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## Structural Changes in Estonian Manufacturing and Regional Development

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# Structural changes in Estonian manufacturing and regional development.

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## **Abstract**

The aim of this work is an analysis of the structural changes in the Estonian manufacturing in transition and its relation with the regional development. The changes in industrial output structure are analyzed by the NACE classification broad sectors. Changes in values and real output are considered. The development of relative prices, industrial employment and labor productivity are also examined. Then we investigated evolution of geographic concentration in the face of the integration of the Estonian economy into the EU. A set of industrial location indices are calculated to study regional industrial dynamics. After that econometric analysis of relation between manufacturing restructuring and the industrial location is considered. The paper ends with the conclusions.

*JEL Category: E17*

**Keywords:** structural changes, output, relative prices, employment, labor productivity, industrial location.

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## **1. Introduction**

In the transition to a market economy the countries of Eastern Europe underwent significant structural changes, which proceed till now. In a broad sense this process concerns all aspects of transition countries development- from the legislation both financial system up to the industrial and labour market structures.

There is a plenty of literature on the structural changes in industry in transition countries (see, for example, Berg 1994, Hansson 1995, Jackson 1997, Repkine and Jackson 1997). Research projects in this field are financed by the IMF, the World Bank, and also European Union and other organizations. One of major problems of these researches is the analysis of structural changes in industry of transition countries (from the most significant work in this area it is possible to note Repkine and Jackson 1997). Some works on industrial restructuring have appeared in Estonia as well (Kilvits 1999). By now the time series of data on this field are long enough to conduct this kind of analysis in a more systematic and formal way.

Important factor of industrial restructuring is the development of location of economic activity, particularly of industrial manufacturing. This regional dimension approach is developed by new economic geography which revealed the impact of economic integration on industrial location dynamics (Amiti 1998, Hanson 1994). This process is generally driven by two opposite forces. On the one hand, a reduction in trade barriers eliminates dependence of production on local consumer, and production moves closer to the regions with higher potential to consume. On the other hand, when trade barriers vanish, marginal transport cost becomes less important than costs of immobile factors of production such as labour.

The main purpose of this paper is to analyze the industrial dynamic and restructuring in transition period in Estonia and also the main factors determined these process based on statistical and econometric analysis of available data.

We used employment data from the Labor Market Division of the Statistical Office of Estonia for the calculation of geographical concentration indices. This employment statistics were collected for each of the NUTS 3 regions (5 regions) of Estonia by NACE broad manufacturing sectors (13 sectors) for 1992-2002. The data was based on the Labor Force surveys. The data for the analyzing of manufacturing output, labor productivity and employment by NACE broad manufacturing sectors for 1992-2003 years was used from the electronic database of the Statistical Office of Estonia.<sup>i</sup>

The structure of the paper is the following. In the second section, we analyse general dynamic and structural changes in the Estonian industry, in the third section, we describe the theoretical concepts of structural changes, in the fourth section changes in industrial output structures have been analyzed, in the

fifth section development of production employment is considered, next section consider theoretical approach and empirical analysis of regional location of industrial activity which followed by econometric analysis of the impact of geographical concentration on the manufacturing output development, the final section contains some conclusions.

## 2. General dynamic and structural changes

The greatest decline in industrial production in Estonia occurred in 1990-1991. During these years price and demand shocks occurred simultaneously. The former was determined by increasing prices of raw materials in Russia on which the Estonian industry was initially fully dependent. The main determinants of the demand shock in these years were the loss of traditional, mainly Russian markets. From 1990 Estonia has tried to conduct its own economic policy including price liberalisation. As a result inflation in Estonia occurred at a higher rate than in Russia and Estonian goods lost their competitiveness in the Russian market. Distortions of production links were also important.

In Appendix A. cumulative output indices for Estonian industrial output by sectors in 1995 constant prices are presented. We analyse structural changes between sectors following the approach of Repkine and Walsh (1999).

Discrete measure of growth over the period t-1 to t in sector i is as follows

$$g_{it} = \left( \frac{y_{it} - y_{it-1}}{(y_{it} + y_{it-1})/2} \right) \quad (1)$$

The contributions of rising and declining sectors are calculated separately as a sum of the growth rates of rising sectors weighed by sector size (POS) and the sum of the absolute value of growth rates of declining sectors weighed by sector size (NEG)

$$POS_{it} = \sum_{i=1}^n S_{it} g_{it} \quad \text{if } g_{it} > 0 \quad (2)$$

$$NEG_{it} = \sum_{i=1}^n S_{it} |g_{it}| \quad \text{if } g_{it} < 0 \quad (3)$$

Net change (NET) is a net outcome that is induced by output growth in rising sectors being offset by output fall in declining sectors

$$NET_{it} = POS_{it} - NEG_{it} \quad (4)$$

The reallocation of output between sectors is captured by the EXCESS index

$$EXCESS_{it} = POS_{it} + NEG_{it} - |NET_{it}| \quad (5)$$

The described above indicators are showed in the Table 1.

**Table 1**

### **Indicators of growth in Estonian industry**

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
POS	0.034	0.060	0.050	0.069	0.170	0.079	0.044	0.160	0.121	0.087	0.102
NEG	-0.259	-0.092	-0.032	-0.041	0.000	-0.029	-0.080	0.000	-0.024	0.000	0.000

NET	-0.226	-0.032	0.019	0.029	0.170	0.049	-0.036	0.160	0.097	0.087	0.102
EXCESS	0.067	0.120	0.064	0.082	0.000	0.059	0.088	0.000	0.047	0.000	0.000

Source: Estonian Statistical office database ([www.stat.ee](http://www.stat.ee)), author's calculations.

We can observe an initial collapse in 1993 (which actually began in 1990) followed by simultaneous growth and contraction of sectors and reallocation of output between sectors. The largest structural changes between sectors occurred in 1994. From 1995, the clear tendency to growth began though the inter-sectoral structural changes occurred until 1997. In 1998 and 1999, because of financial crisis in Russia, structural changes started again. In recent years sectoral structure of manufacturing have been stabilised.

### 3. Theoretical concepts of structural changes

By structural changes means change in the branch composition of output and employment and also change in relative produce prices of the same branch aggregate. (Repkine and Jackson 1997). In the branch level by structural change means the relative contribution of this branch to total production.

The contribution of branch  $b$  is indicated by a share coefficient

$$S_b^t = GO_b^t / GO^t \quad (6)$$

where  $b$  is a number of branch

$t$  is the year

$GO$  without subscript is industrial output in total

Industrial structure in the year  $t$  can be represented by a vector of this share coefficients ( $b=1,2,\dots,n$ ). Changes in industrial structure from year  $t$  to year  $t+n$  can be represented by comparisons of this vectors of share coefficients.

$$S_b^{t,t+n} = S_b^{t+n} / S_b^t \quad (7)$$

Where  $S_b^{t,t+n}$  index of share coefficient of branch  $b$  in year  $t+n$  compare with year  $t$  (relative share).

Changing in value output is determined by two factors- changing in quantity component (real output) and changing in price component. Thus,

$$GO_b^{t,t+n} = GOQ_b^{t,t+n} * GOP_b^{t,t+n} \quad (8)$$

Where

$GO_b^{t,t+n}$  - index of output in current prices of branch  $b$  in year  $t+n$  compare with year  $t$

$GOQ_b^{t,t+n}$  - index of real output (in constant prices) of branch  $b$  in year  $t+n$  compare with year  $t$

$GOP_b^{t,t+n}$  - production price index of branch  $b$  in year  $t+n$  compare with year  $t$

When for example a share of branch  $b$  increase in considering period this mean that quantity index or price index or both have increased more than the respective index of total industry.

The concept of relative change compare the branch index with the same index for industry in total.

The most commonly used indicator is relative price change:

$$RGOP_b^{t,t+n} = (GOP_b^{t+n} / GOP_b^t) / (GOP^{t+n} / GOP^t) \quad (9)$$

Where

$RGOP_b^{t,t+n}$  - relative price change of branch b in year t+n compare with year t

$GOP_b^t$  - production price index of branch b in year t

$GOP^t$  - production price index of total industry in year t

Analogically defined relative output change in current and in constant prices:

$$RGO_b^{t,t+n} = (GO_b^{t+n} / GO_b^t) / (GO^{t+n} / GO^t) \quad (10)$$

Where

$RGO_b^{t,t+n}$  - relative real output change of branch b in year t+n compare with year t

$GO_b^t$  - real output (in constant prices) of branch b in year t

$GO^t$  - real output of total industry in year t

$$RGOQ_b^{t,t+n} = (GOQ_b^{t+n} / GOQ_b^t) / (GOQ^{t+n} / GOQ^t) \quad (11)$$

Where

$RGOQ_b^{t,t+n}$  - relative output change of branch b in year t+n compare with year t

$GOQ_b^t$  - output in current prices of branch b in year t

$GOQ^t$  - output in current prices of total industry in year t

We will use in our analysis both approaches: changing the branch shares and relative changes.

#### 4. Changing industrial output structures

As was mentioned above for the analysis of structural changes two main indicators was used- relative shares and relative indexes. The relative share shows the change in the share of the given branch in current year compare with the base year.

Index of relative output is the ratio of the index of real output of branch b in year  $t$  to the index of real output in total industry in year  $t$ . If it is less than one the sector has declined more (grown less) than industry as a whole and vice versa.

**Table 2**

#### *Relative indexes and relative shares of real output in Estonian industry*

NACE	Category	Relative index 1996	Relative index 2003	Relative share 1996/1992	Relative share 2003-1992
D	Total Manufacturing	1,000	1,000	1,000	1,000
DA	Food, Beverage and Tobacco	0,891	0,478	0,898	0,530
DB	Textiles and Textile Products	0,718	0,582	1,197	1,198
17	Textiles	0,606	0,474	1,314	1,489
18	Apparel, excl. Footwear	1,133	0,980	0,967	0,686

DC	Leather and Leather Products	0,542	0,467	0,912	0,691
DD	Wood Products	1,819	3,789	1,357	2,454
DE	Paper, Printing and Publishing	1,918	2,215	0,908	1,321
21	Paper and Products	1,224	1,782	1,114	1,949
22	Printing and Publishing	2,395	2,512	0,833	1,022
DG	Chemicals, products, fibers	0,981	0,490	0,954	0,517
DH	Rubber and Plastic Products	1,122	3,022	1,213	2,571
DI	Mineral Materials and Products	1,009	1,131	0,951	0,973
DJ	Basic Metals and Fab products	2,118	3,475	1,120	1,876
DK	Machinery, excluding electrical	1,036	1,292	0,942	1,270
DL	Electrical and Optical Equipment	0,981	1,440	1,018	1,616
30	Manufacture of office machinery and computers	-	4,917	1,206	1,587
31	Manufacture of electrical machinery and apparatus	0,663	0,980	0,997	1,659
32	Manufacture of radio, television and communication equipment and apparatus	2,071	4,705	1,061	1,252
33	Manufacture of medical, and optical instruments	0,777	1,838	0,882	2,114
DM	Transport Equipment	0,976	1,148	0,968	1,139
34	Manufacture of motor vehicles, trailers and semi-trailers	0,720	0,852	0,907	0,912
35	Manufacture of other transport equipment	1,467	1,715	1,026	1,365
DN	Other Manufactured Products	1,141	1,340	1,118	1,240

**Source:** Estonian Statistical office database ([www.stat.ee](http://www.stat.ee)), author's calculations.

Table 2 represents the considered above indexes of real output. We analyse 1996 as a first year of manufacturing output growth and 2003 as a last year of available data. It can be seen that essential structural changes in real output have occurred. The most noticeable reductions in the share in total output occurred in food products, apparel, leather products, chemicals, manufacture of motor vehicles. The growing production branches in considered period were wood products, paper products, rubber and plastic products, metals, manufacture of office machinery and computers, manufacturing of communication equipment, other manufactured products (because of the furniture). In general, it can be concluded that the greatest increase in real output appeared in the resource- and labour-intensive export oriented branches.

The dynamic of relative prices is analyzed by comparing the shares of manufacturing sectors in current and constant prices. If the share in current prices is bigger, the relative prices increased and vice versa. In Table 3 such an analysis is submitted.

**Table 3**

**Sector shares and relative prices change in Estonian industry**

NACE	Category	Share of total output in curr.prc 1996	Share of total output in const.prc 1996	Relative price effect on shares 1996	Share of total output in curr.prc 2003	Share of total output in const.prc 2003	Relative price effect on shares 2003
D	Total Manufacturing						
DA	Food, Beverage and Tobacco	33,37	31,31	2,06	17,90	17,79	0,11
DB	Textiles and Textile Products	12,69	13,52	-0,83	10,42	13,04	-2,62
17	Textiles	8,42	9,37	-0,95	6,65	10,24	-3,59
18	Apparel, excl. Footwear	4,27	4,02	0,25	3,77	2,75	1,02
DC	Leather and Leather Products	1,37	1,33	0,04	1,12	0,97	0,15

DD	Wood Products	8,03	10,92	-2,89	16,56	19,03	-2,47
DE	Paper, Printing and Publishing	6,14	5,03	1,11	7,03	7,06	-0,03
21	Paper and Products	1,64	1,36	0,28	2,27	2,30	-0,03
22	Printing and Publishing	4,50	3,60	0,9	4,76	4,25	0,51
DG	Chemicals, products, fibers	8,80	9,25	-0,45	4,41	4,83	-0,42
DH	Rubber and Plastic Products	1,62	1,72	-0,1	4,31	3,51	0,8
DI	Mineral Materials and Products	4,63	4,31	0,32	5,23	4,25	0,98
DJ	Basic Metals and Fab products	5,51	5,12	0,39	9,10	8,26	0,84
DK	Machinery, excluding electrical	2,73	2,32	0,41	3,34	3,02	0,32
DL	Electrical and Optical Equipment	4,42	3,79	0,63	8,06	5,81	2,25
30	Manufacture of office machinery and computers	0,52	0,73	-0,21	0,56	0,92	-0,36
31	Manufacture of electrical machinery and apparatus	1,94	1,94	0	2,96	3,11	-0,15
32	Manufacture of radio, television and communication equipment and apparatus	1,18	0,46	0,72	2,75	0,53	2,22
33	Manufacture of medical, and optical instruments	0,79	0,65	0,14	1,79	1,51	0,28
DM	Transport Equipment	4,05	4,26	-0,21	4,74	4,83	-0,09
34	Manufacture of motor vehicles, trailers and semi-trailers	1,99	1,96	0,03	2,36	1,90	0,46
35	Manufacture of other transport equipment	2,06	2,29	-0,23	2,38	2,94	-0,56
DN	Other Manufactured Products	6,63	7,12	-0,49	7,76	7,61	0,15

Source: Estonian Statistical office database ([www.stat.ee](http://www.stat.ee)), author's calculations.

It can be noted first that the structure of relative prices in the first year of increase (1995) was not very different compared to recent years, but compare with 1992 the structure of comparative prices underwent essential changes.

Textile, wood products, chemical products, furniture and transport equipment underwent the greatest decline in comparative prices. Comparative prices increased the most in food products, apparel, and manufacturing of communication equipment.

In general, it can be concluded that comparative prices decreased in material-intensive manufacturing sectors and increased in labour-intensive sectors. This result is not surprised because of the essential growth of real wages compared with the pre-transition period.

The dynamics of relative prices and real output, when compared, signify a tendency: the reduction of relative prices leads to the growth in output, and vice versa. This means that the demand-side factors are major determinants of the real output dynamics.

## 5. Development of production employment

Development of production employment is primarily characterized by the reduction of absolute size of the employed. This is the common tendency for the transition countries because of the outstripping development of services and the resulting outflow of labor force from the production sector to the sector of services.

Simultaneously, there occurred the process of exemption from the excess labor force in industry thanks to the improvement of management and the new technologies. However, considered by industrial branches these processes occurred unevenly. Table 4 represents the indicators for the analysis of production employment. In comparison with 1992 greatest reduction of employment (and also a relative share) has taken place in textiles, leather products, chemicals, mineral products, machinery and electrical and optical equipment. The greatest increase of a relative share has taken place in apparel, wood products, metals (recent years), transport equipment, other manufactured products. As a whole the structural changes in employment correspond to changes in real output. However, if we compare coefficients of variance of relative shares (1.21 for the real output and 0,31 for the employment in 2003) it is possible to conclude that

during the examined period structural changes in production employment has taken place in a considerably smaller degree than changes in structure of real output

**Table 4**  
***The absolute and comparative dynamic of industrial employment in Estonia***

NACE	Category	Relative index 1996	Relative index 2003	Relative share 1996/1994	Relative share 2003/1994
D	Total Manufacturing	0,81	0,73	1,00	1,00
DA	Food, Beverage and Tobacco	1,00	0,74	1,23	1,02
DB	Textiles and Textile Products	0,82	0,69	1,01	0,94
17	Textiles	0,56	0,48	0,69	0,66
18	Apparel, excl. Footwear	1,23	1,02	1,52	1,40
DC	Leather and Leather Products	0,38	0,26	0,47	0,36
DD	Wood Products	2,66	3,37	3,28	4,62
DE	Paper, Printing and Publishing	0,74	0,61	0,91	0,84
DG	Chemicals, products, fibers	0,59	0,18	0,72	0,24
DH	Rubber and Plastic Products	0,51	0,58	0,63	0,80
DI	Mineral Materials and Products	0,59	0,40	0,73	0,55
DJ	Basic Metals and Fab products	0,78	2,05	0,97	2,82
DK	Machinery, excluding electrical	0,42	0,12	0,52	0,17
DL	Electrical and Optical Equipment	0,46	0,65	0,57	0,89
DM	Transport Equipment	1,44	1,11	1,78	1,52
DN	Other Manufactured Products	1,08	0,93	1,33	1,28

**Source:** Estonian Statistical office database ([www.stat.ee](http://www.stat.ee)), author's calculations.

## 6. Development of productivity by manufacturing branches

Labor productivity dynamics is an important indicator of the efficiency of structural changes. Development of labor productivity by industrial branches is caused by two groups of factors- changes in production volumes and changes in employed. The first one is determined by the changes in technology, management and other supply-side factors, as well as by the changes in demand. Also the exemption from excess labor force on the basis of improvements in management may cause the considerable increase in labor productivity. In the Table 5 we represent the calculated indicators for the labor productivity analysis. In general, noticeable growth of labor productivity is observed. The most essential growth in labor productivity has appeared during the last years. The greatest rates of increase of labor productivity are observed in textiles, wood products, paper products, rubber and plastics, machinery, electrical and optical equipment.

Comparing the dynamics of real output, employment and labor productivity it is possible to analyze which of the listed above factors have influenced the labor productivity by branches. In the branches where the productivity growth was the slowest (food products, apparel, communication equipment etc.) the most important factor was a reduction in real output at considerably smaller rates than the decrease in employment (or slower increase). The economic efficiency of production in these production branches is determined first of all by the growth in the relative prices.

It is possible to divide in two groups the branches where the greatest growth rates of labor productivity have occurred

1. Production branches with significant decrease in employment and rather or average small growth in real output. These are textiles, paper products, electrical and optical equipment

2. Production branches with the significant growth of real output. These are rubber and plastics, transport equipment.

**Table 5**  
***Absolute and relative indexes of labor productivity in Estonian industry***



NACE	Category	Relative index 1996	Relative index 2003	Relative share 1996/1994	Relative share 2003/1994
D	Total Manufacturing	1,44	2,47	1,00	1,00
DA	Food, Beverage and Tobacco	1,12	1,75	0,77	0,63
DB	Textiles and Textile Products	2,07	3,95	1,48	1,53
17	Textiles	2,97	6,49	2,10	2,70
18	Apparel, excl. Footwear	0,90	1,36	0,69	0,47
DC	Leather and Leather Products	1,59	2,15	1,00	0,90
DD	Wood Products	2,48	4,86	2,13	2,92
DE	Paper, Printing and Publishing	1,06	2,14	1,09	1,26
21	Paper and Products	1,55	2,80	1,76	2,35
22	Printing and Publishing	0,95	1,99	0,76	0,82
DG	Chemicals, products, fibers	1,42	2,35	1,61	1,39
DH	Rubber and Plastic Products	1,91	3,30	1,80	2,09
DI	Mineral Materials and Products	1,38	1,86	0,97	0,84
DJ	Basic Metals and Fab products	1,90	3,07	1,32	1,48
DK	Machinery, excluding electrical	1,90	4,61	1,35	2,13
DL	Electrical and Optical Equipment	1,78	3,26	0,81	1,10
30	Manufacture of office machinery and computers	0,89	0,91	1,09	0,56
31	Manufacture of electrical machinery and apparatus	1,77	3,03	0,99	1,14
32	Manufacture of radio, television and communication equipment and apparatus	0,85	1,81	0,35	0,34
33	Manufacture of medical, and optical instruments	3,43	6,65	0,75	2,11
DM	Transport Equipment	1,28	2,94	0,60	0,86
34	Manufacture of motor vehicles, trailers and semi-trailers	1,21	2,32	0,60	0,65
35	Manufacture of other transport equipment	1,28	3,45	0,60	1,10
DN	Other Manufactured Products	1,73	2,76	1,50	1,43

*Source:* Estonian Statistical office database ([www.stat.ee](http://www.stat.ee)), author's calculations.

## 7. Regional Location of Industrial Activity

New economic geography studies revealed the impact of economic integration and structural changes on industrial location dynamics (Amiti 1998, Hanson 1994). Under a condition of liberalised trade theory predicts inverse U-shape relation between geographical advantage and level of trade cost. Just after liberalisation initial shift of activity into the regions with good market access have been predicted. As integration proceeds, however, the dynamics are reversed: trade costs fall, and manufacturing companies locate from centre to the peripheral regions.

The location of manufacturing activities has been a key factor in inconsistency in regional development (Karsten 1996, Aiginger 1999, Haaland et al. 1999). To smooth these dissimilarities, a concept for regional policy was approved by the Estonian Government. In 1998, the Estonian Regional Development Strategy was introduced, which defined regional policy as an explicit activity of the public authorities with the objective of 'creating premises for development for all the regions of the state and balancing socio-economic development proceeding from the interests of the regions and the state as a whole.'

We start our analysis of geographical concentration by considering regional employment shares by industries and geographic concentration rates according to the NACE broad industrial classifications.

$s_{ij}^C$  is the share of employment in industry  $i$  in region  $j$  in total employment of industry  $i$ ,

$$s_{ij}^C = \frac{E_{ij}}{E_i} = \frac{E_{ij}}{\sum_j E_{ij}}; E_{ij} \text{ is the employment in industry } i \text{ in region } j.$$

Rates of geographical concentration are a measure of the relative concentration of a given industry in a region. They were calculated as follows:

$$CR_{ij} = \frac{s_{ij}^C}{s_j}, \text{ where } s_j = \frac{E_j}{E} = \frac{\sum_i E_{ij}}{\sum_i \sum_j E_{ij}}$$

Next, we calculate generalized indices for 1992-2002.

Absolute geographical concentration of industries is captured by the Herfindahl index.

The index was calculated according to the following formula:

$$H_i^C = \sum_j (s_{ij}^C)^2$$

The Krugman (dissimilarity) index measure relative geographical concentration.

The dissimilarity index for geographical concentration is calculated as follows:

$$DCR_i = \sum_j |s_{ij}^C - s_j|$$

where  $s_j$  = the share of total employment in region  $j$  in total employment

One can observe that the most concentrated industries are the manufacture of paper, publishing, printing, chemicals and chemical products, vehicles, electrical machinery, and optical instruments. In most cases, concentration was driven by industry-specific production needs such as economies of scale and the demand for trained and educated labor, which induced companies to locate close to industrial centers.

The least concentrated industries are manufacturing of food products, beverages and tobacco products, textiles and apparel, mineral products, wood and furniture. These industries traditionally locate close to production resources and need relatively cheap labor with average skills.

We base our analysis of geographical concentration dynamics on the percentage change of the geographic concentration index. The calculated results are presented in Tables 6 and 7.

**Table 6. Percentage changes of Herfindahl geographic concentration index**

NACE sectors	Category	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
DA	Food, Beverages and Tobacco	98,5	92,1	92,8	89,7	88,0	85,5	83,0	88,2	93,5	86,3	84,5
DB	Textiles and Textile Products	101,0	104,6	101,2	105,1	99,9	95,5	93,7	93,3	85,1	87,0	91,0
DC	Leather and Leather Products	92,5	88,4	87,3	98,3	100,5	102,6	114,9	126,7	100,5	118,6	120,0
DD	Wood Products	76,5	78,3	86,8	88,2	91,9	95,4	97,7	100,9	92,7	94,9	99,7
DE	Paper, Printing and Publishing	86,2	80,5	74,6	90,8	101,3	98,5	96,7	102,1	114,3	125,0	91,2
DF+ DG	Chemicals, products,	100,5	102,6	104,4	108,9	113,1	116,9	93,7	72,1	92,5	93,1	84,4

	fibers											
DH	Rubber and Plastic Products	93,7	97,6	77,7	57,0	55,2	50,3	44,8	47,0	39,9	44,8	64,2
DI	Mineral Materials and Products	109,9	111,4	120,3	86,6	97,7	117,5	94,0	122,1	130,1	134,3	121,2
DJ	Basic Metals and Products	94,8	101,1	100,0	114,2	103,6	52,5	53,9	58,9	54,3	76,8	70,8
DK	Machinery excluding electrical	97,5	101,2	101,5	94,4	97,8	104,1	102,5	110,6	98,4	99,6	85,2
DL	Electrical and Optical Equipment	99,0	100,1	98,1	75,9	90,7	118,3	116,6	123,8	119,1	95,3	72,2
DM	Transport Equipment	99,2	106,1	110,9	106,7	111,2	93,1	86,2	79,6	70,0	63,2	69,8
DN	Other Manufact. Products	85,8	85,6	86,4	93,8	87,3	83,7	78,7	76,3	80,0	82,3	87,1
Average Manufacturing		96,8	96,9	96,5	94,7	95,1	93,3	89,5	91,7	90,3	90,6	87,8

Source: Statistical Office of Estonia, own calculation.

**Table 7. Percentage changes of geographic dissimilarity index**

NACE sectors	Category	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
DA	Food, Beverages and Tobacco	90,0	93,2	79,6	110,7	96,1	69,7	60,3	55,6	51,2	54,9	56,0
DB	Textiles and Textile Products	108,1	78,1	79,5	80,5	70,4	95,0	104,5	117,2	122,8	110,7	103,2
DC	Leather and Leather Products	100,1	92,4	100,6	192,2	237,8	156,4	162,1	166,0	149,7	200,3	201,6
DD	Wood Products	83,9	90,7	103,3	74,0	83,1	95,6	93,2	99,7	89,5	76,4	96,3
DE	Paper, Printing and Publishing	84,4	75,3	78,2	126,0	134,9	140,3	132,5	128,7	153,3	166,5	103,3
DF+	Chemicals, products, fibers	100,9	105,6	108,0	122,9	127,1	125,5	109,6	73,0	101,4	109,9	82,1
DH	Rubber and Plastic Products	93,8	103,3	74,6	63,1	69,3	46,2	36,2	36,7	65,6	123,2	72,8
DI	Mineral Materials and Products	69,5	53,0	75,9	133,5	133,5	224,5	131,5	114,7	160,7	113,8	89,6
DJ	Basic Metals and Fab. Products	97,5	111,8	120,1	157,6	138,1	40,6	40,3	37,5	49,0	86,8	65,4
DK	Machinery, excluding	104,0	96,8	93,8	91,1	110,4	106,2	116,4	134,0	99,7	112,2	89,7

	electrical											
DL	Electrical and Optical Equipment	96,8	94,4	96,0	68,7	100,9	165,4	157,9	153,5	152,9	108,6	64,0
DM	Transport Equipment	103,3	111,8	120,2	126,8	131,8	120,4	108,8	91,7	81,6	70,1	76,0
DN	Other Manufactured Products	88,7	104,7	86,8	107,5	87,1	126,9	87,6	119,2	95,3	136,0	300,9
	Average Manufacturing	95,6	91,0	89,6	103,2	101,0	104,8	94,7	97,7	98,4	100,2	103,7

Source: Statistical Office of Estonia, own calculations.

Overall, the most rapid increase in geographical concentration of industries has occurred in the paper and paper products, publishing and printing, tanning and dressing of leather, and the mineral products. This can be attributed to the investments into these industries that were directed primarily to the Northern region. Noticeable geographic diversification relative to other industries has occurred in the manufacturing of food, beverages and tobacco products, wood, fabricated metal products, and in the manufacture of rubber and plastic products. The dynamics of the first two industries can be explained by the trend towards relocation closer to production resources, among other factors.

To analyze the dynamics of industrial concentration in general, we have calculated the average percentage changes of the indices considered<sup>ii</sup>. The results are presented also in Tables 6 and 7. As can be observed, the indices captures some tendency towards decline in concentration. To evaluate this trend, we have calculated the average percentage changes for every index<sup>iii</sup>. For the Herfindahl index, it is -0.93 per cent; the regional dissimilarity index shows average growth rate -0.98 per cent.

## 8. Manufacturing Output Development and Regional Location

In this section we attempt to determine the locational factors that account for manufacturing output development. The main analytical model is specified below:

$$\log(y_{jt}) = \alpha + \beta_t \log(\text{CONS}_{jt}) + \varepsilon_{jt}$$

where:  $y_{jt}$  - output indices for Estonian manufacturing industries (in constant prices) in year  $t$  in manufacturing industry  $j$

CONS - geographic concentration measure in year  $t$  in manufacturing industry  $j$

We estimated this equation as a fixed effect model. The measures of geographic concentration in are the Herfindahl and Krugman (dissimilarity) concentration indices at the NASE broad manufacturing industries for Estonia from 1992-2002. Therefore, we had 143 observations in the panel data altogether.

**Table 8. Estimation results\***

Model	Model1 (Herfindahl)	Model 2 (Dissimilarity)
Regional location index	-0.82** (-3.04)	-0.16 (-0.53)
Adjusted R-squared	0.293	0.27
F-statistic	4.32	2.43

\* values of  $t$ -statistics are given in parentheses

\*\* denote coefficient estimates significant at one per cent levels.

Source: own calculations.

Table 8 presents estimation results for sectoral output growth regressed on concentration measures. These regression results show a statistically significant negative relationship between regional concentration and sectoral output growth for Herfindahl index. In the case of dissimilarity result is statistically insignificant. These results can be interpreted as follows. Different manufacturing industries have different locational dynamic. Industries dominating in overall manufacturing output (such as food, beverages and tobacco products; wood, metal products, manufacture of rubber and plastic products, etc) simultaneously underwent noticeable geographic diversification. So we can conclude that overall manufacturing growth as a result of FDI inflow and optimizing of sectoral structure was accomplished by overall diversification of manufacturing location. The last one could stand as a factor of this manufacturing output dynamic.

## 9. Conclusions

1. Industrial output in Estonia developed in U-shape during the transition process and underwent essential structural changes. Initial collapse in 1990-1993 was followed by simultaneous growth and contraction of sectors and reallocation of output between sectors. From 1995, the clear tendency to growth began though the inter-sectoral structural changes occurred until 1997. In 1998 and 1999, because of financial crisis in Russia, structural changes started again. In recent years sectoral structure of manufacturing have been stabilised.

2. There were essential shifts in the structure of real output for examined period. The share of food products, apparel, leather products, chemicals products, manufacture of motor vehicles has decreased the most. The most growing branches in real terms was wood products, paper products, rubber and plastics, metals, manufacture of office machinery and computers, manufacturing of communication equipment, furniture.

3. The structure of comparative prices also underwent essential changes. Textile, wood products, chemical products, furniture and transport equipment underwent the greatest decline in comparative prices. Comparative prices increased the most in food products, apparel and manufacturing of communication equipment. In general, it can be concluded that comparative prices decreased in material-intensive manufacturing sectors and increased in labor intensive sectors.

4. Development of production employment is primarily characterized by the reduction of absolute size of the employed. The greatest reduction of employment has taken place in textile, leather products, chemicals products, mineral products, machinery, electrical and optical equipment. The greatest increase has taken place in apparel, wood products, metals, furniture. The labor market in Estonia is rather rigid compared to the rapid structural changes in industry. A further development of labor mobility is an important precondition of growth and optimization of industrial structure.

5. The most essential growth in labor productivity has appeared during the last years. The greatest rates of increase of labor productivity are observed in textile, wood products, paper products, rubber and plastics, machinery, electrical and optical equipment. In the branches where the productivity growth was the slowest (apparel, printing and publishing) the most important factor was a reduction in real output at considerably smaller rates than the decrease in employment.

6. The level of geographical concentration of manufacturing in Estonia has decreased annually by 0.93-0.98 per cent. However, dynamics across industries varied greatly. The most rapid increase in geographical concentration has occurred in the paper and paper products; publishing and printing; tanning and dressing of leather; and the mineral products.. This can be attributed to investments into these industries primarily to the Northern region. Noticeable geographic diversification has occurred in the manufacturing of food, beverages and tobacco products; wood, fabricated metal products, and in the manufacture of rubber and plastic products. The dynamics of the first two industries can be explained by relocation closer to production resources, among the other factors.

7. An econometric analysis of the impact of geographical concentration measured by Herfindahl index on sectoral output growth has revealed a strong negative relationship between these two variables. It could be concluded from this result that in the years considered (the years of transition and integration into the EC)

overall geographic diversification of manufacturing activity could be a factor of optimizing its structure and output growth.

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## Appendix A.

### Cumulative output indices for Estonian industry (in constant 1995 prices)

NACE	Category	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
D	Total Manufacturing	123	100	97	100	102	121	128	125	145	160	174	193
DA	Food, Beverage and Tobacco	147	115	103	100	92	108	102	83	89	98	100	102
DB	Textiles and Textile Products	145	90	86	100	122	138	143	142	170	193	210	231
17	Textiles	148	80	78	100	134	161	166	166	203	235	262	287
18	Apparel, excl. Footwear	134	103	98	100	99	96	102	104	119	131	133	132
DC	Leather and Leather Products	204	118	105	100	93	106	125	128	147	129	128	133
DD	Wood Products	47	57	82	100	139	190	232	286	340	393	434	474
DE	Paper, Printing and Publishing	101	87	97	100	93	114	127	143	184	202	239	255
21	Paper and Products	197	41	68	100	114	157	189	201	293	319	379	376
22	Printing and Publishing	34	92	104	100	85	94	104	123	131	147	166	197
DG	Chemicals, products, fibers	124	81	92	100	98	98	82	77	78	80	87	100
DH	Rubber and Plastic Products	58	53	92	100	124	187	215	199	255	339	380	496
DI	Mineral Materials and Products	126	107	110	100	97	129	146	121	139	148	164	188

DJ	Basic Metals and Fab products	46	71	88	100	115	145	181	172	218	267	280	362
DK	Machinery, excluding electrical	72	84	90	100	96	97	102	98	146	197	236	245
DL	Electrical and Optical Equipment	270	180	105	100	104	126	182	212	291	221	254	312
30	Manufacture of office machinery and computers	19	42	88	100	123	177	190	168	150	170	211	306
31	Manufacture of electrical machinery and apparatus	209	144	102	100	102	107	132	155	184	224	264	320
32	Manufacture of radio, television and communication equipment and apparatus	622	291	108	100	108	124	181	221	345	182	203	242
33	Manufacture of medical, and optical instruments	229	179	117	100	90	127	219	275	366	294	329	408
DM	Transport Equipment	135	176	122	100	99	116	117	123	136	166	202	220
34	Manufacture of motor vehicles, trailers and semi-trailers	160	192	122	100	93	117	104	113	125	158	176	176
35	Manufacture of other transport equipment	87	152	122	100	105	116	127	133	147	175	230	263
DN	Other Manufactured Products	78	72	90	100	114	143	153	157	182	215	232	239

Source: Estonian Statistical office database (www.stat.ee)

## Appendix B.

### Regional structure of Estonia, data for 2001

Regions (NUTS 3)	Included counties (NUTS 4)	Regional share in GDP, %	Population of region (% of total)	Regional GDP per capita, (% of country average)
Northern Region	Harju county (Tallinn included)	59.8	38.4	155,7
West Estonia	Hiiu, Lääne, Pärnu, Saare counties	9.0	12.1	74,3
Southern Estonia	Jõgeva, Põlva, Tartu, Valga, Viljandi, Võru counties	16,6	25.8	64,3
Central Estonia	Järva, Lääne-Viru, Rapla counties	7.0	10.6	66,6
North-East Estonia	Ida-Viru county	7.6	13.1	58

<sup>i</sup> <http://www.stat.ee>

<sup>ii</sup> Calculated as a weighted average of percentage changes across the industries using employment shares as weights.

<sup>iii</sup> This indicator has been calculated as a geometric average of percentage changes of the indices by years.