000, and 1973/1976 – 1997/2000



The development of the specialisation level in the Norwegian economic regions emerges even more clearly when dividing the economic regions into groups and plotting them graphically. First, the economic regions are divided into coastal regions and non-coastal regions as shown

in Figure 3.5. Coastal regions have on average a specialisation index varying between 0.808 and 0.843 and turn out to be more specialised than the non-coastal regions, which have only specialisation indexes between 0.722 and 0.811. This result comes as no surprise as the coastal regions are in general quite small regions traditionally based on a few corner stone enterprises or exploration of natural resources. Both sets of regions have experienced a general decline in specialisation between the years 1973 and 2000, but the non-coastal regions have experienced the largest index decline.

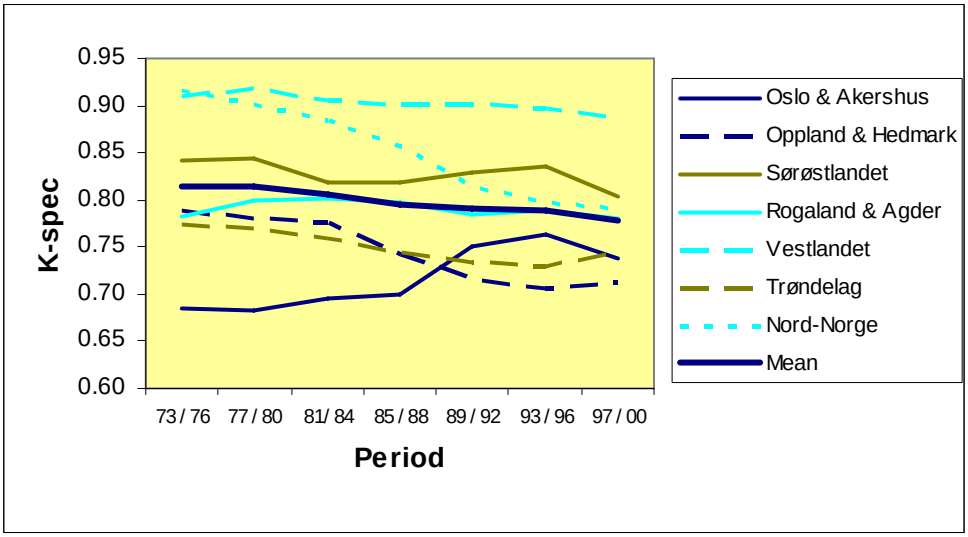
Figure 3.5: Krugman Specialisation Index, Coastal & Non-Coastal Regions.



The second approach groups the economic regions into seven NUTS2 regions as shown in Figure 3.6. The reported average specialisation level of an economic region in each NUTS2 region gives a slightly different picture from the one above. The figure draws a picture of a specialisation level varying widely between the NUTS2 regions in the beginning of the seventies, but also shows a slight movement towards convergence over the period covered by the data set. The economic regions of Vestlandet have experienced the highest specialisation level; the index remained stable at around 0.9 throughout the period between 1973 and 2000. Trøndelag and Sørøstlandet also have a relatively stable specialisation level over the total period. These two NUTS2 regions differ, however, in the initial specialisation level as well as in the direction of change in the last 4-year periods. Sørøstlandet was initially relatively much specialised and experienced a slight increase in the 1980s followed by a decrease in the specialisation index by the end of the 1990s. Trøndelag on the other hand, started out at a relatively low specialisation level and experienced a steady decrease in specialisation till the

mid-1990s. In total both regions decreased their specialisation levels between 1973 and 2000 - a development reflecting the trend of convergence between regions. The development of Nord-Norge and Oppland & Hedmark is quite similar to that of Trøndelag, only with a steeper decrease in specialisation. Finally, the development of Rogaland & Agder coincidences with the mean, marked with a thicker line in the figure. The mean is steadily declining and confirms the former observation of a decreasing specialisation level in Norway on the whole.

Figure 3.6: Krugman Specialisation Index, NUTS2 level.



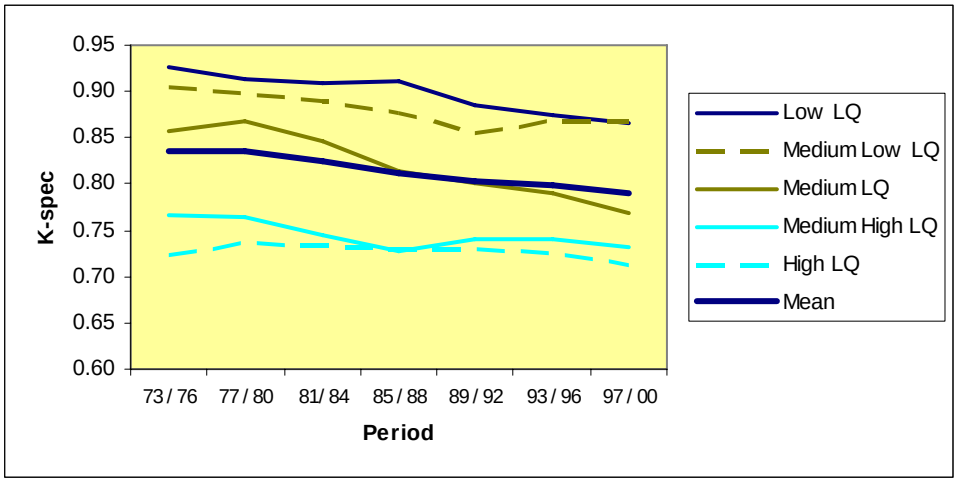
A third approach is to divide the economic regions into groups based on the centrality of the economic regions. There is, however, one aspect of centrality that makes this division a bit problematic. The qualifications of a central region have changed over time, and there exist accordingly a number of different centrality indexes based on different centrality measures. The "old centrality" concept is based on a definition of central place functions covering mainly personal service functions for commodity trade and leisure. The new central place functions forming the "new centrality" concept are services of a more businesslike character, services that are relatively knowledge intensive and aimed at enterprises, not individuals. The centrality index employed in this report is based on localisation quotients of only the tertiary sector[9]. This index is formed by localisation quotients (LQ) for an important indicator of

[9] A localisation quotient tells us to what degree a branch is over- or under-represented in a region. When the value is 1, the branch in question has a size that equals the national average. When the value is more than 1, the

centrality, namely the businesslike services. High LQ indicates a high density of the indicators in question, and, consequently, a high score on the centrality index - and the other way around.

It turns out that the spread is quite symmetric around the mean, and it is possible to identify a pattern of central economic regions being less specialised and vice versa. More specifically, the groups of regions with low and medium low localisation quotients (low and medium low centrality) lie above the mean, these regions are more specialised than the average region, while the groups of regions with high and medium high localisation quotients turn out to be less specialised than the average economic region.

Figure 3.7: Krugman Specialisation Index, Centrality



A last observation worth noting is that, although the economic regions with medium LQ display quite a substantial decline in the specialisation index, grouping of the data based on centrality indicates smaller fluctuations of the specialisation index than the case with NUTS2 regions. It does in other words seem like the centrality of an economic region is a more stable determinant of the regional specialisation level than the actual geographic situation of the region.

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branch is over-represented, and if the value is lower than 1, the branch is under-represented. For a more thorough description of the index, see Selstad et al. (2004).

The Gini Coefficient

An alternative indicator of the level of specialisation in a region is the Gini coefficient[10], which is a measure of the inequality of the activity level in the various economic regions. The coefficient is defined over the relative production shares given by the following equation:

$$r_i^k(t) \equiv \frac{v_i^k(t)}{\bar{v}_i^k(t)}$$

To round off the descriptive numeric analysis, Table 3.1 reports alternative indices of specialisation, represented by these relative production shares.

Table 3.1: Summary measures of the relative shares

	73 / 76	77 / 80	81 / 84	85 / 88	89 / 92	93 / 96	97 / 00
Gini coefficient	0.270	0.231	0.213	0.192	0.192	0.206	0.199
Mean	1.819	1.710	1.663	1.639	1.682	1.708	1.606
Variance	1.401	0.668	0.438	0.313	0.322	0.387	0.328
Coefficient of Variation	0.651	0.478	0.398	0.341	0.337	0.364	0.357
Skewness	0.000	0.000	0.000	0.006	0.062	0.017	0.004
Kurtosis	0.000	0.000	0.043	0.641	0.172	0.623	0.384

The table reinforces the former observations of a declining specialisation trend on average in the economic regions. The Gini coefficient starts out relatively high and decreases steadily till the period 1993/1996 when it increases slightly. During the last period, however, this effect is levelled out again. The mean shows the same tendencies, although with smaller fluctuations, and so do the two measures of variance. As far as the plain variance is concerned, there has been a large decrease over the three decades covered by the datasets, a fact that indicates less dispersion. Up to 1989/1992 the distribution was not noticeably skewed, but in the period of 1989-1992 there was a slight trace of skewness. This was, however, more or less erased by the

[10] The Gini coefficient of specialisation summarises the distribution of relative production shares, $r_i^k(t)$, across industries in a given economic region. The Lorenz curve associated with the measure gives cumulated values of $v_i^k(t)$ on the vertical axis, against cumulated values of $\bar{v}_i^k(t)$ on the horizontal axis. Observations are ranked in descending order by the gradient, $r_i^k(t)$.

end of the last period covered by the datasets, and the development gives at least weak support to the observations of a diminishing specialisation level. There is also some evidence of kurtosis up to 1993/1996, indicating growing weight in the tails of the distribution, but this tendency turned by the end of the period.

3.3 Are there large differences between the regions?

The industry shares for each economic region, $v_i^k(t)$, can be compared with the corresponding shares of the rest of Norway, like in Table B1, or it can be compared pairwise with shares for the other economic regions. Such a bilateral comparison of specialisation is carried out; however, the results form a matrix that is too extensive to be very informative. Instead the economic regions are divided into groups based on NUTS2 regions and centrality, and the results are reported in Tables 3.2-3.5. The tables should be read horizontally; for each NUTS2 region the observation of the region with the most similar specialisation level is marked with numbers in cursive, while the observations of the region with the most different specialisation level are marked with bold numbers.

From the first set of comparisons, presented in Table 3.2 and Table 3.3, it can be seen that Nord-Norge and Oslo & Akershus turn out to be the most different regions in terms of specialisation in the manufacturing industries. Reasons for this can be many; we have already seen that these two parts of Norway feature quite different geographic and demographic characteristics, and we know from Table A.1 in Appendix A that they figure at the two extreme points of the centrality scale. Some of the characteristics of industries located in the different regions, as well as possible implications of this location for regional specialisation, will be discussed in section 3.4. Nord-Norge and Oslo & Akershus remain the most different regions over the whole period of 1985-2000, but the differences were diminishing from 0.046 in 1985/1988 to 0.036 in 1997/2000, a fact that reinforces the general impression of declining specialisation over time. In 1985/1988, Rogaland & Agder and Hedmark & Oppland were the most similar regions in terms of specialisation level, but over time these regions have developed and have become more different from one another. By 1997/2000 Nord-Norge and Trøndelag together with Hedmark & Oppland and Vestlandet, all characterised by K-specs close to the mean (see Figure 3.2), were the most similar regions. Nord-Norge and Trøndelag both have coastlines, they are the two least central regions of Norway (according to the ”new” centrality index), and the manufacturing production in an economic region in one of these

regions is on average dominated by the production of food & beverages and basic metals. Hedmark & Oppland and Vestlandet have one geographical characteristic in common; they are both fairly mountainous regions, but only Vestlandet has a coastline. The average economic region in these areas is not very central according to the new centrality index and about 22% of the total manufacturing is the production of food and beverages.

Table 3.2: Bilateral differences between NUTS2 regions, 1985/1988

	Oslo & Akershus	Hedmark & Oppland	Sørøstlandet	Rogaland & Agder	Vestlandet	Trøndelag	Nord-Norge
Oslo & Akershus	0.000	0.021	***0.012***	0.017	0.027	0.040	**0.046**
Hedmark & Oppland	0.021	0.000	0.009	***0.004***	0.006	0.019	**0.025**
Sørøstlandet	0.012	0.009	0.000	***0.005***	0.015	0.028	**0.034**
Rogaland & Agder	0.017	***0.004***	0.005	0.000	0.010	0.023	**0.029**
Vestlandet	**0.027**	***0.006***	0.015	0.010	0.000	0.013	0.019
Trøndelag	**0.040**	0.019	0.028	0.023	0.013	0.000	***0.006***
Nord-Norge	**0.046**	0.025	0.034	0.029	0.019	***0.006***	0.000

Table 3.3: Bilateral differences between NUTS2 regions, 1997/2000

	Oslo & Akershus	Hedmark & Oppland	Sørøstlandet	Rogaland & Agder	Vestlandet	Trøndelag	Nord-Norge
Oslo & Akershus	0.000	0.024	***0.011***	0.016	0.024	0.034	**0.036**
Hedmark & Oppland	**0.024**	0.000	0.013	0.008	***0.001***	0.010	0.012
Sørøstlandet	0.011	0.013	0.000	***0.006***	0.013	0.024	**0.025**
Rogaland & Agder	0.016	0.008	***0.006***	0.000	0.007	0.018	**0.020**
Vestlandet	**0.024**	***0.001***	0.013	0.007	0.000	0.011	0.012
Trøndelag	**0.034**	0.010	0.024	0.018	0.011	0.000	***0.002***
Nord-Norge	**0.036**	0.012	0.025	0.020	0.012	***0.002***	0.000

The most important information that can be extracted from these bilateral comparisons is probably the development of differences between regions in the period between 1985 and 2000. Of the 21 single pairs of differences, 17 decreased over this exact period, while only 4 pairs of regions actually increased the differences between their respective industrial structures.

The comparison of differences in specialisation level between the NUTS2 regions over time indicates a declining tendency to specialise in the Norwegian regions. However, more

information can be added in order to support (or reject) this assumption. A bilateral comparison between groups of economic regions based on centrality is provided below.

Table 3.4: Bilateral differences between centrality groups, 1985/1988

	Low LQ	Medium-Low LQ	Medium LQ	Medium-High LQ	High LQ
Low LQ	0.000	***0.009***	0.017	0.026	**0.041**
Medium- Low LQ	0.009	0.000	***0.008***	0.016	**0.032**
Medium LQ	0.017	***0.008***	0.000	***0.008***	**0.024**
Medium-High LQ	**0.026**	0.016	***0.008***	0.000	0.016
High LQ	**0.041**	0.032	0.024	***0.016***	0.000

Table 3.5: Bilateral differences between centrality groups, 1997/2000

	Low LQ	Medium-Low LQ	Medium LQ	Medium-High LQ	High LQ
Low LQ	0.000	***0.014***	0.021	0.025	**0.040**
Medium- Low LQ	0.014	0.000	***0.007***	0.011	**0.026**
Medium LQ	**0.021**	0.007	0.000	***0.004***	0.020
Medium-High LQ	**0.025**	0.011	***0.004***	0.000	0.016
High LQ	**0.040**	0.026	0.020	***0.016***	0.000

The relationship between centrality and specialisation has already been discussed. It should therefore come as no surprise that the most centralised regions, those with high LQs (the least specialised regions) according to the tables above, are the most different from the regions with low LQs (regions with a high degree of specialisation). Accordingly, the most similar regions are those with a medium low and medium high LQ and the regions with medium LQ. The most interesting observations are, however, as pointed out before, the development of the bilateral differences. During the period between 1985 and 2000, 8 of the 10 single pairs of differences became smaller and only 2 out of 10 increased.

3.4 In which industries are the economic regions specialised?

To supplement and broaden the previous analysis of specialisation, it will be of interest to find out in which types of industries the economic regions tend to specialise. A mere report on which industries have been moving in and out of which economic regions, will most likely give a lot of information that is laborious and difficult to interpret. A more thorough analysis

of the characteristics of industries that economic regions tend to specialise in, is therefore provided.

Box 3.1: Industry Characteristics

Industry Characteristic	Explanation
Labour productivity	Value added per man hour
Labour costs	Wage costs per man hour
R&D intensity	R&D expenditures as a share of value added
Capital intensity	Gross investments per man hour
Labour intensity	Labour compensation per value added
Industrial growth	Growth in gross production value, 1973-2000

Industry Characteristic Bias

A set of key characteristics, denoted $\{z^k\}$, are identified and listed in Box 3.1[11]. For each economic region the average score on each type of industry characteristic is calculated and then weighted by the share of the industry in question of the total production in the economic region. For each characteristic, the Industry Characteristic Bias (ICB) of an economic region at time t is defined by:

$$ICB_i(t) = \sum_k v_i^k(t) z^k$$

The ICBs for a few selected characteristics will be presented graphically in order to illustrate how the industrial characteristics of an economic region have developed over time. However, the data set exhibits an inconvenient number of economic regions for such a graphical presentation. The economic regions have therefore, like earlier on in this report, been grouped in NUTS2 regions, where the score of a NUTS2 region is the average score of the economic regions in the respective NUTS2 region[12].

[11] The industry characteristics are presented in more detail in Appendix A.

[12] The exact scores of each NUTS2 region are presented in Table B4 in Appendix B.

Table 3.6 sums up the results from the ICB calculation, but serves best to clarify the development of different regions' ICBs over time. For each characteristic, the ICB score is registered, and based on these scores, the observations have been divided into three groups; the two observations with the lowest score (L), the three with middle score (M), and the two with the highest score (H). For each regional characteristic, except the R&D, the score from three periods are reported, for R&D only the two last periods are reported.

Table 3.6: Level of ICB scores in the NUTS2 regions, 1981/1984, 1989/1992 and 1997/2000

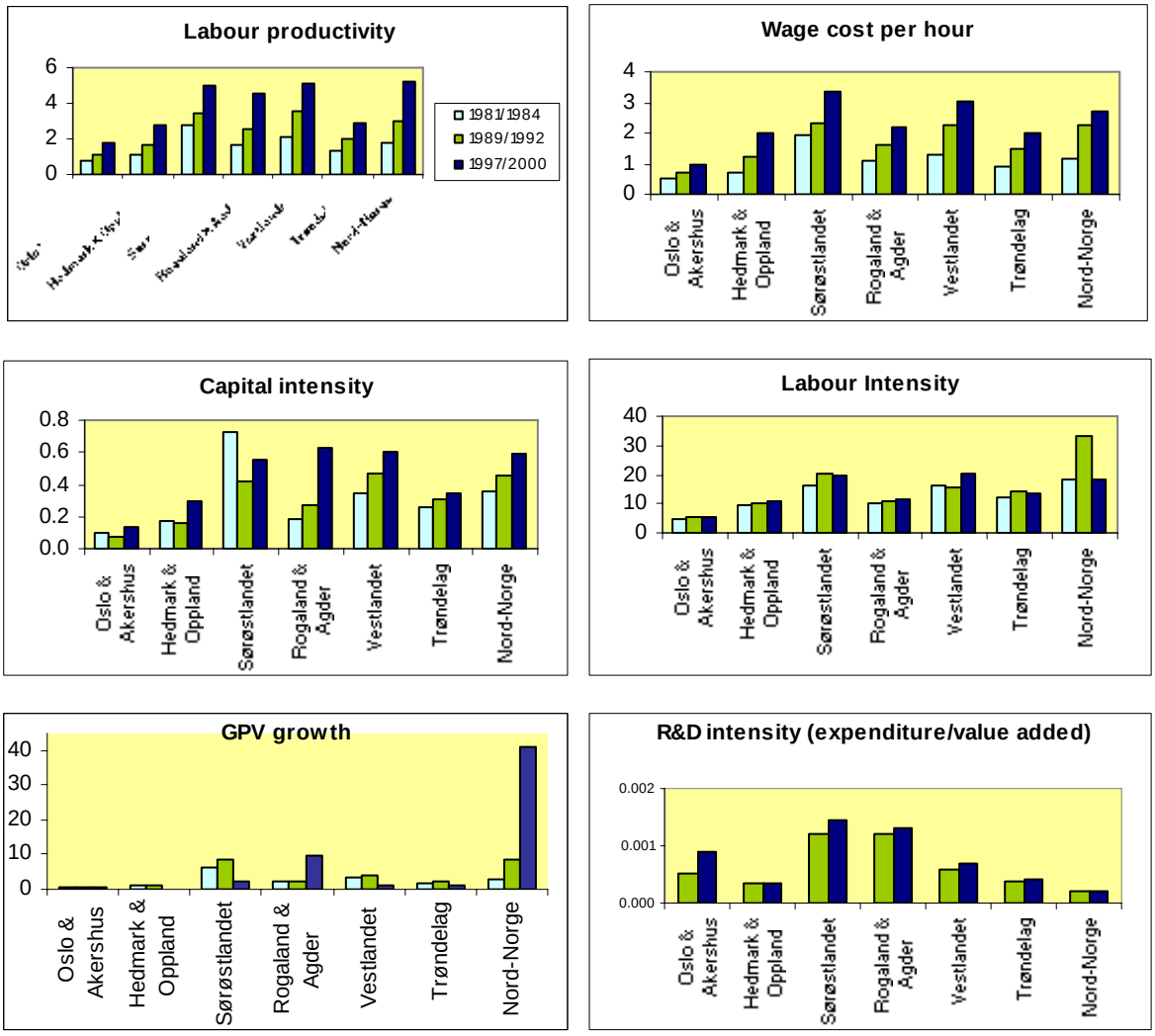
	Labour productivity	Labour costs	Capital intensity	Labour intensity	Industrial growth	R&D intensity[13]
Oslo & Akershus	L L L	L L L	L L L	L L L	L L L	. M M
Hedmark & Oppland	L L L	L L L	L L L	L L L	L L L	. L L
Sørøstlandet	H H M	H H H	H M M	H H H	H H M	. H H
Rogaland & Agder	M M M	M M M	M M H	M M M	M M H	. H H
Vestlandet	H H H	H M H	M H H	M M H	H M M	. M M
Trøndelag	M M M	M M M	M M M	M M M	M M M	. M M
Nord-Norge	M M H	M H M	H H M	H H M	M H H	. L L

When examining the table, the first impression is that Oslo & Akershus and Hedmark & Oppland score low on practically all ICBs, the only exception is the mid-level of R&D in Oslo & Akershus. Sørøstlandet and Rogaland & Agder, on the other hand, score high on R&D in all periods. The most specialised regions (Sørøstlandet, Vestlandet and Nord-Norge) tend to score high or middle on all characteristics. The only exception here is the low R&D intensity in Nord-Norge. More information can be extracted by plotting the scores on each IBC graphically like in Figures 3.8 – 3.12. All regions seem to have experienced continuously increased labour productivity over the period in question. Vestlandet and Sørøstlandet are marked by particularly high labour productivity in all sub-periods, while Nord-Norge improves its position in the last period, and Oslo & Akershus seem to have the lowest manufacturing labour productivity in all three sub-periods. One might expect the wages to rise in accordance with the improved labour productivity, and our material gives no evidence to

[13] In this category there were no available data for the period of 1981/1984. Thus, only the periods of 1989/1992 and 1997/2000 are reported.

contradict such an assumption. The same pattern as for the labour productivity emerges when it comes to hourly wage costs.

Figures 3.8 – 3.12: ICB scores in the NUTS2 regions[14]



Turning to the capital intensity, it is registered as low in the area in and around Oslo. Regions like Rogaland & Agder and Vestlandet on the other hand, are characterised by industries with relatively high capital intensities. On average the production of motor vehicles, non-electronic machinery and ships represented 44% of the production in an economic region in Vestlandet in 1997/2000. These branches are capital intensive and require in particular a lot of physical capital. Rogaland & Agder had a similar structure: the production of non-electronic

[14] Data for R&D expenditures were only available for the two last periods.

machinery, ships and fabricated metal products represented on average nearly 40% of the total manufacturing in an economic region in this part of Norway. With the exceptions of Oslo & Akershus and Sørøstlandet there has been a steady increase in capital intensity in all periods. The low capital intensity in the Oslo area may be a result of high-tech and other capital intensive manufacturing industries locating outside central areas due to official regulations and the relatively small transportation costs once located outside the centre, or it simply reflects the high rent costs in the central area of Oslo and its surroundings.

The labour intensity is particularly high in Sørøstlandet. Capital intensive manufacturing industries like the production of fabricated metal products and pulp, paper & paper products dominate the manufacturing in the region. Nord-Norge also stands out as a region with high labour intensity, but the intensity has decreased substantially between 1989 and 2000. All other regions have had relatively low labour intensities between 1981 and 2000, but a slightly increasing tendency has been observed.

The manufacturing GPV growth has on average been modest, but positive in all regions. In the two first periods, Sørøstlandet and Vestlandet seemed to have the most substantial growth numbers, while this position shifted in the last period. Sometime between 1989/1992 and 1997/2000 Nord-Norge and Rogaland & Agder took over the position of growth regions. The growth in Nord-Norge has, among other factors, been a result of growth in the fish processing industry, but this industry has had a rough time after 2001/2002 and the growth has according to Selstad et al. (2004) stagnated. Rogaland & Agder on the other hand has experienced a period of growth in manufacturing related to petroleum and offshore activities. These activities demand a certain skill level and the region has attracted a base of high skilled labour and has become a relatively knowledge intensive region[15]. Such a situation is likely to create more persistent growth conditions; the prospects for growth in this particular region should in other words be good.

Nord-Norge has exhibited high growth numbers and relatively high labour productivity, but also high wage costs and high capital intensity. On one characteristic however, Nord-Norge scores lowest of all regions. The R&D intensity seems to bee very low in Nord-Norge

[15] The college facilities in this region have been strengthened over the last decades and even received the status of university in 2005.

compared to the rest of Norway. R&D activities normally vary with industrial structure, and the industrial structure may well explain the low R&D commitment in Nord-Norge; the production of food products and beverages has a very dominant position in this region. As much as 44% of the total manufacturing industry is focused on this little R&D intensive branch. Figure 3.13 also shows that all regions kept stable or increased their R&D intensity between 1989/1992 and 1997/2000. Over the whole period, an average economic region in Sørøstlandet or Rogaland & Agder was host for industries with the highest commitment to research and development in Norway. Oslo & Akershus has been a good number three in this context. Gundersen (2002) identifies a few factors that seem to coincide with high R&D intensity[16]. Enterprises located in and around densely populated areas and central regions spend more on internal R&D than other enterprises. This observation seems to fit well with our results as the three mentioned regions are the three most densely populated regions in Norway. The results of Gundersen's study also indicate that the degree of specialisation does not coincide with the degree of R&D intensity. In our case, this fits in well with our observations of Vestlandet, with the highest specialisation level and quite low R&D intensities. However, the two regions with the highest specialisation level after Vestlandet, Sørøstlandet and Agder & Rogaland, are also among the most R&D intensive regions in Norway.

3.5 What are the characteristics typical of a specialised region?

To summarise the findings above; a specialised economic region is not necessarily a particularly central region. Our calculations do rather point out that regions found in the coastal areas of the NUTS2 region of Vestlandet, Nord-Norge or Sørøstlandet are the typical specialised regions. A combination of the specialisation indexes and the ICB scores throws further light on characteristics of the specialised regions. Specialised regions seem to have relatively high labour costs, but also high labour productivity. Factor intensities are generally high. The same goes for R&D intensities; Nord-Norge is an exception, however, with a relatively low economic commitment to research and development. The former mentioned Høyanger and Sunndalsøra are two examples of economic regions that fit in well with the identified characteristics of a specialised economic region. However, as they are both

[16] He uses a slightly different definition of R&D intensity from the one employed in this report, namely R&D expenditure over employment.

economic regions based on power intensive production of aluminium in corner-stone enterprises, they are also examples of specialisation based on local natural resources and national industrial history. Such factors are presumably also important explanation factors when it comes to the specialisation level in the Norwegian economic regions, but will, nevertheless, not be subject to closer examination in this report.

4. Concentration of industrial activity

4.1 Theory and former findings on industrial concentration

According to new economic geography theories, there are two forces pulling in different directions when it comes to the location of an economic activity, see for example Fujita et al. (1999). On the one hand agglomeration forces drive the economic activity to concentrate in certain regions. Access to concentrated groups of suppliers and customers, as well as economies of scale and backward and forward linkages, form such agglomeration forces. On the other hand, however, dispersion forces, like access to natural resources, transaction costs and factor price differences, lead production to locate in the periphery rather than in the cores. Integration is expected to lead to changed good and factor mobility and thereby also affect the localisation of economic activity. Furthermore, if integration has a larger impact on trade costs than on factor mobility, the geographical distribution of factors will work as dispersion forces, see Norman & Venables (1995).

As discussed in the section about specialisation in the Norwegian regions, the regional consequences of globalisation are given neither from theory nor from empiric research. Irrespective of the reasons, a steady process of regional integration has been observed in Norway over the last three decades and theory predicts this integration process to have affected the localisation pattern of Norwegian manufacturing industry. The effects on the localisation pattern depend on whether agglomeration forces or dispersion forces are the strongest forces of change.

Midelfart-Knarvik & Overman (2002) have done a general research of regional specialisation and concentration in the EU, and found the concentration of the manufacturing industry to be slightly increasing. The distribution of overall manufacturing activity at the regional NUTS2 level in the EU seems to have become more concentrated over the last three decades, and it is tempting to believe that the agglomeration forces have been stronger than the dispersion forces in Europe. However, there were great variations among the various industries and the authors concluded that to the extent that there really have been agglomeration forces at work, they have reinforced the pattern of concentration for labour intensive industries, but been dominated by dispersion forces (presumably factor market considerations) in the high tech industries. A later study by Barrios & Strobl (2004) supports the findings of a trend of

increasing concentration in the manufacturing industry in the EU, at the national level as well as at the regional level (NUTS2). However, when decomposing the material it turns out that the initially highly concentrated industries became less concentrated so that there was actually a trend of convergence, not of reinforcement, of already existent differences. The concentration level was consequently higher at the national than at the regional level. Hallet (2000) found a decreasing tendency of concentration for all sectors during the 1980s, but this tendency reversed into increasing concentration in the first half of the 1990s[17]. The manufacturing branches were in general more concentrated than other sectors, and some of the manufacturing branches, like Chemicals and Metals, actually showed a tendency of de-concentration.

In the following, the concentration pattern of the manufacturing industry in the Norwegian NUTS4 regions will be examined. Theory and evidence from Europe do in advance lead us to expect increased concentration over time, and in particular so in the low-skill and labour intensive branches.

4.2 How concentrated are the manufacturing industries in Norway?

A straight forward measure of the concentration level in an industry is, parallel to the specialisation measure, region i's share of industry k's total activity level at time t, defined by $s_i^k(t)$.

$$s_i^k(t) \equiv \frac{x_i^k(t)}{\sum_i x_i^k(t)}$$

In the following sections, two different interpretations of $s_i^k(t)$ will be implemented. First, the concentration measure is interpreted as an economic region's share of the total activity in industry k, with k representing various manufacturing industries presented in Table A.2 in Appendix A. In addition to giving an impression of the degree of concentration in different manufacturing industries, such a measure makes it possible to examine and compare the concentration of the industries over time. Table C.2 in Appendix C, reports the average share

[17] The study covers all sectors, not only manufacturing.

of an economic region of the total activity in industry k over the years 1973-2000. Two graphic presentations of this table are provided in Figures 4.1 and 4.2.

Figure 4.1: The Most Concentrated Industries

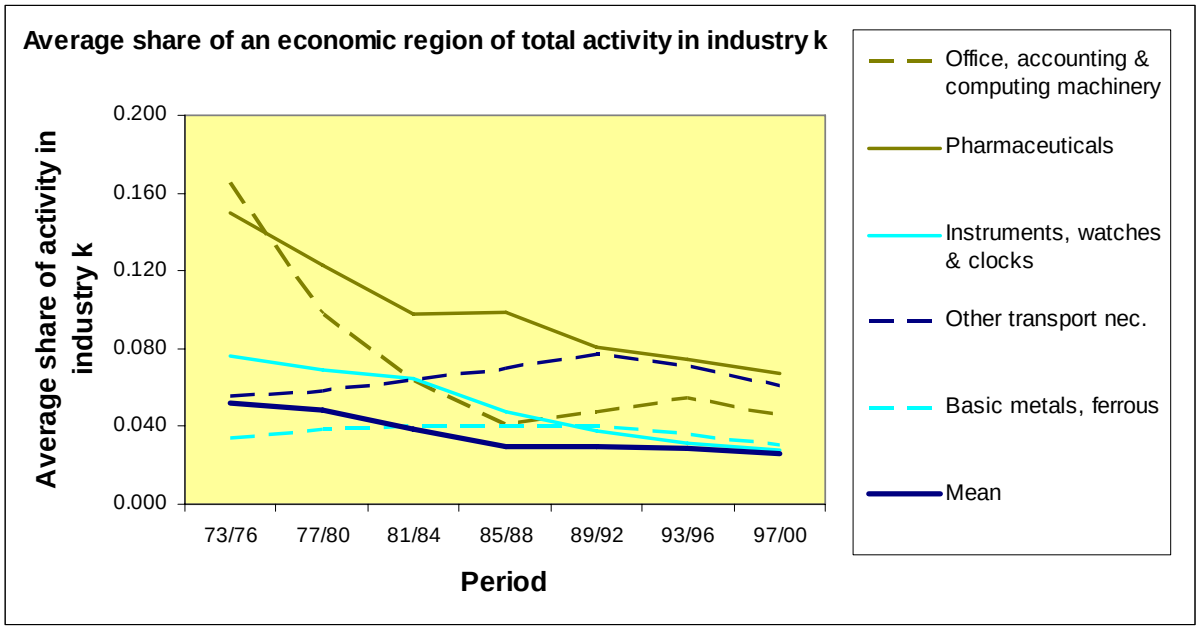


Figure 4.1 shows that a handful of industries stand out as relatively concentrated with shares of up to 15%[18], while the majority of industries are gathering around an average share of about 3%. Among those industries standing out as especially concentrated, is the pharmaceutical industry. On average, an economic region was host to 15% of the total activity in the pharmaceutical industry in Norway in 1973/1976, while the production of office, accounting & computing machinery had an average share of 16.5%[19]. However, this last industry lost its dominant position (in one or more economic regions) during the three decades studied, and by the end of the period, it had reduced its average share to 4.5%.

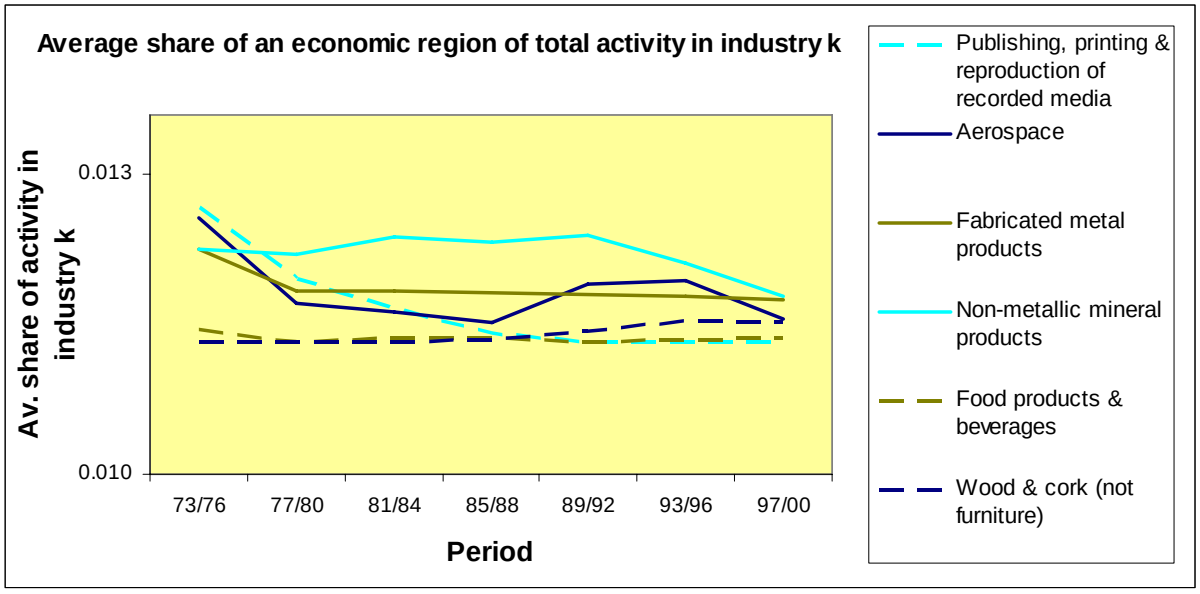
If an industry was to be fully dispersed in space, each economic region would be the host of 1.1% of that industry's total activity. The mean of $s_i^k(t)$, showing values between 5.2% and

[18] In an attempt to make the figure clearer, the tobacco industry is excepted form the figure in spite of its high av. share of activity.

[19] This share must be interpreted as an indication of concentration in one or a few regions, as it is not possible that all economic regions each had 16.5% of an industry.

2.6%, clearly shows that this is not the case for the average manufacturing industry. However, in Figure 4.2 we have plotted the development of a few industries that are actually more or less fully dispersed. The wood & cork (not furniture) industry, as well as the production of food products & beverages, reports average shares of 1.1% in all periods covered by the data set, while several other industries fluctuate closely around 1.2%[20].

Figure 4.2: The Least Concentrated Industries



Midelfart-Knarvik & Overman (2002) identified a pattern of labour intensive, low-skill industries being relatively concentrated, and high-skill industries being relatively dispersed. To the extent that there was a trend in the development of the concentration indexes, it seemed to reinforce the initial patterns. In our data, however, there is a mix of industries in both categories, and it is not possible to find a general trend of labour intensive industries being concentrated and high-skill industries being dispersed. Moreover, even though the least concentrated industries seemed to reinforce this tendency over the three decades studied, the most concentrated industries became less concentrated over the same period. In our data from Norway there is, if anything, a trend of convergence rather than a trend of reinforcement of initial differences. These findings are more in line with those of Hallet (2000).

[20] These shares indicate dispersion, but it is important to be aware of the fact that they are only average shares, and that they can give no final evidence of a perfectly dispersed industry.

4.3 How has the concentration of industries developed over time?

The concentration index in Table C2 gives one more important insight, namely that there has been a decreasing trend of concentration over time. The mean in Figures 4.1 and 4.2 is steadily declining, and Figures 4.3 and 4.4 illustrate the dispersion process even clearer. These results stand in contrast to results from several studies of European industrial concentration, see for example the former mentioned studies by Barrios & Strobl (2004) or Midelfart-Knarvik & Overman (2002), where the concentration of the manufacturing industry was found to be increasing. As Barrios & Strobl (2004) pointed out, however, the concentration is often higher the higher the regional classification level one studies, and the level of regional specification may in our case explain some of these differences from other studies as we have used NUTS4 regions as the point of departure for our analysis[21].

Figure 4.3: Changes in Industrial Concentration

1973/1976 - 1985/1988, 1985/1988 - 1997/2000, and 1973/1976 – 1997/2000

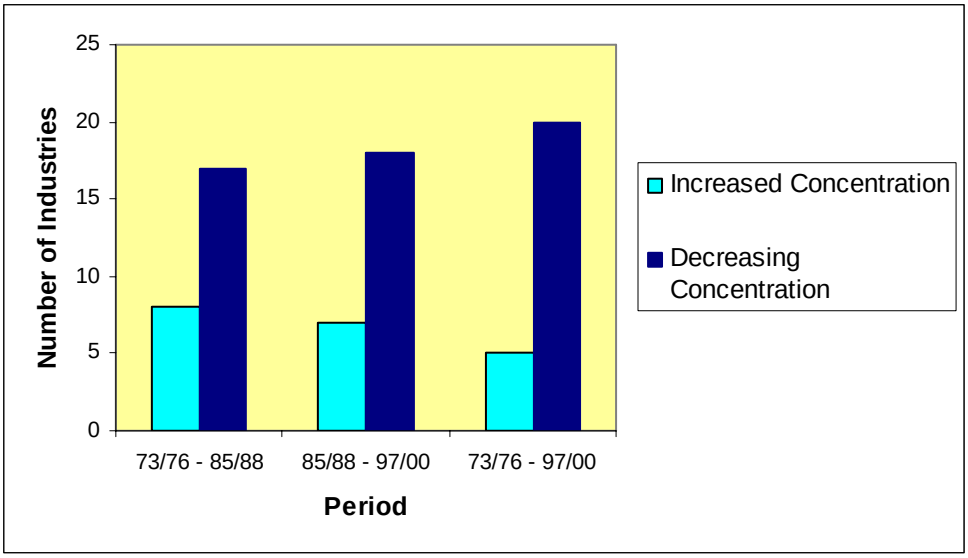


Figure 4.3 shows the change in concentration between 1973/1976 and 1985/1988, 1985/1988 and 1997/2000, and over the whole period covered by the dataset. In the first calculated change period, only 32% of the industries experienced increased concentration, while as many

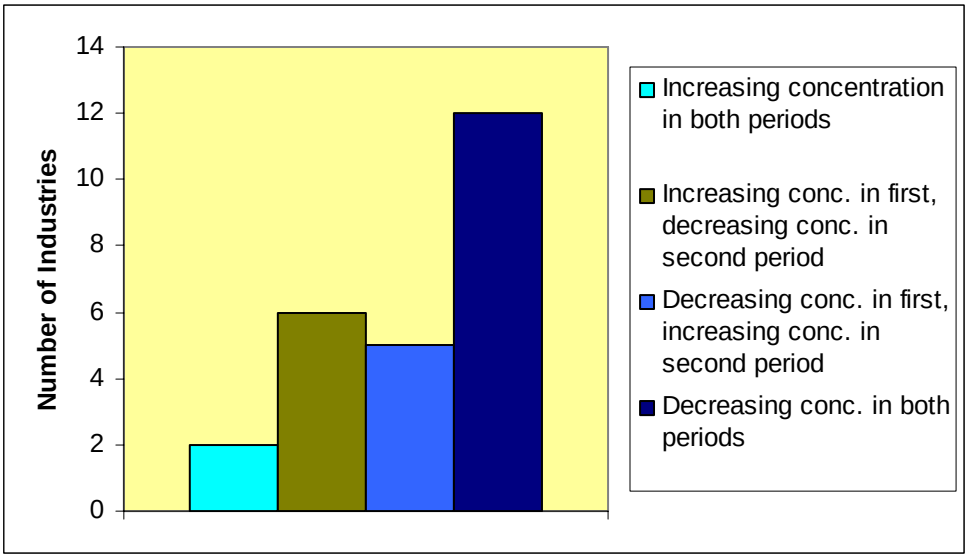
[21] Other studies have analysed location patterns in NUTS2 regions or at the country level.

as 68% experienced geographical dispersion. The following period this tendency was reinforced; 28% of the industries reported increasing concentration, while 72% were dispersing.

The fact that so many of the industries have moved in the direction of geographical dispersion, indicates a general trend, but in order to confirm this, it is necessary to ask: is there a tendency of the same industries to concentrate or disperse over time, or have the changes in industrial location been a more general phenomenon? Figure 4.4 shows that not all industries characterised by dispersion in the first period have reinforced this tendency in the second period. On the other hand, only two industries reinforced their tendency to concentrate while 12 industries actually reinforced their tendency to disperse.

Figure 4.4: Changes in Industrial Concentration

1973/1976 - 1985/1988 and 1985/1988 - 1997/2000



At the outset, based on theory and former findings, we had expectations of increased concentration in the Norwegian manufacturing industry over the last three decades. However, our calculations showed, contrary to our expectations, a general trend of geographical dispersion. Where Hallet (2000) found that there was a trend of dispersion in the 1980s, but the trend reverted into concentration in the 1990s, we found that all periods were marked by

dispersion of economic activity, and that this tendency was particularly strong between 1985/1988 and 1997/2000.

The previously employed concentration measure, $s_i^k(t)$, can also be interpreted as an economic region's share of activity in the manufacturing industry as a whole, with k representing the total manufacturing industry. This second version of the concentration index has been calculated and is shown in Table C1 in Appendix C. This other version of the concentration index supports the former observations of dispersion; between 1973 and 2000 an economic region's average share in the manufacturing industry declined from 3.6% to 2.4%. In section 4.4 a closer examination of this particular concentration index will be form the basis of a discussion about in which regions the industries tend to concentrate.

In order to examine the development of the concentration in the whole of the manufacturing industry even closer, a Gini coefficient of the $s_i^k(t)$, with k = all manufacturing, has been calculated and is reported in Table 4.1[22].

Table 4.1: The Gini Coefficient of Concentration

($s_i^k(t)$, k = all manufacturing, 4 year averages)

	73 / 76	77 / 80	81 / 84	85 / 88	89 / 92	93 / 96	97 / 00
Gini coefficient	0.642	0.613	0.604	0.601	0.601	0.596	0.590

If all economic regions had the same amount of manufacturing, the coefficient would be 0 and if all manufacturing was concentrated in one economic region, the coefficient would be 1. The Gini coefficients are relatively high and suggest a certain level of industrial concentration. However, starting out at 0.642 in 1973/1976, the coefficient sinks steadily during the whole period, ending up at 0.590 in 1997/2000 indicating a development in direction of less concentration over time, in accordance with the former observations.

[22] The Gini coefficient of concentration measures the dispersion of absolute production shares, $s_i^k(t)$, across economic regions for a given industry. The Lorenz curve associated with the coefficient has cumulated $s_i^k(t)$ on the vertical axis, cumulated number of locations on the horizontal axis and the locations are ranked by s_i^k.

4.4 In which economic regions are the industries concentrated?

Applying the variant of $s_i^k(t)$ where k represents all manufacturing industries, makes the concentration measure highly useful for a closer examination of the regional structure of the Norwegian manufacturing industry.

This concentration index for the periods 1973-1976, 1977-1980, 1981-1984, 1985-1988, 1989-1992, 1993-1996 and 1997-2000 is presented in Table C.1 in Appendix C. The table gives, as discussed above, a general picture of a Norwegian manufacturing industry that has been, and continues to be, relatively dispersed. Below follow a few graphical interpretations of the table.

Figure 4.5: Regional Concentration

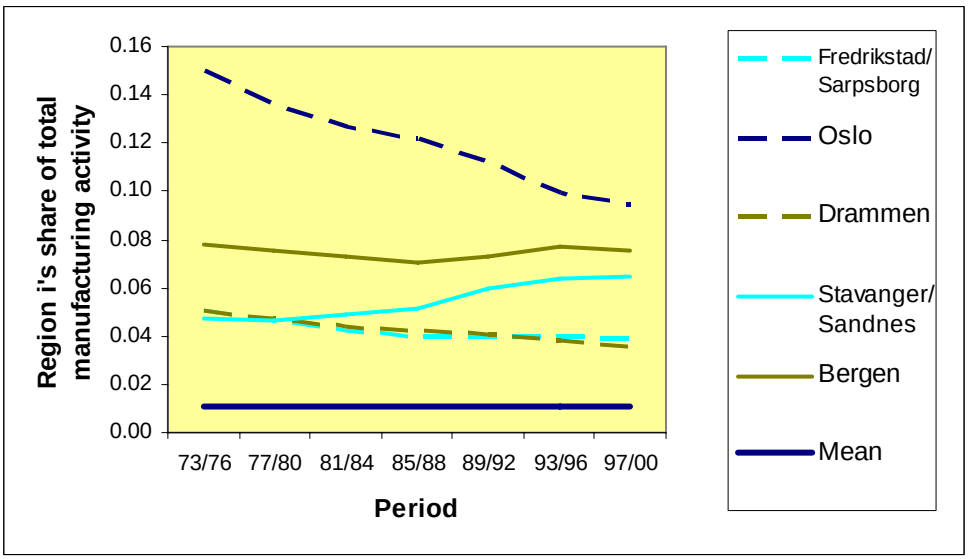


Figure 4.5 highlights the five most concentrated economic regions. Not surprisingly, considering the type of activity measure applied, the economic region that stands out with by far the largest share of the total manufacturing sector is Oslo, the capital of Norway. Oslo counted for about 15% of the total manufacturing activity in the first period, but the share has decreased steadily, and in 1997/2000, Oslo had only 9.5% of the total manufacturing activity. A closer examination of the data reveals that the industrial activity in Oslo as well as in the country as a whole has decreased steadily over the studied period. The activity level in Oslo has, however, decreased more and faster than in the rest of Norway, a fact that should explain Oslo's decreasing share of the total industrial activity. Other large "city regions" like Bergen, Stavanger/Sandnes, Drammen and Fredrikstad/Sarpsborg also stand out as economic regions

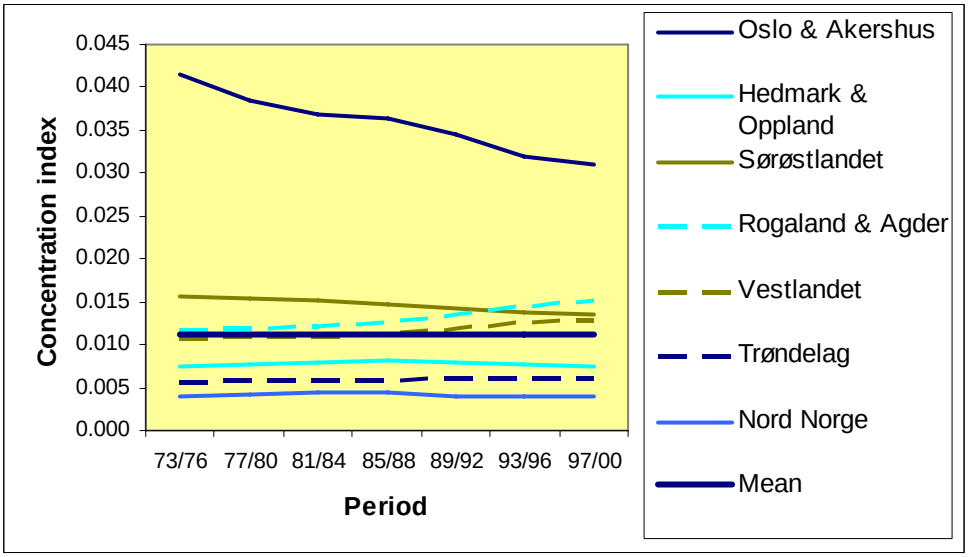
with a relatively high concentration of manufacturing industry. Drammen and Fredrikstad/Sarpsborg are in the neighbouring NUTS2 region of Oslo, namely Sørøstlandet, and they have, like Oslo, experienced a decrease in their manufacturing employment. Drammen started out at 5.1% and ended up at 3.6% while Fredrikstad/Sarpsborg started out at 5% and ended up at 3.9%. Bergen and Stavanger/Sandnes, both economic regions situated on the Norwegian west coast, have, on the other hand, experienced a stable or growing number of working hours in the manufacturing industry. Bergen, which is the second largest city in Norway, has managed to keep its share of the total manufacturing more or less stable at 7.5% over the whole period between 1973/1976 and 1997/2000, while Stavanger/Sandnes has reinforced its position as an important supplier of manufacturing jobs, with an increase from 4.8% in 1973/1976 to 6.4% in 1997/2000. However, it is important to note that the economic regions with a relatively high share of the manufacturing industry are exceptions to the general picture.

Although there seems to be a relatively high degree of industrial concentration in Oslo, the national picture is more characterised by quite a low degree of concentration. In 1973/1976, 64 out of 90 economic regions each had less than 1% of the manufacturing industry. Moreover, during the period the data set covers this picture did not change much; in 1997/2000, 60 of the 90 economic regions had shares of the manufacturing industry that were below 1%. All in all, Figure 4.5 gives the impression of a manufacturing industry quite concentrated around a few economic regions containing what in a Norwegian context are large cities.

Observations from the NUTS4 level are reinforced when the industrial concentration in the NUTS2 regions of Norway is examined in Figure 4.6. In general, the concentration level is quite low and the mean shows clearly that it has been so over time. However, as suggested earlier, a few regions at the NUTS2 level stand out as more concentrated than the average Norwegian NUTS2 region. Oslo & Akershus forms a class by itself, being the most concentrated region over the whole time span. The average share of an economic region in this part of the country decreased from 4.1% in 1973/1976 to 3.1% in 1997/2000. In spite of a tendency to disperse, however, Oslo & Akershus has remained far more concentrated than the next region on the list; Sørøstlandet. Sørøstlandet has followed the tendency of Oslo & Akershus to disperse, but only modestly. Starting out with an average of 1.6% in 1973/1976 the concentration level decreased to 1.4% in 1997/2000. Another interesting observation in

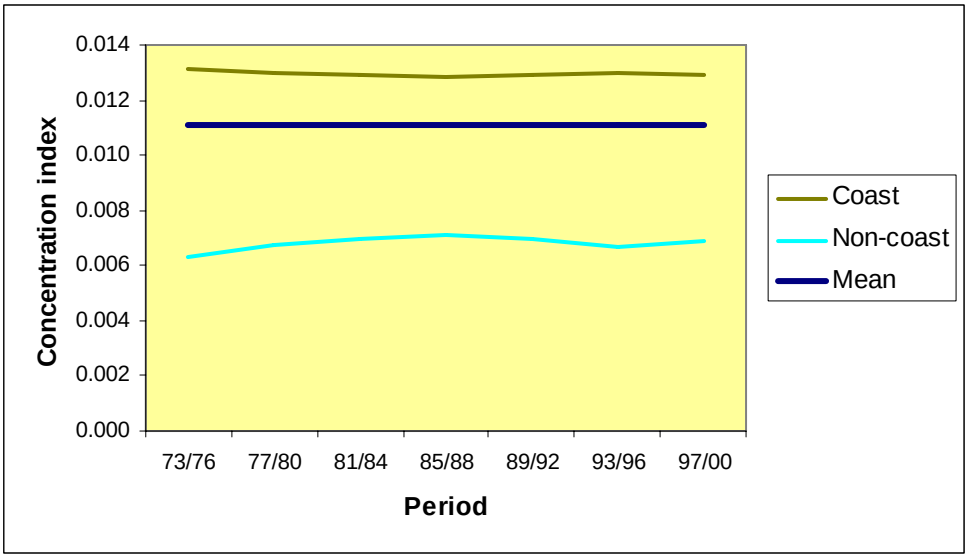
Figure 4.6 is, that all regions at NUTS2 level that were above the mean of 1.4% in 1973/1976, remained above the mean till the end of the observation period when the mean was 1.3%. Similarly, all regions starting out below the mean, stayed below the mean over the whole period covered by the dataset. Nord-Norge and Trøndelag in particular, seem to be the losers of the competition of locating manufacturing industry, a position that has remained the same over the whole period between 1973/1976 and 1997/2000.

Figure 4.6: Regional Concentration, NUTS2 Level



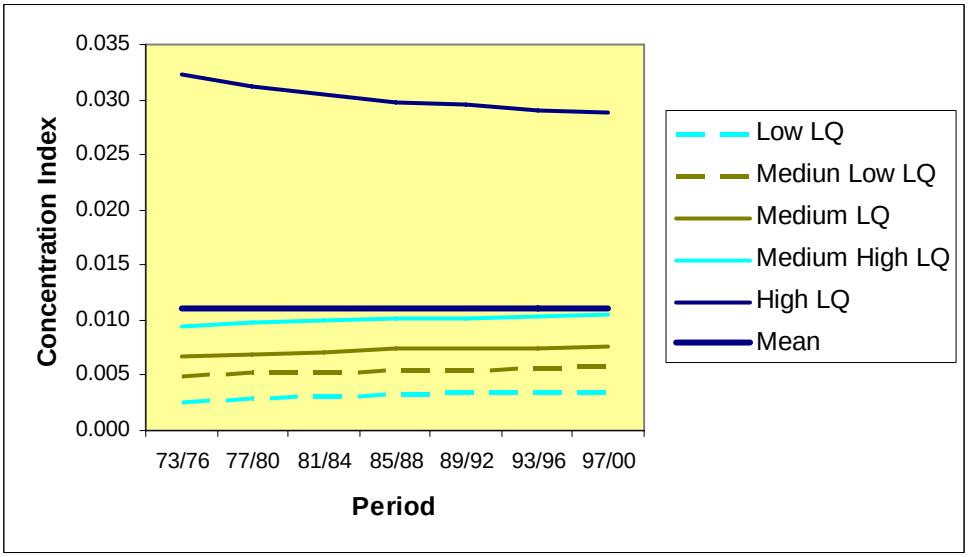
A few characteristics other than mere regional belonging can be interesting to take a closer look at. Calculations show that an average economic region with a coast line is more frequently host to manufacturing industries than an economic region in the inland. Figure 4.7 illustrates this point. The fact that the non-coast concentration index lies quite far below the mean may suggest that the manufacturing industry is non-existent, or more likely; represented to a very low degree, in some of the inland economic regions – a fact supported by the results in Table C.1. The difference between inland and coastal economic regions has remained about the same over the whole period between 1973/1976 and 1997/2000.

Figure 4.7: Regional Concentration, Coastal & Non Coastal Regions



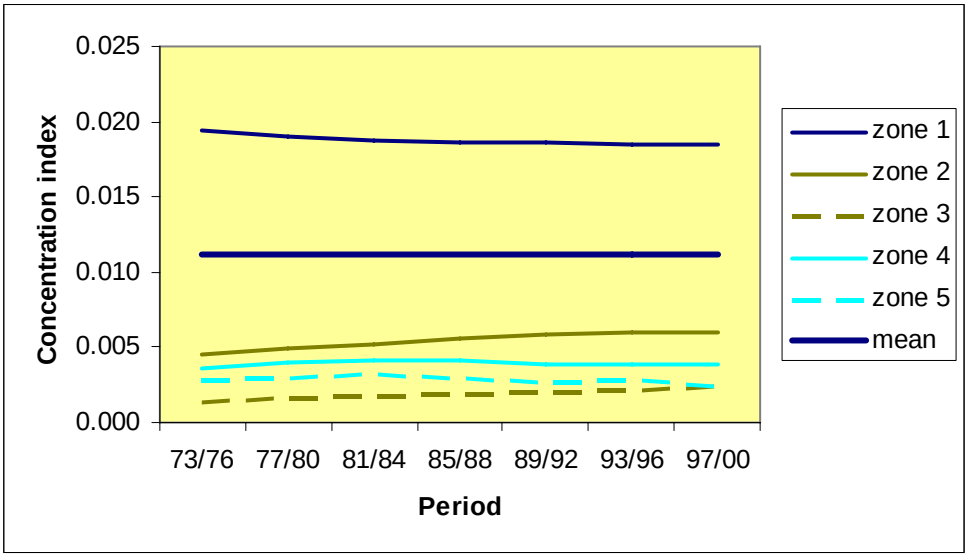
When dividing the economic regions into groups of central and not-so-central location based on the centrality index as shown in Figure 4.8, a quite similar pattern to that of Figure 4.6 emerges. One group, formed by the by far most central economic regions, stands out as the host of a major part of the manufacturing industry, while the rest is gathered below the mean. This fits in well with the pattern in Figure 4.6 where Oslo & Akershus, the most centralised NUTS2 region, is well ahead of the other NUTS2 regions when it comes to attracting manufacturing industry.

Figure 4.8: Regional Concentration, Centrality



It is interesting that our results indicate that in spite of a set of policies and attempts to redistribute income and employment possibilities between urban and rural regions, the differences remain about the same over time. Another interesting feature, which may bee seen from Figure 4.8, is the almost perfect proportional relationship between centrality and industrial concentration; the more central an economic region is, the more manufacturing industry is, on average, located in that particular region.

Figure 4.9: Regional Concentration, Payroll-tax Zone



An alternative indication of centrality, the payroll-tax zone, is implemented in order to explore the concentration level according to a more political interpretation of centrality. The Norwegian system of the differentiated payroll-tax is primarily aimed at stimulating economic activity in order to create new, or more often keep already existent, employment opportunities in peripheral regions. Employers in Zone 1 pay full taxes for their employees, while employers in zone 5 have a total relief from payroll-taxes[23]. Figure 4.9 looks pretty much the same as Figure 4.8 although the centrality measures do not coincide completely. The pattern is more or less the same for both types of centrality measures; firstly, the manufacturing industry tends to concentrate in the payroll-tax zones with the highest taxes and in the most central regions, and secondly, the lower the payroll-tax zone or the more peripheral the region, the less concentration of manufacturing industry is apparent.

[23] In Table A1 in Appendix A the economic regions are listed with their respective payroll-tax zones.

Regional Characteristic Bias

Further knowledge about characteristics of the economic regions in which manufacturing industries tend to concentrate can be added by implementing a regional characteristic bias of industry k (RCB), parallel to that of the industries. The RCB is defined by the following equation:

$$RCB^k(t) = \sum_i s_i^k(t) z_i$$

This measure allows us to sum up the regional characteristics of each industry; it calculates for each industry the average of each characteristic of the regions in which the industry is located, and weighs each regional characteristic by the share of the industry's output in that particular region. Different regional characteristic variables[24] are listed in Box 4.1.

Box 4.1: RCB Characteristics

Characteristics	**Explanation**
Labour costs	Wage costs per man hour
Education	Share of population with higher education
Agricultural production	Agricultural share of GDP
Industrial production	Manufacturing share of GDP
Service production	Service share of GDP
Public production	Public share of GDP
Regional support	"Rammetilskudd" (grant) from the state authorities

The RCBs are calculated for two periods of time, the first 1985/1988 and the second 1997/2000. The industries are then divided into three groups based on the score on each RCB; low, middle and high. The results of these calculations are shown in Table 4.2[25]. The first letter shows the score in the first period, and the second the score in the second period.

[24] A more thorough presentation of the regional characteristics is provided in Appendix A.

[25] The exact scores for each manufacturing branch are listed in Table C3 in Appendix C.

Table 4.2 Industrial RCBs, 1989/1992 and 1997/2000

	Education level	Agriculture's share of GDP	Manufacturing's share of GDP	Services' share of GDP	Regional support	Public production's' share of GDP[26]	Labour costs
Food products & beverages	H H	H H	M H	H H	H H	. H	L H
Tobacco products	L L	L L	L L	L L	H H	. L	M H
Textiles	L L	L L	L L	L L	L L	. L	L L
Leather products & footwear	L L	M L	L L	L L	L L	. L	L L
Wood & cork (not furniture)	M M	H H	H M	H H	M M	. H	L L
Pulp, paper & paper products	H H	H M	H H	H H	M M	. H	M M
Publishing, printing& reproduction of recorded media	H H	L M	M M	H H	H H	. H	M M
Coke, refined petroleum products	L L	L L	L L	L L	L L	. L	H H
Chemicals (not pharmaceuticals)	H H	M M	M H	H H	H H	. M	H M
Pharmaceuticals (NACE244)	M M	L L	H M	M M	H H	. M	H H
Rubber & plastic products	M M	M M	M M	M M	L L	. M	L L
Non-metallic mineral products	M M	M M	M M	M M	L L	. M	M M
Basic metals, ferrous	M M	H H	M H	M M	M M	. H	H M
Basic metals, non-ferrous	H H	H H	H H	H H	M M	. H	H M
Fabricated metal products	M M	M M	H M	M M	M M	. M	M M
Machinery nec.	H H	H H	H H	H H	H H	. H	H H
Office, accounting & computing machinery	M L	L L	L L	L L	H H	. L	H M
Electrical machinery	M M	M M	H M	M M	M M	. M	M H
Instruments, watches & clocks	L L	L L	L L	L L	M H	. L	H H
Motor vehicles	L M	M H	M M	M M	L L	. M	L M
Ships	H H	H H	HH	H H	M M	. H	M L
Aerospace	H H	M M	M M	M M	M M	. M	M H
Other transport nec.	L L	L L	L L	L L	H M	. L	M L
Furniture	M M	H H	M H	M M	L L	. M	L L
Other manufacturing nec.	L L	M M	L L	L L	L L	. L	L L

[26] Calculations are based on numbers from 1999 as data on public manufacturing were only available for this year.

Industries with a low RCB score in one period tend to be low in both periods; only 8 out of 26 observations of change over time included a low RCB in one of the periods. Most of the other industries, on the other hand, move from high to middle and from middle to high on one or more RCBs. The overall picture is nevertheless that of characteristics changing very little over time. After all, only 26 out of 175 observations implied changes in the RCB score level. However, if any characteristic that changes over time was to be emphasised, it would be manufacturing's share of total GDP along with manufacturing wages per hour. As far as the manufacturing's share of GDP is concerned, one might expect a general decrease as a result of the observed structural shift from manufacturing to services, but our results show exactly the same number of industries capturing more shares of the GDP as number of industries losing their shares of GDP. It seems that not all manufacturing industries are scaling down as a result of the shift to services; simply because the products of some industries are not easily replaced with imports of cheaper products from other countries, and because products from several industries are closely related to increasingly demanded services. The industries increasing their share of GDP, illustrate this point; they are industries traditionally located close to suppliers and customers, like the food & beverages industry, or they are industries providing products with a character of design and lifestyle, like the manufacturing of furniture.

The tendency for an industry to score the same on most or all characteristics is another apparent pattern; we have seen that industries with a low RCB score in one period tend to be low in both periods, and apparently it is also so that an industry with a low RCB score on one characteristic often scores low on most of the other characteristics. In particular the industries with low RCBs seem to be persistent in scoring low on all characteristics as well. The textile industry is special as it scores low on all characteristics in both periods. This industry in particular seems to locate in regions that on average have populations with little education, where the share of the population working in agriculture, industry or services is low, and where the public production level and the regional aid are low. Also the industry of coke, refined petroleum products & nuclear fuel scores low on all characteristics except one; average wage cost. Petroleum related industry has traditionally been able to locate outside the traditional centres and the regional characteristic bias is very similar to that of the textile industry. However, as Norway is quite dependent on oil and petroleum related activities, this industry has been subject to substantial investments, both private and public, and job prospects in this industry have been good. Due to special working conditions the labour

organisations have had substantial influence, and this combined with the general feeling of a prosperous future makes it little surprising that the wage level is relatively high in this industry.

At the other end of the scale, production of machinery scores high on all characteristics in both periods and is apparently an industry marked by high wages to a well educated labour force. This particular industry is located in regions where agriculture, manufacturing and service production are responsible for substantial parts of the total regional production value, and where the regional aid as well as the public share of total production is high compared to the rest of the country.

4.5 Are there any characteristics typical to a concentrated industry?

According to our analysis, the typical concentrated industry is located in central regions (regions with a high LQ), generally "city regions" close to Oslo or at the Norwegian west coast. A crossing of the concentration indexes with the calculated RCBs provides further information about the host regions of concentrated industries. The regions, in which concentrated industries tend to locate, are characterised by relatively high wages in spite of a relatively low education level. Regional aid is in some cases substantial and always among the highest in Norway. Sectors other than agriculture, manufacturing and services, like for example construction, mining or petroleum and gas extracting, seem to dominate the region's production income. Furthermore, private production is more important in these regions than in other regions. The pharmaceuticals industry has been the most concentrated industry in Norway over the whole period studied, and is in most aspects a typical concentrated industry. A few observations are, however, special for this particular industry compared to most other concentrated industries; the education level as well as the share of services of total GDP is relatively high.

5. Summary and Concluding Remarks

Summary

Over the three decades studied in this report, there has been a substantial reorganisation of the location pattern of manufacturing industries within Norway. Whether this is a result of agglomeration forces or Norwegian industry and regional policy or both, remains unclear, but a combination is possibly the best explanation. However, our results indicate that, if anything, the dispersion forces have been stronger than the agglomeration forces in Norway between 1973 and 2000. A suggested explanation of this phenomenon has been that the manufacturing production is based on input factors that are constantly being more evenly spread around the country. In the case of Norway, the spread of natural resources has been more or less constant over the whole period studied, but the education level, on the other hand, has increased, and the regional differences have evened somewhat out if Oslo is left out of the count.

The Norwegian economic regions seem to be more specialised than the NUTS2 regions in Europe. This may not be very surprising as it seems logical that smaller regions are more specialised than larger regions. More surprising, however, is the observed tendency of decreasing specialisation and general convergence in the economic regions of Norway. This observation stands in contrast to most of the economic theory about economic integration, but coincides with empiric results from Marelli (2002) among others, and may be explained by integration leading to a more structural similarity between the regions.

Similarly, we have observed an on average steadily decreasing concentration level in the 25 manufacturing industries studied. Although the evidence from Europe is quite inconclusive, not one of the mentioned studies of concentration in European regions has shown a clear tendency of spatial dispersion, like the one emerging from our data. The deindustrialisation process has by many been feared to lead to increasing concentration in central regions, but these fears may be somewhat subdued by our results as the concentration level on average has decreased. Furthermore, it has not been possible to find a general trend in Norway of labour intensive industries being concentrated and high-skill industries being dispersed as was the case for Europe. Moreover, even though the least concentrated industries seemed to reinforce

this tendency over the three decades studied, the most concentrated industries became less concentrated over the same period.

Some characteristics of specialised regions as well as concentrated industries have emerged from the analysis: A typical specialised economic region is not particularly central, it has a coastline and it is specialised in factor intensive industries. A concentrated industry, on the other hand, is generally concentrated in more central economic regions, and in regions with a coastline. Central economic regions are, in short, normally little specialised, but they are hosts to various concentrated industries, while the coastal economic regions on average are quite specialised and tend to specialise in industries that are relatively concentrated. The regions that are neither specialised nor hosts to concentrated industries, and therefore probably the regions least capable of attracting industrial activity, are the peripheral inland regions of Norway.

A few final remarks:

Many of the variables in this report are based on observations given in NOK. These numbers are all nominal, not real, and as a result the reported changes over time may be overestimated (in both directions). A similar experiment to ours, but with real numbers, would thus be interesting. Still; the comparison between regions and industries is valid as the "problem" of nominal values is the same for all categories. The main results in this report are therefore likely to be the same even when real numbers are the basis of the variables.

This study does not involve other sectors than the manufacturing industry, and should therefore be treated with care if it is used as a foundation for decisions concerning regional employment or the forming of regional policies of any kind. Empirical research, see for example Hallet (2000), ascertains that manufacturing is normally more concentrated than other sectors and that there is a general trend towards a shift from manufacturing to services in Europe. The concentration of the manufacturing sector may therefore not be the only relevant variable when deciding about a regional employment policy.

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Appendix A

Sources and Treatment of the Data material

Statistics of value added, manufacturing employment, man hours, investment in capital, wage costs and gross production value are from **the Manufacturing Time-series database** from Statistics Norway. These manufacturing statistics are cleansed in advance of the calculations. The database consists of reports from about 15 000 enterprises each year in the years 1973-2000. Observations with missing reports of the variables needed for our calculations are excluded from the dataset. The same applies to observations with reports of negative values of wage costs, employment, man hours or value added. Industries other than manufacturing as well as regions outside mainland Norway have also been excluded. The basis for all calculations is the aggregated industries listed in Table A.2 and the NUTS4 regions, the so called economic regions, listed in Table A.1.

The **labour-tax zones** are also extracted from the manufacturing time series database. There are five zones, with zone 5 representing the lowest tax level. The zones apply to NUTS5 regions, the so-called "kommuner", and the classification of each NUTS5 region may change from year to year. However, for the purpose of the simple analysis of the labour-tax zones in this report, the classifications from year 2000 are applied. For each economic region the average zone is calculated and rounded off to the nearest integer.

Employment data (by main economic sectors) and data on **regional aid** as well as the **education** data are extracted from different databases and provided for the years 1989, 1991, 1993, 1995, 1997 and 1999 by Statistics Norway. These datasets were all initially reported at NUTS5 level, and have been aggregated to NUTS4 level for our analysis. The employment data must be considered as preliminary. The foundation of the preliminary dataset will be the same as for the final, but at the time Statistics Norway had not yet had the time to quality-check their registrations when the material was handed over.

The **research and development** data are the official numbers reported from Statistics Norway to the OECD OFFBERD database. These numbers are registered every second year and are provided for the years 1989, 1991, 1993, 1995, 1997 and 1999. The data were

reported by manufacturing branches, and our classification of manufacturing industries is based on the one applied in these datasets.

Table A.1 NUTS Classifications, Coastline Indices, Centrality Index, and Labour-tax zones.

NUTS 4	No.	NUTS 2	No.	Coastline	New centrality	Labour-tax zone
Halden	191	Sørøstlandet	3	1	0.61	1
Moss	192	Sørøstlandet	3	1	0.45	1
Fredrikstad/Sarpsborg	193	Sørøstlandet	3	1	0.8	1
Askim/Mysen	194	Sørøstlandet	3	0	0.45	1
Follo	291	Oslo & Akershus	1	1	1.18	1
Bærum/Asker	292	Oslo & Akershus	1	1	2.44	1
Lillestrøm	293	Oslo & Akershus	1	0	0.6	1
Ullensaker/Eidsfjord	294	Oslo & Akershus	1	0	0.68	1
Oslo	391	Oslo & Akershus	1	1	2.11	1
Kongsvinger	491	Hedmark & Oppland	2	0	0.4	2
Hamar	492	Hedmark & Oppland	2	0	0.78	1
Elverum	493	Hedmark & Oppland	2	0	0.39	2
Tynset	494	Hedmark & Oppland	2	0	0.61	3
Lillehammer	591	Hedmark & Oppland	2	0	0.54	1
Gjøvik	592	Hedmark & Oppland	2	0	0.48	1
Midt-Gudbrandsdalen	593	Hedmark & Oppland	2	0	0.23	2
Nord-Gudbrandsdalen	594	Hedmark & Oppland	2	0	0.42	3
Hadeland	595	Hedmark & Oppland	2	0	0.33	1
Valdres	596	Hedmark & Oppland	2	0	0.45	3
Drammen	691	Sørøstlandet	3	1	0.77	1
Kongsberg	692	Sørøstlandet	3	0	0.93	1
Hønefoss	693	Sørøstlandet	3	0	0.7	1
Hallingdal	694	Sørøstlandet	3	0	0.34	2
Tønsberg/Horten	791	Sørøstlandet	3	1	0.87	1
Holmestrand	792	Sørøstlandet	3	1	0.38	1
Sandefjord/Larvik	793	Sørøstlandet	3	1	0.89	1
Sande/Svelvik	794	Sørøstlandet	3	1	0.37	1
Skien/Porsgrunn	891	Sørøstlandet	3	1	0.6	1
Notodden/Bø	892	Sørøstlandet	3	0	0.72	1
Kragerø	893	Sørøstlandet	3	1	0.3	1
Rukjan	894	Sørøstlandet	3	0	0.44	2
Vest-Telemark	895	Sørøstlandet	3	0	0.32	2
Risør	991	Rogaland & Agder	4	1	0.75	1
Arendal	992	Rogaland & Agder	4	1	0.72	1
Lillesand	993	Rogaland & Agder	4	1	0.43	1
Setesdal	994	Rogaland & Agder	4	0	0.16	2
Kristiansand	1091	Rogaland & Agder	4	1	0.93	1
Mandal	1092	Rogaland & Agder	4	1	0.57	1
Lyngdal/Farsund	1093	Rogaland & Agder	4	1	0.29	1
Flekkefjord	1094	Rogaland & Agder	4	1	0.3	1
Egersund	1191	Rogaland & Agder	4	1	0.36	1
Stavanger/Sandnes	1192	Rogaland & Agder	4	1	1.04	1
Haugesund	1193	Rogaland & Agder	4	1	0.55	1
Jæren	1194	Rogaland & Agder	4	1	0.38	1

Bergen	1291	Vestlandet	5	1	0.94	1
Søndre Sunnhordland	1292	Vestlandet	5	1	0.45	2
Nordre Sunnhordland	1293	Vestlandet	5	1	0.45	2
Odda	1294	Vestlandet	5	1	0.21	2
Voss	1295	Vestlandet	5	1	0.54	1
Florø	1491	Vestlandet	5	1	0.52	2
Høyanger	1492	Vestlandet	5	1	0.19	2
Sogndal/Årdal	1493	Vestlandet	5	1	0.46	2
Førde	1494	Vestlandet	5	1	0.54	2
Nordfjord	1495	Vestlandet	5	1	0.36	2
Molde	1591	Vestlandet	5	1	0.42	1
Kristiansund	1592	Vestlandet	5	1	0.49	1
Ålesund	1593	Vestlandet	5	1	0.55	1
Ulsteinvik	1594	Vestlandet	5	1	0.44	2
Ørsta/Volda	1595	Vestlandet	5	1	0.3	1
Sunndalsøra	1596	Vestlandet	5	1	0.18	2
Surnadal	1597	Vestlandet	5	1	0.21	3
Trondheim	1691	Trøndelag	6	1	1.05	1
Frøya/Hitra	1692	Trøndelag	6	1	0.2	4
Brekstad	1693	Trøndelag	6	1	0.25	3
Oppdal	1694	Trøndelag	6	0	0.24	3
Orkanger	1695	Trøndelag	6	1	0.44	2
Røros	1696	Trøndelag	6	0	0.22	3
Steinkjer	1791	Trøndelag	6	1	0.44	2
Namsos	1792	Trøndelag	6	1	0.53	4
Stjørdalshalsen	1793	Trøndelag	6	1	0.37	1
Levanger/Verdalsøra	1794	Trøndelag	6	1	0.28	1
Grong	1795	Trøndelag	6	0	0.41	4
Rørvik	1796	Trøndelag	6	1	0.33	4
Bodø	1891	Nord-Norge	7	1	0.53	4
Narvik	1892	Nord-Norge	7	1	0.51	4
Brønnøysund	1893	Nord-Norge	7	1	0.29	4
Sandnessjøen	1894	Nord-Norge	7	1	0.35	4
Mosjøen	1895	Nord-Norge	7	1	0.3	4
Mo i Rana	1896	Nord-Norge	7	1	0.86	4
Lofoten	1897	Nord-Norge	7	1	0.32	4
Vesterålen	1898	Nord-Norge	7	1	0.44	4
Harstad	1991	Nord-Norge	7	1	0.55	4
Tromsø	1992	Nord-Norge	7	1	0.62	4
Andselv	1993	Nord-Norge	7	1	0.23	4
Finnsnes	1994	Nord-Norge	7	1	0.43	4
Nord-Troms	1995	Nord-Norge	7	1	0.27	5
Vadsø	2091	Nord-Norge	7	1	0.32	5
Hammerfest	2092	Nord-Norge	7	1	0.28	5
Alta	2093	Nord-Norge	7	1	0.43	5
Kirkenes	2094	Nord-Norge	7	1	0.5	5

Table A.2 Definition of Industries

3110	**Food products & beverages**
3120	Tobacco products
3210	Textiles
3230	Leather products & footwear
3310	Wood & cork (not furniture)
3320	Pulp, paper & paper products
3330	Publishing, printing & reproduction of recorded media
3410	Coke, refined petroleum products & nuclear fuel
3421	Chemicals (less pharmaceuticals)
3422	Pharmaceuticals (NACE 244)
3430	Rubber & plastic products
3500	Non-metallic mineral products
3610	Basic metals, ferrous
3620	Basic metals, non-ferrous
3700	Fabricated metal products
3810	Machinery, nec
3820	Office, accounting & computing machinery
3830	Electrical machinery
3850	Instruments, watches & clocks
3860	Motor vehicles
3871	Ships
3872	Aerospace
3873	Other transport nec
3910	Furniture
3920	Other manufacturing nec

Appendix B

Table B.1: Krugman Specialisation Index

(4 year averages)

Economic Region/ Year	73 / 76	77 / 80	81 / 84	85 / 88	89 / 92	93 / 96	97 / 00
191	0.924	0.930	0.942	0.928	0.943	0.965	0.909
192	0.818	0.852	0.941	0.879	0.852	0.967	0.944
193	0.538	0.538	0.566	0.570	0.676	0.719	0.693
194	0.734	0.676	0.620	0.585	0.645	0.616	0.591
291	0.579	0.531	0.484	0.500	0.552	0.594	0.542
292	0.791	0.894	0.940	0.913	0.912	0.928	0.874
293	0.577	0.612	0.567	0.541	0.614	0.603	0.562
294	0.668	0.602	0.618	0.643	0.748	0.711	0.735
391	0.705	0.738	0.814	0.877	0.887	0.932	0.955
491	0.738	0.775	0.718	0.678	0.667	0.678	0.666
492	0.833	0.819	0.771	0.749	0.706	0.699	0.732
493	0.945	0.952	0.901	0.830	0.797	0.839	0.880
494	0.644	0.643	0.672	0.714	0.712	0.657	0.719
591	0.654	0.631	0.619	0.581	0.510	0.513	0.532
592	0.690	0.744	0.778	0.771	0.765	0.850	0.871
593	0.684	0.614	0.725	0.796	0.785	0.747	0.724
594	0.793	0.652	0.679	0.654	0.615	0.611	0.592
595	1.033	1.061	1.016	0.946	0.955	0.940	0.984
596	0.783	0.726	0.726	0.653	0.603	0.577	0.560
691	0.718	0.676	0.697	0.790	0.849	0.874	0.848
692	1.054	1.081	1.045	1.097	1.071	0.974	0.938
693	0.946	0.939	0.927	0.953	0.922	0.897	0.932
694	0.845	0.808	0.818	0.754	0.705	0.679	0.650
791	0.738	0.726	0.628	0.549	0.489	0.552	0.529
792	1.080	1.086	1.147	1.136	1.025	1.118	1.178
793	0.424	0.449	0.428	0.498	0.554	0.580	0.589
794	1.242	1.191	0.970	1.027	1.128	1.161	1.176
891	0.842	0.882	0.891	0.936	0.989	0.986	0.901
892	0.753	0.818	0.811	0.733	0.792	0.788	0.749
893	0.851	0.863	0.827	0.802	0.786	0.826	0.774
894	0.929	0.977	1.000	1.009	0.925	0.834	0.773
895	0.830	0.804	0.749	0.745	0.747	0.739	0.650
991	0.784	0.752	0.763	0.760	0.755	0.737	0.714
992	0.688	0.651	0.663	0.651	0.621	0.616	0.612
993	0.794	0.853	0.875	0.863	0.774	0.715	0.683
994	0.841	0.867	0.763	0.768	0.836	0.844	0.839
1091	0.662	0.619	0.592	0.681	0.626	0.537	0.530
1092	0.827	0.817	0.825	0.884	0.896	0.942	0.938
1093	0.897	0.820	0.773	0.828	0.846	0.910	0.967
1094	0.689	0.686	0.713	0.816	0.827	0.859	0.904
1191	0.658	0.732	0.844	0.885	0.873	0.862	0.893
1192	0.504	0.596	0.713	0.684	0.755	0.803	0.766
1193	0.779	0.755	0.776	0.760	0.756	0.786	0.745
1194	0.914	0.939	0.846	0.754	0.684	0.740	0.741
1291	0.480	0.494	0.491	0.468	0.487	0.466	0.423
1292	0.647	0.673	0.671	0.625	0.541	0.533	0.563
1293	1.190	1.153	1.059	1.093	1.149	1.165	1.139
1294	1.344	1.272	1.143	1.054	1.058	1.075	1.124
1295	0.696	0.704	0.653	0.678	0.705	0.708	0.710
1491	0.926	0.922	0.909	0.855	0.938	1.004	1.067
1492	1.184	1.156	1.128	1.139	1.198	1.247	1.315
1493	1.074	1.085	1.102	1.093	1.017	0.904	0.813
1494	0.680	0.766	0.741	0.718	0.736	0.748	0.755
1495	0.849	0.842	0.857	0.919	0.908	0.899	0.911
1591	0.756	0.747	0.760	0.852	0.875	0.871	0.862
1592	0.796	0.828	0.771	0.723	0.755	0.733	0.709

1593	0.871	0.844	0.834	0.832	0.826	0.811	0.821
1594	0.849	0.928	0.973	1.023	1.063	1.104	1.105
1595	0.828	0.834	0.843	0.841	0.804	0.808	0.827
1596	1.387	1.375	1.349	1.332	1.238	1.216	1.200
1597	0.697	0.734	0.855	0.908	0.870	0.876	0.835
1691	0.386	0.392	0.423	0.469	0.536	0.549	0.516
1692	0.950	0.955	0.987	1.014	0.996	0.892	0.888
1693	0.799	0.757	0.762	0.756	0.717	0.705	0.709
1694	0.800	0.796	0.752	0.677	0.662	0.617	0.758
1695	0.782	0.750	0.651	0.614	0.640	0.680	0.708
1696	0.656	0.682	0.690	0.650	0.618	0.685	0.817
1791	0.668	0.657	0.597	0.553	0.598	0.557	0.523
1792	0.724	0.749	0.727	0.702	0.645	0.621	0.688
1793	0.858	0.814	0.814	0.832	0.868	0.878	0.923
1794	0.886	0.858	0.856	0.860	0.891	0.939	0.932
1795	0.736	0.701	0.749	0.845	0.726	0.703	0.750
1796	0.768	0.808	0.832	0.850	0.905	0.915	0.988
1891	0.645	0.663	0.682	0.613	0.587	0.571	0.554
1892	0.754	0.801	0.820	0.809	0.796	0.662	0.627
1893	1.039	0.921	0.819	0.805	0.824	0.822	0.775
1894	0.817	0.855	0.916	0.845	0.819	0.843	0.874
1895	1.050	0.998	0.964	0.979	1.010	0.971	1.021
1896	1.304	1.298	1.247	1.152	0.893	0.814	0.930
1897	0.945	0.939	0.938	0.874	0.884	0.945	1.032
1898	1.031	0.986	0.949	0.986	0.933	0.886	0.926
1991	0.906	0.894	0.860	0.786	0.693	0.689	0.697
1992	0.707	0.686	0.679	0.670	0.683	0.729	0.705
1993	0.644	0.567	0.602	0.620	0.606	0.551	0.486
1994	0.958	0.944	0.869	0.756	0.785	0.812	0.771
1995	0.723	0.896	0.981	0.979	0.899	0.885	0.865
2091	1.140	1.155	1.168	1.145	1.041	1.040	1.108
2092	1.083	1.048	1.010	0.990	0.903	0.865	0.826
2093	0.839	0.805	0.802	0.830	0.792	0.768	0.733
2094	0.755	0.691	0.584	0.555	0.624	0.674	0.639

Table B.2: ICB scores

NUTS 2	Period	Labour productivity	Labour costs	Capital intensity	Labour intensity	Industrial growth	R&D intensity
Oslo & Akershus	1981/1984	0.788	0.503	0.099	4.853	0.642	0
Oslo & Akershus	1989/1992	1.099	0.721	0.073	5.327	0.627	0.0005074
Oslo & Akershus	1997/2000	1.737	0.944	0.133	5.506	0.715	0.0009006
Hedmark & Oppland	1981/1984	1.082	0.680	0.167	9.167	1.279	0
Hedmark & Oppland	1989/1992	1.713	1.223	0.166	10.201	1.305	0.0003411
Hedmark & Oppland	1997/2000	2.761	1.979	0.292	10.535	0.247	0.0003297
Sørøstlandet	1981/1984	2.722	1.919	0.725	16.416	6.342	0
Sørøstlandet	1989/1992	3.438	2.354	0.423	20.002	8.719	0.0012234
Sørøstlandet	1997/2000	4.995	3.350	0.555	19.623	2.049	0.0014604
Agder & Rogaland	1981/1984	1.659	1.068	0.188	10.194	2.195	0
Agder & Rogaland	1989/1992	2.533	1.607	0.266	10.651	2.051	0.0011949
Agder & Rogaland	1997/2000	4.523	2.206	0.622	11.750	9.573	0.0013222
Vestlandet	1981/1984	2.074	1.293	0.339	16.321	3.186	0

Vestlandet	1989/1992	3.585	2.243	0.472	15.660	3.777	0.0005783
Vestlandet	1997/2000	5.080	3.026	0.608	20.022	0.918	0.0006973
Trøndelag	1981/1984	1.383	0.879	0.256	11.968	1.688	0
Trøndelag	1989/1992	2.049	1.470	0.304	14.213	2.124	0.0003632
Trøndelag	1997/2000	2.888	1.993	0.342	13.250	1.049	0.0004157
Nord-Norge	1981/1984	1.776	1.129	0.354	18.593	2.646	0
Nord-Norge	1989/1992	3.024	2.257	0.458	33.556	8.520	0.0001905
Nord-Norge	1997/2000	5.187	2.719	0.593	18.458	40.728	0.0002042

Appendix C

Table C.1: Regional Structure of the Norwegian Manufacturing

($s_i^k(t)$, k = all manufacturing, 4 year averages)

Economic Region	73 / 76	77 / 80	81 / 84	85 / 88	89 / 92	93 / 96	97 / 00
191	0.011	0.011	0.010	0.010	0.010	0.010	0.010
192	0.018	0.018	0.018	0.017	0.016	0.015	0.014
193	0.050	0.046	0.042	0.040	0.040	0.040	0.039
194	0.011	0.010	0.010	0.010	0.008	0.007	0.008
291	0.007	0.007	0.007	0.007	0.008	0.009	0.010
292	0.018	0.019	0.019	0.020	0.019	0.019	0.018
293	0.025	0.024	0.025	0.026	0.026	0.026	0.028
294	0.006	0.007	0.007	0.007	0.006	0.005	0.005
391	0.150	0.136	0.127	0.122	0.112	0.100	0.095
491	0.010	0.011	0.012	0.012	0.012	0.011	0.011
492	0.020	0.020	0.020	0.020	0.019	0.018	0.018
493	0.008	0.008	0.008	0.008	0.008	0.008	0.008
494	0.001	0.002	0.002	0.002	0.002	0.002	0.002
591	0.006	0.006	0.006	0.005	0.005	0.004	0.004
592	0.021	0.020	0.021	0.022	0.022	0.022	0.021
593	0.001	0.002	0.002	0.002	0.002	0.002	0.002
594	0.002	0.002	0.002	0.003	0.003	0.003	0.003
595	0.004	0.004	0.004	0.005	0.005	0.004	0.004
596	0.001	0.002	0.002	0.002	0.002	0.002	0.002
691	0.051	0.047	0.044	0.042	0.041	0.038	0.036
692	0.011	0.012	0.013	0.013	0.013	0.013	0.015
693	0.002	0.008	0.010	0.010	0.011	0.011	0.010
694	0.003	0.003	0.003	0.003	0.003	0.003	0.004
791	0.027	0.026	0.026	0.024	0.024	0.024	0.025
792	0.005	0.005	0.005	0.004	0.004	0.004	0.004
793	0.022	0.022	0.023	0.022	0.021	0.021	0.021
794	0.004	0.003	0.003	0.003	0.003	0.003	0.003
891	0.036	0.038	0.038	0.038	0.036	0.034	0.032
892	0.006	0.006	0.006	0.005	0.004	0.003	0.003
893	0.004	0.003	0.003	0.003	0.004	0.004	0.003
894	0.003	0.003	0.003	0.003	0.002	0.002	0.002
895	0.001	0.002	0.002	0.002	0.002	0.002	0.002
991	0.002	0.003	0.003	0.003	0.003	0.003	0.003
992	0.014	0.014	0.015	0.015	0.015	0.017	0.018
993	0.002	0.002	0.002	0.003	0.003	0.003	0.003
994	0.000	0.000	0.001	0.001	0.001	0.001	0.001
1091	0.025	0.024	0.025	0.025	0.023	0.024	0.024
1092	0.005	0.005	0.005	0.005	0.005	0.006	0.006
1093	0.003	0.004	0.005	0.005	0.006	0.008	0.009
1094	0.004	0.004	0.004	0.005	0.005	0.005	0.005
1191	0.005	0.006	0.007	0.007	0.008	0.008	0.009
1192	0.048	0.046	0.049	0.051	0.060	0.064	0.064
1193	0.020	0.020	0.021	0.021	0.023	0.024	0.027
1194	0.010	0.012	0.011	0.011	0.011	0.011	0.013
1291	0.078	0.075	0.073	0.070	0.073	0.077	0.075
1292	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1293	0.012	0.013	0.014	0.017	0.019	0.021	0.022
1294	0.005	0.005	0.005	0.005	0.005	0.005	0.004
1295	0.002	0.002	0.002	0.002	0.002	0.002	0.002
1491	0.004	0.004	0.004	0.004	0.006	0.006	0.006
1492	0.002	0.002	0.003	0.003	0.004	0.004	0.003
1493	0.007	0.007	0.008	0.008	0.008	0.008	0.007
1494	0.004	0.005	0.004	0.004	0.004	0.005	0.005
1495	0.005	0.007	0.007	0.008	0.009	0.010	0.010

1591	0.015	0.015	0.014	0.015	0.016	0.016	0.017
1592	0.008	0.008	0.007	0.007	0.007	0.007	0.007
1593	0.024	0.025	0.025	0.026	0.028	0.031	0.034
1594	0.007	0.007	0.007	0.008	0.009	0.011	0.012
1595	0.004	0.004	0.004	0.005	0.005	0.004	0.005
1596	0.004	0.004	0.005	0.005	0.005	0.004	0.004
1597	0.002	0.002	0.002	0.002	0.002	0.003	0.003
1691	0.038	0.037	0.036	0.035	0.036	0.035	0.036
1692	0.001	0.001	0.001	0.002	0.002	0.002	0.003
1693	0.001	0.001	0.001	0.001	0.001	0.002	0.002
1694	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1695	0.005	0.005	0.005	0.005	0.005	0.005	0.005
1696	0.001	0.002	0.002	0.002	0.002	0.002	0.003
1791	0.005	0.006	0.006	0.006	0.006	0.006	0.007
1792	0.003	0.003	0.003	0.003	0.003	0.003	0.003
1793	0.004	0.004	0.004	0.004	0.004	0.004	0.004
1794	0.006	0.007	0.008	0.009	0.010	0.011	0.010
1795	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1796	0.001	0.001	0.001	0.001	0.001	0.001	0.002
1891	0.008	0.008	0.009	0.010	0.011	0.011	0.010
1892	0.003	0.003	0.003	0.004	0.004	0.003	0.002
1893	0.000	0.001	0.001	0.001	0.001	0.001	0.001
1894	0.001	0.002	0.002	0.002	0.002	0.002	0.003
1895	0.004	0.005	0.005	0.005	0.005	0.005	0.005
1896	0.012	0.012	0.013	0.011	0.008	0.007	0.007
1897	0.004	0.005	0.005	0.004	0.004	0.004	0.004
1898	0.004	0.005	0.005	0.005	0.005	0.005	0.005
1991	0.005	0.006	0.006	0.005	0.004	0.004	0.004
1992	0.007	0.007	0.008	0.008	0.008	0.008	0.008
1993	0.000	0.001	0.001	0.001	0.001	0.001	0.001
1994	0.003	0.003	0.003	0.003	0.003	0.003	0.003
1995	0.001	0.001	0.001	0.002	0.001	0.001	0.001
2091	0.005	0.005	0.005	0.004	0.004	0.005	0.004
2092	0.006	0.006	0.007	0.006	0.005	0.004	0.004
2093	0.002	0.002	0.003	0.003	0.003	0.003	0.002
2094	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	100%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Gini coefficient	0.642	0.613	0.604	0.601	0.601	0.596	0.590

Table C.2: Average Share of Regional Activity in Industry *k*.

($s_i^k(t)$, k = industries defined in A.3, 4 year averages)

Industry	73/76	77/80	81/84	85/88	89/92	93/96	97/00
3110	0.011	0.011	0.011	0.011	0.011	0.011	0.011
3120	0.481	0.500	0.308	0.114	0.123	0.118	0.103
3210	0.015	0.014	0.015	0.015	0.015	0.015	0.013
3230	0.016	0.016	0.016	0.016	0.017	0.017	0.015
3310	0.011	0.011	0.011	0.011	0.011	0.011	0.011
3320	0.026	0.027	0.028	0.029	0.030	0.028	0.027
3330	0.012	0.012	0.011	0.011	0.011	0.011	0.011
3410	0.031	0.026	0.023	0.020	0.018	0.020	0.021
3421	0.024	0.024	0.023	0.022	0.024	0.024	0.021
3422	0.150	0.123	0.098	0.099	0.081	0.075	0.067
3430	0.015	0.014	0.014	0.014	0.014	0.015	0.014
3500	0.012	0.012	0.012	0.012	0.012	0.012	0.011
3610	0.034	0.039	0.040	0.040	0.040	0.036	0.030
3620	0.027	0.028	0.030	0.032	0.033	0.031	0.029
3700	0.012	0.012	0.012	0.012	0.012	0.011	0.011
3810	0.021	0.019	0.019	0.019	0.019	0.018	0.017
3820	0.165	0.098	0.063	0.041	0.048	0.054	0.045
3830	0.023	0.022	0.022	0.020	0.019	0.019	0.018
3850	0.077	0.069	0.064	0.048	0.038	0.031	0.028
3860	0.026	0.021	0.021	0.020	0.021	0.024	0.022
3871	0.014	0.014	0.014	0.015	0.016	0.017	0.015
3872	0.012	0.011	0.011	0.011	0.012	0.012	0.011
3873	0.055	0.059	0.064	0.070	0.077	0.071	0.061
3910	0.014	0.014	0.015	0.014	0.014	0.014	0.013
3920	0.020	0.019	0.018	0.017	0.017	0.016	0.014
Mean	0.052	0.049	0.039	0.029	0.029	0.028	0.026

Table C.3: RCB scores

Industry	period	Education level	Agriculture's share of GDP	Manufacturing's share of GDP	Services' share of GDP	Regional aid	Public production's' share of GDP[27]	Average man. wage
3110	1989/1992	0.039	0.005	0.057	0.247	111517.7		0.155
3110	1997/2000	0.053	0.005	0.056	0.266	95125.3	0.066	0.302
3120	1989/1992	0.003	0.000	0.001	0.014	44722.9		0.196
3120	1997/2000	0.003	0.000	0.001	0.010	31876.0	0.002	0.316
3210	1989/1992	0.007	0.001	0.014	0.044	3877.1		0.148
3210	1997/2000	0.008	0.001	0.010	0.037	4394.5	0.009	0.212
3230	1989/1992	0.005	0.001	0.021	0.032	2531.6		0.138
3230	1997/2000	0.004	0.001	0.006	0.019	2350.7	0.005	0.198
3310	1989/1992	0.020	0.007	0.080	0.150	11065.2		0.153
3310	1997/2000	0.024	0.005	0.035	0.135	14756.3	0.036	0.213
3320	1989/1992	0.026	0.003	0.553	0.166	14847.1		0.181
3320	1997/2000	0.031	0.002	0.052	0.155	23120.3	0.041	0.245
3330	1989/1992	0.059	0.001	0.041	0.249	637522.9		0.196
3330	1997/2000	0.078	0.002	0.037	0.270	586638.1	0.050	0.274
3410	1989/1992	0.007	0.001	0.012	0.038	2545.7		0.204
3410	1997/2000	0.006	0.000	0.006	0.027	6774.3	0.006	0.291
3421	1989/1992	0.023	0.002	0.056	0.145	32892.5		0.220
3421	1997/2000	0.027	0.002	0.041	0.137	36242.6	0.034	0.271
3422	1989/1992	0.010	0.000	0.103	0.046	103044.6		0.222
3422	1997/2000	0.018	0.001	0.013	0.069	130397.4	0.016	0.335
3430	1989/1992	0.010	0.002	0.055	0.071	5170.3		0.163
3430	1997/2000	0.013	0.002	0.017	0.069	7484.7	0.016	0.230
3500	1989/1992	0.009	0.002	0.032	0.062	7403.2		0.188
3500	1997/2000	0.012	0.002	0.017	0.062	11370.4	0.015	0.245
3610	1989/1992	0.015	0.004	0.046	0.142	15151.7		0.201
3610	1997/2000	0.023	0.003	0.038	0.133	14990.4	0.037	0.269
3620	1989/1992	0.039	0.010	0.129	0.268	16408.8		0.218
3620	1997/2000	0.043	0.007	0.095	0.217	18911.0	0.063	0.264
3700	1989/1992	0.015	0.002	0.073	0.098	19058.9		0.169
3700	1997/2000	0.022	0.002	0.032	0.106	20213.7	0.026	0.245
3810	1989/1992	0.039	0.009	0.084	0.218	25812.0		0.215
3810	1997/2000	0.060	0.009	0.087	0.262	35448.7	0.061	0.283
3820	1989/1992	0.010	0.000	0.003	0.043	117913.7		0.203
3820	1997/2000	0.009	0.000	0.005	0.034	46271.3	0.010	0.268
3830	1989/1992	0.013	0.001	0.101	0.077	23742.1		0.188
3830	1997/2000	0.016	0.001	0.020	0.076	18598.7	0.016	0.290
3850	1989/1992	0.004	0.000	0.006	0.018	17195.5		0.204
3850	1997/2000	0.006	0.000	0.005	0.024	37156.3	0.005	0.306

[27] Calculations are based on numbers from 1999 as data on public manufacturing were only available for this year.

3860	1989/1992	0.007	0.002	0.049	0.045	3185.1		0.166
3860	1997/2000	0.018	0.003	0.037	0.094	10102.0	0.027	0.242
3871	1989/1992	0.027	0.004	0.091	0.189	13473.5		0.174
3871	1997/2000	0.037	0.004	0.081	0.195	17750.6	0.051	0.240
3872	1989/1992	0.027	0.002	0.060	0.128	15438.0		0.200
3872	1997/2000	0.024	0.002	0.032	0.100	14767.2	0.023	0.279
3873	1989/1992	0.007	0.000	0.006	0.038	45327.1		0.185
3873	1997/2000	0.006	0.000	0.004	0.027	22180.6	0.006	0.227
3910	1989/1992	0.017	0.004	0.049	0.116	8091.6		0.150
3910	1997/2000	0.024	0.004	0.046	0.125	11129.7	0.030	0.214
3920	1989/1992	0.004	0.001	0.021	0.029	9869.2		0.162
3920	1997/2000	0.007	0.001	0.010	0.037	13675.4	0.010	0.222