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# STRUCTURAL CHANGES IN THE MANUFACTURING INDUSTRY OF TRANSITION ECONOMIES*

*This paper addresses the pattern of structural change in selected transition and developed economies in Europe both from the point of view of a national economy and from cross-country perspective as well. It uses cross-industry country data at 2 and 3-digit level of the NACE classification to examine structural changes in the manufacturing industry in the second half of the 90's. To asses the structural change the paper proposes a decomposition of productive efficiency into macroeconomic, or pro-cyclical component and "structural effect" component, based on two-error component model of unobservable effects. Estimation results from panel data models provided empirical evidence for a heterogeneous development pattern with dominating macroeconomic factors in many transition economies and prevailing structural factors in a few countries.*
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## 1. Introduction

Notwithstanding the complexity of the notion of "economic structural change", its view becomes even more complicated when applied to transition economies. This is especially true for the period of the 90's when the transformation from plan to market was taking place, underpinned by a process of resource reallocation and hence structural change of unprecedented scale[2] in the economies of Central and Eastern Europe, the Baltic States and the Commonwealth of Independent States (CIS). Macroeconomic, pro-cyclical factors affected these economies as well, along with the changes in the underlying production technologies, the process of economic development, and the emerging new country's position in the international division of labour. Equally important are the changes in organizational and institutional structures, establishing an entirely new functioning environment for the transition economies at end of the 80's and the beginning of the 90's. Distinguishing between the two type-and-source of changes in the underlying

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[2] De Melo M., C., Denizer and A. Gelb, (1996) define the category structure referring to the structure of the transition economies countries as an indicator of the economic performance by including the following variables: the share of industry, the degree of urbanization, the share of trade with the socialist block, the richness of the natural resource endowment and income.

economic structure – a long-term component reflecting systemic change and a short-term one reflecting asymmetric responses to different disturbances – is important for evaluating the transition process and hence for projecting policy making in these countries.

The paper focuses on manufacturing, as the core of the output fluctuations in the transition process, but from the point of view of its structural characteristics inherent to growth performance. We analyse manufacturing by exploring the origins of the changes in productive efficiency within the sectors in a selected set of transition economies and relating these changes to cross-country comparisons both in the region and with western economies as well. By identifying the main groups of determinants of "productive efficiency" – structural changes at industry-specific level as a response of structural reforms, or changes in the output as a result of national macroeconomic policy factors, including cyclical effects – we draw conclusions on the overall structural adaptation of these countries.

To asses the structural change the paper proposes a decomposition of productive efficiency into macroeconomic, or pro-cyclical component and "structural effect" component, based on two-error component model of unobservable effects. Such an approach draws from the work of Stockman suggesting to isolate changes in output due to national policy effects and to industry-specific disturbances[3]. Estimation results from panel models using a new database provided empirical evidences for a heterogeneous development among transition economies a non-convergent pattern for the period under investigation.

Much of the previous research on structural changes in the transition countries has been concerned with the analysis of the output path during the transformation, the effects of macroeconomic policies, structural reforms and initial conditions. While a few theoretical models concentrate on the dynamics of the output evolution using one-, or two-sectoral models, the empirical work in the field is focused on the properties of a variety of econometric models which aim at identifying the output determinants either by an evaluation of the effects of certain policies[4], or disentangling the three groups of factors mentioned above in a joint framework[5].

[3] Stockman uses a simple statistical model that is assumed to generate industrial production data for a panel of ten sectors across eight countries: seven European and the US, over 21 years in Stockman, A., (1988). Borensztein, E., D.G. Demekas and J. Ostry, (1993) have applied the same statistical model to Bulgaria, Czechoslovakia and Romania in the eary stage of the reforms.

[4] Within variety of research on macroeconomic policies in transition economies only a few studies relate the policy effects to the process of restructuring. Andrew Berg argues that the existing structural adjustments in the early stage of reforms in Poland, in the sense of efficiency augmented changes in resource use, has taken place as a result of macroeconomic reforms. See Berg A., (1994). The first models quantifying the impacts of structural reforms and macroeconomic policies and systematically studying as explanatory to the output dynamics factors in transition economies were done some years later by De Melo, C.Denizer and A. Gelb, (1996) and De Melo and A. gelb (1997). Also macroeconomic policy variables were introduced and analysed in cross-country perspective for these countries for example by Fischer S., R. Sahay and C. Vegh, (1996a) and Fischer S, R. Sahay and C. Vegh, (1996b).

[5] An elaborate study of the macroeconomic variables, structural reforms and initial conditions influences on output path in transition has been done on a panel of 26 transition countries for the period till 1996, decomposing the relative contributions of each of these factors by Berg A., E. Borensztein, R. Sahay

Despite the obvious concern of the governments in the transition economies during the last decade about economic restructuring as an engine of growth empirical analysis of the effect of different policies on a disaggregated level for these countries is still scarce. The few studies in this field focus either on the adjustment of one or several transition economies in the first phase of transformation without any clear-cut answers about the factors of structural change.[6] The level of aggregation in this research varies from the three main sectors of economic activity to firms' performance[7].

This paper aims to contribute to filling in the gap at the meso-level between the analysis of macroeconomic structures, on one hand, and that on firms level, on the other. It utilises the information on the heterogeneity of manufacturing activity displayed at the two-digit data in NACE classifications, and looks at the patterns of manufacturing structural change within a country and the cross-countries relationships.

The study is based on a comprehensive data on two-digit level of disaggregation of the NACE classification in manufacturing for several transition economies: Bulgaria, Hungary, Poland, Romania, Estonia, Latvia and Lithuania, and western European countries: Austria, Finland and Portugal. The improvements in the data on manufacturing, collected at the national statistical offices in the transition economies countries in the 90's, closely related to the association to the EU and the transfer of the statistics of national activities to the NACE classification, provide a reliable and consistent base for comparative evaluations on these countries. The main inferences are drawn on 23 manufacturing industries (see Box1 in Appendix I) with some references on 103 industries, where data was available.

The remaining of the paper is organised as follows. In section II, we analyse the driving forces of structural change in transition and provide empirical evidence from selected countries. We identify changes in the composition of output and employment, as well as common factors of structural change across industries using principal component analysis. In section III, productive efficiency and its cross-industry characteristics are discussed. We propose a new methodological approach to disentangle changes in economic structures and apply this approach to both cross-industry country specific panel models and cross-country inter-industry panel models. Section IV addresses the econometric considerations in estimating these two types of panel data models and analyses the results. Finally,

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and J. Zettlemeyer, (1999). The main conclusion of the authors is on the pre-eminence of the structural reforms in explaining cross-country differences in the recovery process.

[6] Estimating the existence of structural changes in transition economies is surrounded by controversial conclusions. An analysis of the structural reforms in Poland in the early stage of transformation in Borensztein, E. and J. Ostry, (1992) and in Borensztein, E., D.G. Demekas and J. Ostry, (1993), argues that no significant structural change has taken place in Eastern Europe, including Poland in their study, while A. Berg op.cit. provides evidences for structural adjustments in Poland. The implemented methodology of the analysis and the level of aggregation of the estimated variables vary indicating the detailed information on activities as more reliable for evaluation of structural changes. An analysis for the same period and country undertaken on the base of a panel of 88 three-digit manufacturing industries by Barbone L., D.Marchetti and S. Paternostro, (1999).

[7] For a detailed survey paper summarising the empirical experience on enterprises restructuring in transition economies see for example Djankov S., P. Murrel, (2000).

in section V the main conclusions are drawn and the patterns of structural changes in economies in transition are summarised.

## 2. The driving forces of structural change in the transition from plan to market: some empirical evidence

The fundamental changes in the economic and social environment of the transition economies and in their relations with the world gave rise to a process of resource re-allocation of unprecedented scale. The manufacturing industry is especially affected by this process because of the overindustrialisation in the past and the inherited obsolete and inefficient production facilities. The gap between these initial conditions and the goal to achieve sustainable growth through higher productive efficiency implies a fundamental structural change in the manufacturing industry. The fact that such a process is under way in the transition economies is reflected in the dynamics of the manufacturing sector within the recovery of output in the second half of the 90's. The dynamics of manufacturing activity in the region was marked by nearly twice-higher growth rates of gross value added as that in the EU countries[8].

*What have been the driving forces of structural change during the transition from plan to market?*

Although there is no theory for the transition process *per se*, the framework of the general equilibrium as a set of prices, a set of production programmes and a set of consumption requests satisfying the conditions of market equilibrium provides a starting point of such an analysis. In fact, it is this fundamental change of the previous command economic system into a completely new one, incorporating these three main components that provokes a continuous, dynamic and diversified process of restructuring.

Price liberalisation, notably, has been a fundamental factor for the massive resource re-allocation taking place in the transition economies, including their manufacturing industry. The reorientation of economic activity and hence resources towards sectors which are more profitable under market conditions has been an on-going process in these economies. It goes further into and within the manufacturing industries, where changes are transmitted through relative price adjustments. The outcomes of this process: closure of traditional activities and a move towards new sectors, are widely observed in the countries in the region, driving the emergence of a new pattern in the manufacturing industries.

A variety of additional factors underpin the adjustments in manufacturing, by directly effecting producers' and consumers' preferences. Among them, trade

[8] Gross value added has increased for the period of 1995-1998 by 13 % on average for the group of transition economies, including the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia, and by 7 % for the EU-15, and for manufacturing – 16% for the transition countries and 7% respectively for the EU-15. All estimates are in constant 1995 prices from the EUROSTAT, NewCronos database.

liberalization (including substantial reduction in tariff rates and non-tariff barriers) and "hardening" of the budget constraints of the enterprises, coupled with the change in the ownership structure and the emerging entrepreneurship accelerate the process of resource re-allocation. The competitive pressure both on the domestic and international markets, as a result of the increased openness of the economies and the integration with the EU, started an economy-wide process of "creative destruction". Being "the fundamental impulse that sets and keeps the capitalist engine in motion, [this process] incessantly revolutionises the economic structure from within, incessantly destroying the old, incessantly creating a new one"[9]. The intensity of this process in restructuring manufacturing during the transition much depends on the available institutional infrastructure, which allows benefiting from competition and minimising the associated disorganisation[10]. With the advance in transition, and especially in building up the legal and institutional environment of this process, the effects of these factors on the industries will be much more pronounced.

External factors have also been an important source in generating structural adjustments in manufacturing through several channels. Foreign direct investment affects the reallocation of resources by setting up new activities, or accelerating growth in selected sectors by bringing in capital, know-how and managerial skills. The overall effect, both directly on the industries, where FDI is located and indirectly, through the spill over effects to other industries, bring substantial long-term changes in the structures of output, employment and capital. External disturbances, on the other hand, not related to economic reasons, like political crises in a country, or a region (like the Kosovo crisis) could have negative implications for sectors like transport and communication, and affect export-oriented productions and the related suppliers in the short run.

In addition, there has been a series of structural reforms pursuing sustainable growth including privatisation of public enterprises, deregulation of product markets, liberalization and reforms of labour markets, etc. All these reforms have also been affecting the process of structural changes in manufacturing.

Macroeconomic policy, on which transition economies have heavily relied upon in pursue of stabilization in the 90's, including exchange rate regimes and adjustments, may have a restraining effect on economic activity, including manufacturing. The sensitivity of different industries to this type of factors, whose effects are spread all-over the economy, including manufacturing as a whole, is different. Besides, various industries may have different behaviour during a business cycle, (for example some may not follow the phases of the cycle); in such a case the observed changes will not measure re-allocation of productive resources *per se*, but short-term fluctuations only.

[9] Schumpeter J.A., (1943).

[10] An empirical study by Carlin W., J. Haskel and P. Seabright, (2001) on examining competition in both advanced market economies and transition economies on survey firms' concludes on the different effects on productivity and innovation in these two types of economies. The restructuring in transition economies, as a process of new entry and large re-allocation of output between firms is found to be much more weekly associated with improved performance than in established markets.

Thus the overall process of re-allocation of resources in the transition economies is likely to contain both a long-term component reflecting systematic change and a short-run one reflecting asymmetric responses to different disturbances due to the still emerging and vulnerable markets. The actual process of structural change in the transition economies reflects the intertwining of these two components.

Hence one of the goals of the paper is to distinguish between these two types-and-sources of structural change in manufacturing: short-run fluctuations, some of which will by definition be reversed over the business cycle, or long-term changes in the underlying manufacturing structure.

There is no complete and straightforward way to evaluate the contributions of all the driving forces of the structural changes in the transition but focusing on these two groups of factors to structural changes could provide a basis for assessing the underlying process of resource re-allocation. For this reason an empirical procedure to disentangle between the different effects through a statistical decomposition of productivity growth is proposed in the next section of the paper.

***Some empirical evidence of structural change***

For the second half of the 1990's most eastern European transition economies entered a phase of recovery, which is a process combining growth and structural change. During this period manufacturing output started to recover rapidly as a result of both demand and supply factors and its share in GDP increased in many transition economies. The most distinct example is the pattern observed in the Hungarian industry, where the share of manufacturing in GDP has been growing steadily in the last decade reaching the level of 25.2 per cent in 2000, thus marking a 4 percentage points rise as compared to the 1991[11]. The Czech Republic has followed a similar pattern of an increasing share of manufacturing in GDP after the initial drop in the first half of the decade; afterwards the tendency was revised, stabilizing at the level of 28 per cent in 2000. The trend observed in Slovakia was similar; however the shares of manufacturing in GDP reached a somewhat lower level of 24.2 per cent in 2000. For the last five years Slovenian manufacturing share in GDP has stabilized at the 27 per cent level after an initial drop. The second pattern observed in Poland, Estonia and Lithuania is some what different: it is characterized by a smooth decrease of the manufacturing share of up to 2 percentage points for the last five years stabilizing at around 20 percent in 2000. In Bulgaria, Romania and Latvia the initial downturn in the manufacturing share was sharper although there are signs that this tendency has been reversed.

These changes provide some evidence of an on-going process of structural changes both within the manufacturing industry and between this sector and the rest of the economy. A closer look at the compositions of output and employment

[11] All shares reported below are in current prices due to the absence of reliable longer series in constant prices. Notably, these shares do not reflect properly the relative dynamics in real terms because the prices of services in transition economies tend to grow faster than the prices of manufacturing goods. In general, in most transition economies, gross value added in the manufacturing sector has grown faster than GDP in the second half of the 1990's.

at the 2-digit level of NACE aggregation, as presented in Table 1 (See Appendix I), provides evidence of some of the main changes within the manufacturing industry.

In general, the data in Table 1 present a significant change in the composition of supply and employment, though the pattern of structural change varies within a broad range among the transition countries. In terms simply of the composition of output in the industry the branches with the highest shares in the middle of the 90's are food and beverages, chemicals and manufacture of machinery and equipment. After five years only, the distribution of output is marked by sharp changes in the majority of the transition countries, with new emerging and more advanced technological industries, leading in the restructuring: like manufacturing of office machinery and computers, motor vehicles, trailers and semi-trailers, electrical machinery, petroleum and coke. Among the fastest economies in this respect are Hungary, Poland and Slovenia, where much of the activities in these industries are FDI. The changes in the composition of output, however, scratch only the surface of the complex phenomenon of structural changes in the transition.

The general pattern of restructuring of the manufacturing industry could be described using a summary measure to account for the changes in manufacturing output and employment within the 23 industries at the 2-digit level of economic activities according to the NACE Rev.1 classification, presented in Box 1 (See Appendix I.)

As a first step in looking at the structures we use the index of structural change *C*, which measures the changes in the various industry shares between two periods[12] and the index of similarity, which is a mirror image of C. The indexes of structural change C, and that of similarity S are shown in Table 2 (See Appendix I) for the group of the seven transition countries (Bulgaria, Hungary, Poland, Romania, Estonia, Latvia and Lithuania) taken as a whole for the period 1995-1999 based on the NACE two-digit level breakdown of manufacturing industry (23 sectors).

The indexes of structural change C of the distribution of output (measured by the value added in current and constant 1995 prices) and that of employment provide evidence of an on-going process of restructuring for 1995-1999. The lowest degree of change for the period took place in the employment structure, while the highest was observed in the value added in current prices, though the difference between them is of 1 percentage point only.

In order to provide a further insight into the nature of the ongoing structural change, an additional indicator has been calculated to account for the year-to-year changes, which is called an index of "consistency"[13]. It measures the degree to which the changes observed in one year are consistent with the total change for the period, i.e. to what extent they have not been totally or partially reversed in later years. The index indicates no reversal in the industry share movements over time

[12] The index of structural change $C = \sum a_{i2} - a_{i1}$ for all $a_{i2} \geq a_{i1}$, where $a_i$ is the share of industry *i* in the total manufacturing output or employment, in percentage, in periods 1 and 2 respectively.

[13] The index of consistency is a ratio of the index of structural change C to the sum of the year-to-year changes between 1995 and 1999, in percentage points.

(or total consistency of the changes over time) if it is equal to 1, and no consistency of the year-to-year changes (i.e. they completely cancel out) if it is 0. The consistency index for the group of seven transition economies countries, taken as a whole, is presented in Table 3. The changes in the composition of employment exhibit the highest degree of consistency, suggesting that these changes on average have the lowest degree of reversal in terms of the changes in the shares of employment. The changes in the composition of output in constant prices have the lowest degree of consistency among the variables leaving current output in the intermediate position. The transition during the last decade has been characterized by a very rapid change in relative prices over time and different responses of industries to these changes after the initial liberalization process, which has not yet been phased out. Prices still continue to adjust both over time and within industries as reflected in the dynamics of output in current prices. The changes in the latter are most pronounced, with an index of 8.83 and do not reverse for the period, i.e. an index of consistency of the structural changes of 0.586. The changes in the structure of output at constant prices are relatively smaller and at the same time they tend to reverse, exhibiting the lowest degree of consistency among the variables. This points out to two important facts: *first*, producer prices are likely adjusting to a new type of pattern with a consistent structure, which is relatively stable and does not reverse and *second*, changes in real output structure are probably affected to a larger extent by cyclical factors. All this indicates that a process of intensive restructuring of the manufacturing industry is still under way in these countries. Taking into account the differences both in consistency and in structural change of the distributions these results also suggest that the process of output restructuring has been affected to a higher degree by changes in producer prices, and to a lesser extent by changes in the real resource reallocation.

Notably, the changes in the structures of output and employment in the transition countries have been more pronounced than those observed in the western European countries in the past. The index of structural changes varies between 7.60 and 8.83 for the group of the seven transition economies countries while for the western European countries the index of structural change for the same variables has been between 5.3 and 7.8 for the period 1960-1970 and 5.2 and 6.7 for the period 1970-1978[14]. In fact, the pace of restructuring in manufacturing in the transition economies in the 90's is comparable with the changes in the western European industry in the 70's but still remaining at a slightly higher speed of transformation. An interesting similarity is observed between these two different groups of economies and in different periods: changes in employment have a common tendency to adjust slower than output but in a more consistent pattern.

A closer look at the individual countries' measures of structural changes as described by the indices of similarities and consistency of the structural changes in output and employment in Table 3 and Table 4 (See Appendix I) highlights the diversity among the transition countries and suggests that these countries have experienced quite divergent patterns of restructuring in this period.

[14] The index of structural change for total manufacturing industry in western Europe are estimated at 18 branch structure of manufacturing in *Economic Commission for Europe, Economic Survey of Europe in 1980, p.189.*

***Changes in the Composition of Output structure***

Among the transition economies the pace in structural changes of output has been the highest in Hungary, followed by the Baltic countries. Moreover structural changes of output in current and constant prices have the highest differential for Hungary, with the quite consistent year-to-year changes in nominal terms, which suggest a very dynamic restructuring of relative prices. In Poland and Estonia the composition of output in real terms has changed to a larger extent than that in nominal terms. Moreover these changes have greater degree of consistency for the period (Table 3, final column, Appendix I), thus resulting into a relatively stable pattern of restructuring in the real sector. This suggests that in these countries factors other than prices have had a relatively stronger impact on the process of restructuring.

Among the transition countries the most consistent year-to-year dynamics is observed in Latvia, indicating a stable path to a new structure of output.

In Bulgaria and Romania, despite the different values of the indices of structural change for output (with the latter above the average while the former almost at the average level, or below for value added in constant prices) the observed shifts appear to be unstable and there has been a tendency for reversal. This refers to a greater extent to Bulgaria, where the index of consistency for the value added in both current and constant prices is the lowest and close to 0.1.

A comparison of the transition countries' indices of structural changes of output with those for some western European countries shows some similarities between the countries with the highest indices. In particular, the difference between the indices of structural changes in real and nominal output varies from several decimal of a percentage points to not more than 2 percentage points. This fact leads to an important conclusion: the pattern of dynamic output restructuring has a higher degree of consistency in countries where producer prices have already adjusted. A striking dissimilarity between the western European countries and the transition economies is the existence of a pattern, combining of a relatively low structural change with a relatively low consistency in the first group (Austria, Table 3 of Appendix I), and a pattern combining a relatively higher structural change with a lower consistency (almost total reversal) in the second group of countries (Bulgaria and Romania). The observed difference in the pattern of structural change indicates the relatively higher structural response of some of the countries from the transition economies group to cyclical effects than the developed market economies. In the same vein, the pattern of relatively stable structural change both in terms of pace of industry structure and over time changes has not been observed in a transitional environment.

***Changes in the Composition of Employment***

The pattern of changes in the employment structure in the group of the transition countries on average has been less differentiated in terms of consistency than that of output.

In Poland employment has restructured relatively less than in the other countries, but the year-to-year changes have the highest consistency pointing out the emergence of a relatively stable pattern of employment structure in 1999 as compared to 1995 (Table 3 of Appendix I). A structure with comparable degree of non-reversal is observed in Latvia, which is also the economy with the highest index of structural change for the period.

The changes in output for Latvia have the same characteristics as employment indicating an early restructuring and relatively stable structure of industry in the second half of the 90's. Another pattern, that of a high level of changes in the employment structure but with a partial reversal has been taking place in Estonia and Lithuania. Despite the higher than the average index of structural change for Hungary the year-to-year changes are pointing to a tendency of reversal in the changes in employment, which are among the lowest values for the group.

The western European countries exhibit a pattern of structural changes in employment which is quite different from all of the transition economies, with a lower pace of restructuring, indicating a different phase of industrial development. Within this group, Finland is probably the most distinct case of consistent changes in both output and employment.

*The Pattern of Growth in the Manufacturing Industry*

The statistical properties of the structural variables for the countries in the study cast some light into the nature of the on-going structural changes and especially those related to the two dimensions of the process of economic transformation – across industry and over time. The quantitative measures of the dispersions of the growth rates in the structural variables allow drawing some conclusions about the dimension that is most important for shaping up the emerging patterns of structural change. They provide strong evidence in support of the diversity in the growth pattern of the countries for the period. A process of both shifts in the averages for the manufacturing and in the distributions of the growth rates of output, employment and productivity of the industries (Table 5 of Appendix I) reflects the dynamics in the restructuring triggered by within-industry and time parameters. The general tendency for a relatively more stability in the structure of employment than that of output is confirmed by the lower standard deviations of the employment growth rates in 1999 as compared to the same indicators for output.

The standard deviation, as a measure of the dispersion of the variable around its mean, could be used to make inferences for data presented as a panel, which includes both industry-specific and over time (time dependent) characteristics. The results of these measures on the rate of output, employment, wage and productivity are reported in table 6 and on the changes of the structures in output, employment and wages – in Table 7 (Appendix I). The standard deviations in output and employment suggest the importance of the time parameter in the panels for each of the country (the standard deviation over-time exceeds the inter-industry one). The only exceptions are Hungary and Finland, for which the inter-industry standard deviation is higher the one over-time. The importance of time-factors for

almost all of the countries is usually associated with procyclical effects and it is more pronounced for the employment rather than output. The picture for Hungary and Finland suggest changes across industries, i.e. in the manufacturing structure. Regarding productivity the pattern for the countries is of the same type, with over-industry parameter significantly more important for the panels dynamics.

*Common Factors of Structural Change*

As a second step in analyzing the pattern of structural change in manufacturing we search for a set of common factors across-industries which may affect the process of resource re-allocation. The eventual identification of a set of factors which is behind the underlying tendencies in output and employment structures could allow drawing conclusions about the nature of the structural adjustments: whether they are a pro-cyclical, or a structural phenomenon. The logic of the hypothesis here is that if there are common factors that dominate in shaping up the manufacturing structure and its dynamics, then these factors can be assumed to be country-specific and they concern all the manufacturing industries within each economy. The evidence of the importance of time related factors in shaping the pattern of the manufacturing industry discussed above, suggests the existence of such effects, which in general, may be associated with the effect of macroeconomic policy. This may be especially relevant for transition economies where economic adjustments still undergo substantial fluctuations due to fiscal, monetary, income, or exchange rate related instruments. To identify the systematic influence, or the absence of such a group of common factors, it is possible to apply the principal component analysis to the data on output and employment. This is done for all the transition economies and Austria as well as a benchmark for a broader comparison with a patter of a developed market economy[15].

The basic idea is to look if the largest part of the variance of output and employment across sectors could be explained by other factors, the "principal components". These components constitute a linear combination and being mutually orthogonal explain the highest proportion of the variances in the variables. The indicator that is most important is the first principal component, or in some cases it could be the first two, because it explains the largest fraction of the variance in the initial series, i.e. in the output and employment growth.

The results from this kind of analysis are presented in Table 1 and include the first principal component for the series of output and employment, estimated on the bases on the logarithms of the rates of change in the output and employment in cross-industry panels at the 2-digit level of NACE classification of activities of the manufacturing industries.

[15] For more details on the theory and application of the principal component analysis see Everitt, B.S. and Hesketh-Rabe, (1997).

Table 1

Fractions of the Variance in Output and Employment Explained by Principal Components*

| COUNTRY | PRINCIPAL COMPONENT | |
|---|---|---|
| | OUTPUT | EMPLOYMENT |
| Austria | 0.6242 | 0.6095 |
| Bulgaria | 0.5781 | 0.5309 |
| Czech Republic | 0.6726 | 0.5316 |
| Hungary | 0.6057 | 0.6396 |
| Poland | 0.6165 | 0.5809 |
| Romania | 0.5088 | 0.5070 |
| Slovenia | 0.6299 | 0.5158 |
| Estonia | 0.5031 | 0.5003 |
| Latvia | 0.5896 | 0.5950 |
| Lithuania | 0.5622 | 0.6294 |
| Slovakia | 0.6849 | 0.5733 |

*Source: Author's calculations on the dataset of the UNECE and information from the National Statistical Offices for Bulgaria, Hungary, Romania and Austria. The period covered is 1993-1999. Output is measured as value added for all the countries with exception for Romania where gross output growth rate is used.

The reported values of the principal components describing the linear combinations of the variables providing maximum variance have been checked for robustness by another estimating procedure. For this reason another method, suggested by Bartlett, was applied to produce unbiased factors. The estimates were not significantly different from the reported ones suggesting the existence of systematic co-movements in the observed transition economies across sectors rather than structural effects, with relatively lower level of the impact being observed for Romania.

The following main inferences could be drawn out of the principal component analysis about the underlying tendencies across industries in the output and employment growth for the transition economies:

*First*, the existence of co-movements in the output fluctuations by industries has been significantly supported by the effects of factors which are common among the manufacturing industries for both output and employment. Moreover, the pattern is similar across countries to the extent that common factors explain over half of the variances in output and employment. It seems quite likely, that this influence might outweigh the structural factors for the countries in the period under investigation due to the significant value of the first principal component of around 0.60 for all of the countries (Romania and Estonia being the only exceptions of 0.50).

*Second*, the fraction for employment variance is explained to a smaller extent by a common set of factors, but again the percentage points of the variance accounted for by the first factor among the transition economies are similar to that of Austria and above 0.50. This fact is indicative of the relative prevalence of sector-specific

factors in the composition of employment and to the less flexible employment structures as compared to output in response to economy-wide policy measures and impacts. The exception in this tendency is Hungary, where the influence of macroeconomic factors on employment structure has outweighed the structural ones to some extent, the difference in the effects being in the range of 3 percentage points.

*Third*, the results are robust regardless of the level of disaggregation. Estimations at a more disaggregated level of manufacturing activities, corresponding to the three-digit level of the NACE classification and four-digit ISIC, respectively, for some of the transition countries in the sample, confirm the inference on the dominancy of factors common across industries. This conclusion is important for identifying the structural changes in the manufacturing and therefore the study next investigates the factors within the individual countries in a detailed framework, by decomposing productivity growth.

*Forth*, the similarity in the overall existence of nation-specific factors for the transition economies as well as in the comparable magnitude of the common factors across industries suggests a macroeconomic interdependence in a cross-country framework. This conclusion however is tentative and a closer examining of the manufacturing industries in a cross- country framework is done in section 3 of the paper.

## 3. Productive efficiency and the different patterns of structural change

Structural changes could foster economic growth within the limited space of factors inputs in the transition economies countries by raising productivity and productive efficiency. In fact, to go out of the transition trap and reach a growth path of sustainable development, the countries in the region have to implement structural reforms to channel the driving forces of resource re-allocation targeting productive efficiency as a primary goal. Therefore productive efficiency could be regarded as an indicator with a dual characteristic: on one hand, it is an engine of growth and structural change, and on the other, it reflects the outcome of successful structural change.

The theoretical concept revealing these relations in an empirical framework is based on the multi-factor productivity measure and the notion of total factor productivity (TFP)[16]. Throughout the entire period since the initial introduction of the accounting technique in macroeconomics (based on estimating the so called Solow residuals) till nowadays, the results have been widely used to address questions concerning economic growth, aggregate fluctuations, impacts of macroeconomic policies and structural reforms[17]. Despite the variety of the

[16] Total factor productivity was first introduced by Solow R., (1957). Since then, the concept has been developed in various directions, an overview of which are summarized in Hulten, "Total factor productivity: a short biography", NBER Working Paper N W7471, January, 2000.

[17] A recent study on the structural changes in the OECD countries using a panel of 20 countries at two- and three-digit level of aggregation in estimating TFP growth to analyse the dynamic impact of changes in the structural reforms during 1965-1998 is done by Salgado R., (2002).

approaches the main idea is to distinguish between two effects in explaining the variation in output: the first one - caused by variations in factor inputs, and the second one – by the efficiency of the resources transformation process *per se*. In other words, the efficiency of the underlying technology, introduced to capture a certain part of the generated variation in output, could be regarded as a complex measure of the structural adjustments of the components as well.

The dimensions of the structure of output depend on whether the objective of the accounting technique will be to fit a production function on one product, or a set of products for observed data and period. The development of the concept to incorporate the variety of the input mix and therefore account for different sources of the structural change has resulted in estimating production frontiers. They express the "best practice" or the maximum amount of output produced by a given technology from a given mix of input quantities.

The idea of the production frontier could be applied in a macroeconomic context, in which countries produce a certain output, given inputs, could shift to the "best world practice" and become less inefficient[18]. The efficiency gap measures the distance between the actual output and its projection into the world frontier. On the other hand, the implementation of the concept to an individual economy, allows to measure the efficiency gap between a technology (could be represented by an industry) with respect to the production possibilities in a sector (including several industries, or technologies). Such an approach has the advantages to look at the productive efficiency accounting for the heterogeneity of the included industries.

The empirical application of the concept requires data on the output and the inputs: labour and capital. In this framework output growth could be thought of in terms of three components: efficiency change, technical change and input change. The first two components are known as "productivity change"[19]. For the transition economies countries official data on capital is limited to macroeconomic level only while data on the 2-digit level aggregation is scarce. In order to apply the concept of the productive efficiency to assess structural changes in manufacturing on a consistent database this study confines with determining the output growth in the 23 manufacturing industries by the labour factor. Hence, all the other factors, influencing the variation in output will be reflected in the residual of the estimated function, or in "the productive efficiency". Structural adjustments, defined as a movement towards the production possibility frontier (an outward shift is also possible) due to a resource re-allocation process is captured by the "productive efficiency". In addition, it could be split into two parts to assess the extent of structural adjustments as oppose to cyclical response. By evaluating whether the structural changes are due to economy-wide and hence manufacturing-wide

[18] By estimating a "world production function" under the assumption of a common technology, the distance of any country from this frontiers measures the "catch up" to the frontier. Such an approach has recently been used in evaluation of the convergence among countries. For an empirical application to measuring productivity gap between Poland and western countries see Koop G., J. Osiewalski and M. Steel, (2000).

[19] The measurement of the "productivity change" for comparative studies follows two approaches: the use of Data Envelopment Analysis as in Fare R., S. Grosskopf, M.Norris and Z. Zhang, (1994) and the use of stochastic frontier , see for example: KoopG., J. Osiewalski and M.F.J. Steel, (1999).

factors, or they are driven by industry-specific factors, at least two main patterns of structural changes in manufacturing could be observed: (1) a pattern of structural changes in manufacturing, where productive efficiency is mainly driven by industry-specific factors, and (2) a pattern of structural changes, where productive efficiency is a result mainly of economy-wide factors.

By assessing the above patterns we could draw conclusions on systematic structural adjustments in manufacturing and hence successful structural reforms for the period (for the case of the first pattern), or on the mechanical adjustment caused by demand volatility, or other factors, which could be out of no economic reasoning as well but influencing the whole economy, including the manufacturing sector (for the case of the second pattern). The policy implications of whether the structure in manufacturing has exhibited a pattern of the first type, or the second type, are important for assessing the potential and sustainability of the economy (in part of the manufacturing sector). The effects on the manufacturing growth as a response to disturbance shocks in the short-run will vary depending on whether the restructuring has already been finalised and is consistent with a productive efficient path, or this process has not yet triggered sufficiently enough changes in production (and therefore future shifts could be expected as an additional component to the uncertainties). On the other hand, the conclusions are indicative to the success, or failure of the implemented reforms and therefore could be used as an argument for an estimate on whether already past stage in the restructuring (if structural adjustments are systematic), or not finalised process of resource allocation.

The economic literature on the productivity growth builds upon two strands: the first indicates that the sectoral distribution of productivity and the evolution of industrial productivity growth in general reflect industry-specific characteristics, while the second focuses on the factors of productivity growth, such as managerial skills, technology, human and physical capital, regulations and institutions, including trade-unions activities[20].

The empirical assessment of structural change below focuses on productivity growth, which allows accounting for both inter-industry specificities within the aggregation of the panels and for the economic environment affecting manufacturing as a whole. Such an approach draws from the work of Stockman suggesting to isolate changes in output due to national policy effects and to industry-specific disturbances[21]. This strategy is applied both in cross-industry, within country context and in a cross-country, inter-industry perspectives. In order to test the economic hypothesis on the driving forces of structural change through the concept of productive efficiency two kinds of estimates are obtained in the study: (1) structural adjustments among manufacturing industries by estimating national models for productive efficiency in manufacturing on a cross-industry

[20] There is quite a large set of comprehensive studies on productivity analysis for different countries and at different level of economic activities. A concise and exhaustive paper, on the developments in productivity, summarising the main conclusions of the different theories and models developed to understand productivity through enterprise data is done by Bartelsman E., M. Doms, (2000).
[21] See A. Stockman (1988).

country data at two and three-digit level of NACE classification, and (2) structural adjustments across countries at the level of two-digit NACE classification of manufacturing industries by estimating cross-country models of productive efficiency in the manufacturing.

A simple model could be used as a general framework to nest the ideas on estimating productive efficiency with regards to the decomposition of the observed dynamics between macroeconomic or pro-cyclical factors and structural effects. The theoretical background follows the assumptions of the neo-classical production function, which is transformed, into a form, relevant to apply a decomposition procedure for isolating the above mentioned two kinds of effects. Next, as a second step the significance of these two kinds of factors is estimated empirically for each country for the period under investigation by pooling the data into a panel and deriving conclusions from a two-way error component regression model. The empirical estimations of the productivity performance both by countries and within them taking into account cross-section characteristics makes use of the panel data models with fixed effects which include unobservable industry-specific effects to be captured along with a sector-invariant but time-specific effect to account for events that affect production, like legislative changes, implementation of new sets of policy measures, import driven price effects and other factors not included in the model summarised under the total term of 'unobservable time effects'[22]. A brief summary of the methodological and empirical consideration is presented in Appendix II, explaining the rationality of the underlying economic relations in part *A. Economic Framework* and the decomposition applied to productive efficiency in part *B. The Two-Error Component Regression Model of Unobservable Effects*.

***Structural change in manufacturing from a national perspective***

The transformation from plan to market *per se* involves a massive reallocation of resources being driven by unprecedented changes in ownership structures, institutions and legal environment. All these factors affect both the mechanism of blending factor inputs and that of the interaction among them – through price adjustments and markets. The empirical evidence analysed for the output and employment structures in the transition economies in the second half of the 90's in section 2 of this paper suggests for a shift to a new pattern of productivity. The response of the real sector depends on a variety of demand and supply factors, which vary in magnitude and location in terms of sectors and companies being affected. It is justified, therefore, to expect that structural adjustments in the manufacturing are a result of these two groups of factors.

The deeper and faster the restructuring of the real sector, the more changes will be observed both among the manufacturing industries and countries as well, which will drive productive efficiency. Therefore the hypothesis is to start the analysis by

[22] The application of the error-component models in economics has been pioneered by the works of Kuh (1959), Mundlak (1961) and Hoch (1962) on investments and production function. The approach was found useful for empirical analysis of sectoral activities, see for example Balestra and Nerlove (1966) on demand for natural gas and was soon developed into a broad area of panel data models, a variety of which could be examined in L.Màtyàs and P. Sevestre eds. (1992).

relating the existing structural changes in manufacturing both within the industries and between them in time, i.e. in both dimensions of the structures. One could expect that economies, where effective structural reforms are being implemented[23], are experiencing substantial resource reallocation, driven by structural adjustments rather than just being a cyclical expansion. Productive efficiency due to structural changes is expected to be significantly differentiated across industry for such economies, while economy-wide factors will be distributed all over the manufacturing sectors.

According to the relative productivity there is quite a differentiated pattern of productivity dynamics in the countries. The most dynamic and diversified process across industries is observed in Hungary, where sharp acceleration of productivity in some industries goes along with substantial reduction in others. For two of the manufacturing industries (motor vehicles, trailers and semi-trailers and radio, television and communication equipment) there is a doubled increase in productivity relative to the average for manufacturing, while furniture has been driven down to 17 percent in 1999 from 82 percent in 1994. In Poland the process is relatively more homogenous with only a few industries, like office machinery and computers, gaining speed by raising productivity. The relative productivity of motor vehicles, trailers and semi-trailers, rubber and plastic products, and electrical machinery and apparatus have also an advanced position in Lithuania, marking over threefold upsurge in 2000 as compared to 1995 levels. The pattern of relative productivity is quite different in Bulgaria and Romania. There are a few sectors, like basic metals and chemicals (relatively for each of the countries) where productivity has accelerated but in general the changes in the levels are less pronounced then in the rest of the transition economies. The overall picture therefore suggests an on-going process of structural changes across industries, which differ by speed and patterns among the transition countries. In general, a plausible explanation could be that these countries are in different stages of restructuring the manufacturing sector within the whole transformation process of the individual countries. On the other hand it may stem from unsuccessful structural reforms. In order to highlight further the origins of these changes a decomposition of productivity is used as a measure for assessing the pattern of changes in the resource allocation.

***Theoretical and empirical considerations***

The general approach to decompose productive efficiency and by that to isolate the two groups of determinants of structural changes in an economy is applied to a panel of data for each country. It consists of cross-industries time-series for labour productivity, for which the following model is estimated:

(1) $$\Delta(Y/L)_{i,j,t} = \mu + c(j) + s(i,j) + m(t) + u(j,i,t)$$

[23] A. Berg argues that despite the delays in the reforms in privatisation and financial sector structural adjustments in Poland have been observed during the recovery period starting in 1992 (see A. Berg (op. cit.)).

where the indices *i,j* and *t* represent respectively manufacturing industries at 2-digit classification, industries at sector level[24] and time; $\mu$ is the overall mean of labour productivity, *c(j)* is a constant term common to the 2-digit industries; s(i,t) is a term specific to the i-industry and t-period, or it stands for the interaction between the fixed effect of the 2- digit industry and the fixed effect for the time; m(t) is a time-specific effect, common for all industries and u(i,j,t) is an idiosyncratic disturbance term for each j industry at 2-digit.

In terms of the dummy variables, which are introduced to estimate the unobservable effects, s(i,t) is represented by a set of dummy variables specific to industry at 2-digit and time, and are to capture industry-specific factors; m(t) – dummy variables, specific to time period and common to all industries which are to capture the factors, affecting all industries at that level, or cyclical effects in a particular time period.

***Structural change in manufacturing from a European perspective***

Productivity differs significantly between the countries, even if they are in one common region, or in a union, like the EU. At the same time the common tendencies both in the macroeconomic policy design and in industries suggest the possible interdependence between the dynamics. On the other side, the transition as a process for transforming the productive forces from plan to market also raises the assumption that tendencies of common origin might be important in determining structural changes in manufacturing for the countries in the region as a whole. It is also possible that factors related to the progress of the reforms effect the restructuring process. Hungary and Poland have entered the transition at a higher level of development in the private sector in manufacturing than Bulgaria and Romania. The first two countries moved earlier into the stage of transition recovery and by 1995 they have already experienced positive growth. Therefore one could also expect that the underlying driving forces of structural changes would bear national specificities as well. To test the economic hypothesis on the cross-borders effects in productive efficiency (the notion of which is discussed in the previous parts), the study exploits the inference from a cross-country model.

The basic idea behind the decomposition of the productivity growth into two parts draws on the assumptions of the possible explanation of the causes in the variations: whether they are due to domestic factors or to external factors, or disturbances originating from other countries.

Most of the theories on business fluctuations associate any changes in the supply due to innovation with expansive effect on the domestic economy while the impact on foreign countries is predicted to be smaller, or even with different sign. Thus the theory of the `real business cycles models' offers a broader framework of analysing

[24] The model applied at the two-digit level of aggregation assumes the following sector to be defined as a group variable: food products, beverages and tabacco products, textile, wearing apparel, leather and fur products, wood, paper and printing products and publishing, chemical industry, non-metallic mineral products, basic metals and fabricated metal products, machinery and equipment and other manufacturing and recycling.

the aggregates dynamics as being driven by factors under the common heading of being real[25]. This strand of literature offers an adequate theoretical framework for analysing structural change in transition economies because the disturbances, that these economies are experiencing incorporate not only fiscal, monetary and other regulatory policies, but it includes productivity disturbances, which differ across industries rather than countries.

The analysis that follows is based on a specific group of these models of the "real business cycle theory": the ones that assume a dominant role of exogenous, industry-specific productivity shocks and follows an econometric approach to estimate the decomposition of the productivity into two groups: demand-driven, or procyclical factors and structural changes. The empirical evidences of the observed fluctuations are therefore strongly dependent on the possibility to isolate the two kinds of factors.

The differentiated dynamics of productivity in the manufacturing industries of the transition economies implies that the process of resource re-allocation across industries has been an important factor for economic growth for these economies. In this respect, it is important to identify to what extent such a change has been generated by the shrinking of domestic demand, which was observed almost everywhere in the beginning of the reforms, (i.e. it is a cyclical phenomenon), or to what extent it has been a structural phenomenon reflecting the systemic changes in these economies. If such a change has not yet taken place then it is possible to expect a productivity shock as part of the adjustment process to happen in the short-run and therefore provoke a slowdown.

This part of the paper is also based on the decomposition procedures applied to the productive efficiency, as discussed in part 1 of this section. However, this time the focus is on the cross-countries interdependence among sectors in an attempt to differentiate between country-specific effects and cross-country industry specific ones.

The model assumes the variation of productivity growth to be disentangled between a fraction explained by industry-specific effects, common to all countries in the group and a fraction, explained by country-specific effects common to the domestic manufacturing structures. In terms of formalization the following regression is used applying the same error-component mechanism as in the country structural model:

$$y(i,n,t) = c(i,n) + m(n,t) + k(i,t) + u(i,n,t) \quad (2)$$

where assuming the notation from the previous part of the Section and introducing an index for the country *n* : $y_{i,n,t}$ is the productivity growth rate in the *i*-th industry of the *n*-th country in period *t*, *c (i,n*) is a constant term specific to an industry *i* and a country *n*, *k (i,t)* represent the interaction of a fixed effect for the i-th industry with a fixed time effect, which is common to all countries, industry specific in the table, m

[25] See for example Hall R., (1987).

(n,t) represents the interaction between the fixed effect for country and the time effect, which is common across industries, or country-specific factors and u (i,n,t) is the idiosyncratic disturbance term, or i.i.d. random term.

Again the model is unidentified because of the perfect colinearity between the country-specific and industry specific variables. Introducing the orthogonality condition between them helps us to get rid of this problem. Therefore it is assumed that country-specific factor is contained in the fraction, which is in the orthogonal part the estimated model. In the same vein, the industry-specific factor is also reported as its orthogonal component, which corresponds to a situation when an exogenous shock affects productivity growth of an industry, which is likely to be focused on this specific activity, or in the closely related ones.

## 4. Econometric considerations and results

Before discussing the econometric considerations in estimating the decomposition of productive efficiency, as proposed in the previous section, we address the questions regarding the dataset.

***Data:***

To analyse the structural changes in manufacturing we use a new dataset, which has been specifically constructed for this purpose. The models for all the countries, both transition economies and selected western European countries, are estimated using data at the two-digit level of the NACE classification of activities and for two of them (Austria and Bulgaria) at the three-digit level as well[26]. The estimations have been done for the period 1994-2000, depending on the available data for the first and last years[27]. Productivity is estimated as value added per worker in real terms thus covering all medium and large enterprises with 20 or more employees. The producer prices in 23 industries are used as deflators for the correspondent sectors for all the countries. At this level of aggregation both the data on value added and number of employees constitute a balanced panel for almost all countries, the only exception being Estonia and Lithuania, where the panel is unbalanced (with missing observations up to 40 percent of the total per year).

***Estimation results:***

The model as determined in (1) is unidentified due to the number of dummies included in it and the multicollinearity between them. Therefore relations between the dummies are restricted to orthogonality conditions. Imposing this restriction to the estimation of the model identifies the productivity changes as a deviation from

[26] While the availability of the data constrains the comparisons among the country patterns of structural changes at a more disaggregated level, the inferences for the countries where productivity change has been determined on a panel of 103 manufacturing industries as well as on 23 industries, do not contradict each other, but provide a clear evidence for the dominance of a certain group of factors.

[27] The period for the countries is as follows: Austria 1995-1999; Bulgaria 1994-2000; Estonia 1994-1999; Finland 1995-1999; Hungary 1994-1999; Latvia 1996-1999; Lithuania 1995– 2000; Portugal 1995-1999; Poland 1995-2000 and Romania 1994-1999.

the overall average growth, the mean $\mu$, due to changes in the specific industry, in real aggregate demand factors, captured by the fixed time effect, and in the interaction between them. The reported results of the estimations and their interpretation are performed on the basis of the orthogonal components of the time and the industry specific factors, due to the correlation, which otherwise exists between them. For the specification of every country model a choice between a fixed effect and a random specification is made by using the Hausmann test. The results report the fixed effect model because of the consistency of the estimates.

The results of the estimations on determining the productive efficiency in each of the transition economies countries and the selected western European ones are reported in Table 8 (Appendix I). Estonia, Latvia, Romania and Portugal are not included in the reported results because of the insignificant power of explanation of the productivity by the model. The reason mostly likely for this is the great number of missing observations at the two-level of disaggregation as is the case of Estonia and Latvia. The unavailability of data at a more disaggregated level constrains the alternative to estimate the model at lower level of disaggregation in order to check for a pattern of structural changes in productivity.

Overall the regressions are pointing to different patterns of the productive efficiency determinants among the countries, included in the study. The first pattern of structural changes in manufacturing is characterised with productive efficiency, driven mostly by structural adjustments. It is observed across the manufacturing industries in Hungary, where both industry-specific and economy-wide effects are found significant in explaining productive efficiency. It is the model with the highest power to explain the changes in productivity (adjusted $R^2$ = 0.44) among the ones for the transition economies. A straightforward explanation comes out of the systematic influence of the macroeconomic and industry specific factors on the manufacturing structure. In fact, the hypothesis of no industry specific fixed effects and that of no economy-wide effects are both rejected by the estimations. In technical terms the formal test for a joint significance of the industry-specific dummies, the F-test for testing the hypothesis that all the coefficients in front of the dummies are zero, could be rejected with 1 percent error, while that for the coefficients in front of the time dummies – with no error at the 5% significance level (see Table 11).

A further look at the contributions of these two groups of factors to the total model identification, on the base of the analysis of variance, shows that the fraction for explained variation in the dependent variable accounted for by the industry-specific effects *(s(i,t))* and macroeconomic ones *(m(t))* are 70 and 7 per cent respectively. The rest 13 per cent of the explained variation are due to the *c(j)*, which indicates the industry specific characteristics within the sector, together with the effects accounted for by the term *s(i,t)*, shows the dominant role of sector specific effects over economy-wide ones in the productivity dynamics in Hungary[28]. The evidence

[28] A study based on entirely different approach to evaluation of productivity in manufacturing in Hungary, Poland and the Czech Republic concludes about a higher level of relative labour productivity and competitiveness in Hungary due to structural adjustments as opposed to Poland, with less observed variability between branches (see Monnikof E. and Bart van Art, (1996)).

of fundamental structural changes in manufacturing industries with productive efficiency, driven by structural adjustments mainly, is supported by the higher index of structural changes, discussed in section 2 of this paper. The findings of the pattern observed in Hungary suggest successful fundamental structural reforms, causing a shift in productive efficiency even at the 2-digit level of aggregation[29].

This pattern of productivity change with notable structural adjustments in manufacturing industries is not observed in any of the other economies, included in the study. The power of explaining productivity with the same model is comparable only with the results for Austria at the three-digit industries of the NACE classification, where both economy-wide and industry-specific effects are significant. Due to the differences in the level of aggregation a straightforward comparison cannot be done, but it is possible to draw a tentative conclusion on the importance of the outlined groups of factors. The significance of macroeconomic and industry-specific effects in explaining the variations in productivity growth indicates similarity in the overall pattern of structural changes in manufacturing in Hungary and in Austria. In particular, the productivity changes at the two-digit industries in Hungary are reflecting a process of resource allocation across industries comparable to the pace of restructuring observed at the tree-digit level in Austria. In other words, the restructuring process in the transition environment is observable at a higher level of aggregation thus reflecting a more fundamental and comprehensive process of structural change both within a sector and across sectors as compared to that in mature market economies[30].

The model has a relatively low explanation power with respect to the pattern of productive efficiency in manufacturing in Poland and Lithuania, where fixed effects and demand-driven explain just 3 and 9 percent of the variation in labour productivity, respectively. Obviously, within this model, estimated at 2-digit level of aggregation, there is not sufficient evidence in support of the implied hypothesis on restructuring within the 23 manufacturing industries. It should be noted, that there is a possibility of structural changes at lower levels, but they have not yet caused a systematic shift in the positions of the 23 manufacturing industries. For Estonia, Latvia, Romania and Portugal the data by the 23 industries does not provide strong evidences in support of any fixed-effects hypothesis on productivity, modified with different fixed effects[31]. This result could have two possible explanations and the absence of systematic policy instruments and industry-focused measures comes as a first option. On the other side, it may happen that these factors have affected productivity in a more complicated and not so straightforward way, as the linear regression form is assuming. Institutional factors, or exports, for example, might have been hampering, or accelerating structural changes but their effects are

[29] Halpern L. and G. Korosi, (2001) have reached the same conclusion for an improvement in efficiency for the Hungarian corporate sector throughout the transition until 1997 using similar methodology (frontier production functions) at firms' level.

[30] A more precise comparison between patterns of productivity growth in the manufacturing industries of Austria and Hungary require the estimation of the models at the same level of aggregation, which was not possible due to the lack of data at the three-digit NACE industries for Hungary.

[31] For some of the countries – Estonia and Latvia the panel is characterised with missing observations for up to 10 industries while for the others the fit of the model indicates the response of productivity in manufacturing to other, not included in the regressions factors.

mixed into the “unobservable factor” causing the lower fit of the models. This is quite likely to have happened to the Baltic countries, where coefficients of determination are quite low.

For Bulgaria the model in the general version (as applied for the rest of the countries) did not provide satisfactory results. For this reason it was modified to reflect the regime change due to the introduction of the currency board in 1997. The formal test on the significance of the board dummy, covering the period since 1997, could be rejected at 2 percent level of error (Table 13).This has allowed to improve considerably the significance of the results and it is indicative to the role of the implemented policy changes and their effects on manufacturing. Introducing the change in the regime reveals the role of the economy-wide effects as an important factor of structural change. On the other hand, the impact of industry-specific factors is not estimated as significant, which reflects the delays in restructuring the real sector and the slow pace of the changes in the ownership structures in Bulgaria. Therefore the pattern of productivity change is mostly driven by macroeconomic adjustments.

The constant term, specific to the industries, included in a sector, *c(j)* is not significant for any of the countries where productivity is determined at the level of 23 manufacturing industries. This fact indicates certain homogeneity of the industries at this level of aggregation, and it is in the term of *s(i,t)* that they exhibit the industry-specific effects. In the case of Austria, the term *c(j)* is significant, thus reflecting the heterogeneity of the industries at the NACE three-digit level of disaggregation activities.

In general the estimates on productive efficiency as a measure of structural change in manufacturing for the transition countries suggest two main patterns for the period of the second half of the 90’s: (1) a pattern of structural changes, where productive efficiency is a result of systematic structural, industry-specific adjustments rather than the result of economy-wide factors only, and (2) a pattern of structural changes, where productive efficiency is largely dominated by macroeconomic factors while industry-specific adjustments were relatively small, or even negligible. The first pattern is observed in Hungary only, while the second – in the rest of the transition economies. This conclusion has long-term policy implications related to the structural reforms as a series of systematic measures on industry-specific productions if a successful resource allocation is targeted.

In particular the results indicate that real aggregate demand shocks have had a strong positive effect on productivity change, which could be explained by their impact on labour costs. However these shocks could exert a downward pressure and without a sustainable manufacturing structure the repercussions might be worse. A further analysis on the factors is out of the scope of the study but the dominant role of the economy-wide effects emphasise the sensitivity of these economies to policy and external factors. This conclusion is crucial for countries where the pattern of productive efficiency is largely dominated by macroeconomic factors. On the contrary, the economies that display a pattern of productive

efficiency incorporating structural adjustments in terms of long-run factors, the demand-driven impacts could be absorbed at lower costs.

The cross-country model is estimated for three groups of countries: (a) *Group 1* includes Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Austria, Finland and Portugal, (b) *Group 2* – the transition economies countries - Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, and Romania, and (c) *Group 3* - Austria, Finland and Portugal. All the estimations of productivity growth are performed on a panel at two-digit level of NACE classification, including 23 manufacturing industries for the period 1995-1999. The results of the estimations of the cross-country models of productivity growth for the three groups of countries are reported in table 9 (Appendix I).

Overall, the regressions have significant power of explaining the changes in productivity: the adjusted $R^2$ varies between 0.49 and 0.67, the highest being for the western European economies and the lower – for the economies transition countries. Despite the differences in the manufacturing structures in the countries from the third group (Austria, Finland and Portugal) the variation in the productivity growth could be explained by the country-specific and industry-specific effects to a larger extent than that in the transforming economies. This fact suggests that the pattern of structural changes in the transition economies is more differentiated and most likely affected by other factors.

These results provide strong evidence in support of the view that it is rather the macroeconomic factors within a country that affect most productive efficiency in manufacturing and not structural factors: none of the industry-specific dummies are significant in any of the group of countries. The explanation could be related to two major facts: the process of restructuring and industry interdependence takes place at a lower level of disaggregation of economic activity, or the structural reforms so far have not resulted in major resource reallocation among countries at the two-digit level of NACE classification of activities. This suggests that further research efforts should concentrate on the three-digit level of disaggregation in order to come up with a more definite answer about the nature of structural change. It is useful to note that a research on labour productivity and convergence within Europe provide recent evidence of productivity being different significantly among countries of the EU[32].

## 5. Conclusions

The quantitative analysis of the patterns of restructuring of the manufacturing industry in some European economies in the second half of the 90's provides evidence of a dynamic process of resource reallocation. The main empirical findings in the paper can be summarised in several main conclusions.

[32] Barrel R. and D.W. te Velde, (1999).

Since the start of the recovery in transition economies the relatively fast expansion of the manufacturing sector has been combined with substantial structural changes within the sector.

Two main patterns have been identified with respect to the determinants of productive efficiency in manufacturing of these economies: (1) A pattern of structural change, where productive efficiency was a result of systematic structural, industry-specific adjustments (active restructuring) rather than the result of economy-wide factors only. (2) A pattern of structural change, where productive efficiency was largely dominated by macroeconomic factors (passive restructuring) while industry-specific adjustments were relatively small, or even negligible. This pattern prevails for example in Bulgaria and Romania.

The pattern of structural change in the manufacturing industry in the transition economies follows a more diversified path, than that in some western European economies, suggesting that it has been rather the macroeconomic factors within a country and not the structural factors that have affected the most productive efficiency in manufacturing.

These findings, and in particular the results indicating the dominant role of economy-wide effects in most of the transition economies, except Hungary (where strong evidence of active restructuring has been found), emphasise the sensitivity of these economies to policy and external disturbances. In contrast, the economies that display a pattern of productive efficiency based on active restructuring, the demand-driven impacts could be absorbed at lower costs and for a shorter period.

The experience of individual countries highlights the diversity of patterns of output and employment restructuring among the transition economies: from a pattern of dynamic structural change and high degree of consistency of these changes (observed in Hungary) to a pattern of unstable structures, with low degree of consistency (observed in Bulgaria and Romania).

Both the results of a cross-country econometric model and the principal component analysis support the conjecture of the dominant role of macroeconomic factors as compared to structural ones for the transition economies countries in the second half of the 90's in two other ways. In both cases, there is strong evidence suggesting that common factors, effecting manufacturing across-industries are more important than industry-specific at the two-digit level of aggregation.

These findings and, in particular, the sensitivity of the productivity dynamics in manufacturing to macroeconomic shocks have important policy implications with respect to the future restructuring and growth in the manufacturing industry. The group of the transition economies, which have not advanced sufficiently in the restructuring process (in this case the countries where changes in manufacturing structures of output and employment are effected mostly by cyclical short-term factors) are still prone to structural disturbances, which may provoke downward pressure on growth.

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## APPENDIX I

BOX

**NACE Rev. 1[1] classification of economic activities in manufacturing**

| Codes | | |
|---|---|---|
| *Subsections* | *Divisions* | *Description* |
| DA | | Food products, beverages and tobacco |
| | 15 | Food products and beverages |
| | 16 | Tobacco products |
| DB | | Textiles and textile products |
| | 17 | Textiles |
| | 18 | Wearing apparel; dressing and dyeing of fur |
| DC | | Leather and leather products |
| | 19 | Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, h |
| DD | | Wood and wood products |
| | 20 | Wood and products of wood and cork, except furniture; articles of straw and plait |
| DE | | Pulp, paper and paper products; publishing and printing |
| | 21 | Pulp, paper and paper products |
| | 22 | Publishing, printing and reproduction of recorded media |
| DF | | Coke, refined petroleum products and nuclear fuel |
| | 23 | Coke, refined petroleum products and nuclear fuel |
| DG | | Chemicals, chemical products and man-made fibres |
| | 24 | Chemicals and chemical products |
| DH | | Rubber and plastic products |
| | 25 | Rubber and plastic products |
| DI | | Other non-metallic mineral products |
| | 26 | Other non-metallic mineral products |
| DJ | | Basic metals and fabricated metal products |
| | 27 | Basic metals |
| | 28 | Fabricated metal products, except machinery and equipment |
| DK | | Machinery and equipment n.e.c. |
| | 29 | Machinery and equipment n.e.c. |
| DL | | Electrical and optical equipment |
| | 30 | Office machinery and computers |
| | 31 | Electrical machinery and apparatus n.e.c. |

## APPENDIX II

### *A. Economic Framework*

The analytical framework is derived from the following short-term production function:

(1) $$Y = FL$$

where *Y* is the value added in manufacturing, *L* is labour input and *F* represents the effects of all factors on labour productivity: technological change, physical and organisational capital. The exclusion of capital input in the production function (1)

follows from the limitations of the available data as empirical data on physical capital is difficult to compile for manufacturing industries at the 3-digit level of NACE. However other studies have shown that introducing the data on capital stock at disaggregated level does not affect significantly the implied total factor productivity[33]. Constant returns to scale in labour are assumed, which is generally supported by the empirical work both on developed market economies and on transition countries as well[34]. Labour input could be further presented by the number of people employed $E_{i,j}$ and the effort related to different management practices and labour organisation $M_t$, which is usually a time- variant index for the whole economy:

(2) $$L_{i,j} = E_{i,j} \times M_t$$

The choice of explaining productivity, which is the primary goal in this study, entails a choice among some leading models of the business cycle. The preferences to modeling productivity through explicitly introducing labor effort fluctuations[35] stems from the possibility to incorporate an important for the transition economy characteristic: labor rigidities and labor hoarding.

The assumption that labor effort is driven by the aggregate demand and therefore its dynamics follows the economy-wide cycle is consistent to the business cycle theory.

The impact of different factors on productivity, which are introduced in (1) by the term *A* represents both sector and firm's specific components. Identifying the different levels of aggregation for these factors allows to distinguish between the responses to structural reforms by sectors and by firms. Denote technological and organizational changes within a sector *i* at a time *t*, $Q_{i,t}$ and specific for a firm in that sector: $Q_{j,t}$, which will lead to the following expression for the total impact on productivity:

(3) $$F_{i,j,t} = Q_{i,t} \times Q_{j,t}$$

The firm's specific measure of productivity is further presented as the sum of the underlying rate of growth and a noise, i.e. it contains a time-invariant effects $Q_j$ and a random term $u_{j,t}$:

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[33] See for more details Bernanke and Parkinson (1991).

[34] In an empirical study on US manufacturing industries B. Bernanke and M. Parkinson (1991) estimated the coefficients of labour input to be equal or around one for all 10 sectors.
The hypothesis of the constant returns to scale is obviously invalidated for the period of recession for the transition countries when returns to scale were below unity. Since the economy started picking up in the middle of the 90's or earlier for some countries like Poland and Hungary the assumption has empirically been proven. Halpern and Körösi (2000) have estimated production functions for the corporate sector in Hungary on annual data showing a close to unity or slightly larger than one returns to scale.

[35] When studying the phenomenon of short-run increasing returns to labour on a dataset of 10 US manufacturing industries Bernanke and Parkinson found empirical arguments to rule out the technological shocks explanation of procyclical productivity and thus for the real business cycle hypothesis in favour of the true increasing returns and labour hoarding. The tests they perform cannot provide however a clear cut for distinguishing between these two alternatives for industrial activities. The impact of labour effort fluctuations on productivity has thoroughly been studied by Fay and Medoff, 1985 in

(4) $$Q_{i,t} = Q_j \times u_{j,t}$$

Then substituting *F* with the different factors, identified in (3) and (4) leads to the following expression for the output:

$$Y = Q_{i,t} \times Q_j \times u_{j,t} \times L$$

Dividing the production function by the labor input yields the productivity equation:

$$Y / L = Q_{i,t} \times Q_j \times u_{j,t}$$

which could then be transformed into a linear model of productivity after taking the *logs* to the expression:

(5) $$(Y / L)_{j,i,t} = Q_j + Q_{i,t} + M_t + u_{j,t}$$

In this model the rate of growth of productivity is a function of the following factors: economy-wide labor effort *E*, capturing the demand fluctuations, sector specific technological and organizational changes and firm-specific characteristic.

The firm-specific components is then approximated by the lowest possible disaggregation level: this is usually at the 3 digit NACE classification which allows to identify the focus of the structural changes. The model and the estimation procedures however are independent on whether one takes firm level data, or sectoral level data unless two levels of aggregation are identified in the analysis.

### *B. The Two-Error Component Regression Model of Unobservable Effects*

The empirical estimation of productivity growth as a result of macroeconomic demand driven factors along with sector and industry, or firm-specific effects[36] encounters a number of problems an important element of which is finding out proxies for the factors included in the economic framework. Provided productivity is presented at the level of manufacturing sectors, subjected to responses to sectoral disturbances and macroeconomic policy effects, its dynamics could be described by a panel data model where all of the information at the different disaggregated levels are used. Such a model encompassing the cross-section and the time-series dimensions could be presented in the form of:

(6) $$y_{i,t} = \alpha + x^{'} \beta_{t,\tau} + u_{i,t}$$

where $y_{i,t}$ denotes *i*th industry's measure of productivity at time *t*, $\alpha$ is a scalar, $\beta$ is *K x 1* vector and $x_{i,t}$ is the *i-th* observation of the *K* explanatory variables, which can be measured at the lowest level of aggregation, i.e. the firm, or the industry. If such an indicator is not possible to include either because of measurement errors, or lack of observations on it, then the relation still holds leaving for the residuals to take account of the effect. In the majority of panel data applications the error component, $u_{it}$ consist of an unobservable part, or individual specific effect and the remaining disturbances, i.e.:

(7) $$u_{i,t} = \mu_{,t} + \nu_{i,t}$$

[36] In the economy three levels of aggregation are make up the usual framework of the analysis. In this study we adopt the same three level structure but the levels are the following: total manufacturing, industrial sector, which corresponds to the 2 digit level and by industries we mean the 3-digit level classification of activities, 3-digit ISIC and 4-digit ISIC relatively.

where $\mu_{i,t}$ is the specific individual effect and $\nu_{i,t}$ – denotes the remainder of the disturbance. The specific effect is time-invariant and accounts for any industry's effects that are not included in the regression. This could be effects like enterpreneuralship or managerial skills, or other related to specific industry feature. As long as the capital stock is not included in the model, it is in this element that the effects of all these factors capturing the industry specificities such as technological and other organization factors could be accounted for. A fixed effects model is used for this purpose, though for random effects have also been tested in order to specify the underlying decomposition, (discussed in more details later), where $\mu_i$ are assumed to be fixed parameters while $\nu_{it}$ is an independent and identically distributed stochastic term[37]. The presentation in (7) however incorporates industry specific factors, which are time-invariant only. The transformation period for all the TE is a process of profound economy-wide changes, which vary over time. This is taken into account the time component in the productivity performance by explicitly introducing a time-variant component out of the disturbance term for that purpose[38]:

(8) $$u_{i,t} = \mu_i + \lambda_t + \gamma_{i,t}, \qquad i = 1,\ldots,N; \qquad t = 1,\ldots,T$$

where $\mu_i$ denote the unobservable industry-specific effect, $\lambda_t$ denotes the unobservable time-effect and $\gamma_{it}$ is the remainder stochastic disturbance term. It is through the effect of $\lambda_t$ that the impacts of macroeconomic policy applied in different periods of time, or other uncontrollable effects like strikes, oil prices effects, etc. could be estimated.

In terms of applying the panel data model of the above type to the decomposition approach to productivity growth, the approximation of the unobservable effects could be useful by providing further insights about the pattern of change: whether industry-specific, or structural factors have dominated macroeconomic ones, or vice versa. Applying in addition a set of new dummies to capture the regional effects allows to extend the analysis of structural changes from cross-section country inferences to cross-country comparative manufacturing industries.

[37] For a detailed and formal presentation of the error-components models and the specification of panel data models see Hsiao C. 1986, *Analysis of Panel Data, Cambridge University Press, Cambridge* and Baltagi B.H. *Econometric Analysis of Panel Data (1995).*

[38] Wallace and Hussain in (1969), Nelrove (1971b) and Amemiya (1971) are among the first to consider a further decomposition of the disturbance term thus leading the way to developing the two-way-error components disturbances model.

Table 1

**Composition of Manufacturing Output and Employment by 23 industries NACE 2-digit classification in selected transition economies and western European countries, 1995 and 2000[a] (in %)**

| NACE | Poland | | | | Slovenia | | | |
|---|---|---|---|---|---|---|---|---|
| | Output | | Employment | | Output* | | Employment | |
| | *1995* | *2000* | *1995* | *2000* | *1995* | *1999* | *1997* | *1999* |
| 15: Food products and beverages | 17.5 | 17.7 | 17.2 | 18.7 | 12.2 | 11.8 | 8.8 | 8.7 |
| 16: Tobacco products | 0.7 | 1.0 | 0.4 | 0.4 | n.a. | n.a. | 0.2 | 0.2 |
| 17: Textiles | 3.6 | 2.6 | 5.9 | 4.2 | 4.5 | 4.4 | 6.5 | 6.5 |
| 18: Wearing apparel; dressing and dyeing of fur | 5.3 | 3.5 | 9.8 | 8.6 | 2.7 | 2.1 | 8.6 | 8.1 |
| 19: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear | 1.6 | 1.0 | 2.7 | 2.0 | n.a. | 1.3 | 3.7 | 3.2 |
| 20: Wood and products of wood and cork, except furniture; articles of straw and plaiting materials | 3.5 | 4.6 | 3.9 | 4.6 | 4.0 | 3.2 | 5.1 | 5.1 |
| 21: Pulp, paper and paper products | 2.8 | 2.4 | 1.3 | 1.5 | 4.4 | 3.8 | 3.0 | 2.7 |
| 22: Publishing, printing and reproduction of recorded media | 4.5 | 5.7 | 2.4 | 3.1 | 4.6 | 4.2 | 3.4 | 3.5 |
| 23: Coke, refined petroleum products and nuclear fuel | 2.7 | 3.3 | 0.8 | 0.8 | n.a. | 0.6 | 0.1 | 0.3 |
| 24: Cemicals and chemical products | 8.5 | 7.0 | 5.0 | 4.7 | 9.7 | 10.1 | 5.1 | 5.1 |
| 25: Rubber and plastic products | 4.7 | 5.2 | 3.2 | 4.2 | 4.5 | 5.0 | 4.4 | 4.9 |
| 26: Other non-metallic mineral products | 5.6 | 7.3 | 5.9 | 6.1 | 3.9 | 4.2 | 4.8 | 4.7 |
| 27: Basic metals | 6.5 | 4.1 | 5.3 | 4.6 | 5.8 | 4.8 | 3.8 | 3.6 |
| 28: Fabricated metal products, except machinery and equipment | 6.1 | 7.1 | 5.7 | 6.9 | 6.6 | 7.8 | 10.8 | 11.8 |
| 29: Machinery and equipment n.e.c. | 8.5 | 7.4 | 10.7 | 9.2 | 8.8 | 9.9 | 9.7 | 9.9 |
| 30: Office machinery and computers | 0.3 | 0.4 | 0.1 | 0.2 | 0.9 | n.a. | 0.4 | 0.4 |
| 31: Electrical machinery and apparatus n.e.c. | 3.4 | 3.6 | 3.2 | 3.6 | 4.7 | 4.6 | 5.0 | 5.0 |
| 32: Radio, television and communication equipment and apparatus | 1.8 | 1.8 | 1.6 | 1.3 | 2.1 | 2.7 | 2.6 | 2.6 |
| 33: Medical, precision and optical instruments, watches and clocks | 1.5 | 2.4 | 1.5 | 1.5 | 2.2 | 2.3 | 3.0 | 3.1 |
| 34: Motor vehicles, trailers and semi-trailers | 3.2 | 3.8 | 3.5 | 3.8 | 9.6 | 11.2 | 3.0 | 3.0 |
| 35: Other transport equipment | 3.0 | 2.9 | 4.0 | 3.3 | n.a. | 0.7 | 1.3 | 1.2 |
| 36: Furniture; manufacturing n.e.c. | 4.4 | 4.9 | 5.5 | 6.3 | 3.5 | 3.3 | 6.4 | 6.0 |
| 37: Recycling | 0.4 | 0.5 | 0.2 | 0.3 | n.a. | n.a. | 0.3 | 0.3 |

*Source: UNECE database and national statistics.*

*Note: 1. Output is measured as gross output if indicated by a*, and by value added otherwise. 2. Distribution of output is calculated on the bases of current prices in national currencies.*

*[a] In countries where data is not available for 1995 and 2000, the nearest period is reported.*

**Structures of Manufacturing Output and Employment by 23 industries NACE 2-digit classification in selected European countries, 1995 and 2000 [1] (in %)**

| NACE | Hungary | | | | Czech Republic | | | |
|---|---|---|---|---|---|---|---|---|
| | Output | | Employment | | Output | | Employment | |
| | 1995 | 1999 | 1995 | 1999 | 1995 | 1999 | 1995 | 1999 |
| 15: Food products and beverages | 18.0 | 13.0 | 19.0 | 17.2 | 13.9 | 13.8 | 10.3 | 12.2 |
| 16: Tobacco products | 0.5 | 0.6 | 0.3 | 0.3 | in 15 | in 15 | in 15 | in 15 |
| 17: Textiles | 3.2 | 2.2 | 5.9 | 4.6 | 4.2 | 3.7 | 7.7 | 5.9 |
| 18: Wearing apparel; dressing and dyeing of fur | 3.9 | 3.3 | 7.9 | 9.8 | 2.1 | 2.1 | 3.2 | 3.9 |
| 19: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear | 1.7 | 1.2 | 3.3 | 3.3 | 1.4 | 0.8 | 2.9 | 1.9 |
| 20: Wood and products of wood and cork, except furniture; articles of straw and plaiting materials | 2.6 | 2.0 | 3.2 | 2.8 | 3.2 | 2.9 | 2.1 | 3.2 |
| 21: Pulp, paper and paper products | 2.0 | 1.8 | 1.4 | 1.3 | 2.8 | 2.1 | 2.1 | 1.7 |
| 22: Publishing, printing and reproduction of recorded media | 3.8 | 3.2 | 4.2 | 3.0 | 2.5 | 3.1 | 1.6 | 2.0 |
| 23: Coke, refined petroleum products and nuclear fuel | 8.4 | 6.8 | 2.3 | 2.0 | 3.3 | 1.1 | 1.3 | 0.4 |
| 24: Cemicals and chemical products | 11.6 | 6.8 | 6.0 | 5.0 | 5.7 | 6.3 | 4.0 | 3.9 |
| 25: Rubber and plastic products | 3.7 | 3.9 | 3.5 | 4.1 | 3.1 | 4.9 | 2.8 | 3.8 |
| 26: Other non-metallic mineral products | 4.9 | 4.0 | 4.6 | 4.2 | 6.9 | 8.4 | 6.2 | 6.7 |
| 27: Basic metals | 3.6 | 2.6 | 3.8 | 2.8 | 9.0 | 5.5 | 10.1 | 7.7 |
| 28: Fabricated metal products, except machinery and equipment | 7.2 | 6.1 | 7.7 | 7.3 | 9.8 | 9.9 | 7.4 | 10.0 |
| 29: Machinery and equipment n.e.c. | 7.1 | 6.4 | 8.9 | 7.8 | 11.2 | 10.4 | 15.8 | 12.7 |
| 30: Office machinery and computers | 0.2 | 11.3 | 0.3 | 1.5 | 0.2 | 0.2 | 0.2 | 0.1 |
| 31: Electrical machinery and apparatus n.e.c. | 3.9 | 7.0 | 4.7 | 8.2 | 4.8 | 6.3 | 5.1 | 6.2 |
| 32: Radio, television and communication equipment and apparatus | 2.6 | 3.5 | 3.1 | 4.0 | 1.6 | 1.7 | 1.6 | 2.1 |
| 33: Medical, precision and optical instruments, watches and clocks | 2.9 | 1.9 | 2.5 | 1.8 | 1.8 | 2.3 | 1.8 | 1.8 |
| 34: Motor vehicles, trailers and semi-trailers | 5.0 | 9.8 | 3.2 | 4.3 | 4.8 | 9.0 | 5.3 | 6.1 |
| 35: Other transport equipment | 0.6 | 0.7 | 0.5 | 1.0 | 2.0 | 1.4 | 3.4 | 2.2 |
| 36: Furniture; manufacturing n.e.c. | 2.5 | 1.9 | 3.4 | 3.5 | 4.3 | 3.9 | 4.8 | 5.0 |
| 37: Recycling | 0.1 | 0.2 | 0.1 | 0.2 | 1.6 | 0.3 | 0.4 | 0.5 |

*Source: UNECE database and national statistics.*

*Note: 1. Output is measure das gross output if indicated by a*, and by value added otherwise. 2. Distribution of output is calculated on the bases of current prices in national currencies.*

*[1] In countries where data is not available for 1995 and 200, the nearest period is reported*

**Structures of Manufacturing Output and Employment by 23 industries NACE 2-digit classification in selected European countries, 1995 and 2000 [1] (in %)**

| NACE | Bulgaria | | | | Romania | | | |
|---|---|---|---|---|---|---|---|---|
| | Output | | Employment | | Output* | | Employment | |
| | 1995 | 2000 | 1995 | 2000 | 1995 | 1999 | 1995 | 1999 |
| 15: Food products and beverages | 17.9 | 14.2 | 13.2 | 15.1 | 20.2 | 18.6 | 10.5 | 11.2 |
| 16: Tobacco products | 5.3 | 5.2 | 2.0 | 1.8 | 0.6 | 2.4 | 0.3 | 0.3 |
| 17: Textiles | 4.0 | 3.5 | 7.0 | 5.5 | 3.9 | 3.0 | 8.4 | 6.1 |
| 18: Wearing apparel; dressing and dyeing of fur | 4.1 | 8.6 | 10.0 | 18.2 | 3.3 | 4.7 | 8.6 | 14.4 |
| 19: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear | 1.7 | 1.6 | 3.1 | 3.4 | 1.8 | 1.8 | 3.8 | 4.6 |
| 20: Wood and products of wood and cork, except furniture; articles of straw and plaiting materials | 1.1 | 1.3 | 2.0 | 2.3 | 2.3 | 3.4 | 3.5 | 4.6 |
| 21: Pulp, paper and paper products | 2.1 | 1.2 | 2.4 | 2.1 | 1.5 | 1.4 | 1.2 | 1.1 |
| 22: Publishing, printing and reproduction of recorded media | 2.1 | 3.1 | 1.3 | 1.9 | 1.4 | 2.1 | 1.0 | 1.2 |
| 23: Coke, refined petroleum products and nuclear fuel | 7.5 | .. | 1.9 | 1.9 | 9.5 | 10.7 | 1.6 | 1.4 |
| 24: Cemicals and chemical products | 12.1 | 11.4 | 6.5 | 5.8 | 10.8 | 7.8 | 5.7 | 5.0 |
| 25: Rubber and plastic products | 2.9 | 2.4 | 3.2 | 2.9 | 2.6 | 2.4 | 2.2 | 2.1 |
| 26: Other non-metallic mineral products | 4.8 | 4.6 | 5.8 | 4.3 | 4.8 | 4.7 | 5.6 | 5.5 |
| 27: Basic metals | 9.9 | 10.3 | 6.9 | 5.6 | 12.9 | 12.1 | 6.7 | 6.5 |
| 28: Fabricated metal products, except machinery and equipment | 2.7 | 3.0 | 4.1 | 4.1 | 3.5 | 3.7 | 5.6 | 5.2 |
| 29: Machinery and equipment n.e.c. | 11.3 | 10.2 | 15.9 | 13.4 | 7.2 | 5.1 | 14.7 | 11.0 |
| 30: Office machinery and computers | 0.9 | 0.5 | 0.9 | 0.6 | 0.3 | 0.3 | 0.1 | 0.1 |
| 31: Electrical machinery and apparatus n.e.c. | 3.4 | 3.0 | 4.1 | 3.2 | 2.5 | 2.7 | 3.4 | 3.0 |
| 32: Radio, television and communication equipment and apparatus | 0.9 | 0.9 | 1.8 | 1.0 | 1.1 | 1.0 | 0.8 | 0.6 |
| 33: Medical, precision and optical instruments, watches and clocks | 0.8 | 0.7 | 1.4 | 1.1 | 0.5 | 0.5 | 0.9 | 0.7 |
| 34: Motor vehicles, trailers and semi-trailers | 0.8 | 0.5 | 1.1 | 0.6 | 3.8 | 4.8 | 4.8 | 4.8 |
| 35: Other transport equipment | 2.0 | 1.8 | 1.7 | 1.7 | 1.9 | 2.9 | 3.4 | 4.0 |
| 36: Furniture; manufacturing n.e.c. | 1.6 | 2.0 | 3.3 | 3.4 | 3.2 | 3.2 | 6.4 | 6.1 |
| 37: Recycling | 0.1 | .. | 0.1 | 0.1 | 0.3 | 0.5 | 0.3 | 0.3 |

*Source: UNECE database and national statistics.*
*Note: 1. Output is measure das gross output if indicated by a*, and by value added otherwise. 2. Distribution of output is calculated on the bases of current prices in national currencies.*
*[1] In countries where data is not available for 1995 and 200, the nearest period is reported*

**Structures of Manufacturing Output and Employment by 23 industries NACE 2-digit classification in selected European countries, 1995 and 2000 [1] (in %)**

| NACE | Austria | | | | Portugal | | | |
|---|---|---|---|---|---|---|---|---|
| | Output | | Employment | | Output | | Employment | |
| | 1995 | 1999 | 1995 | 1999 | 1995 | 1999 | 1995 | 1999 |
| 15: Food products and beverages | 11.0 | 9.5 | 13.3 | 12.6 | 10.1 | 12.4 | 11.9 | 11.3 |
| 16: Tobacco products | 0.4 | 0.4 | 0.2 | 0.2 | 4.2 | 0.7 | 0.1 | 0.1 |
| 17: Textiles | 3.8 | 2.6 | 4.2 | 3.5 | 8.5 | 8.0 | 12.9 | 10.8 |
| 18: Wearing apparel; dressing and dyeing of fur | 1.4 | 1.0 | 2.6 | 2.0 | 6.5 | 7.5 | 14.9 | 15.3 |
| 19: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear | 0.7 | 0.7 | 1.2 | 1.1 | 3.9 | 4.0 | 7.4 | 7.0 |
| 20: Wood and products of wood and cork, except furniture; articles of straw and plaiting materials | 4.6 | 4.8 | 6.1 | 6.1 | 3.5 | 4.3 | 5.3 | 5.7 |
| 21: Pulp, paper and paper products | 4.7 | 4.3 | 2.8 | 2.8 | 4.9 | 3.6 | 1.5 | 1.5 |
| 22: Publishing, printing and reproduction of recorded media | 4.6 | 4.9 | 4.2 | 4.2 | 4.3 | 5.1 | 3.6 | 3.9 |
| 23: Coke, refined petroleum products and nuclear fuel | 2.2 | 2.9 | 0.5 | 0.4 | 13.8 | 2.3 | 0.4 | 0.3 |
| 24: Cemicals and chemical products | 5.2 | 6.3 | 3.7 | 4.2 | 5.3 | 5.6 | 3.0 | 2.4 |
| 25: Rubber and plastic products | 4.1 | 4.3 | 4.2 | 4.5 | 2.3 | 3.2 | 2.3 | 2.3 |
| 26: Other non-metallic mineral products | 6.9 | 6.1 | 5.6 | 5.4 | 8.6 | 10.4 | 7.4 | 7.3 |
| 27: Basic metals | 6.6 | 6.5 | 5.1 | 5.1 | 1.5 | 2.0 | 1.5 | 1.4 |
| 28: Fabricated metal products, except machinery and equipment | 9.3 | 9.0 | 10.2 | 10.7 | 6.1 | 6.9 | 8.3 | 8.6 |
| 29: Machinery and equipment n.e.c. | 10.6 | 11.3 | 11.1 | 11.9 | 3.3 | 5.6 | 4.1 | 4.8 |
| 30: Office machinery and computers | 0.1 | 0.4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 |
| 31: Electrical machinery and apparatus n.e.c. | 4.9 | 4.4 | 5.0 | 4.5 | 3.0 | 3.5 | 3.0 | 3.3 |
| 32: Radio, television and communication equipment and apparatus | 6.2 | 6.4 | 5.1 | 4.7 | 2.3 | 3.0 | 1.8 | 1.7 |
| 33: Medical, precision and optical instruments, watches and clocks | 1.8 | 2.1 | 2.1 | 2.5 | 0.5 | 0.7 | 0.6 | 0.7 |
| 34: Motor vehicles, trailers and semi-trailers | 4.6 | 5.9 | 3.7 | 4.5 | 3.5 | 5.2 | 2.5 | 2.4 |
| 35: Other transport equipment | 0.9 | 0.9 | 0.8 | 0.8 | 1.2 | 1.1 | 1.7 | 1.4 |
| 36: Furniture; manufacturing n.e.c. | 5.3 | 5.2 | 8.3 | 8.2 | 2.7 | 4.7 | 5.7 | 7.6 |
| 37: Recycling | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.1 | 0.1 | 0.1 |

*Source: UNECE database and national statistics.*
*Note: 1. Output is measure das gross output if indicated by a*, and by value added otherwise. 2. Distribution of output is calculated on the bases of current prices in national currencies.*
*[1] In countries where data is not available for 1995 and 200, the nearest period is reported*

**Structures of Manufacturing Output and Employment by 23 industries NACE 2-digit classification in selected European countries, 1995 and 2000 [1] (in %)**

| NACE | Finland | | | | Lithuania | | | |
|---|---|---|---|---|---|---|---|---|
| | Output | | Employment | | Output | | Employment | |
| | 1995 | 1999 | 1995 | 1999 | 1995 | 2000 | 1995 | 2000 |
| 15: Food products and beverages | 9.3 | 7.4 | 11.5 | 9.9 | 22.4 | 26.2 | 24.2 | 23.2 |
| 16: Tobacco products | 0.2 | 0.1 | 0.2 | 0.1 | | | 0.2 | 0.1 |
| 17: Textiles | 1.2 | 1.1 | 1.8 | 1.6 | 9.2 | 7.1 | 11.6 | 12.0 |
| 18: Wearing apparel; dressing and dyeing of fur | 1.0 | 0.7 | 2.2 | 1.6 | 11.0 | 8.8 | 9.2 | 13.6 |
| 19: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear | 0.4 | 0.3 | 0.9 | 0.7 | 2.1 | 1.6 | 2.6 | 1.5 |
| 20: Wood and products of wood and cork, except furniture; articles of straw and plaiting materials | 4.4 | 4.7 | 6.5 | 6.7 | 4.0 | 6.2 | 6.4 | 12.0 |
| 21: Pulp, paper and paper products | 21.5 | 16.4 | 10.8 | 9.7 | 2.3 | 1.9 | 1.7 | 1.4 |
| 22: Publishing, printing and reproduction of recorded media | 6.4 | 5.9 | 7.8 | 7.3 | 2.5 | 5.6 | 2.0 | 4.1 |
| 23: Coke, refined petroleum products and nuclear fuel | 1.1 | 1.2 | 1.1 | 0.9 | 19.4 | 5.3 | 1.2 | 1.4 |
| 24: Cemicals and chemical products | 6.4 | 6.1 | 4.6 | 4.3 | 5.3 | 4.8 | 3.1 | 2.4 |
| 25: Rubber and plastic products | 3.0 | 3.3 | 3.5 | 3.8 | 0.6 | 2.8 | 1.3 | 2.2 |
| 26: Other non-metallic mineral products | 2.6 | 3.4 | 3.2 | 3.7 | 4.4 | 4.0 | 6.5 | 4.4 |
| 27: Basic metals | 6.5 | 4.2 | 4.4 | 4.0 | 0.4 | 0.6 | 0.6 | 0.6 |
| 28: Fabricated metal products, except machinery and equipment | 5.4 | 5.9 | 7.5 | 8.2 | 2.2 | 3.5 | 2.9 | 3.2 |
| 29: Machinery and equipment n.e.c. | 11.8 | 10.4 | 13.1 | 13.7 | 3.8 | 2.8 | 8.6 | 4.2 |
| 30: Office machinery and computers | 0.6 | 0.1 | 0.9 | 0.5 | 0.2 | 0.1 | 0.7 | 0.1 |
| 31: Electrical machinery and apparatus n.e.c. | 3.4 | 3.2 | 3.9 | 3.8 | 1.6 | 1.6 | 2.7 | 1.5 |
| 32: Radio, television and communication equipment and apparatus | 6.8 | 17.6 | 5.5 | 8.3 | 2.7 | 5.4 | 5.0 | 3.0 |
| 33: Medical, precision and optical instruments, watches and clocks | 2.0 | 2.5 | 2.2 | 2.7 | 0.6 | 1.5 | 1.8 | 1.2 |
| 34: Motor vehicles, trailers and semi-trailers | 1.2 | 1.3 | 1.6 | 1.7 | 0.1 | 0.2 | 0.7 | 0.2 |
| 35: Other transport equipment | 2.3 | 1.7 | 2.9 | 2.7 | 2.2 | 3.0 | 2.5 | 2.3 |
| 36: Furniture; manufacturing n.e.c. | 2.3 | 2.4 | 3.7 | 4.0 | 2.2 | 4.8 | 4.2 | 5.1 |
| 37: Recycling | 0.1 | 0.0 | 0.1 | 0.1 | | | 0.3 | 0.5 |

*Source: UNECE database and national statistics.*
*Note: 1. Output is measure das gross output if indicated by a*, and by value added otherwise. 2. Distribution of output is calculated on the bases of current prices in national currencies.*
*[1] In countries where data is not available for 1995 and 200, the nearest period is reported*

**Structures of Manufacturing Output and Employment by 23 industries NACE 2-digit classification in selected European countries, 1995 and 2000 [1] (in %)**

| NACE | Slovakia | | | | Estonia | | | |
|---|---|---|---|---|---|---|---|---|
| | Output | | Employment | | Output | | Employment | |
| | *1996* | *1999* | *1996* | *1999* | *1995* | *1999* | *1995* | *1999* |
| 15: Food products and beverages | 16.3 | 14.3 | 11.4 | 12.4 | 28.6 | 21.7 | 20.1 | 18.8 |
| 16: Tobacco products | n.a. | n.a. | n.a. | n.a. | | | n.a. | n.a. |
| 17: Textiles | 2.1 | 3.2 | 8.3 | 8.4 | 7.2 | 5.9 | 7.4 | 6.2 |
| 18: Wearing apparel; dressing and dyeing of fur | 1.8 | 2.5 | 3.6 | 3.6 | 6.4 | 6.6 | 10.1 | 11.3 |
| 19: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear | 1.5 | 1.8 | 4.8 | 3.9 | 1.3 | 1.7 | 2.1 | 2.6 |
| 20: Wood and products of wood and cork, except furniture; articles of straw and plaiting materials | 1.8 | 1.6 | 3.3 | 2.9 | 6.9 | 12.6 | 11.2 | 15.2 |
| 21: Pulp, paper and paper products | 4.1 | 5.2 | 3.2 | 3.1 | 0.9 | 1.8 | 3.8 | 3.6 |
| 22: Publishing, printing and reproduction of recorded media | 2.2 | 2.7 | 2.8 | 2.7 | 6.4 | 6.2 | 1.2 | 0.8 |
| 23: Coke, refined petroleum products and nuclear fuel | 8.8 | 4.5 | 1.3 | 1.2 | 0.2 | 0.5 | 4.5 | 2.7 |
| 24: Cemicals and chemical products | 9.9 | 7.4 | 6.0 | 5.4 | 7.0 | 2.6 | in 23 | in 23 |
| 25: Rubber and plastic products | 4.5 | 4.0 | 3.4 | 3.3 | 1.5 | 2.1 | 1.8 | 2.5 |
| 26: Other non-metallic mineral products | 4.3 | 7.0 | 5.6 | 6.2 | 4.6 | 5.7 | 5.3 | 3.9 |
| 27: Basic metals | 9.3 | 7.1 | 7.5 | 7.3 | 0.1 | 0.2 | 4.0 | 6.4 |
| 28: Fabricated metal products, except machinery and equipment | 8.5 | 6.4 | 5.7 | 5.5 | 6.4 | 8.0 | in 27 | in 27 |
| 29: Machinery and equipment n.e.c. | 8.1 | 10.0 | 15.5 | 14.6 | | | 6.6 | 3.4 |
| 30: Office machinery and computers | 2.2 | 2.9 | 3.7 | 3.9 | 0.8 | 0.6 | 5.0 | 6.7 |
| 31: Electrical machinery and apparatus n.e.c. | 1.2 | 2.1 | 2.1 | 2.4 | 2.7 | 1.8 | in 30 | in 30 |
| 32: Radio, television and communication equipment and apparatus | 1.6 | 1.2 | 2.4 | 2.6 | 0.6 | 2.7 | in 30 | in 30 |
| 33: Medical, precision and optical instruments, watches and clocks | 1.1 | 2.7 | 0.2 | 0.8 | 1.0 | 2.0 | in 30 | in 30 |
| 34: Motor vehicles, trailers and semi-trailers | 8.8 | 10.8 | 6.3 | 6.4 | 2.9 | 2.6 | 5.3 | 5.5 |
| 35: Other transport equipment | n.a. | n.a. | n.a. | n.a. | 3.0 | 2.8 | in 34 | in 34 |
| 36: Furniture; manufacturing n.e.c. | 2.5 | 2.6 | 3.8 | 3.8 | 7.4 | 8.9 | 11.7 | 10.4 |
| 37: Recycling | n.a. | n.a. | n.a. | n.a. | | | in 35 | in 35 |

*Source: UNECE database and national statistics.*
*Note: 1. Output is measure das gross output if indicated by a*, and by value added otherwise. 2. Distribution of output is calculated on the bases of current prices in national currencies.*
*[1] In countries where data is not available for 1995 and 200, the nearest period is reported*

| Structures of Manufacturing Output and Employment by 23 industries NACE 2-digit classification in selected European countries, 1995 and 2000 [1] (in %) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NACE | Latvia | | | | | | | |
| | Output* | | Employment | | | | | |
| | 1995 | 1999 | 1995 | 1999 | | | | |
| 15: Food products and beverages | 38.6 | 32.7 | 21.8 | 23.9 | | | | |
| 16: Tobacco products | | | 0.2 | 0.2 | | | | |
| 17: Textiles | 6.0 | 5.5 | 8.5 | 7.0 | | | | |
| 18: Wearing apparel; dressing and dyeing of fur | 2.0 | 3.5 | 5.9 | 9.0 | | | | |
| 19: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear | 1.2 | 0.4 | 2.7 | 1.2 | | | | |
| 20: Wood and products of wood and cork, except furniture; articles of straw and plaiting materials | 10.4 | 20.3 | 9.6 | 18.4 | | | | |
| 21: Pulp, paper and paper products | 0.6 | 1.5 | 1.1 | 0.9 | | | | |
| 22: Publishing, printing and reproduction of recorded media | 3.9 | 6.1 | 4.1 | 6.4 | | | | |
| 23: Coke, refined petroleum products and nuclear fuel | | | 0.1 | 0.1 | | | | |
| 24: Cemicals and chemical products | 7.6 | 3.2 | 5.4 | 3.9 | | | | |
| 25: Rubber and plastic products | 0.8 | 1.7 | 1.1 | 1.1 | | | | |
| 26: Other non-metallic mineral products | 2.7 | 3.3 | 3.9 | 3.1 | | | | |
| 27: Basic metals | | | 1.6 | 1.9 | | | | |
| 28: Fabricated metal products, except machinery and equipment | 2.1 | 3.2 | 2.7 | 3.9 | | | | |
| 29: Machinery and equipment n.e.c. | 4.9 | 2.6 | 7.6 | 4.6 | | | | |
| 30: Office machinery and computers | | | 0.0 | 0.1 | | | | |
| 31: Electrical machinery and apparatus n.e.c. | 2.3 | 1.5 | 3.7 | 2.0 | | | | |
| 32: Radio, television and communication equipment and apparatus | 1.6 | 0.5 | 4.9 | 1.3 | | | | |
| 33: Medical, precision and optical instruments, watches and clocks | 0.4 | 0.7 | 0.5 | 0.7 | | | | |
| 34: Motor vehicles, trailers and semi-trailers | 2.0 | 0.2 | 1.9 | 0.4 | | | | |
| 35: Other transport equipment | 4.8 | 2.6 | 6.8 | 4.3 | | | | |
| 36: Furniture; manufacturing n.e.c. | 3.4 | 3.6 | 5.3 | 5.1 | | | | |
| 37: Recycling | 0.6 | 0.7 | 0.3 | 0.5 | | | | |
| *Source: UNECE database and national statistics.*<br>*Note: 1. Output is measure das gross output if indicated by a*, and by value added otherwise. 2. Distribution of output is calculated on the bases of current prices in national currencies.*<br>*[1] In countries where data is not available for 1995 and 200, the nearest period is reported* | | | | | | | | |

Table 2

## Indices of structural change and similarity for total manufacturing industry [a] in transition economies countries, [b] 1995-1999

| | *Index of structural change* | *Index of similarity* | *Index of the consistency of structural change* |
|---|---|---|---|
| Value added and current prices | 8.83 | 91.17 | 0.586 |
| Value added at constant prices [c] | 7.94 | 92.06 | 0.450 |
| Employment | 7.60 | 92.40 | 0.613 |

Source: UNECE database and national offices.

Notes:

[a)] All indices are calculated as unweighted average of the percentage industries shares of output and employment, respectively for the seven countries.

[b)] The transition countries include Bulgaria, Hungary, Poland, Romania, Estonia, Latvia and Lithuania.

[c)] Value added in constant prices is estimated in 1995 prices

TABLE 3

Indices of structural change and similarity for manufacturing output [a] in transition economies and selected western European countries, 1995 - 1999

| *Country* | *Index of structural change* | | *Index of similarity* | | *Index of consistency of structual change* | |
|---|---|---|---|---|---|---|
| | *Value added at current prices* | *Value added at [b] constant prices* | *Value added at current prices* | *Value added at constant prices [b]* | *Value added at current prices* | *Value added at constant prices [b]* |
| Bulgaria | 8.46 | 5.63 | 91.57 | 94.37 | 0.18 | 0.14 |
| Hungary | 20.35 | 14.74 | 79.65 | 85.26 | 0.68 | 0.52 |
| Poland | 7.77 | 9.09 | 92.23 | 90.91 | 0.38 | 0.43 |
| Romania | 9.46 | 9.22 | 90.54 | 90.78 | 0.44 | 0.36 |
| Estonia | 15.30 | 17.20 | 84.70 | 82.80 | 0.45 | 0.48 |
| Latvia | 12.98 | 11.68 | 87.02 | 88.32 | 0.71 | 0.63 |
| Lithuania | 19.20 | 17.84 | 80.80 | 82.16 | 0.43 | 0.41 |
| Austria | 5.41 | 5.82 | 94.59 | 94.18 | 0.27 | 0.27 |
| Finland | 13.43 | 13.35 | 86.57 | 86.65 | 0.67 | 0.68 |
| Portugal | 16.85 | 15.06 | 83.15 | 84.94 | 0.68 | 0.67 |

**Source:** UNECE database and national offices**.**

**Notes:**

[a] Output is measured as value added.

[b] Constant prices are 1995 prices.

TABLE 4

Indices of structural change and similarity for employment in manufacturing in transition economies and in selected western European countries, 1995 - 1999

| *Country* | *Index of structural change* | *Index of similarity* | *Index of consistency of structural change* |
|---|---|---|---|
| Bulgaria | 9.34 | 90.66 | 0.45 |
| Hungary | 9.86 | 90.14 | 0.42 |
| Poland | 7.16 | 92.84 | 0.68 |
| Romania | 9.25 | 90.75 | 0.51 |
| Estonia | 10.70 | 89.30 | 0.38 |
| Latvia | 18.17 | 81.83 | 0.67 |
| Lithuania | 11.05 | 88.95 | 0.40 |
| Austria | 3.55 | 96.45 | 0.42 |
| Finland | 5.86 | 94.14 | 0.79 |
| Portugal | 4.48 | 95.52 | 0.44 |

Table 5

Mean and Standard Deviation of Selected Indicators in manufacturing in TEs and selected western European countries, 1995 and 1999[a]

| | **Output growth rate** | **Output growth rate** | **Employment rate** | **Employment rate** | **Wage growth rate** | **Wage growth rate** | **Labour productivity rate** | **Labour productivity rate** |
|---|---|---|---|---|---|---|---|---|
| | *1995-94 or 1996-95* | *1999-98 or 1998-97* | *1995-94 or 1996-95* | *1999-98 or 1998-97* | *1995-94 or 1996-95* | *1999-98 or 1998-97* | *1995-94 or 1996-95* | *1999-98 or 1998-97* |
| Bulgaria | 7.1 (37.1) | 31.5 (68.2) | 62.1 (108.2) | -16.4 (13.4) | 4.2 (26.36) | -16.9 (17.9) | 2.9 (54.2) | -12.2 (30.6) |
| Austria | 10.9 (16.6) | 6.96 (41.9) | 2.2 (19.2) | -2.8 (3.6) | 4.9 (15.9) | -1.72 (8.19) | 8.75 (14.1) | 10.8 (48.2) |
| Czech Republic | -2.44 (28.7) | 1.75 (26.5) | 15.6 (89.3) | -2.9 (21.15) | 31.33 (112.6) | 4.20 (22.7) | 65.7 (98.98) | 4.86 (18.4) |
| Poland | 26.42 (6.40) | 12.40 (10.03) | 3.76 (5.0) | -4.03 (4.59) | 42.17 (12.10) | 15.80 (10.56) | 24.57 (15.15) | 16.95 (4.17) |
| Slovakia | 19.75 (33.79) | 1.18 (61.49) | 1.07 (16.92) | -6.73 (23.18) | 30.31 (20.8) | -4.17 (26.85) | 20.51 (34.72) | -0.53 (35.48) |
| Romania | 5.39 (8.69) | -4.51 (3.98) | -9.53 (7.89) | -6.4 (11.57) | 18.41 (18.4) | 17.11 (26.54) | -15.20 (8.4) | -6.80 (23.28) |
| Hungary | 7.64 (37.10) | 8.74 (48.35) | -15.74 (18.72) | 7.25 (28.95) | 3.49 (18.01) | 7.93 (11.92) | -13.13 (23.53) | 4.78 (15.16) |
| Estonia | 13.04 (38.09) | 10.67 (60.5) | -7.57 (4.97) | -0.12 (23.6) | 1.23 (22.1) | 6.84 (18.1) | 16.6 (24.4) | 27.2 (48.7) |
| Latvia | 16.52 (4.92) | 1.63 (4.44) | -5.32 (14.9) | 0.17 (13.7) | -2.28 (22.02) | -3.05 (22.54) | 2.85 (4.01) | 1.51 (5.44) |
| Lithuania | 4.91 (2.78) | 1.15 (3.0) | -13.08 (8.53) | -3.47 (13.54) | 5.57 (1.63) | 13.17 (2.14) | 0.58 (2.81) | 17.19 (2.66) |
| Netherland | -2.20 (5.29) | 2.98 (5.54 | -3.29 (5.39) | -1.11 (3.39) | -2.82 (4.79) | 3.02 (4.76) | 4.26 (4.17) | 5.34 (4.09) |
| Ireland | 7.49 (5.95) | 2.17 (20.33) | 6.42 (5.47) | 1.50 (7.83) | 3.69 (6.29) | 6.52 (10.40) | 1.67 (5.08) | 1.35 (12.04) |
| Finland | 10.31 (8.15) | 8.85 (26.71) | 0.48 (6.48) | -2.25 (9.82) | 11.58 (11.29) | 11.88 (29.17) | 10.19 (10.58) | 12.11 (30.24) |
| Portugal | 16.98 (143.7) | 18.94 (93.43 | -0.52 (4.25) | 10.43 (45.55) | -18.26 (125.01) | 24.67 (92.93) | -17.59 (146.74) | 1.79 (25.33) |

Source: UNECE database, national statistical offices and UNIDO Industrial Statistics Database.
Notes: a The indicators are calculated on 23 manufacturing industries at the 2-digit level of NACE classification with exception for the Czech Republic, Slovakia, Netherlands and Ireland, where 22 industries at the 3-digit level of ISIC are used.

Table 6

Standard deviation of selected indicators and and its components[a] (1995-1999)

| | **Output rate** | **Employment rate** | **Wage rate** | **Productivity rate** | **Productivity change** |
|---|---|---|---|---|---|
| **Bulgaria** | 163.99 | 54.03 | 119.97 | 0.21 | 34.17 |
| - inter-industry | 63.81 | 18.54 | 44.23 | 0.29 | 15.62 |
| - over-time | 150.52 | 50.87 | 111.06 | 0.08 | 31.24 |
| **Austria** | 27.3 | 9.99 | 14.5 | 0.93 | 26.04 |
| - inter-industry | 14.6 | 4.54 | 5.1 | 0.86 | 10.95 |
| - over-time | 23.24 | 8.91 | 13.6 | 0.39 | 23.70 |
| **Poland** | 16.61 | 6.07 | 16.47 | 18.88 | 16.74 |
| - Inter-industry | 7.04 | 3.68 | 7.93 | 16.81 | 5.13 |
| - over-time | 15.11 | 4.88 | 14.52 | 9.18 | 15.97 |
| **Romania** | 28.94 | 16.97 | 15.25 | 0.021 | 42.18 |
| - Inter-industry | 11.17 | 5.45 | 5.96 | 0.036 | 15.39 |
| - over-time | 26.78 | 16.10 | 14.09 | 0.006 | 39.38 |
| **Hungary** | 72.41 | 88.03 | 9.92 | 1.41 | 49.72 |
| - Inter-industry | 65.48 | 41.98 | 4.48 | 1.17 | 36.63 |
| - over-time | 49.57 | 77.78 | 8.90 | 0.81 | 39.59 |
| **Latvia** | 36.41 | 18.32 | n/a | 1.06 | 51.02 |
| - Inter-industry | 20.99 | 14.63 | n/a | 0.85 | 23.05 |
| - over-time | 29.94 | 11.37 | n/a | 0.66 | 45.72 |
| **Lithuania** | 100.71 | 21.46 | n/a | 33.86 | 115.71 |
| - Inter-industry | 53.21 | 11.91 | n/a | 27.29 | 69.46 |
| - over-time | 86.29 | 18.00 | n/a | 18.05 | 93.77 |
| **Estonia** | 49.44 | 23.61 | 23.71 | 29.98 | 70.74 |
| - Inter-industry | 21.58 | 11.31 | 11.15 | 25.51 | 28.42 |
| - over-time | 44.70 | 20.90 | 20.61 | 17.02 | 65.17 |
| **Finland** | 16.99 | 7.95 | 19.82 | 140.29 | 19.64 |
| - Inter-industry | 13.87 | 6.23 | 14.24 | 126.45 | 14.89 |
| - over-time | 12.27 | 5.07 | 15.38 | 63.53 | 15.83 |
| **Portugal** | 51.28 | 23.03 | 49.58 | 30.97 | 20.07 |
| - Inter-industry | 19.96 | 8.20 | 20.70 | 25.37 | 7.03 |
| - over-time | 47.42 | 21.57 | 45.25 | 15.07 | 18.85 |

Source: UNECE database and national statistical offices.
Notes: a The overall standard deviation presents the overall deviation in each of the country's panel of the selected indicators, while the inter-industry deviation is an average of the deviations across industries and the over-time deviation – an average of the deviations over the time period.

Table 7

Standard deviation of the changes in the structures of output, employment and wages[a] (1995-1999)

| | OUTPUT | EMPLOYMENT | WAGE |
|---|---|---|---|
| Bulgaria | 1.55 | 0.71 | 1.21 |
| - inter-industry | 1.52 | 0.35 | 0.53 |
| - over-time | 1.34 | 0.62 | 1.12 |
| Austria | 0.60 | 0.22 | 0.41 |
| - inter-industry | 0.20 | 0.09 | 0.13 |
| - over-time | 0.56 | 0.19 | 0.39 |
| Poland | 0.45 | 0.24 | 0.38 |
| - Inter-industry | 0.21 | 0.17 | 0.21 |
| - over-time | 0.40 | 0.17 | 0.31 |
| Romania | 1.17 | 0.59 | 0.61 |
| - Inter-industry | 0.52 | 0.38 | 0.35 |
| - over-time | 1.05 | 0.46 | 0.50 |
| Hungary | 0.91 | 0.57 | 2.04 |
| - Inter-industry | 0.65 | 0.28 | 1.16 |
| - over-time | 0.65 | 0.50 | 1.75 |
| Latvia | 1.10 | 0.74 | n/a |
| - Inter-industry | 0.72 | 0.61 | n/a |
| - over-time | 0.85 | 0.43 | n/a |
| Lithuania | 1.78 | 0.84 | n/a |
| - Inter-industry | 1.03 | 0.43 | n/a |
| - over-time | 1.46 | 0.72 | n/a |
| Estonia | 1.05 | 1.17 | 1.04 |
| - Inter-industry | 0.74 | 0.63 | 0.59 |
| - over-time | 0.76 | 0.99 | 0.83 |
| Finland | 0.95 | 0.24 | 0.71 |
| - Inter-industry | 0.69 | 0.20 | 0.33 |
| - over-time | 0.65 | 0.14 | 0.64 |
| Portugal | 1.40 | 0.28 | 0.37 |
| - Inter-industry | 0.79 | 0.15 | 0.15 |
| - over-time | 1.16 | 0.24 | 0.34 |

Source: UNECE database and national statistical offices.

Notes: a The overall standard deviation presents the overall deviation in each of the country's panel of the selected indicators, while the inter-industry deviation is an average of the deviations across industries and the over-time deviation – an average of the deviations over the time period.

Table 8

Estimation Results on the Determinants of Productive Efficiency in manufacturing by Country: Transition Economies and Selected Western European Countries at two-digit level of NACE classification, 23 industries, 1995-1999

$$\Delta(Y / L)_{i,j,t} = \mu + c(j) + s(i,j) + m(t) + u(j,i,t)$$

| FACTORS | | VALUE | F-STATISTICS | P-VALUES |
|---|---|---|---|---|
| **Bulgaria**[a] | | | | |
| | *c(j)* | 0.016 | 0.08 | 0.939 |
| Time and industry specific factors | *m(t) + s(i,t)* | | 2.53 | 0.006 |
| Time specific factors | *m(t)* | | 5.77 | 0.000 |
| Industry specific factors | *s(i,t)* | | 0.67 | 0.690 |
| Board dummy factors | | 0.083 | 2,31 | 0.020 |
| | $R^2$ | 0.13 | | |
| **Hungary** | | 0.039 | 1.09 | 0.28 |
| | *c(j)* | | 4.15 | 0.00 |
| Time and industry specific factors | *m(t) + s(i,t)* | | 14.58 | 0.00 |
| Time specific factors | *m(t)* | | 2.05 | 0.01 |
| Industry specific factors | *s(i,t)* | 0.44 | | |
| | $R^2$ | | | |
| **Poland** | | 0.004 | 0.27 | 0.78 |
| | *c(j)* | | 1.33 | 0.21 |
| Time and industry specific factors | *m(t) + s(i,t)* | | 1.95 | 0.10 |
| Time specific factors | *m(t)* | | 0.92 | 0.48 |
| Industry specific factors | *s(i,t)* | 0.03 | | |
| | $R^2$ | | | |
| **Lithuania** | | | | |
| | *c(j)* | 0.002 | 0.48 0.653 | |
| Time and industry specific factors | *m(t) + s(i,t)* | | 1.81 | 0.071 |
| Time specific factors | *m(t)* | | 4.12 | 0.00 |
| Industry specific factors | *s(i,t)* | | 0.27 | 0.95 |
| | $R^2$ | 0.09 | | |
| **Austria**[b] | | | | |
| | *c(j)* | 0.83 | 0.51 | 0.00 |
| Time and industry specific factors | *m(t) + s(i,t)* | | 0.52 | 0.00 |
| Time specific factors | *m(t)* | | 0.53 | 0.00 |
| Industry specific factors | *s(i,t)* | | 0.90 | 0.58 |
| | $R^2$ | 0.47 | | |
| **Finland** | | | | |
| | *c(j)* | -0.0002 | 0.35 | 0.72 |
| Time and industry specific factors | *m(t) + s(i,t)* | | 1.44 | 0.12 |
| Time specific factors | *m(t)* | | 2.00 | 0.11 |
| Industry specific factors | *s(i,t)* | | 1.32 | 0.19 |
| | $R^2$ | 0.11 | | |

Notes:

a For Bulgaria another version of the model is estimated on a panel of 103 manufacturing industries at the three-digit level of the NACE classification of economic activities in manufacturing and the 23 industries according to the two-digit level of aggregation as a group variable. The results confirm the same determinants of the productivity growth within an improvement of the fit of the model: $R^2 = 0.45$.

b For Austria the results refer to the three-digit level of NACE classification of activities.

Table 9

Estimation Results on the Determinants of Productive Efficiency: Cross-Country Results, 1995-1999

$$y(i,n,t) = c(i,n) + m(n,t) + k(i,t) + u(i,n,t)$$

| *FACTORS* | **VALUE** | **F-STATISTICS** | **P-VALUES** |
|---|---|---|---|
| *Group 1: all countries* | | | |
| **c(i,n)** | ***0.000*** | ***0.62*** | ***0.53*** |
| ***Country-specific factors*** | | ***86.52*** | ***0.00*** |
| ***Industry-specific factors*** | | ***0.32*** | ***0.94*** |
| $\mathbf{R^2}$ | ***0.51*** | | |
| *Group 2: transition economies countries* | | | |
| **c(i,n)** | ***0.15*** | ***1.14*** | ***0.24*** |
| ***Country-specific factors*** | | ***42.19*** | ***0.00*** |
| ***Industry-specific factors*** | | ***0.46*** | ***0.86*** |
| $\mathbf{R^2}$ | ***0.49*** | | |
| *Group 3: western European countries* | | | |
| **c(i,n)** | ***0.000*** | ***1.44*** | ***0.152*** |
| ***Country-specific factors*** | | ***218.04*** | ***0.000*** |
| ***Industry-specific factors*** | | ***0.59*** | ***0.771*** |
| $\mathbf{R^2}$ | ***0.67*** | | |