

The background of the page features a large, detailed coat of arms of the University of Groningen. It is a shield-shaped emblem with a crown on top. The shield is divided into several sections: a top section with a lion, a middle section with a book and a banner, and a bottom section with a tree and a landscape. The text 'UNIVERSITY OF GRONINGEN' is written across the top of the shield, and '1614' is at the bottom. The coat of arms is rendered in a dark, stylized color.

**New Estimates of Labour Productivity in the
Manufacturing Sectors of Czech Republic,
Hungary and Poland**

Research Memorandum GD-50

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Groningen Growth and Development Centre
January 2002

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Abstract

In this paper we provide benchmark comparisons of manufacturing unit value ratios and productivity levels for the Czech Republic, Hungary and Poland relative to Germany in 1996. On average, manufacturing prices were about half of those in Germany for all three countries. Hungary was characterised by relatively low price levels in Food Processing, but relatively high price levels in Chemicals, Rubber and Plastic Products, Non-Metallic Mineral Products and Electrical Equipment. Poland appeared weak on price competitiveness in Wood and Wood Products and Printing and Publishing. The Czech Republic has relatively low price levels in Chemicals. For Total Manufacturing, Hungary shows a clear productivity advantage despite a comparable relative price level (compare Figure 1). The Hungarian productivity advantage is in strong Food Products, Paper and Printing, and Wood Products (even though in the latter case it is benefitting from low relative price levels), but also in Machinery and Transport Equipment and in Other Manufacturing. The Polish productivity level is high in Rubber and Plastic Products, and in the Czech Republic it is high in Chemicals, which in both cases is reflected by relatively low price levels. Czech productivity is also relatively high in Non-Metallic Minerals.

* This paper is a contribution to a larger project on "CEEC's Catching-Up, Comparative Advantages and Trade Structure at Industrial Level" carried out by the Vienna Institute for International Economic Studies (WIIW).

1. Introduction.

International comparisons of productivity for transition economies are sparse. Before the transition period comparisons of growth rates and levels were hampered by differences in statistical systems, pricing techniques, etc., between the former socialist countries and the western countries. Since the early 1990s, a major overhaul in the statistical system of the transition countries complicated comparisons further. However, for recent years the quality of the statistics is sufficient to carry out new benchmark comparisons of manufacturing productivity.

The work on productivity and purchasing power parities (“unit value ratios”) by industry is meant to provide an input in the project described above. The methodology is based on the industry of origin approach which has been used and further developed by the ICOP (International Comparisons of Output and Productivity) group at the University of Groningen since 1983 for international comparisons of productivity levels¹. For East European countries earlier ICOP benchmark comparisons have been provided for East Germany/West Germany (1987 and 1992), Hungary/West Germany (1987) Czechoslovakia/West Germany (1989), Poland/West Germany (1989) and Poland/All Germany (1993).² The estimates were extrapolated from benchmark years using national time series at constant prices.

In this paper we provide benchmark comparisons of manufacturing unit value ratios and productivity levels for the Czech Republic, Hungary and Poland relative to Germany in 1996. Section 2 of this paper describes the methodology by which we obtained the conversion factors we used to express productivity levels into a common currency. Section 2.1 describes the general procedure followed in the ICOP research in calculating UVRs. Sections 2.2-2.4 show the calculations for respectively the Hungary/Germany comparison, the Poland-Germany comparison, and the Czech-Germany comparison for 1996. Section 3 uses the calculated UVRs to measure labour productivity levels in manufacturing for Hungary, Poland and the Czech Republic relative to Germany. Section 4 summarises the main competitiveness indicators to be derived from this research, i.e. relative price levels and comparative productivity ratios.

2. Development of Unit Value Ratios

2.1 Introduction

To compare productivity levels between countries a conversion factor is needed to convert values (for instance gross output or value added) into a common currency. For several reasons the use of the official exchange rate is inappropriate. The exchange rate is based upon traded goods only, it is affected by exchange rate policies and currency market fluctuations, and it can change rapidly in short periods of time due to capital movements. Indeed the conversion factors computed for this study are only about half the official market exchange rate.

¹ For a description and presentation of the ICOP project, see Maddison and van Ark (1994) and van Ark (1996). Summary results for 30 countries are available from the ICOP website at <http://www.eco.rug.nl/ggdc>.

Since the 1950s conversion factors have been calculated through the work of the International Comparisons Project (ICP), which provides purchasing power parities (PPPs) using the expenditure approach.³ ICP concentrates on comparisons of national accounts categories such as private consumption, government consumption and capital formation. PPPs are derived at a detailed item level by gathering expenditure prices for a sample of narrowly specified products in each country. Purchasing power parities are derived from the ratios of these item prices, which are subsequently aggregated into higher level PPPs. Expenditure PPPs are available on a regular basis for most countries from the UN, EUROSTAT and the OECD.

Expenditure PPPs are less useful for international comparisons by industry of origin as they only apply to final output. For example, the output of intermediate products, which in manufacturing accounts for at least one third in value, is not covered by such PPPs at all. Other drawbacks are that expenditure PPPs include margins, and indirect taxes and subsidies. Moreover these PPPs include import prices, while export prices are excluded. Attempts have been made to apply the expenditure PPPs to industry output (the so called proxy PPPs) by adjusting these PPPs to a domestic output factor price basis, and allocating expenditure PPPs to specific industries. However, only rough adjustments could be made.⁴

For comparisons by production sectors the industry of origin approach is the appropriate method. Industry specific conversion factors are computed using output data at producer level instead of at final expenditure level. Ideally, these industry PPPs should be based on specified product prices. However, detailed output prices are not available on a large international comparable scale. As an alternative ratios of unit values (UVRs) are used. Unit values are computed by dividing the value of output for a product category by the produced quantities. A unit value can be considered as an average price, averaged throughout the year for all producers and across a group of nearly similar products. The information is mostly derived from production censuses or industrial surveys.

The unit values for the matched products are used to derive the unit value ratios (UVR). Product UVRs are aggregated in a stage wise procedure to higher levels: industry, branch and finally to total manufacturing level. An industry is defined as the lowest level at which economic activities can be compared between countries, that is where output, value added and labour input data are available for both countries. The re-weighting procedure is performed for two reasons: 1. to derive industry and branch output conversion factors which are interesting in themselves, and 2. to ensure that original product UVRs are re-weighted according to their relative importance in the aggregate.

2 For a detailed account of ICOP measures for East European countries, and the specific problems involved for comparisons for the pre-transition period, see van Ark (1996a). For historical comparisons, see Horlings and van Ark (1998).

3 See for example Kravis, Summers and Heston (1982).

4 See for example Hooper (1996). For a more detailed overview of these issues, see van Ark (1996).

Aggregation Step 1: Industry UVR's

The computation of industry UVRs is based upon two alternative indexes: the Laspeyres index, using the quantity weights of the base country ($UVR^{XU(U)}$) and the Paasche index, using the quantity weights of the other country ($UVR^{XU(X)}$). They are expressed below, respectively, for an industry j . As not all products in an industry can be matched it is assumed that the average UVR for the matched products ($1, \dots, I_j(M)$) is representative for the average UVR of all products ($1, \dots, I_j$) in industry j , i.e.:

$$UVR_j^{XU(U)} \equiv \frac{\sum_{i=1}^{I_j} uv_{ij}^X q_{ij}^U}{\sum_{i=1}^{I_j} uv_{ij}^U q_{ij}^U} = \frac{\sum_{i=1}^{I_j(M)} uv_{ij}^X q_{ij}^U}{\sum_{i=1}^{I_j(M)} uv_{ij}^U q_{ij}^U}$$

at quantity weights of base country U, and:

$$UVR_j^{XU(X)} \equiv \frac{\sum_{i=1}^{I_j} uv_{ij}^X q_{ij}^X}{\sum_{i=1}^{I_j} uv_{ij}^U q_{ij}^X} = \frac{\sum_{i=1}^{I_j(M)} uv_{ij}^X q_{ij}^X}{\sum_{i=1}^{I_j(M)} uv_{ij}^U q_{ij}^X}$$

at quantity weights of country X.

However, the assumption of representativeness cannot always held true. In case the average coverage percentage of the matched products in terms of total output value within the industry is lower than 25%, the assumption is not deemed justified (the so called 25% -rule of thumb⁵). To obtain a UVR for those industries that do not meet the 25 % rule we use a UVR based upon all products in the branch to which the non-matched industry belongs. The “non-matched” industries are then treated as a separate industry in each branch.

Aggregation Step 2: Branch Level UVR's

The following step is to derive branch level UVRs. These are obtained through a weighted averaging of the UVRs of industries belonging to a particular branch, using the industries' shares in the branch gross value added (GVA) as weights. With this reweighting procedure one assures that industries which are important in value will get a greater weight in the branch UVR, irrespective of their percentage of matched output (the coverage ratio). Let J_k be the number of industries in branch k ($j=1, \dots, J_k$). Then the UVR for branch k is given by:

⁵ See van Ark (1993, p.28). For a discussion of alternative methods using a stratified sampling method instead of the rule of thumb, see Timmer (2000).

$$UVR_k^{XU(U)} = \frac{\sum_{j=1}^{J_k} GVA_j^{U(U)} \times UVR_j^{XU(U)}}{\sum_{j=1}^{J_k} GVA_j^{U(U)}}$$

at value added weights of base country U, and:

$$UVR_k^{XU(X)} = \frac{\sum_{j=1}^{J_k} GVA_j^{X(X)}}{\sum_{j=1}^{J_k} \frac{GVA_j^{X(X)}}{UVR_j^{XU(X)}}$$

at valued added weights of country X. If no matches are made in a branch, the total manufacturing UVR is assumed to be representative.

Aggregation Step 3: Manufacturing UVR

The manufacturing sector UVR (UVR_{manu}) is derived by aggregating branch UVRs in the same way as the aggregation from industry to branch level. Let K be the number of branches in the manufacturing sector ($k= 1,...,K$), then:

$$UVR_{manu}^{XU(X)} = \frac{\sum_{k=1}^K GVA_k^{X(X)}}{\sum_{k=1}^K \frac{GVA_k^{X(X)}}{UVR_k^{XU(X)}}$$

at value added weights of country X, and:

$$UVR_{manu}^{XU(U)} = \frac{\sum_{k=1}^K GVA_k^{U(U)} \times UVR_k^{XU(U)}}{\sum_{k=1}^K GVA_k^{U(U)}}$$

at valued added weights of base country U.

In case a single currency conversion factor is required, the Laspeyres and Paasche indices are combined into a Fisher index. It is defined as the geometric average of the Laspeyres and the Paasche.

2.2 Hungary-Germany, 1996

There are several reasons why we choose to compare the East European countries with Germany as the base country. Germany is an obvious choice since East European economies are strongly oriented towards the German economy. In addition, from a technical viewpoint, the German economy is large enough to cover most products produced in Eastern Europe which guarantees a sufficient number of

product matches. Moreover the quality of the German manufacturing census is good in the sense that for many products on quantities and values could be collected. The German census no longer makes a difference between former West and East Germany, except for a few variables at an aggregated level.

Both Germany and Hungary conducted an industrial product survey for 1996. In recent years a new European product classification (PRODCOM) has been introduced by Eurostat, which has been adopted by Germany and in an adapted format by Hungary. PRODCOM includes up to 4000 separate product codes. The Hungarian product survey includes quantity and value data for about 900 product codes. The Germany product list shows quantity and price figures for about 2500 product codes. This difference in product details can partly be explained by the greater variety of products produced in Germany and confidentiality of information for the much smaller Hungarian manufacturing sector.⁶ Most importantly Hungary did not publish all available product information but just the most important products in terms of output value.⁷

The first step in computing the ratio of unit values is identifying the same products in both countries (matching). Since both countries use, up to a certain level, the same product classification, matches could be made relatively easily. However, since Hungary used its own product headings below a six digit PRODCOM code, the actual identifying of similar products still had to be done product by product.

In some cases quantities had to be expressed in the same unit for which we used quantity conversion factors⁸. In both countries more than one quantity unit was in some cases. This meant UVRs depended on the quantity unit chosen. We aimed to use those units that were the most objective in terms of quality, if possible weight units. This problem is particularly important for textiles.

Step two is the matching of the industries. Although the Hungarian industry classification is considerably less detailed than in Germany (Germany had 247 four digit industries, and Hungary only 154), most industries compared well. The surveys in both countries also included a considerable amount of service activities related to manufacturing activities, such as repair and installation services.

Industry coverage ratios were calculated on the basis of the percentage of the sales value of matched products in an industry compared to the total sales value of the industry. Using the rule of thumb (a minimum output coverage of 25%) the industry was considered either matched or non-matched, and the UVR calculated from the matched products was considered either representative or not representative for non-matched products.⁹ Subsequently the UVRs of the matched industries were weighted with their value added. For the non-matched industries a UVR based upon all the product matches within a branch was calculated. The latter UVR was given the weight of the value added of

⁶ As Hungarian manufacturing employment is only 10% of that in Germany, a substantial part of the information is withheld for confidentiality reasons as there too few companies in many industries.

⁷ The Hungarian CSO has product information on a large number of additional small products, which has not been used for this study.

⁸ For this we used mostly the Economist Measurement Guide and Reckoner.

⁹ Since in some cases for Hungary not all industries within a branch were known (which may lead to an underestimation of the output value and therefore an overestimation of the matched percentage) the matching percentages for Germany were given more weight in identifying matched and non-matched parts of the branch.

the non-matched industries in the branch. The outcome of this weighting procedure provided the branch UVR. A UVR for total manufacturing was then calculated as the value added weighted average of the branch UVRs.

Table 1
Number of Matches, Matching percentages and Unit Value Ratios, Hungary-Germany, 1996

| Branch | Number of Matches | Percentage of Output Matched | | Unit Value Ratios | | |
|-------------------------------------|-------------------|------------------------------|---------|-------------------|----------------|-------------------|
| | | Hungary | Germany | Hungarian Weights | German Weights | Geometric Average |
| Food products | 48 | 57 | 58 | 59.4 | 59.3 | 58.8 |
| Beverages | 9 | 86 | 76 | 42.5 | 42.3 | 42.4 |
| Tobacco | 1 | 92 | 58 | 35.5 | 35.5 | 35.5 |
| Textiles | 57 | 38 | 51 | 44.3 | 44.9 | 44.6 |
| Wearing apparel | 48 | 23 | 35 | 47.3 | 56.3 | 51.6 |
| Leather and leather products | 10 | 19 | 27 | 47.5 | 54.7 | 51.0 |
| Wood and wood products | 13 | 33 | 52 | 48.6 | 45.2 | 46.9 |
| Paper, printing and publishing | 34 | 51 | 58 | 36.7 | 50.8 | 43.2 |
| Refined petroleum products | 9 | 31 | 22 | 166.0 | 164.4 | 165.2 |
| Chemicals | 62 | 38 | 22 | 69.7 | 77.7 | 73.6 |
| Rubber and plastic products | 27 | 56 | 61 | 57.3 | 56.4 | 56.8 |
| Non-metallic mineral products | 26 | 68 | 59 | 50.2 | 64.6 | 56.9 |
| Basic and fabricated metal products | 39 | 43 | 34 | 63.1 | 65.6 | 64.3 |
| Machinery and transport equipment | 32 | 15 | 10 | 35.4 | 45.8 | 40.3 |
| Electrical equipment | 29 | 34 | 24 | 49.7 | 70.2 | 59.1 |
| Other manufacturing sectors | 39 | 29 | 44 | 38.2 | 49.6 | 43.5 |
| Total excl. Refining | 474 | 43 | 32 | 48.1 | 57.0 | 52.4 |
| Total incl. Refining | 483 | 42 | 31 | 51.1 | 58.0 | 54.4 |

Exchange rate 1996: 101.44 Forint/DM

Source: See Appendix A

Table 1 shows the number of matches, the matching percentage and the resulting unit value ratios. These figures give an indication of the the distribution of the product matches between the branches within the manufacturing sector. In general more product matches and higher matching percentages are preferable to less, though the variability of the individual product UVR's within an industry and between branches can be meaningful as well.¹⁰ We show two results for the total manufacturing sector, one inclusive oil refining activities and one exclusive oil refining activities. This was done in order to show a total comparable to that in the Poland – Germany comparison (see below) for which we had to exclude the oil refining branch.

¹⁰ See van Ark (1993) and Timmer (2000) for a more detailed discussion of the issues in determining the quality of comparisons based upon the ICOP procedure.

In most branches the percentage of total branch output that is covered by product matches is higher for Hungary than for Germany. The most important reason for this is that the Hungarian manufacturing sector is smaller and thus has a narrower range of products. Therefore a given number of products matched will account for a larger share of total manufacturing output in Hungary than in Germany. In addition, due to the procedures used in matching products, simpler less advanced products have a higher probability of being included in the comparisons. This type of products is in general more important in the less developed economy. The matching percentages were lowest in the Machinery and Transport Equipment branch. This is related to the fact that this branch is dominated by the production of passenger cars. Due to lack of data for Hungary we were not able to include this important product in the comparison, which leads to a low matching percentage.

Table 1 also shows the unit value ratios that were calculated. Both ratios, either using the Hungarian production structure as weights or those using the German production structure as weights, as well as their geometric averages are shown. A large spread between the two is an indication of a greater difference between the production structures in both countries. As can be seen from the table there are large differences in unit value ratios between the branches.

2.3 Poland-Germany, 1996

For Poland product data for 1996 were available for about 300 products. Some mining activities were included with oil refining, which is commonly classified in manufacturing. Since it was not possible to divide these two in a satisfactory way, oil refining was excluded from the comparison. Poland uses its own product classification scheme, which is different from PRODCOM. In combination with problems in translating some of the Polish product description, the task of finding identical product categories in both countries was more difficult.

Table 2 shows the results of the Poland-Germany UVR comparison for 1996. The number of product matches was 210. Few matches were made in the electrical equipment branch, and none at all in Other Manufacturing. However, in contrast to the Hungary-Germany comparison, we were able to match passenger cars, which contributes to the relatively high percentage of output matched in machinery and transport equipment. Although the number of product matches is only about half that of the Hungary-Germany comparison, the percentage of output covered by these matches is slightly higher. This implies that the level of aggregation of the product matches is higher, and the problems resulting from aggregation may therefore be more important. The unit value ratio for Total Manufacturing was about 54 percent of the 1996 exchange rate level (the ratio between UVR and exchange rate is an indicator of the relative price level). Again we find that the resulting UVRs differ greatly between branches.

Table 2
Number of Matches, Matching percentages and Unit Value Ratios, Poland-Germany, 1996

| Branch | Number of Matches | Percentage of Output Matched | | Unit Value Ratios | | |
|-------------------------------------|-------------------------|---------------------------------|---------|-------------------|-------------------|----------------------|
| | | Poland | Germany | Polish Weights | German Weights | Geometric Average |
| Food products, beverages | 52 | 67 | 59 | 1.07 | 1.23 | 1.14 |
| Tobacco | 2 | 75 | 63 | 0.50 | 0.50 | 0.50 |
| Textiles | 23 | 49 | 38 | 0.72 | 1.03 | 0.86 |
| Wearing apparel | 9 | 39 | 30 | 0.47 | 0.46 | 0.47 |
| Leather and leather products | 4 | 52 | 33 | 0.71 | 0.76 | 0.73 |
| Wood and wood products | 9 | 26 | 33 | 1.08 | 1.23 | 1.15 |
| Paper, printing and publishing | 4 | 26 | 40 | 1.28 | 1.46 | 1.36 |
| Chemicals | 22 | 32 | 24 | 1.01 | 1.13 | 1.07 |
| Rubber and plastic products | 9 | 53 | 51 | 0.60 | 0.54 | 0.56 |
| Non-metallic mineral products | 21 | 41 | 45 | 0.79 | 0.84 | 0.81 |
| Basic and fabricated metal products | 32 | 46 | 45 | 1.00 | 1.23 | 1.11 |
| Machinery and transport equipment | 17 | 34 | 23 | 0.60 | 0.88 | 0.73 |
| Electrical equipment | 6 | 20 | 6 | 0.55 | 1.43 | 0.89 |
| Other manufacturing sectors* | 0 | 0 | 0 | 0.85 | 1.12 | 0.97 |
| Total excl. Refining | 210 | 52 | 31 | 0.80 | 1.06 | 0.92 |

* - For the sector other manufacturing we used the UVR for total manufacturing.

Exchange rate 1996: 1.794 Zloty/DM.

Source: See Appendix A

2.4 Czech Republic-Germany, 1996

The data on the quantities and values of manufacturing products for the Czech Republic in 1996 are not published. However, we were given access to data provided by the Czech Statistical Office for about 450 products, which represented the most important items in terms of output value. These product data excluded information on the production of wearing apparel. The Czech Republic uses a classification related to PRODCOM.

Table 3*Number of Matches, Matching percentages and Unit Value Ratios, Czech Republic -Germany, 1996*

| Branch | Number of Matches | Percentage of Output Matched | | Unit Value Ratios | | |
|-------------------------------------|-------------------------|---------------------------------|---------|-------------------|-------------------|----------------------|
| | | Czech Republic | Germany | Czech Weights | German Weights | Geometric Average |
| Food products, beverages, tobacco | 74 | 91 | 76 | 9.8 | 12.0 | 10.9 |
| Textile and Wearing apparel | 38 | 60 | 46 | 7.5 | 8.9 | 8.2 |
| Leather and leather products | 4 | 60 | 41 | 8.2 | 8.9 | 8.5 |
| Wood and wood products | 15 | 66 | 80 | 8.5 | 8.4 | 8.4 |
| Paper, printing and publishing | 33 | 63 | 74 | 10.8 | 13.6 | 12.1 |
| Refined petroleum products | 7 | 32 | 21 | 8.0 | 5.3 | 6.5 |
| Chemicals | 77 | 53 | 27 | 6.8 | 9.4 | 8.0 |
| Rubber and plastic products | 28 | 84 | 75 | 7.5 | 8.4 | 7.9 |
| Non-metallic mineral products | 28 | 52 | 55 | 7.1 | 8.9 | 8.0 |
| Basic and fabricated metal products | 60 | 55 | 52 | 10.2 | 12.1 | 11.1 |
| Machinery and transport equipment | 25 | 15 | 21 | 6.6 | 8.6 | 7.5 |
| Electrical equipment | 34 | 27 | 25 | 7.7 | 10.3 | 8.9 |
| Other manufacturing sectors * | 6 | 7 | 4 | 8.0 | 10.0 | 9.0 |
| Total excl. Refining | 422 | 51 | 38 | 7.8 | 9.9 | 8.8 |
| Total incl. Refining | 429 | 50 | 38 | 8.0 | 10.0 | 9.0 |

* - For the sector other manufacturing we used the UVR for total manufacturing.

Exchange rate 1996: 18.04 Kc/DM.

Source: See Appendix A

Table 3 shows the results of the Czech Republic-Germany comparison. Few matches were made in Other Manufacturing. Hence in accordance with other ICOP comparisons for this branch we used the UVR for Total Manufacturing. Like in the Poland-Germany comparison we were able to match passenger cars, which contributed to a relatively high percentage of output matched in Machinery and Transport equipment. The unit value ratio for Total Manufacturing was about 50 percent of the 1996 exchange rate level (the ratio between UVR and exchange rate is an indicator of the relative price level).

3. Labour Productivity Estimates

3.1 Hungary

For Hungary the figures on production quantities and sales value of products refer to enterprises with more than 20 employees. Industry employment data refers to enterprises with more than 20 employees as well, but industry output figures refer to enterprises with more than 10 employees. In order to adjust for the latter, we made use the Hungarian Statistical Yearbook, 1996, which provides value added and output data for enterprises employing over 20 employees on a two digit level. These figures were subsequently linked to the employment data and divided between three digit industries using the distribution of output between the industries for enterprises with more than 10 employees. This means that although all data refer to enterprises with more than 20 employees for Hungary, we used a different source for the employment and output and the ratio of value added to gross output data. All data for Germany refers to enterprises with more than 20 employees.¹¹

In addition to adjusting figures to represent the same size class of enterprises, the definitions of the variables were checked to ensure comparability. Employment as used here is the total of all employees, part time and full time, excluding proprietors. Both manual and non-manual employees are included. In Hungary this includes pensioners, and people with a labour relation with the enterprise without discontinuing their pension.

Gross output represents the value of the output and service activities related to industry performed. Value added is defined as the gross output value from which the value of intermediate consumption - the value of goods and services used for the production - are subtracted. The Hungarian CSO uses the recommendations of the internationally harmonised system of national accounts (SNA93) in order to calculate value added. Both are at factor cost, in other words corrected for consumption taxes, value added taxes and other indirect taxes or subsidies.

When combining the UVRs from section 2 with the output and employment measures we can calculate levels of labour productivity for Hungary relative to Germany. Table 4 shows the results, showing two measures of labour productivity, namely gross output and value added per person employed. Because the ratio of intermediate inputs to gross output can differ between countries the preferred measure of labour productivity is value added per person employed. In the present case both productivity measures show comparable relative levels for Total Manufacturing, because the ratio of Value Added to Gross Output (or in other words the share of intermediate inputs in production) is quite similar between Hungary (30 percent) and Germany (31 percent). However, there are more substantial differences between the two countries at the branch level.

The relative level of labour productivity in Hungarian manufacturing was 38.0 percent of that in Germany. The distribution among the branches suggests a relatively good performance in the Wood and Wood Products, Paper, Printing and Publishing and Machinery and Transport Equipment.

¹¹ See for the underlying data on output and employment in Appendix B.

Textiles, Chemicals and Oil refining and Leather and Leather products showed relatively low productivity levels (see also figure 2 below).

Table 4
Output per Person and Value Added per person, Hungary and Germany, 1996

| Branch | Gross Output per Person | | | Value Added per Person | | |
|-------------------------------------|-------------------------|---------|-------|------------------------|---------|-------|
| | Hungary | Germany | Ratio | Hungary | Germany | Ratio |
| | 1000 DM | 1000 DM | | 1000 DM | 1000 DM | |
| Food products | 155 | 376 | 41.3 | 32 | 77 | 42.1 |
| Beverages | 231 | 490 | 47.1 | 49 | 133 | 36.4 |
| Tobacco | 460 | 855 | 53.8 | 127 | 226 | 56.0 |
| Textiles | 54 | 243 | 22.2 | 20 | 77 | 26.6 |
| Wearing apparel | 36 | 268 | 13.4 | 21 | 66 | 31.2 |
| Leather and leather products | 35 | 269 | 13.1 | 18 | 73 | 24.8 |
| Wood and wood products | 128 | 264 | 48.4 | 46 | 84 | 54.9 |
| Paper, printing and publishing | 205 | 306 | 67.2 | 65 | 114 | 56.9 |
| Refined petroleum products | 122 | 3,714 | 3.3 | 43 | 276 | 15.6 |
| Chemicals | 128 | 459 | 27.9 | 43 | 140 | 30.4 |
| Rubber and plastic products | 141 | 265 | 53.3 | 44 | 96 | 46.2 |
| Non-metallic mineral products | 92 | 274 | 33.5 | 36 | 103 | 35.4 |
| Basic and fabricated metal products | 115 | 277 | 41.5 | 32 | 96 | 33.9 |
| Machinery and transport equipment | 208 | 350 | 59.5 | 60 | 110 | 54.4 |
| Electrical equipment | 107 | 320 | 33.3 | 36 | 106 | 33.7 |
| Other manufacturing sectors * | 111 | 226 | 49.0 | 49 | 87 | 59.9 |
| Total excl. Refining | 129 | 326 | 39.6 | 39 | 104 | 37.3 |
| Total incl. Refining | 131 | 338 | 38.7 | 40 | 104 | 38.0 |

* - For the sector other manufacturing we used the UVR for total manufacturing.

Source: Table 1 and appendix table B1.

3.2 Poland

For Poland, industry data at a slightly more disaggregated level than that of the branch was obtained from the *Statistical Yearbook of the Republic of Poland* for 1998. These figures refer to enterprises employing over 20 employees. This source contained data on gross output, value added and employment. As was the case for the Hungary-Germany comparison, we made no attempt to calculate productivity levels on an hourly basis. In order to obtain an industry weighting system at a more disaggregated level we used information from the *1997 Yearbook of Industry*.

Table 5 shows the results in terms of labour productivity for Poland relative to Germany. As can be seen from the table the relative productivity levels in Polish manufacturing were 25.4 percent for gross output per person employed and 24.9 percent for value added per person employed respectively. The higher outcome in terms of value added per person employed is due to the slightly

lower ratio of intermediate inputs used in Poland as compared to Germany. The ratio of value added to gross output was 34 percent in Poland and 31 percent in Germany.

Overall the relative productivity levels in Polish manufacturing were below those in Hungary. However, when we comparing relative productivity levels for branches we find less variability between branches in Poland as compared to Hungary (see also figure 2 below).

Table 5
Output per Person and Value Added per person, Poland and Germany, 1996

| Branch | Gross Output per Person | | | Value Added per Person | | |
|-------------------------------------|-------------------------|--------------------|-------|------------------------|--------------------|-------|
| | Poland 1000 DM | Germany 1000 DM | Ratio | Poland 1000 DM | Germany 1000 DM | Ratio |
| Food products, beverages | 96 | 395 | 24.2 | 20 | 85 | 23.6 |
| Tobacco | 343 | 855 | 40.2 | 90 | 226 | 39.6 |
| Textiles | 54 | 243 | 22.2 | 20 | 77 | 25.5 |
| Wearing apparel | 52 | 268 | 19.5 | 24 | 66 | 36.8 |
| Leather and leather products | 51 | 273 | 18.8 | 19 | 74 | 25.8 |
| Wood and wood products | 52 | 264 | 19.5 | 17 | 84 | 20.5 |
| Paper, printing and publishing | 80 | 306 | 26.1 | 29 | 114 | 25.5 |
| Chemicals | 129 | 459 | 28.2 | 41 | 140 | 29.1 |
| Rubber and plastic products | 157 | 265 | 59.2 | 54 | 96 | 56.5 |
| Non-metallic mineral products | 78 | 274 | 28.5 | 31 | 103 | 29.8 |
| Basic and fabricated metal products | 75 | 281 | 26.6 | 23 | 96 | 23.9 |
| Machinery and transport equipment | 103 | 360 | 28.5 | 33 | 110 | 30.1 |
| Electrical equipment | 94 | 320 | 29.2 | 33 | 106 | 31.3 |
| Other manufacturing sectors * | 56 | 226 | 24.7 | 21 | 87 | 23.6 |
| Total | 83 | 328 | 25.4 | 26 | 104 | 24.9 |

* - For the sector other manufacturing we used the UVR for total manufacturing.

Note: Refining included some products usually included with Mining. Estimates refer to enterprises with 20 or more persons employed

Source: Table 2 and appendix table B2.

Labour productivity in Poland turned out to be considerably lower than that in Hungary. Still Poland performed relatively well in the branches Tobacco, Wearing Apparel, Rubber and Plastic products and in Electrical Equipment, but productivity levels were below average in Food Products and Beverages and in Wood Products.

3.3 Czech Republic

For the Czech Republic figures on industrial output and employment were taken from CSU, *Industry of the Czech Republic, 1996*. Again the industries are fairly aggregated compared to the German classification. Compared to the other two binary comparisons, the Czech industry figures differ in two important ways. Firstly they refer only to enterprises employing over 100 employees (in the other two

comparisons they refer to enterprises employing over 20 employees). Secondly the figures for employment are for employees only, whereas a more encompassing definition which also includes self-employed persons was included in the previous two cases. These differences limit the comparability between the Czech Republic-German comparison on the one hand, and the Hungary-Germany and Poland-Germany comparisons on the other.

The relative productivity level measured in value added terms came out at only 26.7 percent of the German level in 1996, which was only slightly higher than in Poland. However, in gross output terms, the Czech manufacturing sector performed much better since the ratio of value added to gross output in the Czech Republic was substantially lower (24 percent) than in Germany (31 percent). Relative to Germany, Chemicals and oil refining, Rubber and Plastic products and Non-metallic mineral products showed relatively high productivity levels in the Czech Republic. The lowest relative productivity level was found for Paper, Printing and Publishing.

Table 6
Output per Person and Value Added per person, Czech Republic and Germany, 1996

| Branch | Gross Output per Person | | | Value Added per Person | | |
|-------------------------------------|-------------------------|---------|-------|------------------------|----------|-------|
| | Czech | Germany | Ratio | Czech | Germany | Ratio |
| | Republic | 1000 DM | | 1000 DM | Republic | |
| | 1000 DM | 1000 DM | Ratio | 1000 DM | 1000 DM | Ratio |
| Food products, beverages, tobacco | 157 | 455 | 34.5 | 33 | 96 | 33.8 |
| Textiles, wearing apparel | 70 | 270 | 25.7 | 20 | 77 | 26.5 |
| Leather and leather products | 63 | 307 | 20.6 | 19 | 75 | 25.7 |
| Wood and wood products | 101 | 296 | 34.1 | 25 | 93 | 27.5 |
| Paper, printing and publishing | 106 | 331 | 31.9 | 27 | 196 | 13.8 |
| Refined petroleum products | 1,595 | 3,868 | 41.2 | 105 | 284 | 37.0 |
| Chemicals | 249 | 464 | 53.6 | 62 | 142 | 43.4 |
| Rubber and plastic products | 127 | 279 | 45.5 | 39 | 99 | 38.8 |
| Non-metallic mineral products | 119 | 276 | 43.2 | 45 | 106 | 42.3 |
| Basic and fabricated metal products | 120 | 305 | 39.4 | 24 | 101 | 23.9 |
| Machinery and transport equipment | 122 | 367 | 33.1 | 32 | 113 | 28.5 |
| Electrical equipment | 82 | 335 | 24.5 | 26 | 109 | 23.9 |
| Other manufacturing sectors * | 81 | 246 | 32.8 | 25 | 92 | 27.3 |
| Total excl. Refining | 123 | 351 | 35.0 | 31 | 114 | 27.3 |
| Total incl. Refining | 125 | 365 | 34.3 | 31 | 114 | 26.7 |

* - For the sector other manufacturing we used the UVR for total manufacturing.

Source: Table 3 and appendix table B3.

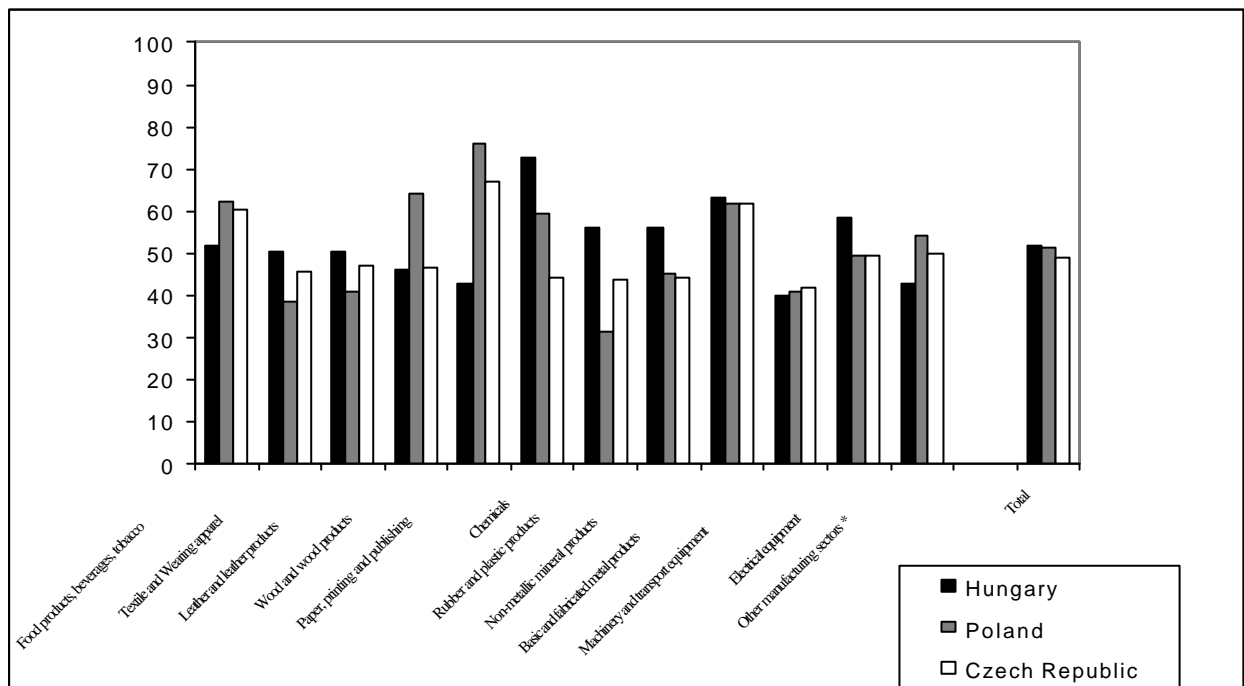
4. Competitiveness Indicators

4.1 Price Competitiveness

Figure 1 shows the distribution of the relative price levels (measured as the UVRs divided by the exchange rate) among branches for all three countries, which provides an indication of the price competitiveness of these branches. On average, manufacturing prices were about half of those in Germany for all three countries. Hungary was characterised by relatively low price levels in Food Processing, but relatively high price levels in Chemicals, Rubber and Plastic Products, Non-Metallic Mineral Products and Electrical Equipment. Poland appeared weak on price competitiveness in Wood and Wood Products and Printing and Publishing. The Czech Republic has relatively low price levels in Chemicals.¹²

Figure 1

Relative Price Levels (Unit Value Ratio divided by Exchange Rate, Hungary-Germany, Poland-Germany, Czech Republic-Germany, 1996



Source: Tables 1 to 3

The spread between the results using Hungarian weights and German weights was considerably lower than the comparable price spreads for the Poland-Germany and Czech Republic-Germany comparisons (see Tables 1 to 3). When we compare the Paasche and Laspeyres results in the case of Hungary the spread is about 13 percent of the geometric average. In the case of the Poland-

¹² Figure 1 excludes the relative price level for Refined Petroleum Products. The composition of oil products and the excise tax structure shows relative price levels which are not representative of actual price competitiveness. The relative price level for this branch is also excluded from the result for Total Manufacturing (see Tables 1 and 3 for results including Refined Petroleum Products for Hungary-Germany and Czech Republic-Germany).

Germany comparison this figure is 29 percent, and for the Czech Republic -Germany comparisons it is 23 percent. This suggests that the price structure in Hungary was more alike that of Germany than in the other two East European countries.

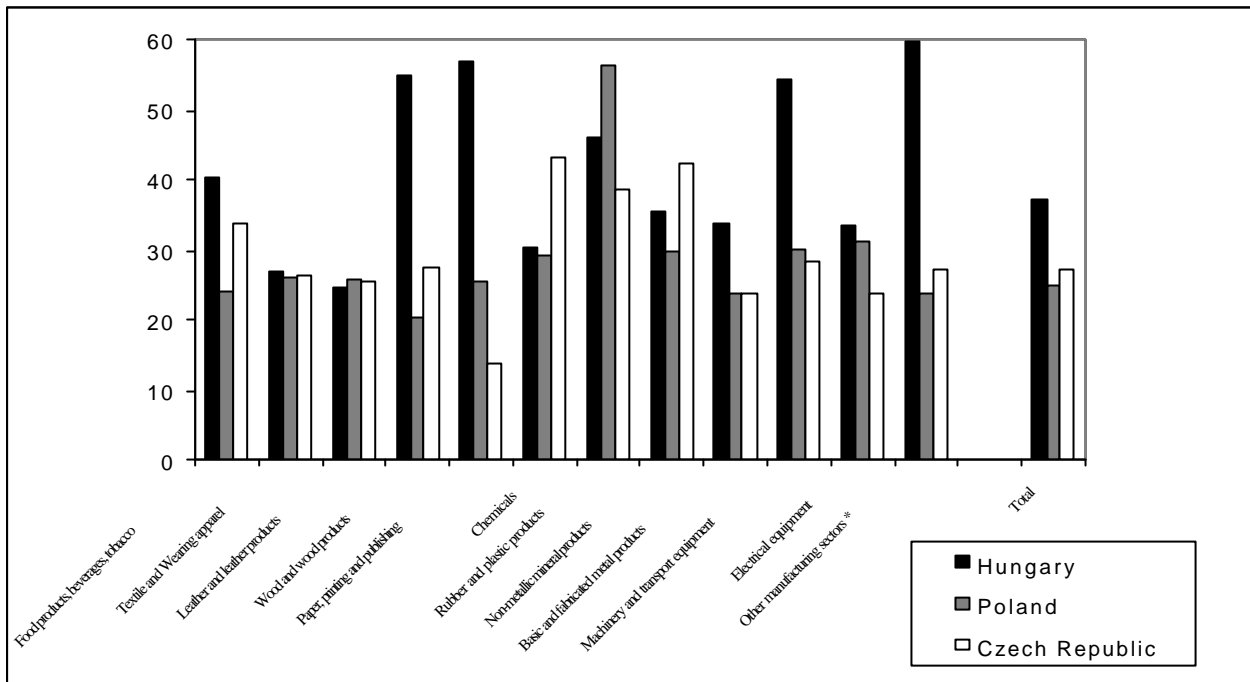
4.2 Productivity Competitiveness

Figure 2 shows competitiveness in terms of productivity. For Total Manufacturing, Hungary shows a clear productivity advantage despite a comparable relative price level (compare Figure 1). The Hungarian productivity advantage is in strong Food Products, Paper and Printing, and Wood Products (even though in the latter case it is benefitting from low relative price levels), but also in Machinery and Transport Equipment and in Other Manufacturing. The Polish productivity level is high in Rubber and Plastic Products, and in the Czech Republic it is high in Chemicals, which in both cases is reflected by relatively low price levels. Czech productivity is also relatively high in Non-Metallic Minerals.

These indicators do of course not provide a full picture of competitiveness. This would also require measures of costs. In particular this research could be usefully extended with comparisons of unit labour cost. Furthermore, as mentioned before, these indicators may not fully take account of important quality differences which reduce the price competitiveness and productivity levels of these countries. In particular, measures of product variety and detailed product characteristics would be useful extension for the present data.

Figure 2

Comparative Levels of Value Added per Person Employed in Manufacturing, Hungary-Germany, Poland-Germany, Czech Republic-Germany, 1996 (Germany=100)



Note: Hungary and Czech Republic relative to Germany refers to enterprises with 20 or more employees. Czech Republic relative to Germany refers to enterprises with 100 or more employees.

Source: Tables 4 to 6

Appendix A. Sources used for the benchmark comparisons of labour productivity, Germany, Hungary, the Czech Republic and Poland, 1996.

(Industry data for Hungary and Poland refer to establishments employing 20 or more employees, for the Czech Republic figures refer to establishments employing 100 or more employees)

Germany

Quantities and Values of Output on product level:

Statistisches Bundesamt, *Produzierendes Gewerbe, fachserie 4, reihe 3.1, Produktion im Produzierenden Gewerbe* 1997, Wiesbaden, 1998.

Industry data on Output and Employment:

Gross Output, Value Added and Employment from:

Statistisches Bundesamt, *Produzierendes Gewerbe, fachserie 4, reihe 4.3, Kostenstruktur der Unternehmen der Verarbeitenden Gewerbes sowie des Bergbaus und der Gewinnung von Steinen und Erden*, 1997, Wiesbaden, 1998.

Hungary

Quantities and Values of Output on product level:

Kozponti Statisztikai Hivatal, *Ipari es Epitoipari Statisztikai Evkonyv*, 1997 (Hungarian Central Statistical Office, Yearbook of Industrial and Construction Statistics, 1997), Budapest, 1998.

Industry data on Output and Employment:

Gross Output and Employment from:

Kozponti Statisztikai Hivatal, *Ipari es Epitoipari Statisztikai Evkonyv*, 1997 (Hungarian Central Statistical Office, Yearbook of Industrial and Construction Statistics, 1997), Budapest, 1998.

Ratio Value added to Gross Output from:

Kozponti Statisztikai Hivatal, *Magyar Statisztikai Evkonyv*, 1996 (Hungarian Central Statistical Office, Statistical Yearbook of Hungary, 1996), Budapest, 1997.

Czech Republic

Quantities and Values of Output on product level:

These data were not published for 1996, and were provided to us by the industrial statistics division of the Czech Statistical Office.

Industry data on Output and Employment:

Cesky Statistický Úrad, Průmysl České Republiky, za leden až prosinec 1996 (Czech Statistical Office, Industry of the Czech Republic, 1996), 1997.

Cesky Statistický Úrad, Vybrané Finanční Ukazatele v Průmyslu ČR v roce 1996 (Czech Statistical Office, Industry of the Czech Republic, Selected Financial Indicators, 1996), 1997.

Cesky Statistický Úrad, Statistická Rocenka České Republiky (Czech Statistical Office, Statistical Yearbook of the Czech Republic, 1997), 1998.

Poland

Quantities and Values of Output on product level:

Główny Urząd Statystyczny, Produkcja Wyrobów Przemysłowych w 1996 R. (Central Statistical Office, Industrial Production 1996), Warsaw 1997.

Industry data on Output and Employment:

Gross Output, Value Added and Employment from:

Główny Urząd Statystyczny, Rocznik Statystyczny 1998, (Central Statistical Office, Statistical Yearbook of the Republic of Poland, 1998), Warsaw 1999.

Główny Urząd Statystyczny, Rocznik Statystyczny Przemysłu 1997, (Central Statistical Office, Statistical Yearbook of Industry, 1997), Warsaw 1997.

Appendix B. Data on Gross Output, Value Added and Employment on branch level, Hungary, Czech Republic, Poland and Germany, 1996.

Table B1

Output, Value Added and Employment, Hungary-Germany, 1996

| Branch | Hungary | | | Germany | | |
|-------------------------------------|--------------|-------------|------------|--------------|-------------|------------|
| | Gross Output | Value Added | Employment | Gross Output | Value Added | Employment |
| | Mil. Forint | Mil. Forint | 1000's | Mil. DM | Mil. DM | 1000's |
| Food products | 998,780 | 208,793 | 109.4 | 189,841 | 38,944 | 505.0 |
| Beverages | 112,910 | 23,604 | 11.5 | 38,892 | 10,538 | 79.4 |
| Tobacco | 36,317 | 10,002 | 2.2 | 11,330 | 2,999 | 13.2 |
| Textiles | 115,921 | 44,036 | 38.0 | 31,439 | 9,942 | 129.2 |
| Wearing apparel | 88,300 | 50,927 | 55.1 | 21,835 | 5,414 | 81.6 |
| Leather and leather products | 40,775 | 20,867 | 22.7 | 7,117 | 1,929 | 26.5 |
| Wood and wood products | 95,606 | 34,689 | 16.0 | 30,600 | 9,778 | 115.8 |
| Paper, printing and publishing | 240,595 | 76,216 | 27.2 | 127,558 | 47,713 | 417.5 |
| Refined petroleum products | 316,711 | 111,134 | 15.7 | 77,772 | 5,777 | 20.9 |
| Chemicals | 407,826 | 136,074 | 43.3 | 233,311 | 71,446 | 508.7 |
| Rubber and plastic products | 170,466 | 53,298 | 21.2 | 91,909 | 33,168 | 346.9 |
| Non-metallic mineral products | 158,295 | 62,857 | 30.3 | 69,706 | 26,236 | 254.8 |
| Basic and fabricated metal products | 485,101 | 136,803 | 65.5 | 234,185 | 80,683 | 844.0 |
| Machinery and transport equipment | 703,587 | 202,280 | 83.9 | 677,335 | 213,014 | 1934.9 |
| Electrical equipment | 346,852 | 116,057 | 55.1 | 200,206 | 66,221 | 624.7 |
| Other manufacturing sectors | 166,562 | 73,294 | 34.5 | 102,006 | 39,391 | 450.9 |
| Total excl. Refining | 4,167,893 | 1,249,797 | 615.9 | 2,067,271 | 657,417 | 6,333.3 |
| Total incl. Refining | 4,484,604 | 1,360,931 | 631.6 | 2,145,043 | 663,193 | 6354.2 |

Table B2

Output, Value Added and Employment, Poland-Germany, 1996

| Branch | Poland | | | Germany | | |
|-------------------------------------|--------------|-------------|------------|--------------|-------------|------------|
| | Gross Output | Value Added | Employment | Gross Output | Value Added | Employment |
| | Mil. Zloty | Mil. Zloty | 1000's | Mil. DM | Mil. DM | 1000's |
| Food products, beverages | 60,539 | 12,658 | 552.4 | 222,935 | 47,972 | 564.1 |
| Tobacco | 2,281 | 596 | 13.3 | 11,330 | 2,999 | 13.2 |
| Textiles | 7,538 | 2,735 | 161.6 | 31,439 | 9,942 | 129.2 |
| Wearing apparel | 7,706 | 3,597 | 316.6 | 21,835 | 5,414 | 81.6 |
| Leather and leather products | 3,422 | 1,274 | 90.9 | 7,117 | 1,929 | 26.0 |
| Wood and wood products | 8,904 | 2,996 | 149.8 | 30,600 | 9,778 | 115.8 |
| Paper, printing and publishing | 14,372 | 5,272 | 132.3 | 126,796 | 47,451 | 415.0 |
| Chemicals | 19,465 | 6,161 | 140.6 | 233,328 | 71,464 | 508.7 |
| Rubber and plastic products | 9,975 | 3,431 | 112.5 | 91,909 | 33,168 | 346.9 |
| Non-metallic mineral products | 11,819 | 4,661 | 186.6 | 69,706 | 26,236 | 254.9 |
| Basic and fabricated metal products | 30,264 | 9,291 | 365.9 | 234,205 | 80,703 | 844.0 |
| Machinery and transport equipment | 38,251 | 12,373 | 510.3 | 677,335 | 213,014 | 1,935.0 |
| Electrical equipment | 12,140 | 4,306 | 146.0 | 200,206 | 66,221 | 624.7 |
| Other manufacturing sectors | 13,689 | 5,065 | 251.9 | 102,006 | 39,391 | 450.9 |
| Total | 240,364 | 74,415 | 3,130 | 1,919,503 | 606,091 | 5,847 |

Sources: see appendix A.

Table B3
Output, Value Added and Employment, Czech Republic -Germany, 1996.

| Branch | Czech Republic | | Employees | Germany | | Employees |
|-------------------------------------|----------------|-------------|-----------|--------------|-------------|-----------|
| | Gross Output | Value Added | | Gross Output | Value Added | |
| | Mil. Kc. | Mil. Kc. | 1000's | Mil. DM | Mil. DM | 1000's |
| Food products, beverages, tobacco | 178,952 | 37,155 | 105 | 195,288 | 41,307 | 429 |
| Textiles and wearing apparel | 56,764 | 16,638 | 100 | 40,742 | 11,604 | 151 |
| Leather and leather products | 13,519 | 4,112 | 25 | 5,180 | 1,265 | 17 |
| Wood and wood products | 16,149 | 4,070 | 19 | 19,605 | 6,135 | 66 |
| Paper, printing and publishing | 47,521 | 12,159 | 37 | 101,815 | 60,165 | 307 |
| Refined petroleum products | 51,761 | 3,405 | 5 | 77,347 | 5,676 | 20 |
| Chemicals | 93,495 | 23,170 | 47 | 220,623 | 67,578 | 475 |
| Rubber and plastic products | 30,267 | 9,186 | 30 | 73,152 | 26,044 | 262 |
| Non-metallic mineral products | 56,809 | 21,331 | 60 | 50,853 | 19,500 | 184 |
| Basic and fabricated metal products | 235,121 | 46,999 | 176 | 188,901 | 62,423 | 620 |
| Machinery and transport equipment | 219,323 | 58,081 | 239 | 630,942 | 194,008 | 1,720 |
| Electrical equipment | 66,022 | 20,838 | 90 | 186,395 | 60,523 | 556 |
| Other manufacturing sectors | 36,195 | 11,245 | 50 | 78,462 | 29,282 | 318 |
| Total excl. Refining | 1,050,137 | 264,984 | 978 | 1,791,959 | 579,833 | 5,107 |
| Total incl. Refining | 1,101,898 | 268,389 | 983 | 1,869,305 | 585,509 | 5,127 |

Note: Estimates refer to enterprises with 100 or more persons employed only

Sources: see appendix A.

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