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Labour market trends in the CEECs

Abstract

In the past decade, labour markets in transition countries were characterized by soaring open unemployment, sharp employment declines, a massive exit from the labour market and only moderate job creation. The economic recovery that started in most countries in 1993 and 1994 led only to a slight or temporary rise in employment, increases that could be sustained only in Hungary and Slovenia. In general in most countries a reallocation of labour occurred, from agriculture and industry to the services sector, which however could only partly offset the job losses in the other two sectors. Tertiary-sector employment is still focused on traditional segments such as trade, tourism and transport, whereas higher value added segments are under-represented. Unemployment, again on the rise, is characterized by some common features all over the region: it varies widely across regions; it affects primarily young and low-skilled persons as well as women and ethnic minorities; and the proportion of long-term unemployment is on the rise.

1 Introduction

Over the past decade the Central and East European countries (CEECs) have undergone a dramatic structural change both in terms of GDP and employment which is still under way. During the communist past a common feature of all CEECs was the process of rapid industrialization and intense urbanization. Employment was highly concentrated in (heavy) industry, and the majority of workers was employed in large-scale state-owned enterprises. Since the start of the transformation the CEECs have been undergoing a reverse process – a rapid de-industrialization and, in most countries, also a de-agrarianization process; consequently the share of services both in value added and employment has expanded. These developments went along with the privatization of the huge state-owned enterprises, the establishment of new private small and medium-sized firms. The transition has caused widespread layoffs in state-owned companies, and thus unemployment and poverty for a very large number of people. However, the magnitude and timing of these developments vary significantly across countries. The present contribution gives a brief overview of the recent economic developments in the ten candidate countries – Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia – and examines the main labour market features based on available data.

2 Output

Almost all Central and East European candidate countries suffered from huge output contractions in the initial period of transition. Output recovery started unevenly in the subsequent years, with Poland enjoying the fastest recovery (from 1992 onwards), while growth in Lithuania and Latvia resumed only in 1996. In the year 2001, three countries, Poland, Slovenia, Hungary and Slovakia already exceeded their pre-transition output level to a considerable extent, while it was higher by some 4.5% in the Czech Republic. Estonia reached 94% of the 1990 level, Romania 88 % and Bulgaria about 84%; GDP recovery has so far been slowest in Lithuania and Latvia. These significant disparities among the transition countries in their economic performance are clearly reflected in the different levels of the GDP per capita. Measured in terms of purchasing power standards, GDP per head is highest in Slovenia, reaching slightly over 70% of the EU average in 2001, thus surpassing the level of Greece and being close to Portugal. The Czech Republic and Hungary come next (61% and 52%), Slovakia reported about half the EU level, Poland and Estonia about 40% each and Lithuania 37% while there is a remarkable gap in the case of Latvia and Bulgaria, slightly over 30% each, and Romania (25%).

3 Labour market

The total population of the candidate countries stood at 104.1 million in 2001, which is by 1.9 million less than in 1990 (Table 1). Poland and Romania account for almost 60% of the total population in the region. The sharpest decline in population over the 1990-2001 period occurred in Estonia and Latvia, by 13% and 11% respectively, followed by Bulgaria (-8%), Lithuania (-6%), and Romania where it declined by about 3%. Population increases were registered only in Slovakia and Poland, while in the Czech Republic the population remained almost stagnant. The main reason for the sharp falls of population was outward migration, particularly in the initial period of transition, e.g. ethnic Russians emigrating from Estonia and Latvia. The continued decline in the subsequent years was mainly due to natural decrease, but also resulting from economic hardship. Between 1989 and 1996 more than half a million people left Bulgaria, which was up to 1993 primarily due to the emigration of Muslims to Turkey, while later on, the poor economic situation caused well educated (young) people to emigrate either to the USA and Canada or to Western Europe. In Bulgaria these developments have led to a considerable depopulation of large areas of the country, mainly the underdeveloped, border and mountain regions (ETF 2000). The steady population decline in Romania from 1991 onwards was caused both by the negative natural increase and net outward-migration. Similar to Bulgaria a remarkable size of young educated people has been leaving the country year by year.

Table 1

Population in 1000 persons

mid-year

	1990	1993	1994	1995	1996	1997	1998	1999	2000	2001	1991-01 cumulated growth in %
Czech Republic	10363	10331	10336	10331	10315	10304	10295	10283	10273	10289	-0.7
Hungary, Dec	10355	10277	10246	10212	10174	10135	10092	10043	10198	10175	-1.7
Poland, Dec	38119	38459	38544	38588	38618	38650	38666	38654	38646	38641	1.4
Slovak Republic	5298	5325	5347	5364	5374	5383	5391	5395	5401	5380	1.5
Slovenia	1998	1991	1989	1988	1991	1987	1983	1986	1990	1992	-0.3
Bulgaria	8718	8472	8444	8406	8363	8312	8257	8211	8170	8020	-8.0
Romania	23207	22755	22731	22681	22608	22546	22503	22458	22435	22409	-3.4
Estonia	1569	1494	1463	1437	1416	1400	1386	1376	1370	1364	-13.1
Latvia	2663	2562	2520	2484	2456	2431	2408	2386	2371	2359	-11.4
Lithuania	3698	3683	3657	3629	3602	3575	3549	3524	3500	3481	-5.9
CEEC-10	105987	105349	105276	105119	104916	104723	104529	104316	104353	104110	-1.8

Source: wiiw Database incorporating national statistics.

The share of the working-age population (15 to 64 years) has been on the increase in all countries since 1993, accounting for roughly two thirds of the total population. As in most western countries, population is ageing in the CEECs, the share of people older than 65 is generally on the rise. Ageing of the population is most pronounced in Bulgaria, followed by the Czech Republic and Hungary. In accordance with the increasing shares of the productive and post-productive age groups, the share of young people up to the age of 14 years has been on the decline. The proportion of the pre-productive age group is highest in Poland and Slovakia, while it accounts for only 17% in Bulgaria.

Employment losses went along with falling activity and employment rates in all candidate countries; to illustrate, in Hungary the activity rate in 1997 was almost 12 percentage points lower than in 1989, the female rate fell even by 17 percentage points.[1] The reasons for the decrease in activity rates are manifold: the increase in early retirements and disability pensions, reduction of working pensioners, the 'discouraged worker' effect (jobless persons no longer actively seeking new employment opportunities), the return of unemployed people to education or employment in the informal sector (see also UNECE, 1995, Vidovic, 2000).

[1] Based on the Labour Force Balance (available up to 1997 only). The given figure may serve only as guideline indicator as caution is warranted in comparing pre- and post-transition employment figures due to considerable conceptual and measurement differences. Available statistics do not provide consistent time series covering the whole transition period e.g. for total employment, activity rates, but also for the sectoral composition of employment for most of the countries.

Over the 1996 to 2001 period, activity rates available from Labour Force Surveys (LFS) based on the working-age population 15-64 years fell most pronouncedly in Lithuania, Latvia and Romania. In 2001 activity rates were highest in the Czech Republic, Slovakia and in Estonia (about 70% each). A comparison between the CEECs and the EU-15 shows that, considerable falls in the transition period have translated into a substantial lowering of activity rates. In all countries but the Czech Republic, Slovakia, Estonia and Lithuania activity rates fell below the EU average of 69.2% in 2001 (Table 2).

Available LFS data indicate a decline in employment rates (total number of employed relative to the population 15-64 years) in all countries except Hungary, Slovenia and Latvia over the 1996-2001 period (Table 3). In Hungary, where employment (rates) resumed growth in 1998, the upward trend continued in the subsequent years. Poland, however, reporting increasing employment rates in the 1996-1998 period, saw a slowdown starting from 1999; in 2001 only the Czech Republic still recorded a higher employment rate than the EU average (63.9%) and Slovenia resembled the EU-level. In the other countries employment rates ranged between slightly over 65% in the Czech Republic and close to 50% on the lower end in Bulgaria. The male employment rate exceeds the female rate in all countries. However, the gender gap in employment remained smaller in the CEECs compared to most countries of the European Union. With the exception of Bulgaria and Hungary, female employment rates in the countries under consideration were higher than in the EU member states.

Table 2

Economic activity rates in the CEECs, LFS

labour force in % of working-age population 15-64

	1996	1997	1998	1999	2000	2001
Czech Republic	72.1	72.1	72.2	72.2	71.6	71.1
Hungary	58.5	57.8	58.4	59.9	60.3	60.0
Poland	66.9	68.0	66.1	65.7	65.8	65.7
Slovakia	69.7	69.5	69.5	69.7	70.0	70.6
Slovenia	67.9	68.8	68.8	67.7	67.8	68.3
Bulgaria	62.9	63.2	62.5	60.8	60.1	61.5
Romania	70.7	70.5	69.0	68.7	68.6	67.4
Estonia	72.1	72.5	71.9	70.6	70.8	70.4
Latvia	71.6	70.6	69.7	68.9	67.6	68.1
Lithuania	78.8	73.0	73.6	74.4	70.9	69.7
EU-15	67.5	67.7	68.2	68.6	69.0	69.2

Source: Eurostat; Employment in Europe 2002; national LFS statistics for respective countries.

Table 3

Employment rates in the CEECs, LFS

employed in % of working age population 15-64

	1996	1997	1998	1999	2000	2001
Czech Republic	69.3	68.7	67.5	65.9	65.2	65.3
Hungary	52.7	52.8	53.9	55.7	56.4	56.6
Poland	58.4	60.1	59.0	56.4	55.0	53.5
Slovakia	61.9	60.8	60.1	57.7	56.4	56.5
Slovenia	63.0	63.6	63.2	62.4	62.9	63.9
Bulgaria	54.0	54.1	53.7	51.2	49.9	49.2
Romania	65.5	65.9	64.2	63.5	63.3	62.5
Estonia	64.9	65.4	64.7	61.7	60.9	61.4
Latvia	57.1	59.8	59.7	59.0	57.7	58.9
Lithuania	60.3	62.6	63.7	63.8	59.8	58.6
EU-15	60.1	60.5	61.2	62.3	63.2	63.9
France	59.5	59.5	60.0	60.8	62.0	63.1
Greece	55.0	55.1	55.5	55.3	55.7	55.4
Germany	61.4	63.7	63.9	64.8	65.4	65.8
Portugal	62.8	64.0	66.6	67.4	68.3	68.9
Spain	46.8	48.2	49.9	52.5	54.8	56.3
United Kingdom	69.1	70.0	70.6	71.0	71.5	71.7

Source: Eurostat; Employment in Europe 2002; national LFS statistics for respective countries.

3.1 Employment

The dramatic fall of the GDP at the beginning of transition was accompanied by strong employment declines. Bulgaria, Estonia, Latvia and Hungary were affected most by job losses while employment dropped less pronouncedly in Poland, the Czech Republic and in Lithuania. In the majority of East European countries the bulk of job losses occurred in the initial stage of the transition. Economic recovery, starting in most countries in 1993 and 1994, has led only to slight or temporary employment increases that could however not be sustained.

Recent developments show that despite the continuation of economic growth in 2001 there was little improvement on the labour market in most countries of the region. Employment continued to grow only in Hungary and Slovenia, in both countries for the third consecutive year and stagnated in the Czech Republic. Poland, being successful in creating new jobs in the mid-1990s, has been suffering from painful employment cuts since 1999. As for the Baltic states, hit hard by the Russian crisis, the employment decline slowed down in Estonia, while it accelerated in Lithuania and remained stationary in Latvia.

A comparison between employment and GDP growth shows that most countries achieved productivity gains over the last decade. Exceptions are Lithuania and Latvia, where the employment drop was at times much smaller than the fall in output, implying a considerable decline in productivity. Productivity gains were most pronounced in Poland, Hungary and Slovenia over that period.

Table 4

GDP and employment growth 1990-2001

cumulated growth in %

	GDP			Employment			Employment growth, 1000 persons		
	1990-92	1993-01	1990-01	1990-92	1993-01	1990-01	1989-92	1993-01	1989-01
Czech Republic	-13.2	18.9	3.2	-8.8	-5.1	-13.4	-475.9	-249.2	-725.1
Hungary	-17.6	31.3	8.1	-21.9	-5.5	-26.2	-1144.5	-223.2	-1367.7
Poland	-15.6	51.5	27.9	-13.7	2.9	-11.2	-2325.2	423.4	-1901.8
Slovak Republic	-22.1	34.1	4.4	-13.7	-1.8	-15.3	-344.0	-39.4	-383.3
Slovenia	-17.9	43.6	17.8	-17.1	-0.6	-17.7	-162.2	-5.0	-167.3
Bulgaria	-25.6	2.9	-23.4	-25.0	-10.2	-32.6	-1091.4	-333.4	-1424.7
Romania	-25.0	11.2	-16.6	-4.5	-19.7	-23.3	-487.7	-2061.0	-2548.7
Estonia	-31.9	26.6	-13.8	-8.6	-19.7	-26.6	-72.2	-151.0	-223.2
Latvia[1)]	-39.9	15.1	-30.9	-8.1	-19.9	-26.4	-114.5	-257.2	-371.7
Lithuania	-28.2	-2.7	-30.1	-2.5	-18.0	-20.0	-48.1	-333.4	-381.5

Note: 1) Employment data start from 1990.

Source: wiiw Database incorporating national statistics.

3.2 Employment patterns

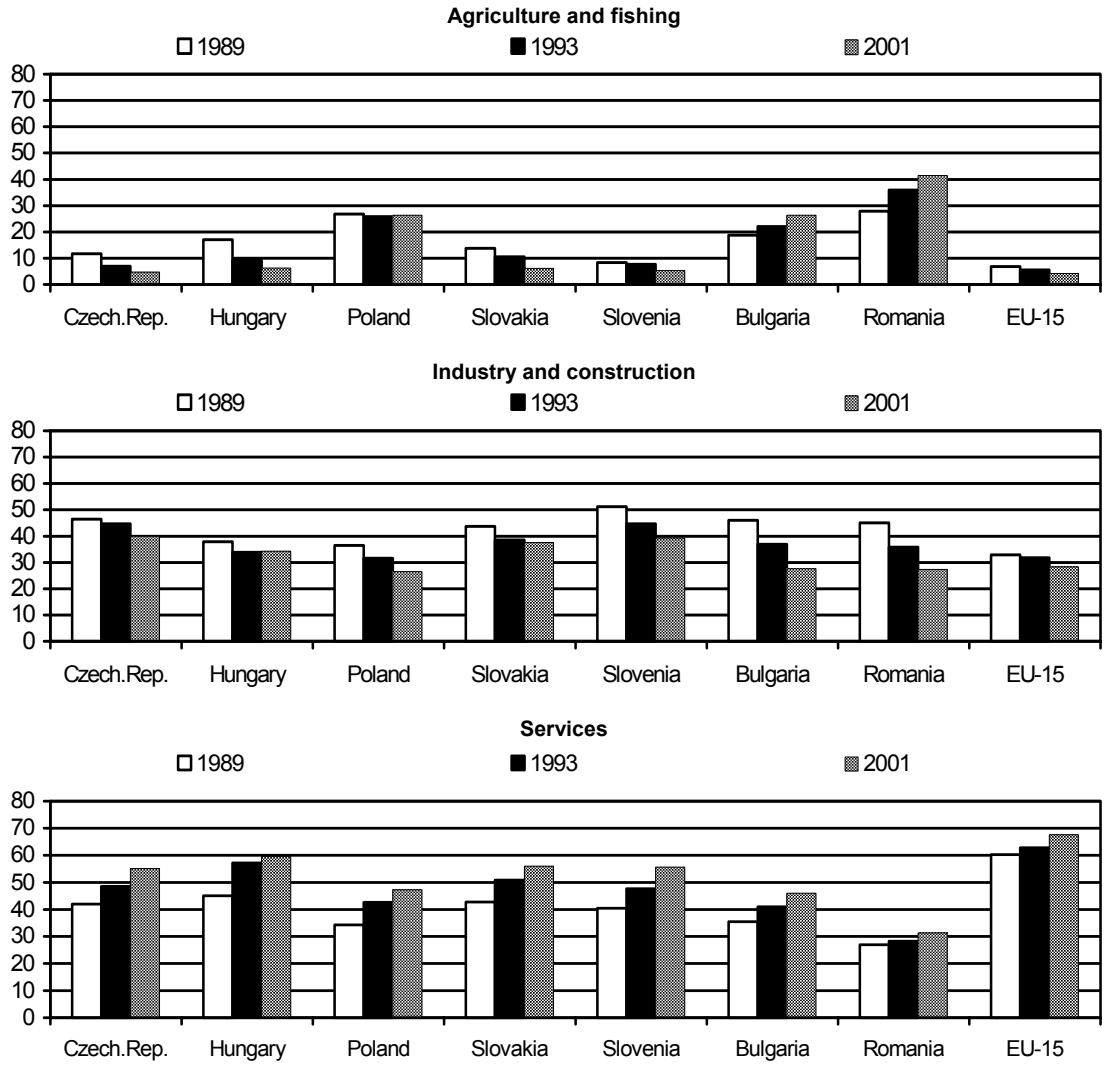
The past decade witnessed significant changes in the economic structure and consequently in the sectoral composition of GDP and employment. In most countries a reallocation of labour occurred, from agriculture and industry to the services sector (Figure 1). Opposing that trend, Romania is an extreme case where agricultural employment has been growing both in relative and absolute terms and the proportion of employed in agriculture accounts for 43% of the total. Similar trends were observed in Bulgaria and Lithuania, with the respective shares reaching 26% and 16% in 2001. These developments are partly caused by the emergence of numerous small private farm units after the ownership transformation of huge agricultural enterprises, but also due to economic hardship that has forced people to return to self-employed farming (Burda, 1996). Also in Poland the proportion of those employed in agriculture is still very high – though LFS data show a steady decline. In 2001 it was 19% down from 24% in 1994 (registration data put the share still at 26%). According to Polish estimates, hidden unemployment in the country's agricultural sector comprises about 1 million persons. Labour shedding in agriculture was highest in Estonia and Hungary, where the number of

employed in 2001 contracted to about one fifth and less than one third, respectively, of the 1989 level.

Figure 1

Employment structures of selected CEECs, 1989, 1993 and 2001

(share in % of total employment)



Source: LFS of the respective countries.

Employment in industry (including construction) has declined in all countries since 1989, reflecting the high over-employment prevailing under the previous system. Most affected were Bulgaria, Latvia and Romania, where in 2001 industrial employment was less than half of what is was in 1989; in Poland and Estonia employment was cut by between 36-39%, in Slovenia by one third and in Slovakia and in the Czech Republic by about one

quarter as compared to 1989.[2] But despite these huge employment losses the share of employed in that sector is still high compared to western countries: in Hungary and Estonia industrial employment accounts for about one third in the total; Slovenia and the Czech Republic – the most advanced countries under review in terms of GDP per capita – and Slovakia report still the highest share of employment in industry, reaching 37-40%. In Latvia, Lithuania, Poland and Romania the proportion is lowest, only about one quarter of employed work in industry.

In accordance with declining employment in the secondary sector (industry and construction) and, in a few countries, in the primary sector, the share of the services sector in total employment increased substantially in all Central and East European countries. In the more advanced transition countries, services sector employment has gained momentum from 1992 onwards, in Romania from 1994 and in Bulgaria from 1995. Estonia, Latvia and Hungary report the highest levels of services sector employment (close to 60%) and display a similar pattern as the southern EU countries. With the exception of Romania, services employment accounted for the largest share in total employment in 2001. The proportion of those employed in the services sector was about half of the total in Slovenia and less than one third in Romania. In the Czech Republic and Slovakia employment in services accounted for 56% of the total in 2001. Part of these rapid structural changes was of 'passive nature' (Dobrinsky, 2001), mostly reflecting a less pronounced decline in the services sector than in manufacturing and agriculture. It should also be noted that in the past, industry and to some extent agriculture masked a number of service-type jobs, such as transport and distribution, repairs and maintenance and the provision of food and other services to the workers. Thus, a significant portion of the employed registered in the services sector or of the drop in agriculture and industry might be the result of methodological changes in statistics rather than of new job creation (see also OECD, 1995, p. 21).

However, compared with the huge job losses in industry and agriculture, employment increases in absolute terms in the services sector were rather modest in most of the countries and far from sufficient to offset job losses in the other two sectors. In the whole region services jobs grew by an estimated 1.1 million during the period 1989 to 2001, while in agriculture and industry about 9.3 million jobs were lost. The most outstanding growth rate of services sector employment was reported for Slovenia, showing a 18% increase over the period 1994 to 2001, followed by Slovakia (13%) and Romania (10%). Looking at the increase in the absolute number of persons employed in the services sector, Poland is in the lead: in the period 1994 to 2001 about 900 thousand services

[2] The given figures may serve only as guideline indicators as caution is warranted in comparing pre-transition and post-transition employment figures due to considerable conceptual and measurement differences. Available statistics do not provide consistent time series covering the whole transition period e.g. for total employment, activity rates, but also for the sectoral composition of employment for most of the countries.

sector jobs were created. Next come Romania and the Czech Republic, reporting services jobs to have grown by 300 and 110 thousand persons over the same period[3]. Most of services employment has been created in trade, real estate renting and business activities, financial intermediation, but also in public administration. A more detailed picture on the services sector development in the CEEC-7 is given in the following section.[4]

On top of the sectoral changes, also the skill structure of employment has been undergoing substantial changes over the past decade. The emerging picture is rather uniform for all countries, showing that 'there were strong negative employment developments in the lowest skill categories while there were positive labour market pressures for the higher skill groupings' (for further details see Chapter 2 in this volume).

3.3 The services sector employment

There is extensive literature investigating the various aspects of structural changes in manufacturing in the CEECs in general and in individual countries in particular. However, given the growing importance that services play in the transition economies, developments in that sector have been treated only marginally in the analyses of the structural changes in the Central and East European countries. Rask and Rask (1994) were among the first who had emphasized the pivotal role of organizational services (identical with market services, but excluding tourism) in facilitating growth and development in transition countries. Similarly, Kostecki and Fehervary (1996) argue that producer services[5] are the motive power of restructuring transition economies and also remain critical determinants for the successful implementation of market-oriented reforms in the future (quoted in Stare, 2001). In order 'to develop an efficient and dynamic economy, transition countries have to upgrade their service sectors and improve the quality of services. For that purpose capital, know-how, special knowledge skills are necessary, which may be lacking in those countries but can be provided through FDI' (Stare and Vanyai, 1995, p. 349). Kigyóssi-Schmidt et al. (2002) pointed out that in the specific case of the Central and East European countries, business services are an important vehicle for establishing linkages between macroeconomic stabilization, real structural adjustment and institution building. The services sector development is, however, dependent on overall economic growth as the demand for services tends to increase along with income. More prosperous countries have a larger services sector, a denser infrastructure and a more developed financial system than poorer ones (Gros and Suhrcke, 2000).

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[3] Data for the Czech Republic refer to the 1993-2000 period.

[4] CEEC-7 comprises the Czech Republic, Hungary, Poland, Slovakia, Slovenia, Bulgaria and Romania.

[5] Producer services: telecommunications, financial services and a variety of business services (Stare, 2001).

Growth of the services sector in the transition economies is largely driven by market-oriented reforms and the adjustment of industrial production to technological transformation (Stare and Zupancic, 2000, Stare 2001):

(1) In order to manage the adjustment of industrial production to business cycles, to technological changes and to widening competition, enterprises increased their demand for specific services (research and development, marketing, information-related services).

(2) Private sector firms established in the wake of market-oriented reforms are in need of supporting services such as consulting, bookkeeping, accountancy etc. In addition new services supporting the privatization process as a whole (asset valuation, auditing) were created.

(3) The dissolution of large industrial conglomerates into smaller enterprises has required companies to focus on core capabilities, which consequently led to an outsourcing of services (functions) that had previously been performed internally (contributing to the statistical growth of services). Modernizing the production process and the introduction of information-communication technologies required sophisticated services and intensified the linkages between industry and the services sector.

(4) An additional explanation for the accelerating tertiarization process in the transition countries is the growing consumer demand for services unfulfilled or only insufficiently provided under the previous system. In 2001, three quarters of all firms in the seven CEECs were active in the services sector (Gács, 2001).

For a more detailed analysis, we compare the employment structure of the sub-sectors and their respective segments in the CEECs and in selected EU countries (EU-15 and EU-South), and examine the importance of individual segments of the services sector.

The structural shift towards a service economy is evident when looking at the growth segments of employment in the transition countries. They are all in the services sector, especially within market services (Figure 2)[6]. Industry, in contrast, has been a declining sector, except in Hungary – agricultural employment grew only in Romania. Data for the year 2001 indicate that in all CEECs the contribution of the market services sector to total employment was by far higher than that of the community services sector – comprising public administration, education, health and social work and other community services. In Hungary and the Czech Republic the market services sector absorbed about one third of the total, in Slovenia and Slovakia about 30%. The values obtained for Poland and

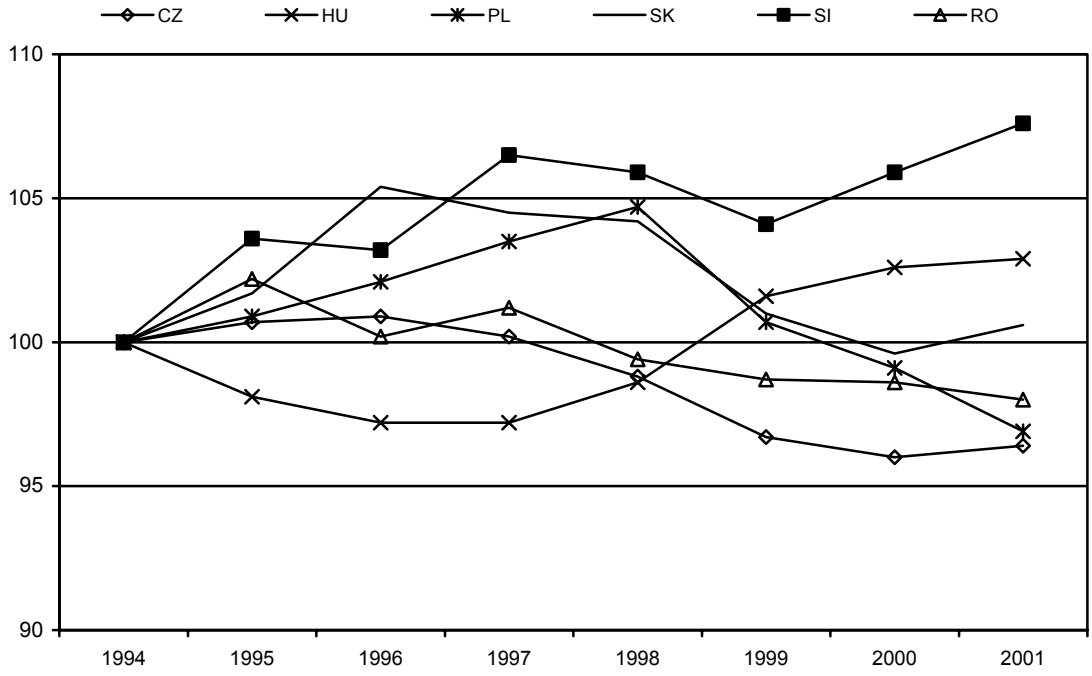
[6] The increasing importance of the services sector in contributing to the CEECs' GDP has been proved also by Gács (2001). Accordingly in 1988 all candidate countries were located far below the main trend of development (in a comparison of 124 countries) while in 1999 already six out of ten candidate countries were above the normal level of services intensity and all candidate countries had joined the mainstream.

Bulgaria were slightly below that mark, while market services in Romania accounted for only 17% of total employment. Measured in absolute terms, in the period 1994 to 2001, jobs were created most of all in the market services sector, while at the same time employment in the community services sector grew less dynamically or even declined (Hungary, Poland).

In the year 2001 all CEE countries had a lower employment level in the market services segment than either EU group; the countries coming closest to the EU-South values are Hungary, the Czech Republic, Slovakia and Slovenia – but still they lag behind considerably. As for community services, the CEECs employed fewer people than the current EU member states, while the deviation was less pronounced compared with EU-South, with Hungary's and Slovenia's structure falling somewhere in between. The Czech Republic and Slovakia show a very similar pattern compared with EU-South, while the strongest deviation was shown by Romania.

Figure 2

Overall employment trends, 1994-2001 (1994 = 100)

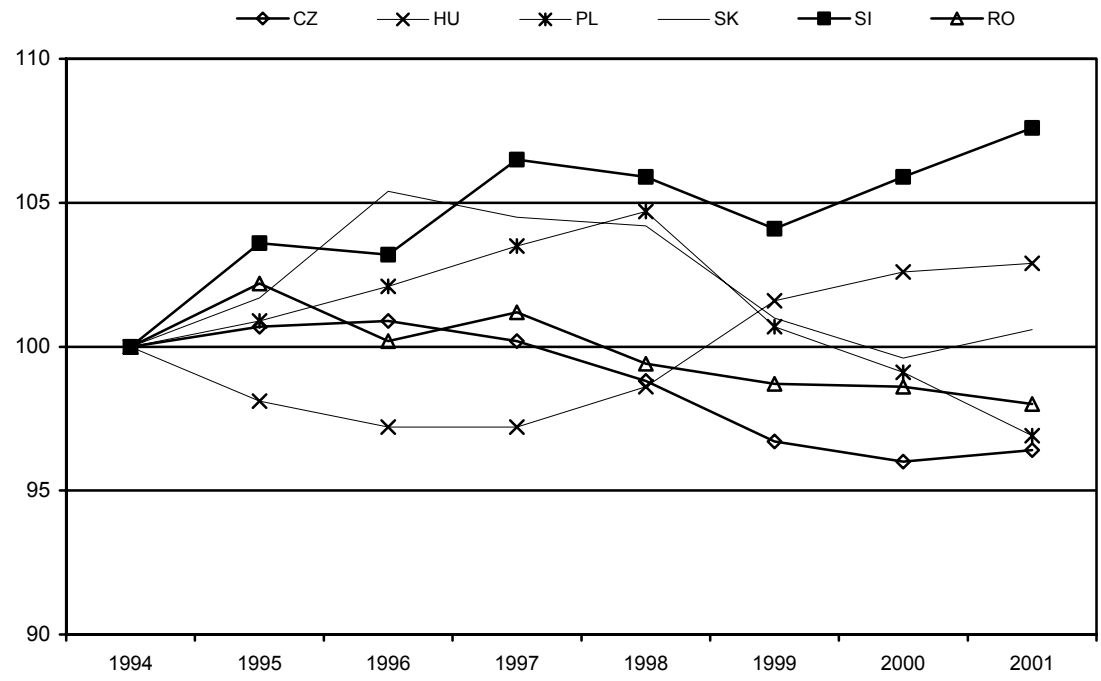


Source: LFS of the respective countries.

Figure 3

Employment trends in the market service sector in selected CEECs 1994-2001

(1994 = 100)



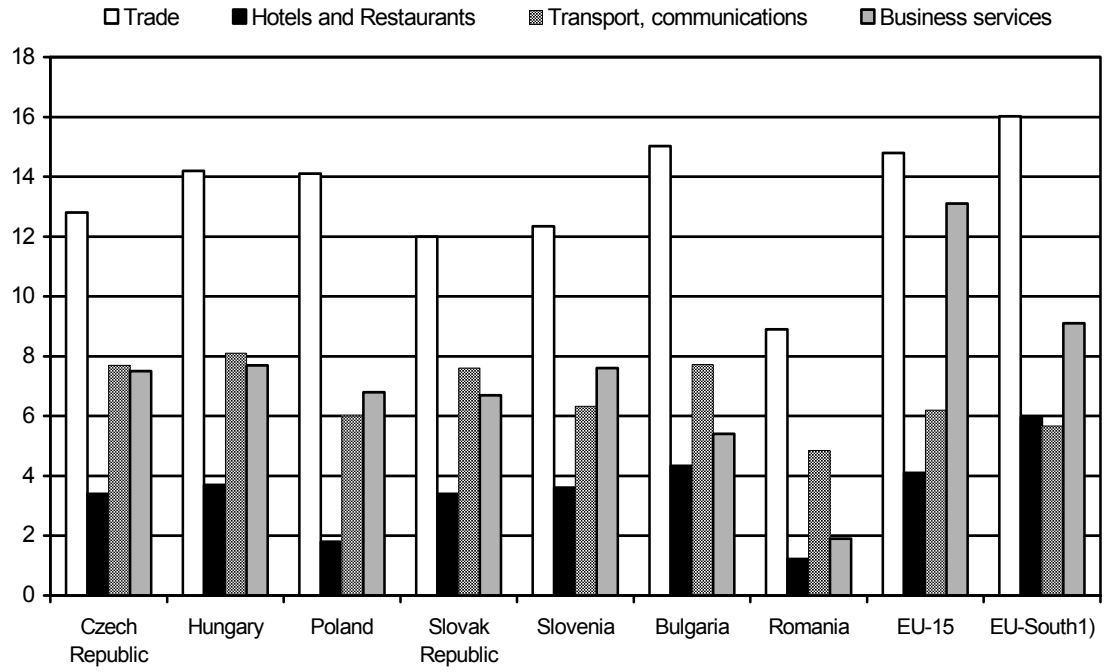
Source: LFS of the respective countries.

Market services

It was primarily the market services sector showing remarkable employment growth in the 1994 to 2001 period, of which most strongly in Poland and Slovenia. Within this sub-sector, *trade* is the dominant segment, absorbing 14% of total employment in Bulgaria, Hungary and Poland, which is similar to EU-15, but lower in all other CEECs - most remarkably again in Romania (Figure 4). The share of retail/wholesale trade tended to grow in Bulgaria, Hungary and in Slovakia and remained almost stagnant elsewhere. However, in the period 1994 to 2001 trade was only in Romania the most expanding segment measured in relative terms.

Figure 4

CEECs' market services sector employment compared with EU-15 and EU-South, 2001



Note: 1) EU-South: Greece, Portugal, Spain.

Source: LFS of the respective countries.

Though experiencing remarkable employment cuts in most countries (except in Slovenia and Poland) over the last decade, the *transport and telecom* segment has maintained its important position as an employer in the transition economies. Considering that the transport sector had to undergo remarkable changes in the transport sector during the transition period, while the telecom segment has developed favourably in most countries, it might be assumed that the major job losses occurred in the former rather than in the latter sector; at least in the case of Hungary this is an established fact. The employment structures in Slovenia and Poland are much the same as in the EU-15, exceeding both the EU average and the southern European level in the Czech Republic, Slovakia and in Hungary and is lowest in Romania.

The largest gap between the CEECs and both the EU average and the southern EU countries could be observed in the business services segment (finance, insurance, real estate and other business related services). Measured as a proportion of total employment *finance and insurance* ranks at the bottom in all countries (except Poland) with an average share of 1.8% in total employment, but was the fastest growing employment segment in the Czech Republic, Slovakia and Romania. The financial services sector remains underdeveloped in Bulgaria and Romania, absorbing about 1.2% and 0.7%, respectively, of the total. Compared to the EU-15, where financial sector employment reaches some 3.5% of the total, there is still some room for new job creation

in the CEECs. Over the last decade the transition countries' financial sector has undergone dramatic changes, from state monopolies to a two-tier banking system, and a large number of private banks were established. In all countries except Slovenia the privatization process of the banking sector has been completed, mostly through foreign direct investment. The insurance industry (part of the financial intermediation segment) increased at relatively high rates, but the market is still very small and underdeveloped as it started its development from very low levels. In 1999, in the transition countries as a whole the 'average insurance penetration', measured by total insurance premiums as a percentage of GDP, was estimated at 1.7% for non-life and 0.7% for life insurance. In Western Europe these ratios amounted to 3% and 5% respectively (UNECE, 2001). Consequently this segment might be one of the main sources of future employment growth in the services sector.

In Hungary, Poland, Slovenia and Bulgaria new jobs were created primarily in the *real estate, renting, and business activities* segment over the period 1994 to 2001. The proportion of the latter in total employment has been growing in all countries except Romania. Together with the Czech Republic and Hungary, Slovenia exhibits the highest proportion of employed in that segment (this trend is also mirrored by soaring FDI).

Employment in *tourism* grew most significantly in Poland, with the number of employed up by 55% in 2001 compared with 1994, which is also confirmed by a significant increase in the value added over that period. A strong employment growth is also reported for Slovakia and Hungary, up by 32% and 29%. Over the same period about 10% of jobs in tourism were lost in Romania, which recorded also the lowest proportion of employed in that segment. Slovenia's proportion of those employed in tourism is higher than in the EU-15, Hungary's similar, while all other countries employ less than the EU average and much less than the southern EU countries (being traditional tourist destinations).

Community (non-market) services

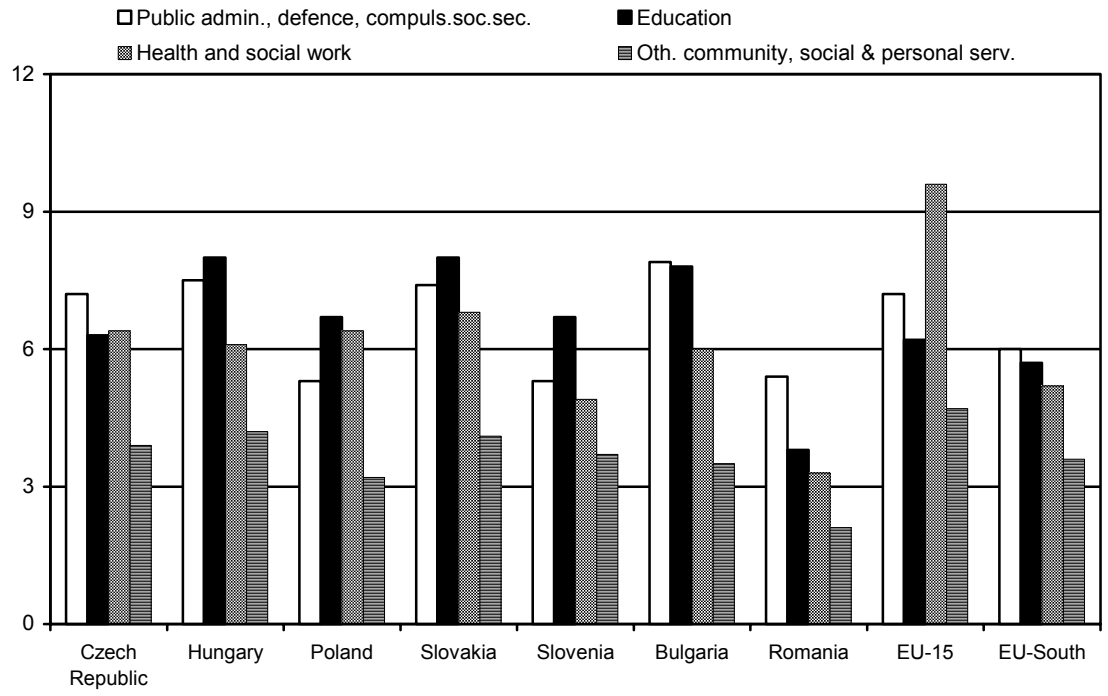
Measured in absolute terms employment in the community services sector has been on the increase in all countries in the 1994-2001 period, of which most significantly in Poland and Slovenia – this is also reflected in strong value added growth. The proportion of employed in that sub-sector increased in the majority of CEECs and fell in Hungary and Poland. In 2001, its share in total employment ranged between 15% in Romania and roughly 26% in Hungary and Slovakia.

Education is the main employer in this sector in most CEECs, except in the Czech Republic and Romania where public administration ranks first. However, looking at the period 1994 to 2001, the number of employed in education contracted in all countries but Slovenia. Falls were most pronounced in Bulgaria and Romania, where the number of employed in 2001 was 20% lower than in 1994. In Hungary and in Slovakia employment

in education fell by 9% and 6% respectively. From a comparative perspective it is interesting to note, that most CEE countries employ more people in education than both the EU on average and the southern EU countries, the Czech Republic resembles the EU-15 pattern and Romania is again on the lower end of the scale (Figure 5).

Figure 5

CEECs' community services sector employment compared with EU-15 and EU-South, 2001



Note: EU-South: Greece, Portugal, Spain.

Source: LFS of the respective countries.

At the same time employment in *public administration* has been growing rapidly across all countries but Hungary. Employment in that segment grew most strongly in Slovenia and Bulgaria, where in 2001 it was about one third higher than in 1994 and 1996 respectively; in Slovakia and Romania it increased by 29% and by one quarter respectively.[7] Only in the Czech Republic was job creation in administration rather modest, up by about 6% over the whole period. Bulgaria, Hungary, the Czech Republic and Slovakia have been exhibiting the highest level of employed in administration, absorbing 7-8% of the total workforce, while in the remaining countries this share

[7] Apart from the creation of an independent state, which necessitated the building-up of an adequate administration, employment in that sector has e.g. in Slovenia been attracted by wages higher than in the private sector (OECD, 1997); job security was/is another important factor for taking a job in public administration (the latter is of course not only specific for Slovenia and is also true for other countries under consideration).

accounts for slightly over 5%.[8] Employment levels in public administration are similar to the EU average values in the former countries, while they are still below EU-South levels in Poland, Slovenia and Romania.

Employment in *health and social work* fell in four out of seven countries between 1994 and 2001, of which most strongly in Slovenia; this trend is also reflected in the lowest proportion of employed in that segment (5% of the total).[9] Jobs in health care grew quite remarkably in the Czech Republic and somewhat in Slovakia and remained stagnant in Poland and Romania. Except in Slovenia and Romania all CEECs employ a higher proportion in health and social work than the southern EU countries, but there is still a enormous gap compared with EU-15.

If measured as a proportion of the GDP, non-market services had and still have a relatively high level in the transition countries comparable to that in the EU, implying that the CEE countries are lagging behind the EU in the market services segment rather than in community services.[10]

3.4 Unemployment

Unemployment, while believed to be of a temporary nature only at the beginning of transition, has become a long-lasting phenomenon. In all countries but the Czech Republic (at least until the mid-1990s), the number of registered unemployed was increasing rapidly over the last decade (Table 5). The year 1993 witnessed a record level, followed by a slowdown until 1997, caused mostly by the exit from the labour market of a huge number of persons rather than by new job creation. In 1998 unemployment started to accelerate again in all countries, except in Hungary and Slovenia.

By 2001 the LFS unemployment rate reached the highest level since the beginning of transition in Bulgaria, Slovakia, Lithuania, and Poland and decreased somewhat elsewhere. Unemployment rates ranged between 5.7% in Hungary and over 19% in both Bulgaria and Slovakia. In Poland, where unemployment was falling in the mid-1990s, the number of jobless has been rising again from 1998 onwards. On top of the slowing down of the GDP growth the sharp increase of jobless is due to several factors (UNECE, 2001): (1) mass layoffs in coal mining and in the steel and textile industries, (2) the expiration of

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[8] In Germany public administration absorbs 8.7% of total employment, in Italy 9.3%, in the Netherlands 7.1% and in the UK 6%.

[9] The strong decline in Slovenia's health sector employment can hardly be explained. Figures based on registration data indicate a job increase of more than 20% over that period.

[10] The high level of non-market services in the transition countries is to be associated with the priorities of the former system regarding health and education. Thus in the past the CEECs had achieved a relatively higher rank in the human development indicators than in other economic indicators (see also Gács, 2001).

employment guarantees in privatized firms, and (3) the baby boom generation entering the labour market. Results obtained from registration data reveal a different picture: according to that measure Hungary, Slovenia, Bulgaria and Romania report declining unemployment rates, while in the Czech Republic and Latvia unemployment rates remained almost stagnant and continued to increase in Lithuania, Poland and Slovakia.

Table 5

Unemployment rates based on registration data

in %, end of period

	1995	1996	1997	1998	1999	2000	2001
Czech Republic	2.9	3.5	5.2	7.5	9.4	8.8	8.9
Hungary	11.7	11.4	11.0	9.6	9.6	8.9	.
Poland	14.9	13.2	10.3	10.4	13.0	15.0	17.5
Slovak Republic	13.1	12.8	12.5	15.6	19.2	17.9	18.6
Slovenia	14.5	14.4	14.8	14.6	13.0	12.0	11.8
Bulgaria	11.1	12.5	13.7	12.2	16.0	17.9	17.3
Romania	9.5	6.6	8.9	10.4	11.8	10.5	8.6
Estonia	4.7	5.2	4.3	4.9	5.2	5.9	6.1
Latvia	6.6	7.2	7.0	9.2	9.1	7.8	7.7
Lithuania	6.1	7.1	5.9	6.4	8.4	11.5	12.5

Source: wiiw Database incorporating national statistics.

Although there are substantial inter-country differences, several common features of unemployment can be identified: (1) unemployment varies significantly across regions, while at the same time there is low mobility of labour; (2) the proportion of long-term unemployed is steadily on the increase; (3) in most countries women are more affected by unemployment than men; (4) youth unemployment has been increasing rapidly; (5) the lowest skill and educational groups are over-proportionately affected; and (6) unemployment levels among ethnic minorities and other socially disadvantaged groups are many times higher than the average rate (see also Vidovic, 2000).

Regional differences in unemployment

Similar as in western countries, there are large regional disparities on the CEECs' labour markets. Imbalances are to a high degree attributable to the regional industrial structures prevailing under the previous system. For instance mono-structured regions – esp. regions concentrating on armament, mining, steel and textile industries in the past – are more affected by unemployment than others; often the entire social and economic infrastructure had been focusing on a single industry. In general, unemployment in the CEECs tends to be lowest in: (1) big cities with a developed services sector, (2) regions with a diversified industrial structure, (3) regions offering good opportunities for tourism and leisure, and (4)

areas bordering on more developed countries, where people can commute for work (Keune, 1998). In most countries under review there is a low incidence of unemployment in the capital cities, which is also true in respect of youth and female unemployment. As far as border areas are concerned, unemployment rates recorded for the Hungarian and Slovak regions bordering Austria and the Slovenian regions bordering Italy are lowest or among the lowest rates of the respective country. In contrast, Polish regions adjacent to the German border display higher unemployment rates than average (Behrens 2001). Similar as in the European Union the internal mobility of labour is low in the CEECs; it is aggravated by the lack of housing and/or high rents, high transport costs and the cutting of pubic transport services (Köllö, 1999).

In *Poland* the regions most heavily affected by unemployment are in the north and west, where there was a large decline in industry, but also due to the splitting up of large state-owned farms. The lowest rates are reported for the south and parts of the east, which are still dominated by agricultural employment. In the *Czech Republic* labour market differences at the regional level are less pronounced than in the other CEECs. However, larger regional disparities can be observed if regional unemployment rates are observed at the level of districts. The highest jobless rates are reported for northern Bohemia and northern Moravia, which are characterized by heavy industry, coal mining and steel industry. In southern Moravia labour market problems are caused mainly by the agricultural heritage. Regional unemployment in *Hungary* is lowest in the western most advanced counties (apart from Budapest) bordering Austria and highest in northern Hungary and the northern Great Plain. *Slovakia* displays the widest gaps of regional unemployment rates among all candidate countries. There is a large mismatch between the density of economic activities and the concentration of the unemployed with a booming Bratislava region - over 60% of all foreign direct investment are concentrated in the Bratislava agglomeration - and persistently high unemployment rates in the eastern and southern regions of the country. The latter are still suffering from huge layoffs in the armament industries and the impact of agricultural reforms (OECD 1999). In contrast, *Romania* shows the smallest variations of regional unemployment from 3.4% in the Bucharest region to 7.3% in the South East region. In *Bulgaria*, the regions Montana, Plovdiv and Russe report higher unemployment than most others, which is closely related to the respective employment structure (Montana has a high share of agricultural employment, while in Plovdiv and Russe there is a high share of industrial employment in declining sectors of heavy industries). In *Slovenia* the northern part of the country – the regions of Podravska, Pomurska and Zasavska – are affected most by unemployment. Based on data obtained from the labour force surveys, regional disparities in unemployment occur mainly between rural and urban areas. Regions reporting high unemployment are in south-eastern Estonia, eastern and south-eastern Latvia and some southern areas of Lithuania.

In general, regional labour market imbalances have been deteriorating over the past decade in most countries and it seems that this trend will continue – unless the strong regional disparities are mitigated by EU Structural Funds.

Long-term unemployment

Long-term unemployment, a stubborn problem also in the European Union (46% of total unemployed), has become a major feature of unemployment in the CEECs, though available data show an uneven picture (Table 6).

Table 6

Long-term unemployment in the CEECs, LFS

more than 12 months, in % of total unemployed

	1996	1997	1998	1999	2000	2001
Czech Republic	28.2	28.1	29.5	36.0	48.3	57.1
Hungary	48.3	43.8	41.6	44.6	44.0	41.8
Poland	39.1	37.9	37.5	32.9	37.9	43.1
Slovakia	51.6	50.3	50.7	46.9	53.9	57.9
Slovenia[1)]	52.2	56.7	57.7	57.7	62.4	63.5
Bulgaria[1)]	.	60.4	59.1	56.8	58.2	62.5
Romania[1)]	51.3	47.7	41.9	44.3	51.5	49.5
Estonia	55.3	45.8	47.0	45.8	44.4	46.3
Latvia[1)]	.	47.1	33.6	.	56.0	52.0
Lithuania [1)]	.	68.5	55.0	39.1	52.2	59.0

Note: 1) More than 11 months.

Source: Eurostat, national LFS of the respective countries.

The highest values are reported for Bulgaria and Slovenia, where more than 60% of total unemployment was long-term in 2001, followed by Lithuania, Slovakia and the Czech Republic (57-59%); in the latter this share has been growing most rapidly over recent years. In Romania and Latvia long-term unemployment ranges from 49-52% of the total. On the other hand, the incidence of long-term unemployment is less severe in Hungary and Poland. In contrast to the European Union where long-term unemployment tends to be proportionately higher in high unemployment countries (European Commission 1999b), this phenomenon is distributed unevenly in the CEECs.

Unemployment by gender

The decline in employment has disproportionately hit women: for example in Hungary female employment fell by 40% over the 1985-1997 period, while about 30% of male jobs got lost, the respective figures in Estonia were 31% and 11%, and even the smallest cut in female employment recorded for the Czech Republic was ten times higher than for males (ECE 1999). The strong employment drop is not necessarily reflected in the unemployment figures as many female employed decided to leave the labour force altogether. Thus, the unemployment rates of women are not much higher than that of men, in some countries even lower. Across the region the spread of female unemployment rates is ranging from about 5% in Hungary to almost 18-20% in Poland, Slovakia and Bulgaria (Table 7).

Table 7

Unemployment rates by gender, LFS

in %

	1996	1997	1998	1999	2000	2001
Czech Republic						
Total	3.9	4.8	6.5	8.7	8.8	8.1
Male	3.3	3.9	5.0	7.3	7.3	6.8
Female	4.7	5.9	8.2	10.5	10.6	9.9
Hungary						
Total	9.9	8.7	7.8	7.0	6.4	5.7
Male	10.7	9.5	8.5	7.5	7.0	6.3
Female	8.8	7.8	7.0	6.3	5.6	5.0
Poland						
Total	12.3	11.2	10.6	13.9	16.1	18.2
Male	11.0	9.3	9.1	12.4	14.4	16.9
Female	13.9	13.2	12.3	15.8	18.1	19.8
Slovakia						
Total	11.3	11.8	12.5	16.2	18.6	19.2
Male	10.2	11.0	11.9	16.1	18.7	19.5
Female	12.7	12.9	13.2	16.4	18.5	18.8
Slovenia						
Total	7.3	7.4	7.9	7.6	7.0	6.4
Male	7.5	7.1	7.7	7.3	6.8	5.9
Female	7.0	7.6	8.0	7.9	7.3	7.0
Bulgaria						
Total	14.1	14.4	14.1	15.7	16.9	19.7
Male	14.2	14.3	14.3	15.8	17.1	20.5
Female	14.1	14.4	13.8	15.5	16.6	18.8

(Table 7 continued)

Table 7 (continued)

	1996	1997	1998	1999	2000	2001
Romania						
Total	6.8	6.0	6.4	6.9	7.1	6.6
Male	6.3	5.7	6.5	7.4	7.7	7.1
Female	7.4	6.4	6.1	6.2	6.4	5.9
Estonia						
Total	10.0	9.7	9.9	12.3	13.7	12.6
Male	10.7	10.1	10.8	13.6	14.6	12.9
Female	9.2	9.2	8.9	11.0	12.7	12.2
Latvia						
Total	20.3	15.2	14.2	14.2	14.5	13.0
Male	20.7	15.3	14.5	14.9	15.4	14.4
Female	19.8	15.0	13.9	13.5	13.5	11.7
Lithuania						
Total	16.4	14.1	13.3	14.1	15.4	17.0
Male	.	14.2	14.3	15.6	17.3	19.7
Female	.	13.9	12.2	12.6	13.3	14.2

Source: National LFS of respective country.

All but three countries – the Czech Republic, Poland and Slovenia - report lower unemployment rates for women than for men and a lower-than-average rate. In the case of Hungary this development can be explained by the drastic cut of female employment over the transition period, which was higher than in any other country. Poland and the Czech Republic report female unemployment rates that are 3 percentage points higher and Lithuania that are 5.5 percentage points lower than the male rates.

Youth unemployment

The incidence of unemployment is high for young people and those with a low level of education. The sharp employment decline over the transition period has made entering the very tight labour market extremely difficult for young people. In addition demographic developments have contributed to an aggravation of the situation, as the number of young entrants (esp. in Poland) has been steadily on the increase. In most countries of the region the LFS unemployment rate among people younger than 25 years is twice as high as the total unemployment rate (similar as in the EU), in Romania it is even three times higher (Table 8). The high rates varying between 37% and 41% in Slovakia, Bulgaria and Poland, and 30% in Lithuania indicate a quite critical situation of young people on the labour market of the respective countries. The lowest values can be found in Hungary (11%), in the Czech Republic, Romania and in Slovenia (about 17-18%).

Table 8

Youth[1)] unemployment rates in the CEECs, LFS

in %

	1996	1997	1998	1999	2000	2001
Czech Republic	7.2	8.6	12.4	17.0	17.0	16.6
Hungary	18.0	15.9	13.5	12.4	12.1	10.8
Poland	28.5	24.8	23.2	31.3	35.1	41.0
Slovakia	20.9	21.7	23.6	32.1	35.2	37.3
Slovenia	18.8	17.6	18.5	17.9	16.9	18.1
Bulgaria	33.5	34.8	32.2	34.0	35.3	39.5
Romania	20.2	18.0	18.4	18.9	18.7	17.5
Estonia	16.0	14.4	15.7	19.8	23.9	22.2
Latvia	29.0	24.9	27.8	23.9	22.8	22.1
Lithuania	27.4	25.2	22.2	26.5	28.9	30.2
EU-15	20.8	20.1	18.6	17.0	15.5	14.9

Note: 1) 15 to 24 years.

Source: Eurostat, Statistical Yearbook on candidate and South-East European countries, Employment in Europe 2002; CANSTAT 2002/1, national LFS statistics.

The youth unemployment rate varies also significantly across EU members: it is particularly high in Greece and Italy, where more than 30% of young people of the labour force are unemployed (European Commission 2002).

4 Conclusions

The results obtained are mixed: even in the five economically most advanced transition countries labour market developments are far from being uniform, they rather reflect the diversity of the respective macroeconomic situation. Only Hungary and Slovenia have succeeded in increasing employment and combating unemployment, and these trends are likely to continue.

In general, huge job losses in industry and agriculture have been offset only to a certain extent by new jobs in the tertiary sector; the latter is still underdeveloped by western standards in most countries. Despite the progress achieved in the services sector development in the last decade, its level is lagging behind that of the European Union. The main shortcomings consist in the lower efficiency and quality of services in the transition countries, their poor competitiveness on the world market, and the dominance of traditional services segments (transport, distribution, hotels and restaurants) over higher value-added services segments (Stare and Zupancic, 2000), which represents also an important obstacle to the trade in services.

Job creation in the private sector is still too weak to contribute to a noteworthy improvement on the labour market. More than eight million jobs got lost over the last decade resulting in a decline of activity rates all over the region. A huge number of people, primarily women, exited from the labour market. The high proportion of long-term unemployed indicates that many of them will leave the labour force, implying a further decline of activity rates, but more so an increase in poverty. In order to overcome all these deficiencies, a lot will depend on the general macroeconomic situation in the individual countries but also on the priorities of economic and social policies.

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Gábor Hunya *Chapter 4*

Structural development of manufacturing FDI in the more advanced CEECs

Abstract

This chapter discusses the basic features of foreign-domestic gaps in the performance of manufacturing industries in the second half of the 1990s. Looking at the main indicators, foreign penetration was high in Hungary already in 1996 and increased only marginally thereafter. In more recent years, fast increases of foreign shares were recorded in the Czech Republic and in Poland. In Estonia and in Slovenia foreign penetration increased more slowly. Technologically more advanced sectors, such as electrical and optical equipment and the car industry, have been the main focus of manufacturing FDI. The countries bordering the European Union are becoming important producers in these industries with products mainly exported to the EU.

Introduction

The 'Luxembourg-group' countries that started EU-accession negotiations ahead of others: Estonia, the Czech Republic, Hungary, Poland and Slovenia (CEEC-5), are the most advanced among the economies in transition in terms of per capita gross domestic product (GDP), FDI penetration and economic transformation. In the second half of the 1990s they enjoyed association agreements with the EU and together with other three CEECs they are to join the Union in 2004. The five countries had better economic growth performances than other economies in transition during the second half of the 1990s, but only Slovenia and Poland had stable economic growth rates over that period. Other countries underwent a second transition related recession, Hungary in 1995-1996, the Czech Republic in 1997-1999, Estonia in 1999. Similar difficulties became obvious in Poland in the early 2000s. (See for details of economic development: Havlik et al., 2003).

The relationship between FDI and economic growth varied country by country in the second half of the 1990s. In Hungary, growth can be attributed primarily to the success of export-oriented FDI projects. In Slovenia, growth is related to a high degree of integration into European company networks, mostly not through FDI, but trade. The growth in Poland was mainly domestic demand-led, generating increasing imports but less exports, the trade gap being financed by both FDI and loans. The Czech Republic is emerging from the second transition-related recession to a large extent due to its improved attractiveness to FDI. Estonia with its highly open economy attracted relatively high amounts of FDI but

mainly outside the manufacturing sector. Further economic growth in all these countries would require continuing technology transfer financed by FDI.

Main characteristics of FDI inflows

The CEEC-5 have been net direct capital importers like other medium-income developing countries. They have been the most important FDI targets among all economies in transition.

FDI inflows to CEEC-5 were USD 11 billion in 1995 but then declined to 8-9 billion in the following two years. They climbed again to USD 13 billion in 1998, a substantial USD 4 billion increase over the previous two years. They increased further to USD 16 billion in 1999 and 2000. Recently high inflows took place to the Czech Republic and Poland. Per capita FDI inflows and inflows per gross fixed capital formation in most of these countries are similar to those for large FDI recipient emerging markets in Latin America and South-East Asia. FDI stocks are in the range of 30-40% of GDP in Hungary, Estonia and the Czech Republic, shares that are high by international standards.

Table 1

FDI flows into CEEC-5, 1995-2001

(As recorded in the balance of payments, millions of dollars and percentage)

Country	1995	1996	1997	1998	1999	2000	2001	2000 inflow per gross fixed capital formation (%)	1999 inflow per capita (USD)
Czech R.	2 562	1 428	1 300	3 720	6 324	4986	4916	34.3	485
Estonia	202	151	267	581	305	387	542	32.9	283
Hungary	4 453	2 275	2 173	2 036	1 970	1649	2443	14.6	161
Poland	3 659	4 498	4 908	6 365	7 270	9 342	5713	23.8	242
Slovenia	177	194	375	248	181	176	503	3.6	68
Total	11 053	8 253	9 023	12950	16 050	16640	14117		

Notes: Estonia: Equity capital cash + reinvested earnings + loans.
Czech Republic: Equity capital cash + in kind + reinvested earnings from 1998.
Hungary: Equity capital cash + loans from 1996.
Poland : Equity capital cash + in kind + reinvested earnings + loans - on a transaction basis.
Slovenia: Equity capital cash + in kind from 1997.

Source: National banks of respective countries; wiiw Database.

In the first half of the 1990s, Hungary was the most important FDI recipient, the outcome of early liberalization and privatization-induced FDI. Some utility companies were privatized in 1995 which caused a onetime jump in FDI. In recent years, more and more FDI has gone into countries that began to involve foreign investors in privatization at a later stage, like the Czech Republic and Poland. Just as in Hungary in 1995, telecoms and utilities as well as banks have been the main targets of FDI. Recently Hungary came only third as an FDI

target, with most FDI entering through greenfield investment and the expansion of existing projects. The FDI environment in Slovenia did not changed for the better, despite a government programme to attract FDI.[11] Greenfield projects have located mainly in Hungary, Poland and the Czech Republic, close to EU borders. These countries can be considered as competitive European production sites and there is increasing competition among them for new projects, especially in high-technology industries.

Table 2

FDI stocks in CEEC-5, 1995-2001 (year-end)

(As recorded in the balance of payments, millions of dollars and percentage)

Country	1995	1996	1997	1998	1999	2000	2001	2000 stock/GDP (%)	2000 stock per capita (USD)
Czech R.	7 350	8 572	9 234	14 375	17 552	21644	26767	42.2	2108
Estonia	737	838	1 148	1 822	2 467	2 645	3160	51.5	1935
Hungary	11 926	14 958	16 086	18 517	19 804	19804	23562	42.5	1942
Poland	7 843	11 463	14 587	22 479	26 475	34227	41031	21.7	870
Slovenia	1 759	2 069	2 297	2 907	2 684	2893	3209	15.5	1411

Notes: Estonia: Equity capital + reinvested earnings + loans.
Czech Republic: Equity capital cash + in kind + reinvested earnings from 1997 + loans from 1997; excluding privatization revenues.
Hungary: Equity capital cash + loans from 1996.
Poland: Equity capital cash + in kind + reinvested earnings + loans - on a transaction basis.
Slovenia: Equity capital + reinvested earnings + loans.

Sources: National banks of respective countries; WIIW database.

Characteristics of FDI penetration in the manufacturing sector of the CEEC-5

Manufacturing is the most important target of foreign investors, except in the case of Estonia where it accounts for only one third of the country's FDI stocks (Table 5). In Poland and Slovenia, manufacturing attracted 45-50% of the invested capital. The Czech Republic also belonged to the latter group until 1998; more recently, telecommunication and other service investments lowered the share of manufacturing to below 40%. Hungary stands out with high FDI in electricity and gas distribution, as well as in real estate and business services; thus the share of manufacturing has been below 40%. The more even spread of FDI in Hungary is mainly due to early moves in privatization. In the case of Estonia, the low share of manufacturing FDI reflects both the weakness of this sector and the strength of the country as a regional transport and financial centre.

[11] The low level of FDI inflows into Slovenia was partly due to the fact that the data include only equity investments, while higher volumes come in the form of reinvested profits and loans. When privatization was stepped up in 2001, FDI inflows surged.

Table 3

FDI stock, by economic activity (NACE-1 digit), year-end of 2000

(Percentage)

NACE Code		Czech R.	Hungary	Poland[1)]	Slovenia
A,B	Agriculture, forestry, fishing	0.2	1.1	0.1	0.02
C	Mining and quarrying	1.9	0.4	0.2	0
D	Manufacturing	38.1	36.8	41.2	40.7
E	Electricity, gas, water supply	6.6	9.4	2.8	0.6
F	Construction	1.5	1.2	5.2	0.2
G	Trade, repair of motor vehicles, etc.	15.0	12.4	11.4	14.0
H	Hotels and restaurants	0.3	1.8	1.2	0.6
I	Transport, storage, communications	11.2	7.7	10.7	1.6
J	Financial intermediation	14.7	11.3	23.1	25.8
K	Real estate, renting & business act.	9.2	15.7	1.2	13.3
L	Public administr., defence, social sec.	.	.	.	.
M	Education	0.0	0.0	.	0.0
N	Health and social work	0.1	0.1	.	0.0
O	Other community, social & pers. activ.	1.1	1.9	3.1	0.8
	Other not classified activities	.	.	.	2.4
	Total	100.0	100.0	100.0	100.0
	Total, USD million	21644	10310	53152	2809

Note: 1) Realized investment with more than USD 1 million capital, 2001.

Sources: Czech R. and Slovenia: National Banks; Hungary: Central Statistical Office; Poland: Foreign Investment Promotion Agency, PAIZ

Table 4

Share of foreign affiliates by main indicators of the manufacturing sector, 1996 and 1999

(Percentage)

	Equity capital		Employment		Investment		Sales		Export sales	
Country	**1996**	**1999**	**1996**	**1999**	**1996**	**1999**	**1996**	**1999**	**1996**	**1999**
Czech Republic	21.5[1]	41.8	13.1	26.9	33.5	52.7	22.6	42.4	15.9	60.5
Estonia	43.5[a]	43.2[1]	16.8	25.0	41.8	.	26.6	32.7	32.5	43.3
Hungary	67.4[2]	72.9[2]	36.1	46.5	82.5	82.2	61.4	73.0	77.5	88.8
Poland	29.3	50.5	12.0	29.4	30.6	63.1	17.4	49.0	26.3	59.8
Slovenia	15.6	21.8	10.1	13.0	20.3	22.3	19.6	23.3	25.8	30.3

Notes: 1) Own capital. – 2) Nominal capital in cash.

Source: Hunya (2001); see also footnote 12.

Among the top privatization deals in CEECs in 2000-2001 only about one fifth of the cases were in manufacturing, the rest in services. (See EBRD Transition Report 2001, p. 23.) The shift in privatization did not totally change the sectoral distribution of FDI as green field investments in manufacturing continued. The following analysis focuses on the manufacturing sector, which is by no means representative of the foreign sector as a

whole. But manufacturing FDI takes a prominent role as a means of technology transfer and as a producer of export goods.

Table 5

Sales, share of foreign affiliates in manufacturing, 1994-1999

(Percentage)

Country	1994	1995	1996	1997	1998	1999	Increase 1999/1994
Czech Republic	12.5	16.8	22.6	27.2	32.1	42.2	337
Estonia	.	20.1	26.6	27.1	28.2	32.7	163[1)]
Hungary	55.4	56.1	61.4	66.1	70.0	73.0	132
Poland	17.4	23.6	31.9	36.0	40.6	49.0	281
Slovenia	16.9	17.6	19.6	21.1	24.4	23.3	137

Note: 1) 1999/1995.

Source: Hunya (2001).

The size of foreign penetration can be described by the share of foreign affiliates in nominal capital, assets, value added, employment, sales, export sales, investment outlays and profits derived from the income statements / tax declarations of companies.[12] The indicators – equity capital, sales or output, employment and investment outlays – are available for all five countries (Table 6). The importance of foreign affiliates increased for almost all indicators over the period 1996-1999. As capital indicators are not unified, the most widespread common indicators, sales and employment, are discussed in more detail below. At the development of foreign penetration over time one must keep in mind the distortions caused by the shift from the domestic to the foreign sector in case of privatization.

The highest share of foreign affiliates by all indicators has been reached by Hungary. Seventy-three per cent of the country's manufacturing sales come from foreign affiliates,

[12] Companies with any foreign shares in their equity capital – defined here as foreign affiliates – were sorted out from national databases containing data on companies' financial statements. The remaining companies were classified as domestic enterprises. Estonia is a special case where only majority-owned foreign affiliates could be included in the database. Data sources are the national statistical offices of the given countries. They are based on the financial reports of companies. Data were specially collected and processed for the Phare-ACE project P97-8112-R by Urmas Varblane in Estonia, Alena Zemplínerová in the Czech Republic, Andrea Éltetö in Hungary, Bohdan Wyznikiewicz in Poland and Matija Rojec in Slovenia. In most countries, the data in this database differ from the statistics found in statistical yearbooks for the total manufacturing sector due to methodological differences between national statistics and company bookkeeping. In the case of Hungary in 1997-1999 and Slovenia, the coverage could be limited to companies with at least 10% foreign ownership, which corresponds to the internationally accepted definition of FDI. For the Czech Republic and Poland, companies with even lower foreign shares had to be included. The database is biased towards large companies which reflects the data collection policy of national statistical offices. In Hungary and Slovenia, only very small ventures, in Poland those with less than 5 employees. The data for the Czech Republic cover only companies with 100 or more employees. The data for Estonia cover companies with more than 20 employees for 1996-1999, for 1995 the limit is 50 employees.

Table 6

Concentration of the foreign sector: Share of most important industries (ISIC codes) in the sales and investments of FIEs in 1999, in %

Czech Republic	**Sales**	**Investment**
37 motor vehicles	28.7	29.2
26 other non-metallic min.	8.3	12.4
25 Rubber and plastic	6.2	8.0
15 Food, beverages	9.0	7.1
Estonia	**Sales**	**Investment**
15,16 Food, bev, tobacco	19.1	
17 Textiles	12.0	
30-33 electric machinery	11.4	
26 other non-metallic min.	9.8	
23-24 cook, chemicals	9.7	
Hungary	**Sales**	**Investment**
37 motor vehicles	18.4	20.4
15 food, beverages	13.3	9.1
32 radio TV sets	9.9	8.7
23 coke and petroleum	9.7	12.8
24 chemicals	7.7	16.0
Poland	**Sales**	**Investment**
15 food, beverages	23.0	9.1
37 motor vehicles	22.8	22.7
23 coke and petroleum	13.4	10.6
24 chemicals	7.8	8.1
26 other non-metallic min.	7.0	10.6
Slovenia	**Sales**	**Investment**
37 motor vehicles	34.2	5.6
29 machinery and equipment n.e.c.	11.1	7.7
24 chemicals	9.0	8.7
21 Paper	7.5	10.8
25 Rubber and plastic	4.7	34.7

Source: Hunya (2001).

which employed 46% of the manufacturing sector's labour force in 1999. The second place is occupied by Poland with 49% of sales and 29% of employment. The Czech Republic comes next, with 42% and 27% of sales and employment, respectively. The difference between Hungary, on the one hand, and the Czech Republic and Poland on the other was threefold in 1996 and narrowed to less than two times in 1999. The most dynamic increase has been recorded in the Czech Republic. This was due to an acute crisis of domestic owned companies which were privatized by vouchers or by insiders and lacked investment means and marketing skills. Their partial take-over by foreign investors as well as new

green-field investments caused a turnaround in the Czech industry at the end of the 90s. In Slovenia and Estonia, foreign penetration is lower and has increased more slowly than in the other countries.

Countries show different development paths in terms of foreign penetration in manufacturing. Foreign penetration in the Czech Republic almost doubled between 1994 and 1996, and again in the subsequent three years. The foreign sector showed a rapid expansion not only in terms of capital and sales, but also in terms of employment. In Estonia, the rate of penetration by 1996 was the second highest among all the countries under discussion. This was mainly the result of the fast opening and privatization after the introduction of the currency board in 1993. But the increase in the performance of foreign affiliates after 1996 was slow. The country remained behind Poland and was overtaken by the Czech Republic. In Hungary, foreign penetration in manufacturing had already reached 50% before 1994. Sales, especially export sales, were the indicators for which the share of foreign affiliates increased the fastest between 1996 and 1999 as a result of the intensive investment activity during the first half of the 1990s. Poland had a later start, but a fast expansion of foreign penetration in the late 1990s due to the upswing of privatization which stimulated foreign takeovers. The rapidly growing domestic market attracted also greenfield investments. While economic growth on the whole was strong, its main driving force changed from newly established domestic small and medium-sized enterprises (SMEs) to foreign affiliates. Sluggish domestic demand and an appreciating currency ate up profits and ruined the competitive position of many companies which drove the country into a severe economic slowdown beginning with 2000. Slovenia has had the lowest foreign penetration by all indicators among the CEEC-5. Although the share of foreign affiliates in sales had increased, the gap in comparison to the other four countries grew between 1996 and 1999. The Slovenian economy has maintained a strong international competitive position in traditional industries mainly by successful domestic-owned companies and with the help of stable real exchange rate.

The role of the foreign sector in production, employment and exports changes

Manufacturing industries in CEECs differ significantly in terms of foreign penetration. In general, some industries are primarily under foreign control, while in other industries domestic firms dominate. The difference between industries in terms of foreign penetration[13] tends to grow over time (Appendix Tables A1, A2, A3).

[13] Data on foreign penetration are available for 23 industries, and a number of indicators among which most widely available indicator is revenues from sales. Industries with less than three foreign affiliates had to be merged with other similar industries for Estonia, or put together as residual (*) in case of Slovenia.

The industry with the highest above-average foreign penetration in all CEEC-5 is the manufacturing of motor vehicles. Except for Estonia, this industry has over 80% foreign penetration. The auto industry was attractive to FDI both because of unsatisfied domestic demand and because of favourable conditions for low-cost production. Also, tobacco manufacturing is usually foreign-owned as only big international companies can cope with brand name and promotion costs. Radio and TV set production has become increasingly foreign-owned with above average rates of foreign penetration in all five countries. Electrical machinery has a high rate of foreign presence in the Czech Republic and Hungary. In the other three countries, the paper industry, a major exporter, has become foreign-controlled. High foreign penetration in the chemical industry is specific to Hungary, due most probably to worldwide internationalization in the pharmaceutical industry. While foreign penetration takes place in a similar set of industries in four countries, Estonia shows a different pattern, with light industries having a higher degree of foreign domination.

The degree of foreign penetration in the CEEC-5 depends on industry-specific features and on the characteristics of the privatization policies. FDI in CEECs follows worldwide characteristics in terms of the corporate integration of industries, with technology-intensive electrical machinery and auto production being the main targets. Foreign capital has also penetrated industries with relatively stable domestic markets, e.g. beverages and tobacco industries. Privatization has attracted FDI to all industries in Hungary, but only to a few in other countries. Foreign presence has remained relatively small in industries with structural difficulties and oversized capacities, such as steel industries. Foreign penetration has thus shifted the industrial structure to more modern and higher value added industries more capable to withstand competitive pressure.

Table 7

Sales increase in manufacturing total and FIEs, 1996-1999, national currency and %

	Total sales	FIE sales	FIE/Total %
Czech Republic, CZK billion	368.2	340.6	92.5
Estonia, EEK billion	10.9	5.4	49.5
Hungary, HUF billion	4552.2	3897.2	85.6
Poland, PLN billion	91.3	77.7	85.1
Slovenia, SIT billion	711.1	233.5	32.8

The expansion of the foreign sector had an overwhelming influence on the dynamics of changes in manufacturing in the Czech Republic, Hungary and Poland in 1996-1999 (see Tables 8, 9, 10). The foreign sector was responsible for more than 85% of the increases on sales, export sales and employment in these countries. Estonia and Slovenia increased sales mainly based on domestic companies, in case of Slovenia also the exports remained determined by domestic firms. As to employment, FIEs' manpower increased in all the five countries while declined with the domestic owned companies.

Table 8

Employment change in manufacturing total and FIEs, 1996-1999

	Total number	FIE	DE
Czech Republic, thousand	47.6	146.7	-99.1
Estonia, thousand	-11.0	7.4	-18.4
Hungary, thousand	16.4	73.6	-57.2
Poland, thousand	-315.8	96.3	-412.1
Slovenia, thousand	-3.3	2.9	-6.2

Table 9

Export sales change on manufacturing products, 1996-1999

	Total	FIE	FIE/Total %
Czech Republic, CZK billion	174.9	175.6	100.4
Estonia, EEK billion	6.1	3.9	63.9
Hungary, HUF billion	3056.2	2957.9	96.8
Poland, PLN billion	26.7	23.8	89.1
Slovenia, SIT billion	424.4	90.4	21.3

Industries differ a lot concerning the change of foreign penetration in the second half of the 1990s. Looking first of all to the share of foreign affiliates in manufacturing sales this increased in almost all industries in the five countries. The main catching up countries were the Czech Republic and Poland with percentage point increases of 19.8 and 17.3 respectively. But even with this rapid increase they did not reach the Hungarian level of 1996. Meanwhile the already high level of foreign penetration increased further in Hungary, by 11.6 percentage points. In Estonia, foreign penetration expanded modestly with 6.1 percentage points. Slovenia did not participate in the 'race' for FDI and had a low, 3.6 percentage point increase in the three-year period.

Shift of foreign penetration 1996-1999 by industries

The most important industries that gained in foreign penetration in *the Czech Republic* are:

DL, Electrical and optical equipment

DD, Wood and wood products

DE, Pulp, paper, printing publishing

DM, Transport equipment

These industries gained between 28 and 36 percentage points, far above the average of the country which is a sign of increasing selectivity of foreign investments. All these industries with the exception of DD had above average foreign penetration already in 1996.

This means that foreign investors strengthened their presence in such industries where they had success before. Two of the increasing industries are traditional ones, wood and paper, two of them are modern industries, electrical equipment and transport equipment. Decreasing foreign penetration could not be observed in any of the manufacturing industries in the Czech Republic. Among the high penetration industries, foreign penetration increased only modestly in DI non-metallic minerals.

The most important industries that gained in foreign penetration in *Estonia* are:

DC, Leather and leather products

DN, Manufacturing n.e.c.

DD, Wood and wood products

The two most strongly growing industries in Estonia had already higher than average foreign penetration in 1996. Also further two industries with high foreign penetration had above average increases: DI, non-metallic minerals and DL, Electrical and optical equipment. Industries with declining foreign penetration in Estonia include DB, textiles and DH, rubber and plastic. In both industries overall production declined more in the foreign than in the domestic sector. In further four industries, most severely hit by the overall output decline in the wake of the Russian crisis, the sales of domestic companies declined more than of FIEs which gave the result of growing foreign penetration by this indicator (DA food, DF petroleum, DI non-metallic minerals, DJ metals).

In *Hungary* there is only one important gaining industry, DL, electrical and optical equipment. This modern industry expanded a lot in the 1996-1999 period due to foreign green-field investments (IBM, Philips, Nokia). In some other foreign controlled industries like the motor vehicles industry there was little room for further penetration. But in two industries with lower than average foreign penetration there was higher or close to average increase: DC leather and DB textiles. This shows that industries competing mainly with low wages kept their international competitive position with productivity increasing ahead of wage costs. If fact, also in the case of the high-tech industries it was mainly the wage intensive, low-tech part of the production process which was located in Hungary. In one industry, DE paper and printing, the significance of foreign affiliates in sales decreased dramatically. This is a mainly domestic market oriented industry where local SMEs could catch up with foreign affiliates.

The most important industries that gained in foreign penetration in *Poland* are:

DF Coke and petroleum

DL Electric and optical equipment

DG Chemicals

DD Wood and wood products

The opening of the petroleum industry for privatization was a major event of foreign penetration in Poland. In the other three industries foreign penetration expanded close to the average rate. DL and DD were traditionally significant targets of foreign investors, in the chemical industry investments came hand in hand with the petroleum industry. There was one branch with decreasing foreign penetration, DE paper and publishing. This development is similar though not as radical as in Hungary.

In *Slovenia* there were two industries where the importance of foreign affiliates grew significantly:

DI Non-metallic minerals

DL Electric and optical equipment

Even in these industries foreign penetration remained below 30%. The only industry with high foreign penetration remained DM, transport equipment. There was some decrease in the significance of foreign affiliates in sales in DA food industry and in DN manufacturing n.e.c.

The characteristics of recent developments in terms of foreign penetration in the most important industries can be summarized as follows:

DA The food, beverages and tobacco industry has lower than average foreign penetration in all countries except Poland. It is also not growing more rapidly than the average.

DB, DC Textiles and leather have low foreign penetration in all countries. Growing significance of foreign affiliates is remarkable in Hungary and the Czech Republic.

DD, DE The wood, paper, publishing industries have higher than average foreign penetration with the exception of Hungary. This may be explained by the availability of natural resources. Foreign penetration is growing rapidly in the Czech Republic, partly in Poland, while declining in Hungary.

DF The coke and petroleum industry is either open to privatization and then it has significant and growing foreign presence like in Hungary, Poland and Estonia, or still in state hands in 1999 with no foreign presence.

DG The chemicals industry has low foreign penetration with the exception of Hungary. The share of foreign affiliates in sales grows rapidly only in Poland. In general, the sub-industry medicines is more foreign controlled than the production of basic chemicals.

DH Rubber and plastic has highest foreign penetration in the Czech Republic and Poland and altogether a less significant industry in the other countries.

DI Non-metallic minerals is a favoured target industry of foreign investors in all five countries. Fast increases over the period 1996-1999 can be observed in Poland and Slovenia.

DJ The industry 'Basic metals' suffers from over-capacity and delays in privatization in most countries. The engagement of foreign investors in this sector is small, increasing only slowly.

DK The traditional machinery and equipment sector including part of the military sector has a low share of foreign affiliates in the output but there is a close to average speed of increase over the three years under discussion.

DL Electric and optical equipment production is one of the main recent targets of foreign penetration with rapidly increasing foreign shares in all the five countries.

DM Transport equipment is the industry with the highest and increasing rate of foreign penetration in all the countries but Estonia.

DN Other manufacturing industries, mainly furniture and other consumer goods production is not very important in any respect.

Future structural change due to the activity of the foreign affiliates is indicated by their investment propensity calculated as investment outlays per sales volume. In 1999, FIEs invested 70% more per sales than domestic companies in Poland and Hungary and 50% more in the Czech Republic. Following the trend of other indicators, in Slovenia domestic companies had on average higher investment propensity. (There are no comparable data for Estonia.)

Foreign – domestic productivity gaps and the evidence for spillovers

Labour productivity in foreign affiliates is on average as much as two times higher than in domestic enterprises. In this respect, there has been little difference among the CEEC-5 in the 1990s. The exceptions (with lower gaps) were Poland before 1998 and Estonia after 1996. Countries diverged in terms of productivity dynamics during the 1994-1999 period (Table 11). The gap between foreign affiliates and domestic enterprises increased fast in Hungary until 1996, then it stabilized for two years and increased again in 1999. In 1999, foreign affiliates were 3.1 times more productive than domestic enterprises, which is by far the largest gap among CEEC-5. This is due to the impact of especially productive new foreign owned greenfield assembly lines. In Poland, the productivity gap increased from 1.5 to 2.3 during the 1994-1999 period, while a stable 1.9 times gap was characteristic of the Czech Republic through 1995-1998. The productivity gap is now very similar in the Czech Republic, Poland and Slovenia. The outlier is Estonia, where the rapidly decreasing productivity gap may be due to the dominance of low value-added industries, in which the technology and thus the productivity gap between firms is small.

Table 10

Sales per employee: foreign affiliates as a ratio to domestic enterprises in manufacturing, 1994-1999

(Percentage)

Country	1994	1995	1996	1997	1998	1999	*Increase1999/1994*
Czech Republic	186	191	194	189	189	201	108
Estonia	.	241	188	160	150	146	61[1)]
Hungary	209	260	282	279	287	311	149
Poland	155	157	185	185	194	231	150
Slovenia	241	228	218	198	197	203	84

Note: 1) 1999/1995.

Source: Hunya (2001).

The lead of foreign affiliates in terms of labour productivity is not specific to the CEEC-5, only its exceptionally large size. In OECD countries, the productivity advantage of foreign affiliates compared with the average productivity of the manufacturing sector is only 30% (OECD, 1996). The larger and the more specialized the foreign sector, the larger is its lead over the domestically owned sector. The higher productivity of foreign affiliates is due to lower labour inputs due to narrower specialization, as well as the absence of management and research functions. In addition, foreign affiliates usually possess advanced technology, management and marketing compared with domestic, especially state-owned, enterprises. The productivity advantage exists both in technical terms and in terms of higher output values due to higher sales prices. Higher prices for affiliate products can be obtained through better market position, western brand names etc., but revenues from such prices may be diverted through transfer pricing.

Table 11

Sales per assets: foreign affiliates as a ratio to domestic enterprises in manufacturing, 1994-1999

(Percentage)

Country	1994	1995	1996	1997	1998	1999	*Increase 1998/1994*
Czech Republic	124	116	121	124	133	133	107
Estonia	..	..	44	59	62	..	142[1)]
Hungary	..	..	..	..	..	..	..
Poland	96	102	130	119	110	113	118
Slovenia	141	150	140	132	129	116	82

Note: 1) 1998/1996.

Source: Hunya (2001).

The learning process in domestically owned companies may, with time, lead to direct spillovers, i.e. to narrower gaps between foreign affiliates and domestic enterprises. Indirect spillovers may take place through the income and knowledge transferred by individual employees. If the foreign sector is very different from the domestic one, the two segments of the economy may find it difficult to cooperate, and the foreign sector may function as an enclave. In that case, direct spillover effects do not take place.

Endowment with capital is higher in the foreign sector than for domestically owned enterprises. This may confirm the expectation that foreign investors use more recent, capital-intensive and labour-saving technology. It also reflects the concentration of FDI in manufacturing industries with high capital intensity. Capital productivity is higher in foreign affiliates than in domestic enterprises in the Czech Republic, Poland and Slovenia (sales per assets, Table 12). In these countries the advantage of foreign affiliates in terms of total factor productivity is obvious. Capital productivity of foreign affiliates is lower than of domestic enterprises only in Estonia.

Productivity indicators reveal significant differences in CEEC-5 due to foreign penetration. The duality of performance in the manufacturing sector appears in two respects:

– The dichotomy between modern, foreign-dominated industries, on the one hand, and traditional industries with both domestic and foreign companies on the other. This duality appeared in all countries examined here and has grown over time. The extreme case is Hungary, where 9 foreign-dominated industries represent 50% of manufacturing sales.

– In the industries with both foreign and domestic companies, a comparison of indicators shows that the foreign sector is more efficient and more export-oriented than the domestic sector. This dichotomy of performance between foreign and the domestically owned companies in the same industry is the largest in Hungary and the smallest in Slovenia.

The above reasoning is weakened by the problem that the database is not able to control for the shift of companies from the domestic to the foreign sector. Using two unique panel data sets that cover almost all firms in Slovenia and Estonia between 1994 and 1998, Jože Damijan et al. (2001) made a test for intra-industry spillovers from FDI. After controlling for potential selection bias for foreign investment decisions, common economic policy influences and industry effects, it was shown that technology is transferred through the parent-affiliate relationship and arm's-length trade, but that the expected spillover benefits to purely domestic enterprises rarely materialize. Without these benefits, restructuring and the development of domestic enterprises may be inhibited, thereby reinforcing fears that an enclave economy might be emerging in both countries.

As to the Czech Republic, a nation-wide, firm-level panel data set comprising 2,500 manufacturing firms analyzed by Alena Zemplínerová and Martin Jarolim (2000) showed that firms with foreign participation achieved higher productivity growth rates than domestically owned firms. Contrary to previous studies by Simeon D. Djankov and Bernard Hoekman (2000), who worked with much smaller sample sizes, the results of this dynamic empirical analysis suggests that foreign firms achieved significantly higher growth rates of total factor productivity than domestic firms. This fact confirms the important role that FDI plays in transferring technological, marketing and managerial knowledge to affiliates. The existence of positive or negative spillovers from foreign firms in an industry was not proved. Unlike Djankov and Hoekman, who found negative and statistically significant spillover effects of FDI, this article has shown that the presence of FDI has a positive, but statistically insignificant effect on the total factor productivity growth of domestic firms. (For a summary of recent research findings on spillovers in CEECs, see UNECE, 2001, chapter 5.)

Export structure and foreign penetration

Foreign affiliates have exhibited high and growing shares in terms of export sales. Their outstanding export performance relative to sales indicates that these affiliates are more export-oriented than domestic firms (Tables 13 and 14).

Table 12

Export sales: share of foreign affiliates in manufacturing exports, 1994-1999

(Percentage)

Country	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	***1999/1994***
Czech Republic	15.9	..	..	41.9	47.0	60.5	381
Estonia	..	25.4	32.5	32.1	35.2	43.3	170[a]
Hungary	65.5	68.3	73.9	83.3	85.9	88.8	136
Poland	26.3	33.9	40.5	45.1	52.4	59.8	227
Slovenia	21.1	23.2	25.8	28.0	32.9	30.3	144

Note: 1) 1999/1995.

Source: Hunya (2001).

In this respect, Hungary stands out as having the most export-oriented foreign sector and the biggest share of foreign affiliates in exports (almost 90%). Hungary is followed by the Czech Republic and Poland, in which foreign affiliates provide 60% of exports (these shares have grown more rapidly in the former than in the latter country). Over time, the Czech Republic has increasingly become similar to Hungary. During the recession period of 1997-1999, Czech domestic companies scaled down sales, while foreign affiliates became more export oriented and more greenfield investment was attracted. Polish

domestic enterprises and foreign affiliates are both more domestic market-oriented than in other countries. This has to do with the size of the country and the rapid increase in domestic demand in the mid-1990s. Estonia and Slovenia represent a distinct group with significantly less importance of foreign affiliates in terms of exports. Both countries are small and strongly export-oriented, with both domestic enterprises and foreign affiliates having a high proportion of exports in sales. While this is a stable feature of Slovenia, in Estonia foreign affiliates have seen their export shares grow in 1999.

Table 13

Exports per sales: foreign affiliates as a ratio to domestic enterprises in manufacturing, 1994-1999

(Percentage)

Country	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	***Increase 1999/1994***
Czech Republic	132.3	..	..	193.3	187.5	208	157
Estonia	..	135.1	132.7	127.5	137.9	140	104[a]
Hungary	152.9	168.6	177.8	255.8	259.9	293	192
Poland	168.3	166.5	146.0	146.8	161.8	155	92
Slovenia	131.7	141.7	142.5	145.6	152.1	143	109

Note: 1) 1999/1995.

Source: Hunya (2001).

Table 14

Market shares of CEECs in EU-15 imports from non-member countries, 1995-2000

(Percentage)

Item	**Czech Rep.**	**Estonia**	**Hungary**	**Poland**	**Slovenia**
Market share 1995	1.94	0.17	1.65	2.53	0.97
Market share 2000	2.58	0.36	2.63	2.72	0.76
Market share change, percentage point	0.65	0.18	0.98	0.29	-0.21
Market share 2000 in % of 1995	133	200	160	107	78
Export volume 2000 in % of 1995	247.4	370.8	295.9	199.1	145.2
Share of foreign affiliates in export sales, 1999	60.5	43.0	88.8	59.8	30.3
Foreign affiliates: export sales/sales, 1999	60.3	56.6	60.0	27.4	68.2

Source: Eurostat Comext database and Hunya (2001).

The CEEC-5 export competitiveness in terms of penetrating EU markets can be measured by the share of each country in the EU's imports and the volume of exports into the EU imports from each of these countries (Table 15). Hungary, Estonia and the Czech Republic have increased their export volumes to EU (EU-15 imports) both over time and in terms of market shares. Their exports to EU have increased due to reorientation and to overall export dynamics. Reorientation of trade took place mainly in the early 1990s; after 1995 it

was significant only for Estonia. Low export dynamism and stagnating market shares characterize Poland. Slovenia's market share decreased.

Table 15

Imports of EU-15 from selected CEECs, by industry: market share gains/losses, top 3 winning and losing industries, 1994-2000, %

Czech Republic	***Winning industries 1995-2000***	***Market share 2000***	***Foreign affiliate share in exports 1999***
34. Motor vehicles	5.6	8.3	94.8
22. Publishing, printing	3.3	5.9	29.0
25. Rubber and plastic	2.6	5.6	75.2
	Losing industries		
26. Non-metallic minerals	-1.1	9.3	62.8
19. Leather	-1.0	1.5	15.1
20. Wood	-0.5	4.5	62.2
Other high market share industries			
28. Fabricated metals	2.5	8.6	55.9
31. Electrical machinery	2.1	5.3	79.1
Hungary	***Winning industries 1995-2000***	***Market share 2000***	***Foreign affiliate share in exports 1999***
34. Motor vehicles	5.1	9.8	98.7
30. Office machinery	3.0	3.3	97.2
32. Radio and TV sets	2.2	3.2	91.9
	Losing industries		
16. Tobacco	-0.8	0.1	100.0
18. Clothing	-0.5	2.1	71.8
19. Leather	-0.4	2.3	82.3
Other high market share industries			
31. Electrical machinery	1.7	5.4	79.1
28. Fabricated metals	0.2	2.8	55.9
26. Non-metallic minerals	-0.1	2.7	62.8
Poland	***Winning industries 1995-2000***	***Market share 2000***	***Foreign affiliate share in exports 1999***
34. Motor vehicles	3.4	7.6	96.1
25. Rubber, plastic	1.5	3.9	84.6
22. Publishing, printing	1.4	2.4	88.6
	Losing industries		
26. Non-metallic minerals	-2.0	6.1	62.4
18. Wearing apparel	-1.3	4.1	52.3
19. Leather	-0.4	1.6	50.3
Other high market share industries			
20. Wood	0.5	8.8	60.7
28. Fabricated metals	1.0	7.5	50.5
36. Furniture, manuf. n.e.c.	0.8	5.8	70.3

Source: Eurostat Comext database and Hunya (2001).

The relationship between market share development and foreign penetration is most obvious in the case of Hungary and Slovenia, two opposite examples (Table 14). The rapid market gains of Hungary were the result of the restructuring and market-conquering activity of foreign affiliates. Slovenia recorded low FDI, a low share of foreign affiliates in export sales and a loss of EU market shares. Estonian exports increased fast, Czech exports at medium speed, while Polish export shares stagnated. Next to Hungary, the Czech Republic and Poland have the strongest foreign share in terms of exports, but only the Czech Republic could improve its EU market share. The reason is that FDI in Poland is more for domestic market-oriented activities, as indicated by export sales as low as 27% of total sales compared to about 60% in the other countries.

Market share developments at the industry level show which industries have gained or lost competitiveness during 1995-2000 (Table 15). In the case of the Czech Republic, two thirds of the 21 industries gained shares. The major winners were the motor vehicles, publishing and printing, rubber and plastic. The main losers were non-metallic minerals leather, wood. The shift of exports was towards high value-added products. Most industries with the highest gains were dominated by foreign capital, while losing industries have generally lower foreign penetration.

The trend for Hungary was similar to that in the Czech Republic, but the winning industries were more concentrated. Motor vehicles, office machinery, radio and TV sets, the major industries gaining market shares were all totally foreign controlled. The losers had lower foreign shares except the tobacco industry. As to Poland, both gains and losses of market shares are of a small magnitude, showing that structural change is slow. In the first years of the period gaining industries were electrical machinery and radio and television sets. In later year motor vehicles, rubber and plastic, publishing and printing gained more in terms of market shares, all dominated by FIEs in exports.

As for Slovenia, loss in market shares has affected a wide range of industries, among them traditionally strong ones with previously high market shares, such as paper, apparel and non-metallic minerals. Market-share winners such as metal products, electrical machinery and printing and publishing are industries with low foreign penetration. Industries with the highest foreign penetration, such as motor vehicles, paper and radio and television sets, have, by and large, stagnating market shares in the EU-15.

In conclusion, Hungary has had a clear competitiveness gain due to FDI penetration. Estonia has shown a competitiveness gain as well, but less linked to FDI. The competitiveness gain of the Czech Republic is less than that of the former two countries, but it is mainly driven by FDI. Poland has had a strong foreign penetration, but with little effect on overall competitiveness. Slovenia has lost market shares in the EU, owing to relatively low foreign penetration and FDI in modern industries.

Conclusions

The analysis presented above suggests the following conclusions and policy implications derived therefrom:

– The deeper the foreign penetration, the faster has been the speed of structural change. Deepest and most rapid in Hungary, followed by the Czech Republic and Poland. This is relevant both in terms of changes in the structure of output and for each country's exports to the EU. Slovenia, although the most advanced in terms of per capita GDP, has recorded low FDI, a low share of foreign affiliates in export sales and a loss of EU market shares.

– The size and industry distribution of foreign penetration depends on industry-specific features and on the characteristics of privatization policies. FDI in CEECs follows the worldwide characteristics of the corporate integration of industries: technology-intensive electrical machinery and automobile production are the main targets. FDI has helped CEECs to shift their product structures into line with those of the more developed EU countries. This may give further impetus to economic growth and narrow the development gap between the more advanced CEECs and the EU.

– Foreign presence has been relatively small in industries with structural difficulties and oversized capacities, such as the steel industry. Privatization is not enough to set the restructuring of these industries in motion. Sectoral policies and financial restructuring are necessary to make companies attractive for foreign takeovers.

– A duality between foreign- and domestically-dominated industries appeared in all countries, and it has been growing over time. It appeared between modern, foreign-dominated industries on the one hand and traditional industries with both domestic and foreign companies on the other and as a foreign–domestic gap within the industries with both foreign and domestic companies.

– The dichotomy of productivity between the foreign- and domestically-owned companies in one and the same industry is the largest in Hungary and the smallest in Slovenia. Hungary in the second half of the 1990s was the most rapidly growing CEEC, the one with the strongest upgrading of the industrial structure, had the most gain in market shares in the EU but is subject to the most severe duality and lack of spillover in the relationship of the foreign and the domestic sector. In Slovenia, the balanced relationship between the domestic and the foreign sector is coupled with a low average rate of foreign penetration and a relatively small presence of technology-intensive industries. The small gap between the foreign and the domestic sectors may indicate a slow rate of technological progress and absence of spillovers.

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Appendix

Table A1

FIEs' share in net sales by industry and country, 1996, %

NACE Code	Industries	Czech Rep.	Estonia	Hungary	Poland	Slovenia
DA	Food products, beverages, tobacco	24.7	20.0	51.1	38.4	10.0 [1]
DB	Textiles and textile products	8.6	53.3	43.6	17.6	5.7
DC	Leather and leather products	3.9	43.5	46.1	12.0	*
DD	Wood and wood products	11.5	11.5	42.6	34.1	0.9
DE	Pulp, paper; publishing and printing	21.3	22.4	71.6	66.3	19.8
DF	Coke and petroleum	0.0	37.0 [2]	99.2	0.4	*
DG	Chemicals	11.3	.	78.7	19.0	17.4
DH	Rubber and plastic	43.8	28.0	54.6	54.6	16.0
DI	Other non-metallic minerals	45.6	53.5	63.5	37.2	13.3
DJ	Basic metals	10.8	5.7	33.9	12.3	4.6
DK	Machinery and equipment n.e.c.	8.1	16.9	45.1	14.8	21.3
DL	Electrical and optical equipment	30.7	45.4	65.1	42.7	20.1 [3]
DM	Transport equipment	55.0	10.6	84.1	56.4	82.3 [4]
DN	Manufacturing n.e.c.	28.2	15.2	30.9	52.2	5.6 [5]
*	Industries with less than 3 FIEs					12.9 [6]
D	Manufacturing	22.6	26.6	61.4	31.7	19.6

Notes: 1) Without tobacco. - 2) DF=DF+DG. - 3) Without office machinery. - 4) Without other transport equipment. - 5) Without recycling. - 6) Tobacco, tanning and dressing of leather, coke and petroleum, office machinery, other transport equipment, recycling.

Table A2

FIEs' share in net sales by industry and country, 1999, %

NACE Code	Industries	Czech Rep.	Estonia	Hungary	Poland	Slovenia
DA	Food products, beverages, tobacco	29.1	23.6	59.7	49.6	8.9 [1]
DB	Textiles and textile products	27.0	49.9	54.6	26.8	7.8
DC	Leather and leather products	10.9	57.8	63.1	22.9	4.9
DD	Wood and wood products	46.2	22.7	44.8	51.3	3.5
DE	Pulp, paper; publishing and printing	57.7	31.9	48.2	65.5	25.3
DF	Coke and petroleum	0.0	47.7 [2]	99.9	57.9	0.0
DG	Chemicals	27.2	.	84.3	37.3	21.4
DH	Rubber and plastic	63.6	22.5	57.0	59.0	20.6
DI	Other non-metallic minerals	54.5	64.3	71.1	53.8	26.5
DJ	Basic metals	23.8	11.4	42.5	20.2	10.0
DK	Machinery and equipment n.e.c.	25.1	27.8	55.0	27.4	25.9
DL	Electrical and optical equipment	65.4	55.8	88.9	62.2	28.1 [3]
DM	Transport equipment	83.1	12.8	93.8	70.7	76.5
DN	Manufacturing n.e.c.	40.0	29.5	36.3	53.0	0.4 [4]
*	Industries with less than 3 FIEs					31.2 [5]
D	Manufacturing	42.4	32.7	73.0	49.0	23.3

Notes: 1) Without tobacco. - 2) DF=DF+DG. - 3) Without office machinery. - 4) Without recycling. -5) Tobacco, office machinery, recycling.

Table A3

FIEs' share in net sales by industry and country, 1996-1999

NACE Code	Industries	Czech Rep.	Estonia	Hungary	Poland	Slovenia
DA	Food products, beverages, tobacco	4.4	3.6	8.6	11.2	-1.1 [1]
DB	Textiles and textile products	18.4	-3.4	11.0	9.2	2.0
DC	Leather and leather products	7.0	14.2	17.0	10.9	.
DD	Wood and wood products	34.7	11.2	2.2	17.2	2.5
DE	Pulp, paper; publishing and printing	36.4	9.6	-23.4	-0.8	5.5
DF	Coke and petroleum	0.0	10.7 [2]	0.7	57.5	.
DG	Chemicals	15.9	.	5.6	18.3	4.0
DH	Rubber and plastic	19.8	-5.5	2.4	4.4	4.6
DI	Other non-metallic minerals	8.9	10.7	7.6	16.6	13.3
DJ	Basic metals	13.1	5.7	8.6	7.9	5.4
DK	Machinery and equipment n.e.c.	17.1	10.9	9.9	12.7	4.6
DL	Electrical and optical equipment	34.8	10.4	23.8	19.5	8.0 [3]
DM	Transport equipment	28.1	2.2	9.8	14.3	.
DN	Manufacturing n.e.c.	11.8	14.2	5.4	0.8	-5.3 [4]
*	Industries with less than 3 FIEs					.
D	Manufacturing	19.8	6.1	11.6	17.3	3.6

Notes: 1) Without tobacco. - 2) DF=DF+DG. - 3) Without office machinery. - 4) Without recycling.

*Mark Knell** *Chapter 5*

Technological activity in Eastern Europe at the turn of the century

Abstract

This chapter describes the patterns of technological activity in Eastern Europe at the turn of the century. After considering the importance of technology in catching up with the richest countries, the chapter describes the importance of human capital, R&D and inventive activities, innovative activities and international sources of technological knowledge. One important conclusion that emerges from this chapter is that the innovation systems in Eastern Europe had to be substantially restructured and that this process is still going on. The reason is mainly because most R&D activity in the command economy was financed from above and performed in institutes external to the enterprise. In the EU, USA and Japan most R&D activity is innovation-driven, requiring competition, incentives for generating, diffusing and utilizing technology, and collaboration between industry and science. Effective innovation policy would continue the restructuring of the science and technology systems in Eastern Europe by promoting the development of innovative capabilities within enterprises, linkages between universities, institutes and industry, and the commercialization of publicly funded research.

1 Introduction

Speeding up the process of technical change and technological learning is an important objective of the economic transformation of Eastern Europe. With knowledge-intensive production now making up more than 50% of the Gross Domestic Product (GDP) in the major OECD countries, these countries must develop the capability to gain access to the new technologies available on the global market. Without this capability, this region will have little hope of catching up to the average income level in the European Union anytime soon. An important long-term problem, therefore, is whether they will succeed in acquiring these technological and organizational capabilities.

Bell and Pavitt (1993) define technological and organizational capabilities as the 'resources needed to generate and manage technical change, including skills, knowledge and experience, and institutional structures and linkages'. Building technological capabilities is a cumulative, path-dependent activity that generates technical change, investment in new

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capacity and growth. The process of building social and technological capabilities is also a complex and diverse activity that takes place between users and producers and between firms and organizations, engendering different patterns of technological accumulation and innovation depending on the learning structure. The incentive structures and competences of institutions support and sustain the rate and direction of technological learning and provide a role for public policy to influence the innovation process.

The technological capability of a firm also represents its absorptive capacity to assimilate technical knowledge from both home and abroad. In the global economy foreign direct investment, joint ventures, strategic alliances, technology licensing, subcontracting, and embodied technology transfer all play an important role in the growth process. These knowledge flows appear as an externality or technological spillover in neoclassical endogenous growth theory and as a joint product in the classical theory of production. Cohen and Levinthal (1989) define absorptive capacity as the 'firm's ability to identify, assimilate and exploit knowledge from the environment'. When firms wants to apply knowledge transferred from technological spillovers, they must enter into a time-consuming and costly process of investing in their absorptive capacity if they want to imitate or improve. Thus, the idea of absorptive capacity becomes a connecting device between what Abramovitz (1989) described as the potential for catching up (technological opportunities) and its realization (appropriability conditions).

Technological opportunities can arise from changing patterns of demand, changes in the size of markets, the product cycle or developments in science and technology. The technological capabilities of the business enterprise lie in its engineering, design, research and marketing resources and assets. Technology can either be generated internally or acquired through the domestic or international market. The realization of these technological opportunities will depend on the factors that facilitate the creation and diffusion of knowledge, the growth of demand (both global and national) and the strategic behaviour of the firm including the ability to develop the capability of taking advantage of these opportunities. 'Being backward in the level of productivity carries a potential for rapid advance', as Abramovitz (1989) put it, but the realization of this potential depends on whether the transition countries can develop the technical competence.

Research and development (R&D) and education and training are important factors in determining the absorptive capacity of firms. Their importance lies not only in generating new information, as Cohen and Levinthal (1989) point out, but also in creating the technical competence to exploit new opportunities. In the endogenous growth model of Romer (1990), for example, competence created by the R&D process is nonrivalrous and at least partly excludable depending on the ability of the owners of the knowledge to protect their property rights. The inability to protect these rights may lead to certain 'positive externalities' or 'knowledge spillovers' that can offset the marginal diminishing returns to

capital in the economy as a whole. Firms try to maintain a high degree of excludability to gain profit, mainly because they have a certain amount of proprietary or tacit knowledge that does easily transfer to other firms. But it is in the interest of the society to maintain a low degree of excludability to create knowledge spillovers and increasing returns.

R&D and patenting activity are the two most commonly used indicators of technological capabilities. R&D activities measure the science-based inputs that go into technological activity and patenting activity measures the intermediate outputs of these R&D activities. While both indicators capture only part of the innovation process, they provide a perspective of the science and technology systems in Eastern Europe. They tend, however, to overestimate research activities in the universities and laboratories and underestimate technological activities related to production. Other measures of technological activity, including innovation surveys and the 'technology balance of payments', tell us more about R&D activity, innovation and the adoption process. But such data are not always easy to obtain. Firm-based innovation surveys are now required in the member states of the EU, but only Poland and Slovenia have undertaken a comparable survey. There is also a deficiency of technology balance of payments data, but royalty payments in the IMF balance of payments statistics approximate these data.

This paper describes the patterns of technological activity in Eastern Europe and the CIS countries and considers the question of whether R&D activity and industrial innovation leads to economic growth in the region. After summarizing the patterns of productivity growth in Eastern Europe, the paper describes some of the underlying causes of these patterns both across the region and between industries within each country. This includes a discussion of why R&D expenditures have declined much more rapidly than GDP during the early 1990s and what this implies for catching up with the EU. Attention then shifts to the innovation surveys carried out in Poland and Slovenia and draws some conclusions about the innovation process during economic transformation. The paper then assesses the patterns of technology transfer and diffusion in Eastern Europe and closes with a brief discussion of science and technology policy.

2 Is Eastern Europe closing the technology gap?

The patterns of industrial labour productivity and per capita income provide a rough indication of how successful Eastern Europe has been in managing technological and organizational change. There were two distinct phases of economic transformation in the 1990s. During the first phase of the transition, which took place between 1990 and 1993 in Central Europe and somewhat later in the Baltic States, enterprises followed a more defensive restructuring strategy (cost-cutting through divestments and lay-offs), even if they were already privatized or receiving foreign capital. Table 1 shows that the countries in this region fell further behind the EU during this phase.

The recovery of industrial output from about 1993 onward encouraged enterprises to be more assertive and search for new products and markets. An increase in global demand combined with the establishment of new market institutions stimulated growth and enterprises found it profitable to follow a more strategic approach that focused mainly on reorganizing their asset structure. The process of industrial restructuring speeded up during this phase as enterprises concentrated on eliminating redundant labour and developing the capability to reorganize and transform themselves into global competitors. By 2000, productivity gains in Eastern Europe narrowed the technology gap with the United States and the EU, though there is still a long way to go.

Table 1

GDP per capita relative to the EU at current PPPs and annual rates of industrial labour productivity catch-up

(percentage growth)

	Rate of productivity catch-up		GDP per capita (EU = 100)	
	1990-1993	1994-2000	1993	2000
Bulgaria	-9.4	-1.3	27	24
Croatia	-12.8	-0.2	27	33
Czech Republic	-9.5	-0.1	60	59
Estonia	-15.4	0.8	32	41
Hungary	-3.7	7.3	45	53
Latvia	-15.9	2.4	25	30
Lithuania	-20.2	-2.6	31	30
Macedonia	-14.0	-2.8	21	21
Poland	-3.2	6.5	30	41
Romania	-14.3	-1.2	30	27
Slovakia	-7.1	1.4	39	49
Slovenia	-8.5	0.4	61	73

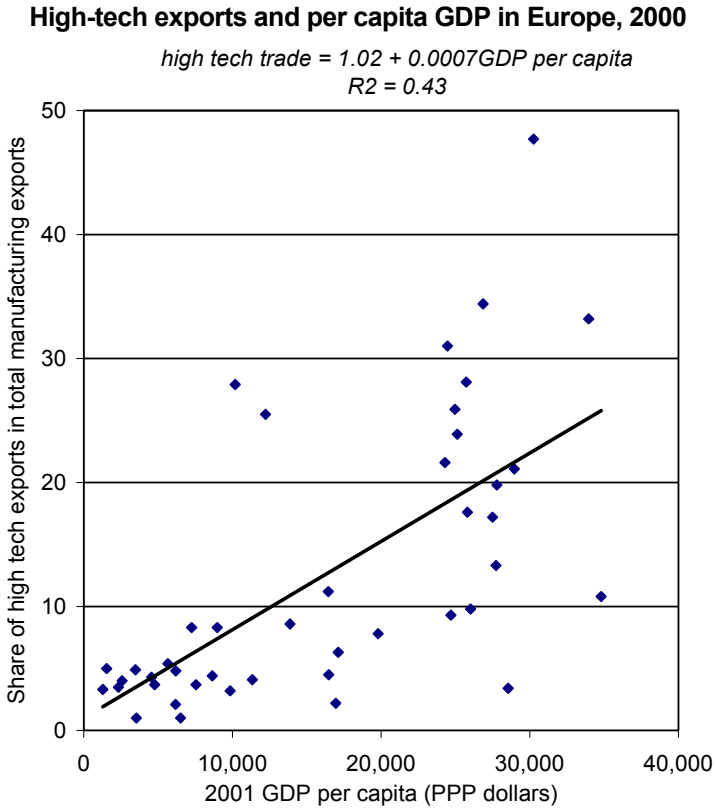
Note: EU covers the 11 Euro-zone countries.

Source: Own calculations based on UNECE, wiiw and Eurostat statistics.

The share of high-technology exports in total exports illustrates the relationship between technology, economic development and catching-up. High-technology products, which include aerospace, computers, pharmaceuticals, scientific instruments and electrical machinery, generally have a high R&D intensity. While these sectors vary enormously in terms of spin-off or linkage potential (from computers at the top to aerospace at the bottom), their aggregate share of exports provides some indication of the technological capabilities of a country. Figure 1 illustrates the relationship between the share of high technology exports in total manufacturing exports to GDP per capita in every European country, including the CIS countries plus the United States, Canada and Japan at the turn of the century. This figure reveals that countries having the highest rate of catch up with the United States at the turn of the century tend to be well above the trend line for this

indicator, with Estonia, Hungary, Ireland and the Netherlands being the most significant outliers. Some countries, such as France, Russia and the United Kingdom, had above average high-technology exports, but diverged from the United States per capita GDP over the period analysed. This seems to be related to a heavy reliance on aerospace as opposed to the ICT industries. Structural problems in Russia (and in some other transition economies) may have been an important factor in these countries actually falling behind in the 1990s.

Figure 1



Source: Own calculations based on World Bank Development Indicators, 2003.

A simple econometric test can be performed to illustrate the impact that technological activities can have on the economic transformation of Eastern Europe. Suppose that the variation in the share of high technology exports can be explained through own R&D activity and purchases of disembodied technology from other countries:

$$\underset{(0.217)}{\textit{High tech trade}} = 0.49 + \underset{(5.735)}{7.79}\textit{R\&D} + \underset{(4.864)}{5.61}\textit{Licences}$$

Here R&D is the gross expenditures on R&D as a share of GDP and licences are the payments for technology-related activities purchased from abroad as a share of gross

expenditures on R&D. Both variables were highly significant and together explain 58% of the variation in high-tech exports.[14] Together they are two of many sources of knowledge that go into the development of new products and processes. Being able to export high-technology products indicates that some countries in Eastern Europe have the accumulated the technological competence to produce competitive goods. Moreover, once Ireland is dropped from the regression, some correlation appears in the two independent variables indicating that own R&D activity and purchases of technology from abroad are complementary, that is, R&D is not only used for generating new technology, but also for absorbing technology from abroad as Cohen and Levinthal (1989) pointed out. Subsequent sections describe some of the sources of knowledge and the impact these might have on the economic transformation of Eastern Europe.

3 Human capital and economic growth in Eastern Europe

The level of education can be an important driving force in the creation and absorption of new technology. Education is an investment in human skills and competences that, over time, become part of the human capital stock, or social capabilities, of a country. The rich human capital stock in the transition countries is a key element in their underlying resource endowment, although it does not translate directly into capabilities that can be directly used in the process of economic transformation. Still, the institutional arrangements of the educational system and the level of effectiveness of education policies can also constrain the process of acquiring knowledge. General indicators of the human capital stock include various measures of the educational attainment of the population and workforce. Investment in human capital can be measured as the resources that each country puts into education and, in particular, its spending per student at each educational level.

Educational attainment remains the best indicator available of the human capital stock despite its inability to take into account the skills or competences gained after completion of formal education, or when competences become obsolete, which often happened as Eastern Europe reoriented itself toward Western Europe. Table 2 provides a breakdown of the educational attainment of the workforces of Eastern Europe at the turn of the century, based on national labour market surveys. Having a lower secondary education means that the worker has achieved an ISCED level 2 programme and an upper secondary education means the worker has completed an ISCED level 3 and/or 4 programme (for definitions of these programmes see UNESCO, 1997). Those with an applied degree from an institution of higher learning completed an ISCED level 5b programme and those that complete a theoretically based degree or achieved an advanced research qualification completed an ISCED level 5a and 6 programmes respectively. Although there is considerable variation

[14] There were 37 observations with F-Value =25.59 R^2 = .60 adjusted R^2 = .58 DurbinWatson = 1.98. t-statistics are in parenthesis.

across countries, both Eastern Europe and Russia have attainment levels similar to the US, and often surpasses it at the tertiary level, reflecting the fact that education was an important objective under central planning. Although many of the competences taught under the old system have become obsolete, especially in the social sciences, the general level of education has made it easier for firms to establish technological congruence between the human capital stock and the production process through the investment process, a key condition of effective redeployment. This in turn has helped to attract multinational corporations to take advantage of the relatively high skills and low unit labour costs in these countries.

Table 2

Educational attainment of the workforce, 2000

(Percentage share)

	First level and below	Lower secondary	Upper secondary	Applied tertiary	Degree tertiary
Croatia	7	18	58	7	10
Czech Republic	x	10	78	x	11
Estonia	1	11	46	23	18
Hungary	1	18	65	x	16
Lithuania	4	15	44	21	15
Poland	x	16	69	3	12
Romania	14	21	52	4	9
Slovakia	9	4	41	35	11
Slovenia	3	19	63	7	9
Russia	2	10	34	x	54
Austria	*x*	*21*	*69*	*2*	*7*
Germany	*2*	*16*	*58*	*10*	*14*
United Kingdom	*12*	*6*	*47*	*9*	*17*
USA	*5*	*8*	*51*	*8*	*27*
Japan	*x*	*20*	*49*	*12*	*19*

Notes: An x indicates that the data are included in the adjacent right-hand column. Data are1997 for Japan; 1998 for Croatia, and the Russian Federation; and 1999 for the United States.

Source: ILO, Yearbook of Labour Statistics (Geneva), 2001, except for United States data, which come from OECD, Education at a Glance (Paris), 2001.

Investment in human capital can be measured in terms of money and time devoted to study, but these measures neglect less formal kinds of learning. Since a substantial proportion of the resources devoted to education come from public sources, government expenditures on education can be a useful approximation of human capital formation. Table 3 shows the public expenditure on education as a percentage of GDP and compared with GDP per capita at the secondary and tertiary levels. Sweden was included in this table because it spends the most money on education as a percentage of GDP in Europe. Spending per student varies considerably across Eastern Europe. With exception of the

Baltic States, which often follow Scandinavian trends, all of the acceding countries spent significantly less money on education relative to national income than Sweden, but surprisingly all of them spent more than Japan, with the exception of Romania. The acceding countries as a whole, however, were not very different from the EU average, which conceals considerable variation across its Member States. At the secondary level, spending per student is almost ten times more in Austria than in Romania, but the gaps close significantly if the expenditure is expressed in terms of GDP per capita. And Sweden spends almost six and a half times more for each student at tertiary level than in Romania.

Table 3

Spending on education relative to national income, 2000

	Public expenditure on education as % of GDP	Private expenditure on education as % of total expenditure on education	Expenditure per student in EUR PPS		Expenditure per student compared to GDP per capita	
			Secondary	Tertiary	Secondary	Tertiary
Bulgaria	4.4	13.3	.	.	.	.
Czech Rep.	4.4	10.1	3,035	5,199	24	41
Estonia	6.7	3.5	.	.	.	.
Hungary	4.5	11.7	2,085	5,069	20	57
Latvia	6.0	24.9	1,855	3,018	27	43
Lithuania	5.9	13.4	.	.	.	.
Poland	5.1	3.4	1,657	2,818	18	31
Romania	2.9	8.3	899	1,938	17	37
Slovakia	4.3	3.6	1,772	4,720	17	43
Acceding countries	4.9	4.6	2,075	3,641	21	37
EU	*4.9*	*11.6*	*5,639*	*8,334*	*25*	*37*
Austria	*5.7*	*5.8*	*8,452*	*10,003*	*33*	*39*
Sweden	*7.4*	*3.0*	*6,719*	*13,651*	*28*	*57*
USA	*4.9*	.	.	.	.	.
Japan	*3.6*	.	.	.	.	.

Note: Private expenditure data are 1999 for Bulgaria, Estonia, Latvia, Lithuania and Poland.

Source: Eurostat New Cronos Database, June 2003.

Participation on formal education provides a measure of how much time people put into formal education. Table 4 shows the net enrolment ratio for secondary education and the gross enrolment ratio for tertiary education. Net enrolment ratios (adjusted for the number of students in the age group) in secondary education are high across Eastern Europe, but there marked differences between the relatively poor countries in the region such as Albania versus the richer countries which have ratios that are similar to Austria and the United States. There is much more variation in the gross enrolment ratio (not adjusted for the age of the student) in tertiary education ranging from just over 15% in Albania to

Table 4

Secondary and tertiary education, 2000/2001

	Secondary		Tertiary		
			percentage of which:		
	Net enrolment ratio	Gross enrolment ratios	Life sciences	Computing	Engineering
Albania	73.9	15.1	1.0	0.8	3.5
Bulgaria	87.6	40.8	0.6	1.6	16.0
Croatia	79.3	32.6	.	.	
Czech Rep.	88.3	29.8	1.7	8.5	8.7
Estonia	82.8	57.5	1.4	3.5	7.7
Hungary	87.2	40.0	0.5	1.8	13.8
Latvia	87.0	63.1	0.9	3.2	7.1
Lithuania	88.6	52.5	0.6	2.6	13.1
Macedonia	81.0	24.4	1.5	3.1	12.7
Poland	90.9	55.5	1.3	1.2	9.5
Romania	79.6	27.3	2.7	.	.
Yugoslavia	76.8	26.2	.	.	.
Slovakia	74.9	30.3	1.1	3.7	13.4
Slovenia	96.1	60.5	1.0	2.6	12.0
Russia	83.3	64.1	.	.	.
Austria	88.5	57.7	3.1	4.2	7.0
Germany	88.8	.	.	4.3	9.0
United Kingdom	93.7	59.5	4.6	5.1	5.9
USA	88.1	72.6	.	.	.
Japan	99.6	47.7	.	.	.

Note: Secondary education is defined as ISCED 2-4 and tertiary education as ISCED 5-6. Secondary education data for Russia is gross and not net. Secondary enrolment data for Hungary, Japan and Macedonia are 1999/2000.

Source: Enrolment data from UNESCO database, June 2003, percentage tertiary enrolment calculated from Eurostat New Cronos Database, June 2003.

just under 73% in the United States. The table also presents the percentage of tertiary students in study programmes considered important for certain key technologies. Enrolment in engineering programmes continues to be significant in Eastern Europe, continuing a legacy from the central planning period that emphasized mechanical technologies. By contrast, enrolment in computing and life science, important for ICT and biotechnology, tend to be below the percentage share in Austria, Germany and the United Kingdom. Nevertheless, there is strong evidence that the social sciences, and especially business education, has improved significantly in Eastern Europe, as well as in Russia.

4 R&D activity in Eastern Europe

Financial and human resources devoted to R&D are two of the most commonly used indicators of technological inputs. Finance for R&D is generally channelled to basic research, applied research or experimental development. Researchers, including scientists

and engineers, with at least tertiary level qualifications in an S&T field of study, carry out these activities. Together, they measure the scientific inputs that go into technological activities, but they do not capture innovative activities that go beyond R&D (OECD, 2002).

Table 5 shows the evolution of gross expenditure on R&D (GERD) as a percentage of GDP, and the number of researchers per thousand of employment. Through the 1990s R&D activity increased in the EU, the US and Japan, whereas it decreased in Eastern Europe and Russia, especially during the first years of transition. This decline appears less dramatic in the tables as the rapid decline in aggregate output during this period masked the extent of the decline in total R&D activity. Bulgaria and Slovakia experienced the greatest decline in R&D intensity, while it declined negligibly in Croatia and Slovenia. Some countries experienced a growth in GERD as a percentage of GDP at the end of the 1990s, especially in Hungary where it increased by almost 0.3% from 1999 to 2001. The rapid rise in the production of knowledge-based products, combined with a subsidy programme in Hungary to attract R&D laboratories, explains much of this growth.

All of the CIS countries experienced sharp falls in GERD, and in research intensity (despite the large reductions in absolute levels of GDP) through the 1990s. In some countries, such as Russia and Ukraine, the falls in the number of researchers were much less dramatic, as research institutes, particularly those under the Academy of Sciences, managed to survive through a mixture of financial improvization and relying on the bare essentials, often involving the redeployment of scientists as instrument-makers, service engineers, etc. In others, such as Armenia and Uzbekistan, GERD and the number of researchers both declined sharply, as entire research institutes were shut down. Nevertheless, much of the old system remains intact in the CIS countries, and in some cases the organization of R&D has not been restructured in any meaningful way. (See appendix for the CIS countries.)

A hardening of the soft budget constrain and the disintegration of the old industrial ministries after the collapse of central planning left most of the industrial R&D institutes in the former command countries without finance. This came at a particularly difficult time, when exposure to international competition effectively made the bulk of their competences obsolete (Pavitt, 1997). At the same time this exposure also revealed an ineffective innovation system with inadequate links between the academy of sciences (mainly basic research), and the industrial R&D institutes and universities (mainly applied research). In other words, enterprises in the command economy depended much more on extramural R&D activity than a market-based economy. The result was a tenuous connection with innovation, diffusion and productivity gains. It therefore became imperative for the transition economies to make the innovation system more effective and responsive to the market, but this meant changing the functions of the institutes and integrating them into industrial enterprises (Radošević, 1998). The inherited system made it easier for some countries

Table 5

R&D activity in Eastern Europe and selected countries, 1990-2001

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Gross domestic expenditure on R&D (GERD) as a percentage of GDP											
Bulgaria	1.53	1.64	1.18	0.88	0.62	0.52	0.51	0.57	0.56	0.52	.
Croatia		1.01	1.04	0.84	0.96	0.99	0.77	0.71	0.98	.	.
Czech Rep.	2.02	1.72	1.21	1.1	1.01	1.04	1.16	1.24	1.24	1.33	1.30
Estonia	.	.	.	.	.	.	.	0.61	0.75	0.66	
Hungary	1.07	1.05	0.98	0.89	0.73	0.65	0.72	0.68	0.69	0.80	0.95
Latvia	.	0.59	0.49	0.42	0.53	0.46	0.42	0.45	0.40	0.48	0.44
Lithuania	.	.	0.43	0.51	0.48	0.52	0.57	0.57	0.52	0.6	0.68
Macedonia	.	.	.	.	.	.	.	0.43	.		
Poland	0.81	0.83	0.83	0.76	0.69	0.71	0.71	0.72	0.75	0.70	0.67
Romania	0.79	0.85	0.91	0.77	0.8	0.71	0.58	0.49	0.4	0.37	0.40
Slovakia	2.16	1.80	1.39	0.92	0.94	0.94	1.09	0.79	0.66	0.67	0.65
Slovenia	2.31	1.91	1.60	1.76	1.69	1.44	1.42	1.48	1.51	1.52	1.63
Yugoslavia	1.15	0.86	.	1.17	1.11	1.26	1.29	1.24	1.40		
Russia	1.43	0.74	0.77	0.84	0.79	0.90	0.97	0.92	1.01	1.05	1.16
EU	*1.90*	*1.88*	*1.87*	*1.82*	*1.80*	*1.80*	*1.80*	*1.81*	*1.86*	*1.89*	*1.93*
Austria	*1.47*	*1.45*	*1.47*	*1.54*	*1.56*	*1.60*	*1.71*	*1.78*	*1.85*	*1.84*	*1.90*
USA	*2.72*	*2.65*	*2.52*	*2.43*	*2.51*	*2.55*	*2.58*	*2.60*	*2.65*	*2.72*	*2.82*
Japan[1]	*2.75*	*2.7*	*2.62*	*2.57*	*2.69*	*2.77*	*2.83*	*2.94*	*2.94*	*2.98*	*3.09*
Researchers and scientists per thousand employment[2]											
Bulgaria[2]	13.9	11.4	8.4	3.8	4.2	4.4	3.8	3.8	.	3.0	.
Croatia[2]	.	6.7	6.9	6.9	7.1	6.9	5.2	4.2	5.4	.	.
Czech Rep.[2]	.	4.0	2.7	2.6	2.3	2.5	2.4	2.4	2.6	2.7	.
Estonia[2]	.	.	7.1	7.3	6.9	6.8	6.7	6.3	6.9	6.9	.
Hungary	3.2	3.0	3.1	3.1	2.9	2.9	3.1	3.2	3.3	3.8	3.8
Latvia[2]	.	.	.	3.8	3.0	3.2	2.9	3.1	3.4	5.1	4.8
Lithuania[2]	.	.	.	.	.	2.5	2.5	2.7	2.6	2.5	2.5
Poland	.	.	.	2.7	2.9	3.1	3.2	3.3	3.3	3.2	3.3
Slovakia	.	.	.	4.2	3.9	4.0	4.0	4.0	3.6	3.8	3.6
Slovenia	.	.	4.0	5.1	5.1	4.7	4.2	4.4	4.6	4.5	4.5
Romania	.	.	3.8	2.8	2.7	2.6	2.4	2.4	2.0	1.8	1.7
Yugoslavia[2]	4.7	4.4	4.7	4.9	5.2	5.6	5.5	5.3	.	.	.
Russia	.	.	.	8.4	8.4	7.7	7.3	6.7	6.8	7.1	7.2
EU	4.4	4.5	4.6	.	4.8	4.9	5.0	5.1	5.3	5.5	.
Austria	.	.	3.3	.	.	.	.	4.7	.	.	.
USA	7.6	.	7.7	.	7.7	.	8.4	.	9.0	.	.
Japan	9.1	9.4	9.6	9.9	10.1	9.2	9.2	9.7	9.9	9.7	10.2

Note: Data from Bulgaria, Croatia, Estonia, Latvia, Lithuania. Macedonia, and Yugoslavia are from national sources and may not be compatible with the OECD guidelines. - 1) Adjusted by OECD up to 1995. - 2) Researchers and scientists per thousand labour force.

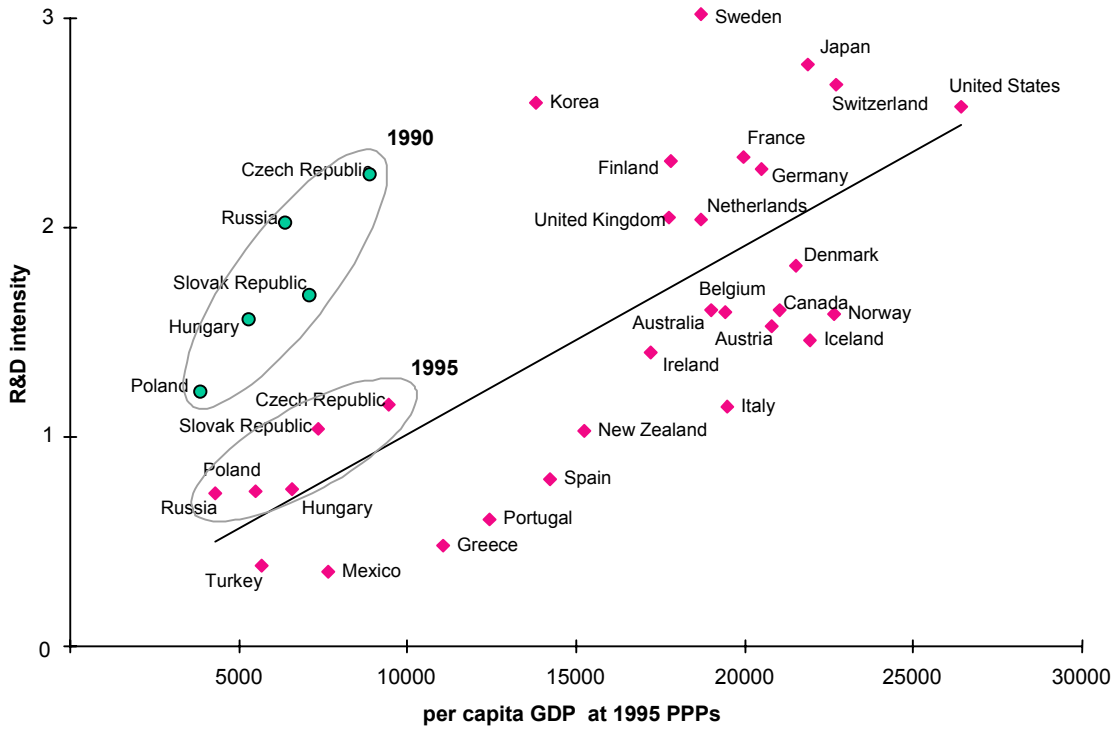
Source: OECD Directorate for Science, Technology and Industry and national sources.

such as Slovenia and Croatia to restructure the existing institutions, but other countries such as Russia dismantled much of the system, loosing some of the advantages that might have been better exploited in a market economy.

After the initial declines, the R&D intensity flattened out at a level comparable with other countries with a similar GDP per capita by 1995. Tight R&D budgets combined with the need to shift priorities away from extramural to intramural expenditures explain much of the decline. Figure 2 shows the research intensity and per-capita income for the OECD countries in 1995 and the countries of Eastern Europe and Russia in 1990 and 1995. In this figure GERD as a percentage of GDP is positively associated with a certain level of overall economic development. It may be the case that R&D leads to a higher GDP per capita, or it could also indicate that a higher level of economic development allows firms to spend relatively more on R&D. There is likely to be processes of cumulative (two-way) causality at work here. Figure 2 also shows the relative positions of Eastern Europe and the Soviet Union at the time of the collapse of central planning in 1990 and in 1995. The R&D intensity in both Eastern Europe and Russia was similar to the less developed economies of the European Union (Greece, Portugal and Spain) by 1995, all of which have a GDP per person two times higher on average. In comparison with countries of similar GDP per person (Mexico, Turkey) their R&D intensity is twice as high, indicating that there was still considerable scope for restructuring the innovation system at the time.

Figure 2

Research intensity and GDP per capita, 1995

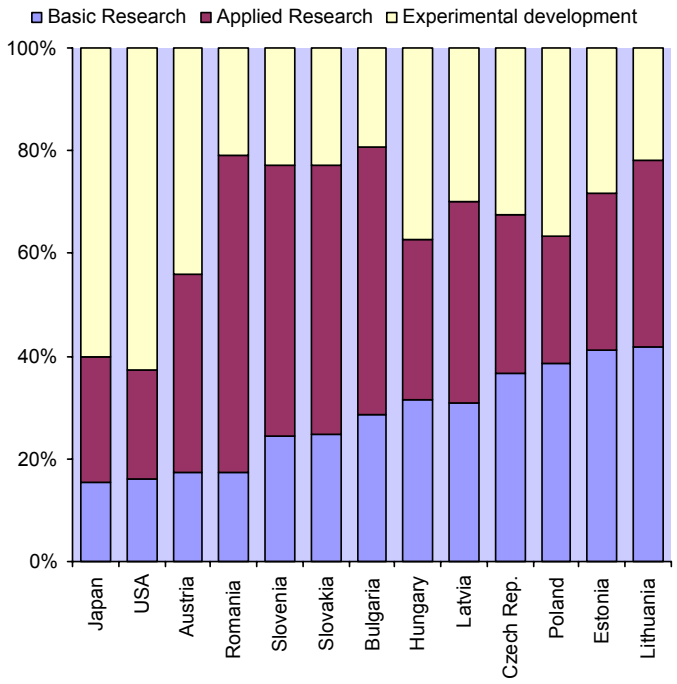


Source: Own calculations based on national sources and OECD Directorate for Science, Technology and Industry.

At the turn of the century the transition economies continued to focus more on basic research interests and much less on the problems of production and manufacturing. As figure 3 illustrates, all of the transition economies do much less experimental development as a percentage of all R&D activities then the USA and Japan. This suggests that the transition economies may still have a problem in translating knowledge gained from basic research and applied development into operational programmes and viable products.

Figure 3

GERD by type of activity, 2000 (percentage of total GERD)



Source: OECD Directorate for Science, Technology and Industry and Eurostat New Cronos database, Sept. 2003.

This problem becomes more evident when R&D activity is looked at from the point of view of source of financing and performing sector. Table 6 reveals that Eastern Europe and Russia still depended more on government performing and financing R&D activities than western economies at the turn of the century. The relatively low percentage of R&D financed by the government in the Czech Republic and Slovakia reflects the abrupt withdrawal of financial support to the majority of research institutes and the attempt to privatize some of the R&D institutes in these countries. Yet the relatively high percentage of R&D being performed by government across the region indicates that remnants of the old S&T system still survive. The Hungarian and Polish governments, for example, have pursued a strategy of gradually restructuring R&D, an approach that has included subsidization of certain research institutes, many of which are under the control of the old academies of sciences. On the other hand, the relatively higher percentage of R&D performed by higher education in these two countries shows that some parts of the S&T system are being substantially restructured.

Table 6

R&D expenditure by source of financing and performing sector, 2000

As a percentage of total GERD

	Source of financing				Performing sector		
	Industry	**Govern-ment**	**Other national sources**	**Abroad**	**Business enterprise**	**Govern-ment**	**Higher education**
Bulgaria	24.4	69.2	1.1	5.3	21.4	68.6	9.9
Croatia	42.2	46.2	10.8	0.8	35.0	26.6	38.4
Czech Rep.	51.2	44.5	1.1	3.1	60.0	25.3	14.2
Estonia	24.2	59.2	3.9	12.7	22.5	23.1	52.4
Hungary	37.8	49.5	0.3	10.6	44.3	26.1	24.0
Latvia	37.8	49.5	0.3	10.6	44.3	26.1	24.0
Lithuania	.	.	.	.	21.5	42.0	36.5
Poland	32.6	63.4	2.1	1.8	36.1	32.2	31.5
Slovakia	54.4	42.6	0.7	2.3	65.8	24.7	9.5
Slovenia	53.3	40.0	0.4	6.2	56.3	25.9	16.3
Romania	49.0	40.8	5.3	4.9	69.4	18.8	11.8
Russia	32.9	54.8	0.4	12.0	70.8	24.4	4.5
EU	*55.8*	*34.7*	*0.7*	*7.1*	*64.2*	*13.6*	*21.4*
Austria	*40.2*	*39.9*	*0.3*	*19.6*	*63.6*	*6.4*	*29.7*
USA	*69.3*	*26.0*	*4.7*	*0.0*	*75.2*	*6.8*	*13.9*
Japan	*72.4*	*19.6*	*7.6*	*0.4*	*71.0*	*9.9*	*14.5*

Note: Data for Croatia and the performing sector in Austria are 1998 instead of 2000.

Source: OECD Directorate for Science, Technology and Industry, Eurostat New Cronos database, July 2003, and national sources.

While Russia also relies heavily on the government for funding R&D expenditure, the business enterprises perform comparatively more R&D than most countries of Eastern Europe. Many of the Russian high-tech enterprises were forced to search for funds abroad in the late 1990s, which financed 17% of R&D activity in 1999 (OECD MSTI database). The high proportion of R&D performed by the business sector in Russia reflects its dependence on defence-related R&D spending and other government programmes, rather than the dynamism of innovation enterprises. It also suggests that higher education is still not playing a significant role in Russia in the performance of R&D. Across the transition region, firms still rely on central sources for R&D funding to an abnormal extent. This confirms the impression that the national innovation systems of Eastern Europe and Russia still retains many features of the old system at the turn of the century.

5 The sectoral composition of national R&D activities

Differences in R&D intensity are known to be much greater across industries than across countries within an industry. These differences reflect both general changes that are

Table 7

Sectoral distribution of industrial R&D expenditures, 2000

As a percentage of total manufacturing sector

		Bulgaria	Czech Rep.	Estonia	Hungary	Lithuania	Latvia	Poland	Romania	Slovenia	Slovakia	Russia	Austria	USA	Japan
D	Total Manufacturing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
DA	food, bev. & tobacco	0.3	0.8	8.0	2.7	16.4	7.8	2.9	0.1	2.4	0.0	0.1	1.1	1.2	2.5
DB	textiles	0.0	1.1	2.0	0.1	3.8	5.2	2.7	2.1	2.8	0.4	0.2	1.2	0.2	0.7
DC	leather	0.0	0.1	0.0	0.0	0.1	0.0	0.2	in db	1.8	0.0	0.1	in db	in db	in db
DD	wood prod.	0.1	0.1	0.0	0.6	0.0	8.9	1.9	1.3	0.5	0.0	1.0	0.6	0.1	0.3
DE	paper & publishing	0.1	0.1	0.0	0.6	0.0	0.0	0.7	0.9	0.4	0.0	0.5	0.9	2.4	0.8
DF	petroleum prod.	in dh	0.1	0.0	1.0	0.0	0.0	1.9	0.6	0.0	0.0	0.6	1.2	0.9	0.3
DG	chemicals & fibres	47.4	10.3	35.3	50.7	5.0	44.4	17.2	7.6	37.2	19.3	4.9	12.2	16.4	15.8
DH	rubber & plastic prod.	16.2	2.1	0.0	1.7	20.0	0.0	2.8	1.4	2.3	13.3	0.5	2.7	1.3	2.5
DI	non-metallic mineral prod.	in dh	2.2	0.0	0.3	29.9	3.4	1.4	3.2	1.8	0.0	0.9	2.7	0.7	1.7
DJ	basic & fabricated metals	0.6	7.4	1.6	0.8	1.1	4.1	6.4	16.1	6.3	0.0	2.2	6.4	2.0	4.1
DK	machinery & equip.	7.3	13.0	11.3	4.0	6.5	22.6	19.2	67.2	9.7	16.5	18.6	11.2	5.2	9.7
DL	electrical & optical equip.	25.5	9.3	4.2	33.5	13.8	3.7	20.9	in dk	33.7	30.1	11.3	43.9	45.6	46.3
DM	transport equipment	0.0	51.4	29.9	4.4	1.2	0.0	21.7	in dk	0.9	4.7	59.7	14.5	23.3	14.2
DN	manufacturing n.e.c.	0.0	2.0	3.8	0.2	0.0	0.0	1.0	0.8	0.6	3.1	0.0	1.2	0.6	0.9

Note: Data for Austria are 1998.

Source: Own calculation based on OECD Directorate for Science, Technology and Industry ANBERD and New Stan databases, and Eurostat New Cronos database, July 2003.

Table 8

R&D intensity by industry, 2000

Business enterprise RSE per thousand workforce

		Bulgaria	Czech Rep.	Estonia	Hungary	Lithuania	Latvia	Poland	Romania	Slovenia	Slovakia	Austria	USA	Japan
D	Total Manufacturing	0.39	2.22	0.46	1.52	1.00	0.19	0.89	1.07	3.39	1.77	4.58	8.52	9.20
DA	food, bev. & tobacco	0.64	0.16	0.21	0.27	0.61	.	.	0.41	.	.	0.41	1.07	2.03
DB	textiles	.	0.43	0.07	0.03	0.22	0.09	0.43	0.16	1.44	0.16	1.34	0.51	2.16
DC	leather	.	0.48	.	0.00	.	.	0.20	.	1.49	.	.	.	.
DD	wood prod.	0.04	0.05	0.00	0.69	.	0.08	0.46	0.40	1.22	.	0.55	0.43	2.66
DE	paper & publishing	0.89	0.03	0.00	0.18	.	.	0.09	0.22	0.16	.	0.50	1.85	0.94
DF	petroleum prod.	.	0.18	.	0.23	.	.	0.34	0.34	1.26	.	1.87	3.05	0.56
DG	chemicals & fibres	1.61	3.43	3.84	7.61	1.93	2.36	2.04	1.22	13.36	5.23	15.13	12.59	17.79
DH	rubber & plastic prod.	2.63	0.97	.	0.67	7.09	.	0.60	0.67	1.51	5.64	5.45	2.85	19.69
DI	non-metallic mineral prod.	.	0.56	.	0.09	7.85	0.22	.	0.62	1.48	.	3.01	2.18	4.60
DJ	basic & fabricated metals	0.02	1.07	0.11	0.15	0.32	0.08	0.53	1.29	1.05	.	1.91	1.60	3.26
DK	machinery & equip.	0.28	2.93	1.49	1.05	2.00	1.11	2.50	9.39	3.95	3.89	4.45	5.51	9.61
DL	electrical & optical equip.	1.90	1.86	0.20	2.69	1.62	0.18	2.65	.	8.87	5.95	15.89	21.43	20.67
DM	transport equipment	.	9.95	2.65	0.50	0.37	.	2.98	.	0.79	0.79	10.99	16.17	12.74
DN	manufacturing n.e.c.	.	1.11	0.21	0.19	.	.	0.21	0.16	.	2.45	1.04	1.33	1.45

Notes: Value added based on factor prices. Data for Austria are 1998.

Source: Own calculation based on OECD Directorate for Science, Technology and Industry ANBERD and New Stan databases, and Eurostat New Cronos database, July 2003.

common to all industries and changes in industrial composition. Table 7 presents the sectoral distribution of business enterprise R&D expenditures. While the level of disaggregation is not enough to properly identify the high technology sectors, pharmaceuticals is including in DG, computers, electrical machinery and optical equipment are included in DL and aerospace is included in DM. As expected, most of the R&D expenditures are concentrated in only a few sectors. Over 50% of the Bulgarian and Hungarian R&D expenditures in manufacturing are in the chemical industry, and mainly in pharmaceuticals in Hungary. In the Czech Republic and Russia, over half of the R&D expenditures by manufacturing firms is in transport equipment, mainly automobiles in the Czech Republic and aerospace in Russia. Machinery and equipment remain important in Romania. Other countries do not have such a high concentration of R&D activity in one industry, but almost all of this activity is concentrated in the industries that produce relatively high-tech products and/or use high-tech equipment.

R&D intensity measures the technological sophistication of an industry. Table 8 shows these intensities as R&D expenditures per unit of value added. Although the variation of R&D intensity is smaller across countries than across industries, all of the countries of Eastern Europe are below the R&D intensity in Austria, the United States and Japan. Part of the reason is that the definition of high-technology depends on the R&D intensity in the most technologically advanced countries. Because it is defined in this way it does not imply that a low R&D intensity means a low level of technology. In Austria, which has an overall R&D intensity of about half of the United States and Japan, innovation depends on the intermediate and capital good imports form other sectors, both domestically and from abroad. A low R&D intensity can also indicate fragmentation in the global production system. When the production system is fragmented, some enterprises can perform relatively low-skilled assembly of relatively high tech components, as is the case in Estonia and Hungary.

6 Inventive activity in Eastern Europe

Patents are a means of protecting inventions, and as such can be taken as a measure of inventive activity or the output of R&D. Table 9 presents the average number of resident patent applications from 1998 to 2000 and the average number of US granted to the inventor from 1998 to 2002. Since the United States has the largest market for technology, the number of patents granted in the United States provides one of the best technological ‘output’ indicators. Because the United States is the home country of American inventors, the number of United States patents per million of the population is biased upward, but the table does show clearly the differences between Western and Eastern Europe. As with other indicators, the more advanced East European economies have similar patterns of patenting activity to the southern EU countries, but Hungary and Slovenia are well above the average of these countries.

Table 9

Patenting activity, 1998-2002

	Resident patent applications		USPTO patents granted			
					RTA	RTA
	Average 1998 to 2000	patents per million pop.	Average 1998 to 2002	patents per million pop.	ICT	biotech
Bulgaria	279	34.4	4	0.5	0.25	2.31
Croatia	303	69.1	11	2.5	0.13	.
Czech Republic	619	60.3	31	3.0	0.25	1.71
Estonia	18	13.3	2	1.5	0.19	7.06
Hungary	806	79.7	48	4.8	0.33	1.84
Latvia	130	54.4	2	0.9	0.51	0.64
Lithuania	96	27.2	2	0.5	0.17	0.00
Poland	2,372	61.4	21	0.6	0.26	1.64
Romania	1,132	50.4	5	0.2	0.28	0.00
Slovakia	231	42.8	7	1.2	0.18	6.05
Slovenia	309	155.7	17	8.7	0.12	0.39
Yugoslavia	421	39.6	4	0.3	1.24	6.36
Russia	20,140	138.1	221	1.5	0.64	1.37
Ukraine	5,462	109.9	23	0.5	0.28	1.34
Austria	3,071	379.0	505	62.3	0.37	1.28
USA	157,772	562.8	84,481	301.3	1.05	1.27
Japan	370,104	2920.2	32,320	255.0	1.26	0.32

Source: Own calculations based on OECD Directorate for Science, Technology and Industry, Patent Database and World Bank Development Indicators, 2003.

Resident patent applications in each home country provide an alternative view of the patenting process, but they do not take into account the number of patents actually granted. The difference between the number of resident patent applications in the United States and the number of patents granted to residents of the United States provides a rough indication of the rate of success of patent applications. It is clear that there are many inventions for which researchers file patents in their home countries but not in the United States. Nevertheless, the general pattern of patent applications within each country is similar to the pattern of patents granted in the United States. In general, countries with a higher level of overall development generate more new technology than those at lower levels of development – not unexpectedly, because countries with relatively lower levels of GDP per capita generally acquire or absorb technology that is already patented.

To adjust for the relative patenting activity across countries, and to evaluate the relative strengths of ICT and biotechnology in Eastern Europe, the revealed technological advantage (RTA) was calculated for most countries using the US patent data. The RTA index was calculated in the table by taking each country's share of all patenting activity in

ICT and biotechnology over its total patenting activity (Patel and Pavitt, 1995).[15] The RTA index varies around unity, such that values greater than one indicate that the country is relatively strong in ICT or biotechnology. The second two columns of table 9 show that Eastern Europe is relatively weak in ICT, but shows some promise in biotechnology. Several countries have RTA's above one in this technology, which is foreseen to be the frontier technology in the coming decades.

7 Innovative activities in Eastern Europe

Formal R&D and patenting activity may not provide an accurate picture of the innovation process. Firm-specific capabilities are reflected in the ability of the firm to introduce higher quality products, cost-saving processes, and improved organizational and managerial processes. Such capabilities are often not captured in the traditional measures because they do not require R&D and are covered by other forms of intellectual property rights (IPRs). Innovation surveys collect data on the input to, and output from, innovation at the firm level, and identify the main factors influencing the innovative behaviour of firms. Eurostat carried out three innovation surveys, one in 1994 (CIS-1) one in 1997 (CIS-2) and another in 2001 (CIS-3). Latvia, Lithuania, Poland, Romania, Russia, Slovakia and Slovenia carried out their own surveys in the late 1990s, using a similar methodology. The Czech Republic, Estonia, Latvia, Lithuania, Poland and Slovenia carried out surveys in parallel with CIS-3.

Table 10

Percentage of innovative manufacturing firms in Eastern Europe and the EU

	Eastern Europe			European Community Innovation Surveys	
				II	III
	1994-96	1998-2000		1994-96	1998-2000
Estonia	.	39	European Union	54	47
Czech Rep.	.	30	Austria	67	53
Latvia	37	.	France	48	46
Lithuania	50	.	Germany	70	66
Poland	36	37	Italy	50	40
Slovenia	30	.	Greece	.	27
Romania	56	.	Spain	29	38

Note: Latvia is for 1996-98, Lithuania covers only product innovation and is for 1997-98.

Source: Eurostat New Cronos database, September 2003.

Table 10 summarizes some of the results from these surveys. About 54% of all manufacturing enterprises in the European Union introduced a product or process

[15] The index is defined as $(P_{ij}/\sum_j P_{ij})/(\sum_i P_{ij}/\sum_i\sum_j P_{ij})$, where P denotes the number of patents in country i and technology j.

innovation from 1994 to 1996 and about 47% introduced one of them from 1998 to 2000. The slight decline may also be due to differences in the questionnaire and to the group of countries included in the EU average. Although there were considerable differences across countries, the survey confirmed that product innovation and process innovations tend to occur together. The main reason is that the introduction of a new product almost always entails the introduction of a new method of production. Countries with a large proportion of dynamic high-tech industries also had a stronger tendency to innovate. One interesting observation is that Austria had a higher than average rate of innovation, although it had lower than average R&D intensities. This indicates that global markets are an important source of technology for these countries, as the table 6 had indicated.

Table 11

Percentage of innovative firms in Eastern Europe by industry

percentage of realized firms in sample

	EU	Czech Rep.	Poland	Lithuania	Latvia	Slovenia	Poland	Romania
		2000			1998		1996	
D Total Manufacturing	*46.6*	*30.2*	*36.5*	*50.1*	*37.4*	*31.9*	*36.0*	*55.5*
DA food, bev. & tobacco	44.3	29.4	35.2	57.8	50.0	0.0	35.3	38.7
DB textiles	31.7	17.0	23.6	9.1	2.9	1.8	3.2	4.7
DC leather	28.1	In DB	12.6	35.7	0.0	19.0	17.1	37.5
DD wood prod.	40.6	21.5	31.0	27.8	30.2	14.7	20.4	45.8
DE paper & publishing	44.6	In DD	26.3	45.9	12.5	10.1	20.8	33.3
DF petroleum prod.	61.8	73.0	64.3	100.0	100.0	0.0	71.4	100.0
DG chemicals & fibres	65.0	In DF	65.7	82.1	66.7	53.2	73.3	77.3
DH rubber & plastic prod.	57.8	29.8	40.3	59.3	22.2	26.8	46.5	78.8
DI non-metallic mineral prod.	46.1	25.6	44.6	55.6	28.6	24.5	30.9	58.8
DJ basic & fabricated metals	43.2	40.3	40.2	44.6	53.8	25.3	41.2	59.8
DK machinery & equip.	58.0	43.8	50.9	43.2	60.0	43.2	52.9	69.7
DL electrical & optical equip.	62.2	42.9	52.4	74.4	36.4	50.0	60.4	83.6
DM transport equipment	49.6	28.9	41.9	47.6	33.3	44.1	50.0	79.6
DN manufacturing n.e.c.	45.5	73.0	36.7	66.2	28.0	25.3	34.8	54.7

Note: EU is the average of all Member States except Ireland and UK.

Source Eurostat New Cronos database, September 2003 and national sources.

East European firms where much less likely to innovate. Innovative activity in Romania and Lithuania appeared slightly above the European Union average in both CIS-2 whereas Czech Republic Estonia, Poland and Slovenia appeared below the average in both surveys. A second survey made in 1998 indicates some improvement in Slovenia, and in Poland the share of technologically new and improved products in total sales steadily increased between 1996 and 1999 (GUS, 2000). However, Russia appears to have

serious problems in introducing new products and processes. This confirms the belief that there has been little reform of the S&T system in Russia.

The spread of innovative activity across industries and the frequency of product and process innovation is also important for determining the rate of structural change in Eastern Europe. Table 11 provides a breakdown of innovative activities by industry in several Eastern European countries. As we might expect, firms in the science-based industries such as chemicals (DG) and electrical and optical equipment (DL) tend to be more innovative than firms in other industries. Petroleum firms (DF) were important innovators in every country except Slovenia.

8 Domestic R&D and international technology transfer in Eastern Europe

International technology transfer and local diffusion has been especially important for small countries such as those in Eastern Europe attempting to catch up with the technological leader. There are at least five ways that technology can be transferred across countries: (1) foreign direct investment; (2) joint ventures; (3) strategic alliances; (4) technology licensing; and (5) capital goods imports (or embodied technology transfer). Most often, domestic R&D efforts complement technological knowledge obtained from abroad. R&D undertaken by the enterprise is necessary for identifying, assimilating and utilizing existing knowledge from abroad as pointed out by Cohen and Levinthal (1989).

Inward foreign direct investment (FDI) frequently includes a transfer of technology. Certain activities by multinational enterprises can help to shape the speed and direction of the economic transformation of Eastern Europe by transferring technology directly to affiliates and indirectly to domestic firms through technology spillovers. But this may not always be the case. Damijan et al. (2003a) analyse panel data from a sample of enterprises in eight accession countries for intra-industry spillovers from FDI, firms' own R&D accumulation and international R&D spillovers. After controlling for potential selection bias for foreign investment decisions, common economic policy influences and industry effects, the analysis shows that technology often transfers through the parent-subsidiary relationship and trade, but that the expected spillover benefits to purely domestic enterprises are rare. In addition, there is evidence that there are significant crowding-out effects for local firms in competing industries in some countries. For the Czech Republic, Poland, Romania and Slovenia, there is evidence that trade may be a more important channel of technology transfer than FDI. A small innovation survey carried out during 1996 in Hungary suggests that foreign affiliates introduce process innovations more often than local enterprises, but that the local enterprises are more likely to introduce new products (Tamas, 1997).

The technology balance of payments measures the international trade in scientific or technological knowledge. Table 12 shows the technology balance of payments as a

percentage of GERD. This table shows that Hungary to be highly dependent on imported scientific and technical knowledge and relatively less on the domestic R&D effort. By contrast the United States and Russia depend more on domestic R&D activity. But openness and size of the country will also matter, as the high share observed in Austria and Germany illustrate. The highest country in the world is Ireland, which had international royalty and licence fees that were more than 6 times its own R&D expenditures in 2000.

Table 12

Technology balance of payments as a percentage of GERD, 1993-2000

	1993	1994	1995	1996	1997	1998	1999	2000
Czech Rep.	.	.	.	.	49.8	72.1	83.9	.
Hungary	..	..	..	73.3	95.1	109.0	152.8	..
Poland	..	17.8	26.7	34.6	40.1	35.5	57.7	73.7
Slovakia	..	..	14.8	23.1	26.0	34.4	46.3	48.8
Slovenia	2.6	3.9	3.5	4.2	3.9	3.2	4.0	8.1
Romania	..	0.9	0.7	0.9	2.5	1.0	11.3	4.4
Russia	..	..	..	..	..	2.2	19.1	6.7
Austria	52.6	50.6	58.5	69.8	71.6	79.4	67.5	69.2
Germany	22.4	21.7	23.7	26.3	30.6	32.7	33.5	38.7
UAS	3.0	3.4	3.8	4.0	4.3	5.0	5.2	6.1
Japan[1]	2.6	2.7	2.7	3.1	3.0	2.8	2.7	2.9

Source: OECD Directorate for Science, Technology and Industry and national sources.

9 Is there a role for science and technology policy?

In the market-based economy the social returns to R&D tend to be well above the private returns. This difference supports the idea of an innovation policy to encourage and support research and institution-building to ensure that there are the incentives for private industry to take initiatives. Substantial distortions in the market economy keep R&D spending from approaching its optimal level. Jones (1998) identifies three such distortions: (1) the profitability of research; (2) duplication of knowledge; and (3) consumer-surplus effects. The basic sciences have, for example, considerable scope for knowledge spillovers and consumer-surplus effects in the long run, but little possibility for making profit until someone can find some consumer use for the idea. This is one reason why subsidies to research in universities and collaborative efforts between universities and private business are so important.

The centrally planned economy had the opposite problem. Several authors including Hanson and Pavitt (1987) pointed to the problem of excessive R&D spending especially in the military by Eastern Europe and the Soviet Union before 1990. This problem was

exacerbated by chronic shortages in the economy and the belief that any expenditure on R&D would increase the growth rate. Since the organization of industry provided little scope for knowledge spillovers, the scale research and development encountered diminishing returns and ultimately a declining growth rate. Although there was a conscious attempt to reduce the static inefficiencies of the market economy, central planning ended up eliminating the dynamic efficiencies that create the positive feedback. Continually falling further behind, the science and technology systems of Eastern Europe and the former Soviet Union were exposed to the global market during the rapid transition from autarky to free trade. Pavitt (1997) argues that this transition has led to the creation of obsolete technical competences and social capabilities.

The chapter raised an important question: Does R&D activity and industrial innovation lead to economic growth in Eastern Europe? This question is difficult to answer since R&D can have a direct effect in creating new products and processes and an indirect effect in helping to create the capacity to absorb technology from abroad. Regression analysis of a cross section of industries in the industrial database shows that significant increasing returns are present in Eastern Europe. R&D activity, however, does not appear to explain productivity growth in the region, but it does explain innovative activity in Poland and Slovenia to a great extent.

There may be several reasons why R&D activity does explain the rapid rise in productivity growth. First, the organization of R&D in Eastern Europe has changed significantly during the 1990s. Radošević (1998) points out that R&D activity in the command economy depended heavily on state organizations such as the Academy of Sciences and other independent institutes that did research for industry. This organization together with the soft-budget constraint led to few technological spillovers, making the R&D system appear inefficient. This would explain why labour productivity rapidly increased while the R&D intensity rapidly declined. Second, demand can be a more important determinant of productivity growth than R&D activity. Kaldor (1966) observed that increasing demand encourages technical change and technological learning as firms try to rationalize production. This would explain why there is a high correlation between output growth and productivity growth in Eastern Europe. Third, the main objective of R&D activity is to enhance the ability of firms to assimilate and take advantage of technical knowledge from abroad. Cohen and Levinthal (1989) point out that firms often engage in R&D activity to improve their ability to imitate new process and product innovations. This may explain why there is a high correlation between R&D activity and industrial innovation in Eastern Europe. Finally, Patel and Pavitt (1995) observed that R&D activity is sectoral-specific and tends to underestimate technological activities related to production and in small firms. This is why innovation surveys and other indicators become important for determining the potential for Eastern Europe to catch up with the European Union.

The share of government funding of R&D remains high in Eastern Europe and Russia. Although it is higher than the EU average, this funding can play an important role in fostering growth and innovation depending on the socio-economic objective. Table 13 provides a breakdown of the government budget appropriations by socio-economic objective. Two patterns appear in the table: (1) US and Russia appropriate a high share of their R&D budgets on defence and space-related projects; and (2) Eastern Europe spends the largest share on economic development. Europe could represent a third pattern since it allocates a considerable proportion of the budget to the military and space, but the largest share of the budget goes to the universities. But the EU also becomes a peculiar example since the priorities of each member state vary widely.

Table 13

Government budget appropriations for R&D by socio-economic objective, 2002

In million current PPP $ and as a percentage of total R&D budget

		per cent of total GBOARD	*per cent of civil GBOARD*				
	Total Appropriation	Defence	Economic Development	Health & Environment	Space	Non-related	University
Romania	206	1.6	42.8	16.2	1.9	32.4	.
Slovakia	224	9.2	32.1	12	0	35.7	18.3
Slovenia	195	0.2	15.3	6.6	0	73.3	4.8
Russia	5,431	43.5	43.3	12.5	17.9	24.8	0
EU	74,169	15.1	20.7	16.2	6.2	17.4	38.3
Austria	1,388	0	12.5	8	0.1	13.6	65.8
USA	98,029	54	13.1	59.7	14.5	12.7	.
Japan	24,133	4.1	33.7	7.7	6.3	16	36.3

Note: Data for Slovenia, Russia and EU are 2001.

Source: OECD Directorate for Science, Technology and Industry, MSTI database 2003.

These issues point strongly to the need for the accession countries to strengthen their technology and innovation policy. Such a policy should not focus only on the appropriate level of public funding, but on strengthening the science and technology system. Direct support for R&D is only one element of a science and technology policy. Other policies can promote co-operation between government, industry and education, strengthen the education and training system, introduce measures to enhance technical change and technological learning in private business, and encourage multinationals to transfer technology to their foreign affiliates.

The re-emergence of growth theory has provided the rationale for technology and innovation policies. Instead of focusing on the static effects of 'market failures', economists now focus more on the systemic failures arising from inappropriate institutions. The economic transformation of Eastern Europe is a process of changing institutions. But this

process of institutional change must include not only structural reform, but also improving access to financial resources, improving the physical infrastructure and promoting skills development. And it may also require specific support measures that strengthen science and promote innovation.

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Appendix

The entire Commonwealth of Independent States (CIS countries) experienced a rapid decline in R&D expenditures. But unlike Eastern Europe, GDP continued to fall in most of the countries through the 1990s. As Table A1 shows, these declines in GERD as a percentage of GDP were very dramatic in some cases, reaching as low as .04% in Taijikistan. The decline in the percentage share was also much more dramatic than in Eastern Europe. Most of the decline was due to the disintegration of the Soviet Union and the Soviet innovation system. In the Soviet Union industrial institutes were dominant both in terms of R&D expenditure and research scientists. As pointed out by Radošević (1998), this institutional structure was inappropriate in a knowledge-based economy. In some cases such as Latvia, these research institutes were transformed into academic institutes with their old functions dissolved and in Hungary they became more constancy firms. Since most of the CIS countries produce very few knowledge-intensive products, the easiest solution was to eliminate funding the research institutes. In some cases they squeezed the research institutes by forcing down wages faster than the national average. As a result much of the system remains intact and in some of the CIS countries the R&D organization has not be restructured in any meaningful way. Table A2 shows that the number of researchers per thousand in the labour force has not declined so dramatically. Nevertheless some countries such as Armenia and Uzbekistan experienced a rapid decline of both GERD and RSE, indicating that they have dismantled some of the research institutes. However, Russia and to a lesser extent Ukraine continue to produce some relatively high technology products, especially in aerospace.

Table A1

Gross domestic expenditure on R&D (GERD) as a percentage of GDP, 1991-1999

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Armenia	1.09	0.83	0.30	0.22	0.08	0.27	0.23	0.28	0.30	0.26
Azerbaijan	0.75	0.53	0.69	0.51	0.31	0.24	0.38	0.42	0.38	0.35
Belarus	1.43	0.82	0.78	0.80	0.95	0.93	0.94	0.82	1.09	0.81
Georgia	1.10	0.48	0.04	0.09	0.11	0.20	0.33	0.25	0.28	0.19
Kazakhstan	0.56	0.26	0.43	0.33	0.27	0.35	0.22	0.22	0.19	0.17
Kyrgyzstan	0.33	0.31	0.20	0.27	0.26	0.22	0.21	0.21	0.14	0.13
Moldova	1.03	0.55	0.59	0.80	0.75	0.87	0.94	0.88	0.55	0.58
Russian Fed.	1.89	0.91	0.94	0.97	0.81	0.98	1.06	1.09	1.22	1.09
Tajikistan	0.44	0.46	0.26	0.29	0.11	0.06	0.04	0.04	0.06	0.07
Turkmenistan	0.48	0.51	0.58	.	0.26	0.20	0.15	0.10	0.07	
Ukraine	1.81	1.40	1.49	1.49	1.34	1.38	1.36	1.22	1.24	1.14
Uzbekistan	1.16	0.86	0.78	0.70	0.39	0.41	0.33	0.37	0.36	.

Sources: Own calculations and the Interstate Statistical Committee of the Commonwealth of Independent States.

Table A2

Researchers and scientists per thousand labour force, 1991-1999

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Azerbaijan	4.4	3.7	4.5	4.2	3.6	3.4	3.3	3.1	3.1
Armenia	10.3	10.2	4.7	4.2	4.5	5.1	4.4	4.9	3.7
Belarus	11.8	8.0	7.5	6.3	6.1	6.0	5.1	4.9	4.8
Georgia	9.9	12.4	12.6	9.3	10.9	8.1	8.0	6.0	6.2
Kazakhstan	3.6	2.7	3.1	3.0	2.7	2.2	2.0	2.0	1.8
Kyrgyzstan	3.3	2.7	1.9	2.1	2.2	2.0	1.6	1.5	1.4
Moldova	6.2	4.8	4.9	4.4	3.5	3.4	3.4	3.2	3.0
Russian Federation	14.6	13.7	11.1	9.4	9.3	8.7	8.3	7.7	7.7
Russian Federation (adj.)	.	.	.	8.4	8.4	7.7	7.3	6.8	.
Tajikistan	2.2	1.8	1.7	1.1	1.0	1.3	0.7	1.3	1.6
Turkmenistan	3.7	2.9	3.3	…	2.3	2.6	1.7	1.6	.
Uzbekistan	5.0	3.4	2.2	2.6	2.0	1.9	1.7	1.6	1.7
Ukraine	11.8	10.1	9.3	9.0	7.6	6.9	6.3	6.0	5.8

Source: Own calculations based on data from the Interstate Statistical Committee of the Commonwealth of Independent States. Adjusted figure for the Russian Federation is from the OECD Directorate for Science, Technology and Industry.

Roman Römisch *Chapter 6*

Developments in regional GDP and regional unemployment

Abstract

This chapter analyses the significant disparities that exist among the CEE regions in GDP per capita as well as in unemployment. Not only are these disparities of significant size but we also find that they have been growing over time. This has resulted in a clear segmentation of regions into a small group of well-developed regions and a lagging group comprising the vast majority of regions. As explanatory factors for these developments we find that the legacies of the past, and the production structure have a major influence. Thus regions with inherited heavy industry were struck hard by the transformation process as well as those regions specialized in agriculture. Furthermore we also show that regions that are closer to the western borders (i.e. western markets) generally have an advantage over other regions; the reason is the relatively short distance to potent markets that opens up business opportunities for domestic producers but also makes those regions preferred locations for FDI. Above all we find capital cities to be the regions with the highest economic development potential. As a rule all CEE capital cities are not only at a much higher development stage than all other regions of the respective country, but are also growing faster than all other regions. In summary, one can conclude that regional development in the CEECs is characterized by only few, but very dynamic growth poles that are – with some exceptions – concentrated around the capital cities.

Introduction

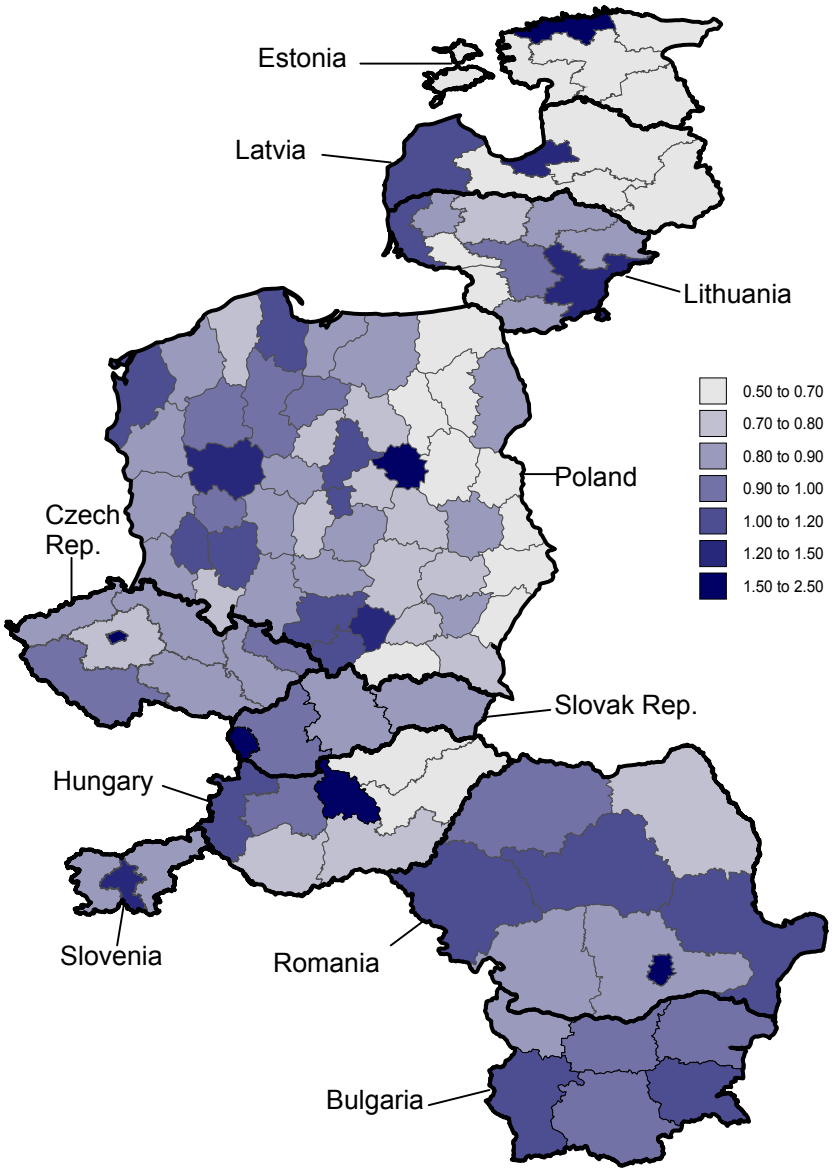
In this paper we present an overview of the economic situation in the regions of the Central and East European countries (CEECs) by analysing the development of regional GDP (per capita) and regional unemployment. For convenience we dedicate to each variable its own section. Both sections are basically structured in the same fashion; we first look at the *status quo*, highlighting existing regional disparities; in a second step we assess how these disparities evolved over time; in a final step we try to find some explanations, undertaking a number of econometric exercises to analyse why regions differ in their GDP per capita or unemployment situation.

1 Regional GDP

Every CEEC, even those most developed (in terms of GDP at PPS) such as Slovenia and the Czech Republic, consists of a heterogeneous set of regions. Thus within a given

Map 1

Relative GDP level in ten CEECs, 1998



country one regularly finds a number of well developed regions that are sometimes close to or even surpass EU average standards, as well as regions that are clearly staying behind.

To document this, Map 1 presents the regional distribution of GDP per capita for ten CEECs. In this map the GDP per capita level of an individual region is expressed as a fraction of the corresponding country's average GDP per capita level. This move from absolute values to relative measures allows a comparison of the existing disparities within

each CEEC (and its regions). It also provides insights about the similarities of the regional disparities across the CEECs. However, it does not indicate the absolute position of a region in one country compared to any region in another country.

An inspection of Map 1 immediately shows the most striking feature of the regional distribution of GDP within the CEECs: it is the dominant position of the capital city regions. In basically every country, with the exception of Poland, these regions have a much higher GDP per capita than the rest of the regions of their country. Poland is an exception in so far as there exist, apart from the capital city of Warsaw, two additional regions (Poznan and Krakow) that show above-average high per capita income levels.

Another major aspect of the regional distribution of GDP across the CEE regions is the fact that in most countries there exists an east-west pattern of income levels. This is fairly obvious for Hungary, Slovakia and Poland, where the regions in the west of each country have mostly higher income levels than the eastern regions. A similar pattern can be detected in Latvia and Lithuania, and it can be assumed (for reasons that will be mentioned later) that such a pattern exists for the other CEECs as well – though it might be blurred by other, more important factors that influence regional income levels.

1.1 Regional GDP dynamics

After having established the basic features of existing regional disparities, we proceed with an investigation of the evolution of these disparities: This analysis will build the basis for the third and final section of the paper, dedicated to explaining the evolution of the regional disparities theoretically as well as empirically.

The first two facts presented here are two well-known indicators – the Gini coefficient and the Coefficient of variation.

Table 1 shows the Gini coefficients for the regional GDP distribution in nine CEECs for the beginning and the end of the observation period.[16] In this case the Gini coefficient measures the size of the disparities concerning the regional distribution of GDP within a country. Thus, if the Gini coefficient is large, it implies that few regions (or sometimes just one) produce and earn a major part of (total) domestic GDP; if it is low, the country's GDP is quite evenly distributed across the regions. Additionally calculating the Gini coefficient for two distinct points in time allows to evaluate whether the distribution has become more or less even across regions.

[16] See data appendix for a description of the observation period.

Table 1

Gini coefficients, regional GDP, nine CEECs

	first year	last year
Bulgaria	0.215	0.262
Czech Republic	0.142	0.159
Estonia	0.404	0.439
Hungary	0.305	0.320
Latvia	0.368	0.400
Lithuania	0.399	0.444
Poland	0.421	0.435
Romania	0.083	0.090
Slovak Republic	0.139	0.146

Source: National Statistical Offices, own calculations.

Comparing the Gini coefficients of the individual countries it can be seen that there are basically two groups of countries: one with a quite equal distribution of GDP across regions and another group where the main weight in domestic income seems to be concentrated in few regions.

Romania, Slovakia and the Czech Republic, and to some extent also Bulgaria, belong to the first group, whereas all other countries (Estonia, Hungary, Latvia, Lithuania and Poland) fit in the second group.

However, it has to be noted that a comparison of Gini coefficients across countries is hampered by the differences in the detail of the regional breakdown across these countries. The size of the Gini coefficient depends heavily on whether a country has a regional division at a very aggregated level or at a disaggregated, detailed level. This is so because the more aggregate the regional breakdown, the more do regional differences generally disappear, as larger regions, containing a number of smaller sub-regions, always form a weighted average over these sub-regions.[17] This effect may partly explain the low values of the Gini coefficient especially for Romania and Bulgaria, since in both countries the size of the regions (in terms of population) is bigger than in other countries.

More interesting though – regardless of the group and the aggregation level of the regional division – is the fact that the distribution of income has become more uneven within every CEEC from the beginning to the end of the observation period.

[17] You can also think of the most extreme case of regional aggregation, which is the country as a whole and has the weighted average value of all regions and shows no disparities.

The calculation of the Coefficient of variation[18] in the same countries and for the same two points in time as before gives some additional information, since the point of reference is not the share in total GDP but the GDP per capita levels (at PPP) in each region. Thus the advantage of the Coefficient of variation over the Gini coefficient is that it abstracts from the size of the regions. Hence whereas larger regions – *ceteris paribus* – have a higher share in total GDP than smaller regions and therefore matter in the calculation of the Gini coefficient, size is of no importance for the Coefficient of variation, since the latter only looks at the income per capita. As a consequence, the Coefficient of variation is used here to determine the size of the disparities in GDP per capita across the regions, making it a valuable and complementary indicator to the Gini coefficient above.

The Coefficient of variation indicates that the per capita GDP levels are most evenly distributed in Bulgaria, Lithuania and Romania, whereas the highest disparities are to be found in Estonia and the Slovak Republic.

Note that it is not irrelevant whether total GDP or GDP per capita is used for measuring regional disparities. This is documented by the differences in the results of the Gini coefficient and the Coefficient of variation regarding the distribution of income across regions.

However, just as the Gini coefficient, the Coefficient of variation taken at two distinct points in time shows that the disparities across regions have increased, with the exception of Bulgaria where the per capita income levels seem to have converged.

Table 2

Coefficient of variation, regional GDP, nine CEECs

	first year	last year
Bulgaria	0.106	0.096
Czech Republic	0.269	0.344
Estonia	0.323	0.403
Hungary	0.243	0.292
Latvia	0.258	0.311
Lithuania	0.128	0.204
Poland	0.216	0.254
Romania	0.197	0.247
Slovak Republic	0.394	0.405

[18] The Coefficient of variation is calculated as the sample standard deviation divided by the sample mean.

Both indices used here point towards growing regional divergence in basically every CEEC. However, neither of the indicators tells us anything about which regions are growing faster and which are lagging behind. The next step of our analysis is going to shed some light on this point.

1.2 Distribution dynamics

This sub-section employs a relatively new non-parametric approach to a convergence / divergence analysis which, to the author's knowledge, was first used in an economic context by Quah (1997). The general principle of this method is to analyse the distribution of incomes (or other economic variables) over time, allowing to check graphically whether convergence or divergence occurred. Using this method for a discrete distribution usually means the calculation of a transition probability matrix, which gives the probability of moving between different discrete states. In the case of continuous distribution this means the computation of a stochastic kernel, which is the continuous counterpart of a transition probability matrix.[19]

Figures 1 and 2 present the kernel density estimates for the distribution of regional GDP per capita over time. Both figures are basically identical, only the perspective differs in so far as Figure 1 shows the three-dimensional version and Figure 2 shows the contour plot.

To read these figures, imagine that at the beginning the CEE regions are grouped and ordered on the t axis from the left to the right according to their GDP per capita level (relative to the average GDP per capita level). Thus regions with relatively low levels of per capita income are found on the left and the highest-income regions are found on the right. Since the t axis represents the first year of the observation period this grouping and ordering of regions gives in this context the (limit probability) distribution of regional per capita incomes at this point in time.

The same applies to the t+1 axis, which represents here the last year of the observation period.

The stochastic (Gaussian) kernel itself shows how likely it is for one region to move from one specific income level at point t in time to a certain income level at t+1.

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[19] For a technical description of a stochastic kernel estimation see Quah (1997).

Figure 1

Kernel density estimates for the distribution of regional GDP per capita over time, three dimensional

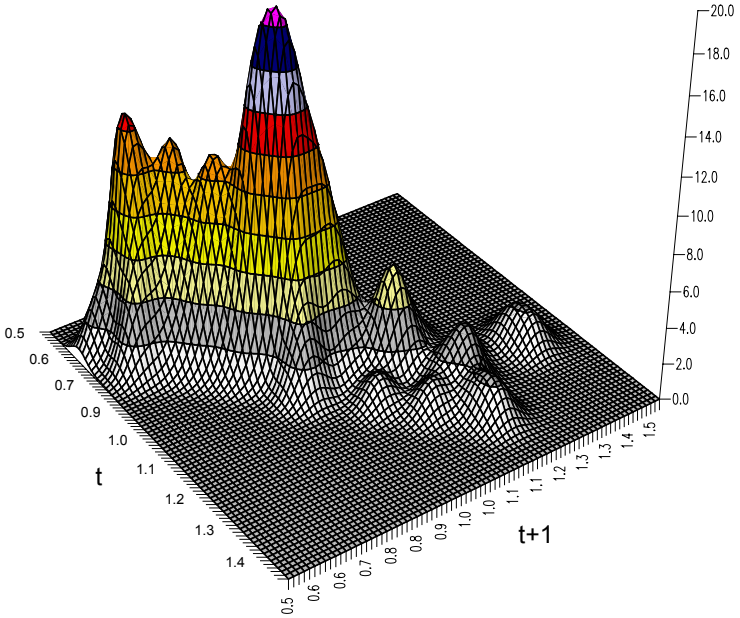
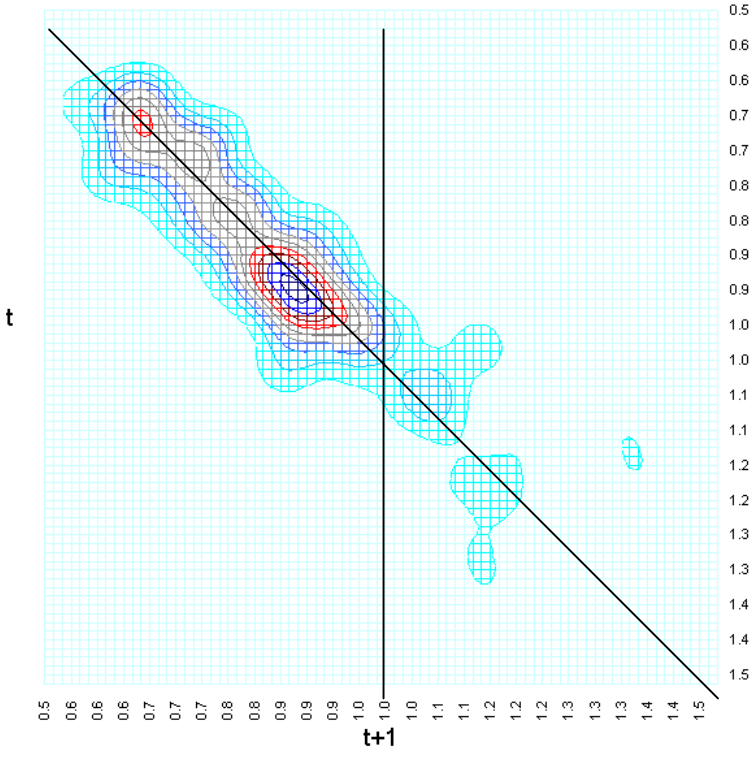


Figure 2

Kernel density estimates for the distribution of regional GDP per capita over time, contour plot



Assume, for example, that a region started with a slightly below-average income level at point t in time, i.e. it would lie at point 0.9 on the t-axis in the figure.[20] From this point on the t-axis, assume a line normal to the t-axis and parallel to the t+1 axis. The level at which this imaginary line crosses the 'mountain' in the figure indicates the probability of this region to reach a certain income level at t+1, since the height of the mountain corresponds to the likelihood of reaching this income level at t+1. Thus the higher the 'mountain', the higher the probability of reaching the corresponding income level – indicated form the t+1 axis; it follows that the point where the imaginary line crosses the (local) peak of the 'mountain' stands for the point the region is most likely to end up with at t+1. In this example this would mean that the line crosses the peak at a point which corresponds to a relative income level of 0.9 (again) at point t+1 in time.

For ease of interpretation two benchmark lines have been included in the contour plot. The first, diagonal line is the benchmark for a stable distribution over time. This can be easily seen by taking any value on the t-axis, moving straight to the diagonal and taking the corresponding value on the t+1 axis; the value from the t-axis should be identical to the value on the t+1 axis, i.e. a movement from a certain state at t to the same state at t+1.

The second, vertical line is the benchmark for complete convergence. This is also easily verified, since regardless of the value chosen on the t axis one would always end up with one and the same value (i.e. the average 1) at t+1.

It is important to note that in both figures some capital city regions have been left out because they were extreme outliers[21] and therefore would lie too much to the right, which would reduce the readability of the figure too much.

The computation and analysis of the estimated kernel delivers certain interesting insights. Following the two reference lines in Figure 2 clearly shows that the main part of the dynamic distribution of relative regional per capita GDP levels lies parallel but left to the diagonal reference lines. The interpretation of this is that the vast majority of regions (especially the poorer ones) have lost relative to few rich regions, especially the capital cities. Unfortunately this does not show in the figure as most capital cities are not included in the figure 'directly'[22], but it can be shown that the capital city regions are all positioned to the right of the diagonal reference line, just as the small bump in the lower-right quadrant.

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[20] For easier interpretation use Figure 4 for checking.

[21] The capital cities that were within reasonable bounds were Ljubljana, Sofia and Vilnius. In the case of Ljubljana only one additional region exists in Slovenia and regional disparities were not too large; in the case of Sofia, the capital city regions include not only Sofia but also neighbouring, poorer regions, which drove down the difference of Sofia vis-à-vis other regions; as for Vilnius, it simply did not show a much above-average income level.

[22] Implicitly all capital cities are included via the average GDP per capita level.

The fact that the majority of regions lies parallel to the reference line is also very interesting, since it suggests that without the capital cities the distribution over time has been stable and neither convergence nor divergence has occurred across the majority of the (poorer) regions in the countries.

2 Underlying reasons for regional disparities

2.1 Theoretical background

To understand the developments that have led to the existing regional disparities in the CEECs it is important to know that under communism the regional location of industries was to a great extent centrally imposed. The geographic pattern of production often followed political considerations rather than economic efficiency criteria, which resulted in industrial monocultures in certain regions (e.g. coal-steel conglomerates). This fact and a general preference of the communist system to foster heavy industry left a hard legacy to overcome for most of the CEE regions after the collapse of the centrally planned system. Hence, the fall of the iron curtain was a shock to many CEE regions, first of all because the old Soviet-oriented markets for which these regions had mostly produced existed no longer. In addition these regions were all of a sudden exposed to free market competition, for which they were not prepared as this meant a radical change in economic behaviour and revealed the poor shape of competitiveness they were in. Regions with large (and non-competitive) industrial or agricultural conglomerates suffered most from the systemic change, whereas regions with a mix of industries (including light industry) or a large share of services were able to cope better with the transformation shock. Thus the regions' different legacies from the communist era alone led to a significant rise in regional disparities.

Apart from that, the set-in of market forces brought about also some other 'mechanisms' of regional economic development that generally aggravated these disparities. Luckily, the rise during the past decade of the (so-called) new economic geography theory, which comprises a mix of trade and location theory, has helped us to understand most of these 'mechanisms' at work in regional development.

Referring to trade theory, the classical theories of Ricardo and Heckscher-Ohlin in particular might be of use to assess the past and future specialization patterns that will prevail in the CEE regions. Accordingly, existing technological capabilities (Ricardo) and, on the other hand, factor endowments (Heckscher-Ohlin) are assumed to have played, and to play in the future, an important role in the short- and long-term development of the CEE regions.

However, since classical trade theories have certain well-known limitations, it is decisive to take a look at the other two branches of the new economic geography in order to understand the past and future evolution of regional disparities in the CEECs.

The existing theoretical literature on new economic geography develops one major result on location and specialization: depending on trade costs or more generally transaction costs, there will be either a dispersion of production – which might lead to economic convergence of regions – or a core-periphery structure will emerge, where industries producing under economies of scale as well as innovation activities will be placed in the core and specialized manufacturing industries (not producing under economies of scale) will be located in the periphery.

As several authors point out (Brülhart and Torstenson, 1996, Fujita and Thisse, 1996, Ottaviano and Puga, 1997, Puga, 2001), very high and very low trade costs favour the dispersion of production, whereas at an intermediate level of trade costs an agglomeration of industries sets in which leads to the mentioned core-periphery structure. In this context Fujita and Thisse clearly identify scale economies and product differentiation (see also Fujita and Mori, 1998) which work as centripetal forces, while increasing labour costs at the core have centrifugal effects. Additionally Ottaviano and Puga, and Puga (2001) see labour immobility, the production of non-tradables and industrial specialization as fostering the dispersion of production. Similarly, Gersbach and Schmutzler (1999) state that decreasing communication costs might lead to an agglomeration of R&D activities in the core, in order to absorb the positive externalities from other R&D production there, which also leads to a core-periphery pattern in the geography of innovation.

Another point frequently mentioned is that agglomeration of industries tends to be self-reinforcing, not only because of positive spillovers, economies of scale and economies of scope, networking externalities and increasing forward and backward linkages in production, but also because the labour force adjusts to the labour demand in the core. Thus the labour pool in the core becomes more specialized for the core production, resulting in diminishing search and training costs for producers and as such being a strong centripetal force.

That the locational choice of production relies – besides other variables – on the labour mix of a region has already been stated by Marshall (1890). Indeed Marshall points out four determinants of locational choice, two of which have already been mentioned above. In the opinion of Marshall the chief cause for the localization of industries in certain distinct locations 'have been physical conditions; such as the character of the climate and the soil, the existence of mines and quarries in the neighbourhood'[23]. Other causes for

[23] Marshall (1890), The Principles of Economics, Book 4, Ch. 10, 2.

agglomeration he identified are intellectual spillovers from firm to firm and lower trade costs (already mentioned above) as well as the fact that localized industries create their own constant market for skills. Following Marshall's insights, Dumais, Ellison and Glaeser (1997) found, while analysing the concentration process in the US, that indeed the labour mix is the driving factor behind locational choices in the US.

A somewhat different but nonetheless interesting approach to industry location or, better, to the spread of industries across countries is presented by Puga and Venables (1996). In their model they argue that initially industrial production is agglomerated in only one country, but the increasing tension between centripetal and centrifugal forces (wage differences relative to other countries) might lead to a spillover of industries to countries with lower wage costs. Thus labour-intensive industries tend to move first into a new country, exerting there stronger centripetal than centrifugal forces, which leads to an agglomeration of industries and to an economic upturn in this country. If the tension between agglomeration and wage costs in this country becomes too high, the game starts anew with a third country and so on.

Apart from the new economic geography there exists another branch of economic theory that is of interest in the context of regional development. This theory deals explicitly with the theory of multinational enterprises (MNEs), which is especially of interest for a theoretical view of the FDI inflows to the individual CEE regions. One of the most prominent proponents of this theory, Markusen, determined in a number of papers the conditions under which horizontally or vertically integrated MNEs might arise and what effects this will have on welfare, wages etc. In this analysis he relies especially on trade costs and the skill differences between countries (see Markusen and Venables, 1996a, Markusen, 1999a and 1999b). He also highlights the interdependence between MNEs and foreign trade (see Markusen and Venables, 1995 and 1996b, Markusen, 1995 and 1997, Markusen et al., 1996) and the importance of FDI for development processes in less developed countries.

Finally, standard growth theory – exogenous as well as endogenous – might also contribute to explaining the evolution of regional disparities within the CEECs. Growth theory tells us that above all technical progress is the driving force of economic growth and development (see e.g. Barro and Sala-i-Martin, 1995, or Aghion and Howitt, 1998). This opens a wide array of variables influencing long- and short-run growth (or both) to analysis.

A particularly important set of variables in growth theory is the stocks and developments of human capital or human skills. That these are among the decisive factors for technological advance and thus for regional development is well known not only from the new growth theory but also from the theoretical literature dealing with regional developments – see e.g. Bal and Nijkamp (1998), who design exogenous as well as endogenous regional growth

models where growth is generated by an increase in human capital; similarly in Bretschger (1999) and Tamura (1996). Bretschger moreover sees knowledge diffusion – either from firm to firm within a region or from region to region – as being significant for regional development. With this he is in line with Caniëls and Verspagen (1999), who create a regional knowledge spillover model to analyse the effects of learning capabilities, integration and spatial proximity on regional growth. Nijkamp and Poot (1998) also use diffusion of innovation (besides factor mobility and trade) to model its influence on technological change and growth in spatially interdependent regions.

Related to human skills is the role of R&D in regional development. The relevance of this variable is shown again by Caniëls and Verspagen, who also include R&D activities in their model, as well as by Huang and Xu (1999), who construct an interesting endogenous growth model, highlighting the importance of a diversified set of financial institutions for the success of R&D activities.

Another point that is mentioned in regional growth theory is infrastructure. The most prominent proponent of the major role of infrastructure investment in regional development is Aschauer (see e.g. Aschauer, 1990). Although Button (1998) finds infrastructure as not convincing for regional growth, Munnel (1990), Tondl (1999b) as well as Aschauer show empirically that it has a significant impact.

2.2 Regression results

The theoretical outline above has produced a huge set of variables, each of them playing a role in regional development. In this paper it is for certain reasons (e.g. data availability) not possible to test all the variables for their significance concerning the regional disparities in CEECs. Nevertheless, out of this set of variables we can pick those which seem to be most relevant for an explanation of the development of regional disparities within the accession countries.

The actual set-up of the regression specification is heavily influenced by the insights gained from the kernel density estimation. Since in the case of the regional distribution of GDP per capita the respective kernel density estimates show that, apart from the capital cities, neither divergence nor convergence can be detected, it appears to be misleading to test for convergence or divergence. Instead we test why certain CEE regions have higher relative GDP per capita levels than other regions.

As a consequence we relate the relative GDP per capita levels as the endogenous variable to certain exogenous variables which are included because of the above theoretical outline.

As was stated earlier, the previous economic structure is supposed to exert a decisive influence on the regional economic performance; hence it appears straightforward to include in the regressions certain exogenous variables that control for the economic structure of the regions. Although it would have been interesting to have more detailed data on the regional production structure, the best data available for all regions were employment data, split up into the three main sectors of the economy (primary, secondary and tertiary). As far as agriculture and services are concerned, this seemed to be less of a problem as a further breakdown of both variables was assumed to improve the tests only marginally. However, regarding the secondary sector, more detailed data would have been welcome in order to be able to distinguish e.g. between light and heavy industries, or high- and low-tech industries. Since these data are not available, we cannot expect – *a priori* – that any industry variable produces significant results because positive and negative impacts are likely to cancel each other out.

For practical regression purposes we include the share of employment in the primary, secondary and tertiary sectors. To avoid complications, these employment shares are not shares in total employment – because then we would have to leave out one of the three variables – but are shares in population. Additionally, and since our dependent variable is the relative GDP per capita level, we correct for the differences in average participation rates across the countries by dividing the regional employment shares in population by the country average employment share in each sector. Following this we get relative regional employment shares in the primary, secondary and tertiary sectors, which are denoted in the regression by rel_empld1, rel_empld2 and rel_empld3.

Additional variables that were proposed by the theory are two distance variables. The first of these two variables (dist_west) is the distance to West European centres. To calculate this variable we take the minimum distance of each region to one of four European capital cities (Helsinki, Stockholm, Berlin and Vienna). The second distance variable (dist_cap) measures the distance from each region to its country's capital city. These two distance variables serve multiple purposes. First of all, they can be seen as proxies for transport costs, which appear to be important for regional agglomerations and trade; second, distance is also seen to exert an influence on economic spillovers and on FDI. Following the theoretical predictions, the priors concerning these two distance variables are that, the farther the distance either from the West or the capital city, the lower the GDP level.

The next variable (aggl) included is meant to capture the agglomeration effects that were mentioned above. To proxy these effects we take the region’s share in total GDP, with the assumption that, the higher the share in total GDP, the stronger the agglomeration effects and the stronger the positive effect on the regional development level.

In order to check for sensitivity of regression results we perform two alternative estimations: one with the full sample including the capital city regions, and another with a reduced sample excluding the capital city regions. This is done in order to check whether the capital cities blur the econometric results, just as they did in the kernel density estimation and also in the two maps.

The most remarkable result of the regressions[24] is the strong influence of the services sector on the relative GDP and unemployment levels. As can be seen from Table 3, services show the highest coefficient in each regression, are always highly significant and work in the right direction, i.e. high GDP levels and low unemployment levels are always strongly correlated with a high share of employment in the services sector. This result is however not that surprising – it is, e.g., a stylized fact that the most advanced (regional) economies have also the highest shares in services employment. The result is a clear indication that the (past and present) economic structure plays a decisive role in the economic development of the CEE regions. The fact that the services variable works also in the specification without the capital city regions is a strong confirmation of this interpretation, since in this specification a possible bias stemming from the capital cities, which in general have the highest employment shares in services, is *a priori* excluded.

The distance to the West variable also yields strong results, showing highly significant coefficients with the expected sign for every regression specification. The estimation shows that, *ceteris paribus*, the farther from the West a CEE region is located, the lower is its per capita GDP and the higher is its unemployment rate compared to the other regions of the respective country. Unfortunately, distance plays an important role in trade theory as well as for spillovers and for FDI. Thus it is not clear from the regressions through which of the three channels distance actually works. It can be assumed though that all three (trade, spillovers and FDI) make at least some positive contribution to economic development.

The distance to the own capital variable has an extremely low, nevertheless in most cases significant influence on the state of regional development (in the right direction). Following the theory it seems most likely that by this variable spillover effects from the capital cities are measured. Since the coefficients for this variable are extremely low, it can be assumed that the spillovers from the capital cities are either extremely low or are confined to few neighbouring regions (or both).[25]

Significant results with the expected sign are also reported for the agglomeration variable. These significant results might be an indication that there are indeed agglomeration forces at work in the CEE region which exert some positive influence on regional development

[24] Because of data problems Bulgaria and Slovenia were not included in the regression data set.

[25] A problem that might have biased downwards the coefficient for the distance to the capital city variable is the fact that some capital regions do not only contain the capital city itself but also its surrounding regions.

through positive spillovers, emerging economies of scale, economies of scope and networking externalities as well as increasing forward and backward linkages in production.

Mixed results are obtained for the share of agricultural employment in total population. On the one hand this variable shows no significant (neither positive nor negative) impact on the regional GPD level, on the other hand it has a highly significant impact on the regional unemployment rate. Hence the results indicate that with a higher share of agricultural employment the unemployment rate, *ceteris paribus*, tends to become lower. This of course reflects the empirical observation (e.g. in Poland) that in structurally weak regions a lot of hidden unemployment is found in agriculture.

Insignificant results are obtained for the industrial employment variable; the expectation that the positive effects of advanced industries and the negative effects of backward industries would cancel each other out is largely confirmed. Nevertheless, one significant result produced by this variable is worth mentioning. This result says that, disregarding the capital cities, a high share of industrial employment coincides with relatively high levels of per capita GDP, which indeed might be not too far from the true picture.

Table 3

Regression results

Dependent Variable:	relative per capita GDP	relative per capita GDP
	full sample	without capitals
REL_EMPLD1	0.028	0.038
	(0.029)	(0.027)
REL_EMPLD2	-0.018	0.173**
	(0.080)	(0.069)
REL_EMPLD3	0.918***	0.661***
	(0.078)	(0.138)
DIST_WEST	-0.157***	-0.133***
	(0.041)	(0.041)
DIST_CAP	-0.001**	-0.001
	(0.0002)	(0.0002)
AGGL	0.068***	0.060
	(0.025)	(0.041)
adj. R^2	0.87	0.72
No. of observations	96	88

Country dummies included in each regression, but not reported here;
White Heteroskedasticity-Consistent Standard Errors in brackets;

*** significant at the 1% level; ** significant at the 5% level.

All in all the regression results are to a certain extent unsatisfactory, as many important variables have either been left out completely (e.g. human capital) or have been included just implicitly (trade linkages, FDI, transport/transaction costs, industrial structure), so there is ample space for future research on this topic.

3 Regional unemployment

This section about regional unemployment is separated into two parts.

The first part contains a snapshot of the current unemployment situation in the CEE regions ('current' referring to the latest year for which data were available for all countries). As a rule data refer to the year 2000, only for Poland 1998 data were used. Poland changed its regional division between 1998 and 1999 and using the year 2000 for Poland would have precluded intertemporal comparisons.

The second part contains an analysis of regional unemployment dynamics, by analyzing developments over the years 1993 to 2000.

Throughout this section unemployment refers for most countries to registered unemployment data, only for Bulgaria and Estonia we had to use Labour Force Survey data, because other data were not available.

3.1 Status quo

We start our analysis with a presentation of basic facts about the unemployment situation in the regions of nine CEECs. For this purpose Table 4 presents basic indicators on regional unemployment in the year 2000 (1998 for Poland).

The first row in this table shows the weighted average regional unemployment rate, which is identical to the country's unemployment rate. Though absolute figures are of minor importance here, partly because we are mixing labour force survey data with registered data, it can be seen that overall the Slovak Republic and Bulgaria had the worst unemployment record. On the other hand the Czech Republic, Latvia and Hungary have the lowest unemployment rates within this group.

The major insight that can be gained from this table is that in all countries there is a significant spread of regional unemployment rates. The easiest way to check this is to look at the minimum and maximum regional unemployment rates given for each country. Thus most countries have certain regions with unemployment rates well below the 10% level (certain regions even have unemployment rates below 5%), but on the other hand each country has also at least one region showing extremely high rates of unemployment.

By looking at the additional indicators given in the table, one could also say something concerning how unemployment rates are distributed regionally. By an analysis of the variance, the skewness and the kurtosis (the second, third and fourth distribution moments) it can be found out for example whether regions with low (or high) unemployment rates are more or less outliers (compared to the other regions of one country), as is the case e.g. in the Slovak Republic. Here the size of the variance, but especially the negative value of the skewness[26] point clearly towards the existence of one (or only few) regions with low unemployment rates, whereas the bulk of regions tends to have significantly higher rates – this is also indicated by the fact that the mean value is lower than the median.

Table 4

Indicators on regional unemployment in nine CEECs, 2000

	Bulgaria	Czech Republic	Estonia	Latvia	Lithuania	Hungary	Poland	Romania	Slovak Republic
weighted average	**16.4**	**8.8**	**13.7**	**8.5**	**11.5**	**8.9**	**10.4**	**10.5**	**17.9**
mean	17.9	8.5	14.2	10.0	12.7	10.0	12.0	10.8	17.6
median	16.5	7.7	13.5	10.1	13.4	10.3	11.8	10.9	19.3
variance	26.9	12.7	9.5	19.3	7.2	23.1	17.0	9.3	36.9
skewness	-0.4	1.2	1.4	0.8	-0.2	0.5	0.0	-0.1	-0.8
kurtosis	-0.7	0.9	1.8	1.8	-1.7	-0.1	0.0	-0.2	0.0
minimum	8.6	3.4	11.5	4.7	9.2	2.6	2.6	4.5	6.4
maximum	23.7	16.1	19.2	16.8	16.3	20.4	20.5	16.7	24.4
no. of regions	9	14	5	5	10	20	49	41	8

Source: National statistical offices, own calculations.

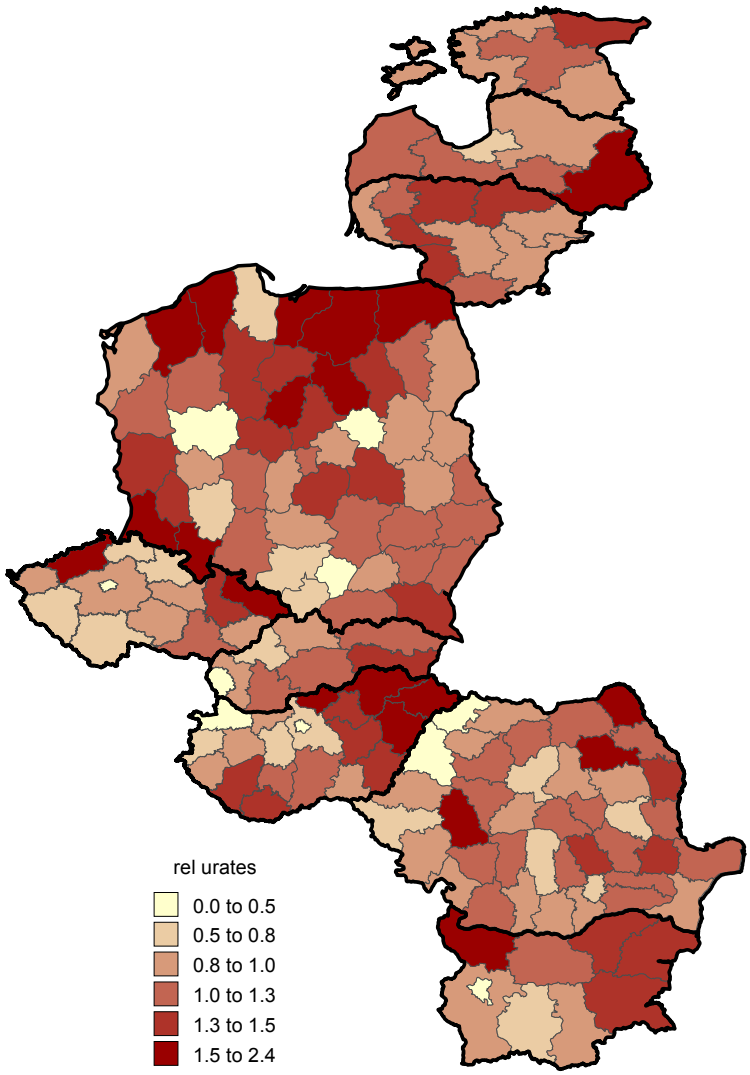
The spread of regional unemployment rates can be shown in a more concise way by using a graphical illustration given by Map 2. It gives the unemployment rates for each region; yet the unemployment rates are not given in absolute values but rather in relative terms. Hence the unemployment rate of an individual region is expressed as a fraction of the corresponding country's average unemployment rate shift. This abstraction from absolute values to relative measures allows not only a comparison of the existing disparities within each CEEC (and its regions), but also provides better insights about the similarities of the regional disparities across the CEECs.

An inspection of Map 2 immediately shows the most striking feature of the regional distribution of unemployment within the CEECs: this is the dominant position of the capital city regions. In basically every country, with the exception of Poland, these regions have a

[26] The skewness of a symmetric distribution, such as the normal distribution, is zero. Positive skewness means that the distribution has a long right tail and negative skewness implies that the distribution has a long left tail.

Map 2

Regional unemployment rates (relative to country average unemployment rate), 2000 (Poland 1998)



much lower unemployment rate than the rest of the regions of their country. Poland is an exception in so far as there exist, apart from the capital city of Warsaw, two additional regions (Poznan and Krakow) that show significant below-average unemployment rates.

Another major aspect of the regional distribution of unemployment across the CEE regions is the existence of an East-West pattern in many countries. This is fairly obvious for Hungary, Slovakia, the Czech Republic and Romania, where the regions in the West of each country have mostly lower unemployment rates than the Eastern regions.

From theory it could be assumed that such a pattern exists for the other CEECs as well – though it might be blurred by other, more important factors that influence regional unemployment levels.

As we have shown above, economic theory offers a wide range of factors that are at work in the determination of regional development and hence regional unemployment. In reference to this we have picked out certain variables considered to have a significant impact on regional unemployment, and we used them for an econometric analysis.
Thus in the following paragraphs we present results of estimations on the influence of a number of factors on regional unemployment levels.

The first three factors we regarded as being important were the degree of specialization[27] in agriculture, industry and services, in order to take account of the differences in the production structures of the individual regions. Thereby we expected that a high degree of services specialization should act in favour of a (relatively) low unemployment level, because of the stylized fact that the most advanced (regional) economies have also the highest shares in services employment.

As far as industry specialization is concerned, we had no priors concerning the influence of this variable on unemployment, mostly because of the high aggregation level of the data it was not possible to distinguish e.g. between light and heavy industries, or high- and low-tech industries. Hence it might well be that the positive influence of e.g. high tech industries and the negative impact of e.g. low-tech industries on unemployment cancel each other out in the regressions. Finally, agriculture is expected to lower unemployment, mostly for its capability to 'hide' otherwise unemployed people.

As a fourth control variable we decided to use the distance to Western borders[28]. First of all they can be seen as proxies for transport costs, which appear to be important for regional agglomerations and trade; second, distance is also seen to exert an influence on economic spillovers and on FDI, too. Following the theoretical predictions, the priors concerning these two distance variables are that the farther the distance from the West the higher should be the unemployment level.

We also included dummies to control for capital cities, which are in a special position within the CEE regions as they are by far the most developed regions. One advantage among others of capital cities is that they exert agglomeration externalities (big market for producers and consumers, qualified labour force etc.). Yet this advantage attributes not

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[27] Specialization in a sector is defined as the sectoral share of a branch in a region divided by the country average share of that branch.

[28] In fact it is the distance from each CEE region to either Vienna or Berlin, depending on which distance was the smaller one.

exclusively to capital cities but also to other big cities or regions with a high population density. Therefore we included population density as an additional control variable, in order to find out whether positive effects on unemployment are restricted to capital cities only or whether it is a more general feature of bigger cities.

Finally we also included (distance weighted) unemployment rates from neighbouring regions in our estimations in order to control for spatial dependencies, which were shown to be important in studies on regional unemployment in the EU (see Overman and Puga, 2000). In the case of this variable we included two variants, one that only takes into account neighbouring regions of the same country and the other using information on all regions regardless of national borders.

For comparison reasons we estimated the influence of these variables on regional unemployment at two distinct points in time (1993 and 2000). In the regression with year 2000 data we also included the relative regional unemployment rates of the year 1993 in order to test whether unemployment is a persistent problem.

Furthermore for each year we ran several regressions, each with a different mix of our exogenous variables to test the sensitivity of our results.

Therefore our estimated equations look like this:

$$rur_{t,r} = \alpha_i + \beta X_{t,r} + \rho W_1 rur_{t,-r} + rur_{t-1,r} + u_r$$

with the dependent variable $rur_{t,r}$ being the relative unemployment rate of region r in year t (1993 or 2000); α_i stands for country dummies that we included in our regressions, $X_{t,r}$, contains the conditioning variables explained above. $W_1\ rur_{t,-r}$ is the distance weighted unemployment rate of neighbouring regions, with W_1 being the distance weighting matrix and the –r means that information of all regions except the region r itself are used in the distance weighted unemployment rates. Finally, and only applicable to the year 2000 regression, we also add the initial relative unemployment rate in the regressions (marked by t-1).

The results of the 1993 estimations are meagre. As a matter of fact none of the variables seems to have a significant explanatory power except for population density and (in the estimation where population density is left out) the capital city dummy. Therefore all that can be said from these regressions is that indeed, bigger cities tend to have lower unemployment rates than the other regions.

Yet comparing these results with the results of the year 2000 estimations the picture becomes more interesting. First of all the significant and positive value for the 1993

unemployment rate (in the year 2000 regressions) shows that regional unemployment is indeed persistent over time, although it is interesting to see that the regression coefficient for this variable is significantly smaller than 1[29], showing that there have been some changes in the unemployment situation of the regions since 1993.

Table 5

Regression results, explaining year 1993 unemployment rates

Variable				
agricultural specialisation	0.24	0.54	0.28	0.28
	(0.53)	(0.58)	(0.54)	(0.54)
industry specialisation	-0.28	-0.11	-0.18	-0.14
	(0.51)	(0.57)	(0.54)	(0.52)
services specialisation	1.08	0.93	1.02	0.98
	(0.64)	(0.70)	(0.66)	(0.64)
distance to west	0.13	0.13	0.12	0.13
	(0.09)	(0.09)	(0.09)	(0.09)
capital city	-0.32*	-0.73***	-0.37**	-0.37**
	(0.16)	(0.13)	(0.16)	(0.16)
population density	-0.23***		-0.19***	-0.19***
	(0.07)		(0.07)	(0.06)
distance weighted unemployment rate (cross border, distance weight = 1)	0.03	-0.01		
	(0.02)	(0.02)		
distance weighted unemployment rate (within border, distance weight = 1)			0.01	
			(0.02)	
Adjusted R-squared	0.17	0.12	0.16	0.17
Akaike info criterion	0.72	0.78	0.73	0.72
Durbin-Watson stat	1.80	1.84	1.79	1.79

Country dummies included in each regression, but not reported here;
White Heteroskedasticity-Consistent Standard Errors in brackets;
*** significant at the 1% level; ** significant at the 5% level; * significant at the 10 % level.

[29] A regression coefficient of 1 would indicate complete persistence.

Table 6

Regression results, explaining year 2000 unemployment rates

Variable	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
agricultural specialization	-0.83***	-0.83***	-0.85***	-0.74***	-0.65**
	(0.28)	(0.28)	(0.27)	(0.27)	(0.32)
industry specialization	-0.26	-0.28	-0.20	-0.28	-0.37
	(0.31)	(0.30)	(0.28)	(0.31)	(0.41)
services specialization	-0.40	-0.39	-0.49*	-0.42	0.26
	(0.32)	(0.31)	(0.28)	(0.32)	(0.41)
distance to west	0.24***	0.24***	0.24***	0.23***	0.32***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.10)
distance weighted unemployment rate	0.00				
(within border, distance weight = 1)	(0.02)				
population density	-0.07	-0.07	-0.10***		-0.20***
	(0.05)	(0.04)	(0.03)		(0.06)
capital city	-0.14	-0.14		-0.26**	-0.39**
	(0.14)	(0.14)		(0.11)	(0.18)
unemployment rate 1993	0.66***	0.66***	0.67***	0.69***	
	(0.08)	(0.08)	(0.08)	(0.08)	
Adjusted R-squared	0.54	0.54	0.54	0.54	0.21
Akaike info criterion	0.23	0.22	0.21	0.22	0.76
Durbin-Watson stat	2.03	2.03	2.03	2.02	1.88

Country dummies included in each regression, but not reported here;
White Heteroskedasticity-Consistent Standard Errors in brackets;
*** significant at the 1% level; ** significant at the 5% level.

Additionally the distance to the west variable is now positive and significant, saying that regions farther away from Western borders tend to have relatively higher unemployment rates. In contrast to the 1993 regressions agricultural specialization has also a significant impact on the relative unemployment situation of the regions, in so far as a higher degree of specialization implies a (relatively) lower unemployment rate.

Hence the comparison of the regression for the two years shows that within this period of time some interesting unemployment dynamics occurred, which deserve a closer examination. This is done in the following section.

3.2 Unemployment dynamics

To give a first impression of regional unemployment dynamics, Figures 3 and 4 present again – as in the section on regional GDP – the kernel density estimates for the distribution of regional relative unemployment rates over time. Both figures are basically identical, only the perspective differs in so far as Figure 3 shows the three-dimensional version and Figure 4 shows the contour plot.

In both figures regions are ordered on the t and the t+1 axes from left to right according to their relative unemployment rates. Regions with particularly high unemployment rates are found on the left end of the axes and regions with the lowest unemployment rates are positioned on the right end (close to point 0).

An inspection of Figures 3 and 4 shows that the highest concentration of regions can be found around or slightly below the country average level – which has the value 1 on both axes.

It is also obvious that this concentration of regions lies perfectly on the 45° degree reference line, which indicates that these regions have not changed their (relative) position within their countries. However, it can also be seen that those regions with higher than average unemployment rates at point t in time had even higher relative unemployment rates at t+1. This becomes evident from Figure 4, where the long upper-left tail of the distribution kernel lies below the diagonal reference line.

On the other hand the few regions with relatively low unemployment rates have improved their relative positions, as the lower-right part of the kernel has moved to the right of the reference line. According to our interpretation the kernel therefore indicates a slowly growing divergence in unemployment rates, caused mainly by those regions that do extremely well in unemployment rates any way.

Although the kernel density estimation above delivers useful insights on the general dynamic behaviour of regional unemployment rates in the CEECs, it lacks the spatial dimension. Hence in order to know which regions could improve their unemployment situation, we will again make use of maps to show unemployment dynamics in a true geographical context.

Figure 3

Kernel density estimates for the distribution of regional unemployment rates (relative to country average unemployment rates) over time, three dimensional

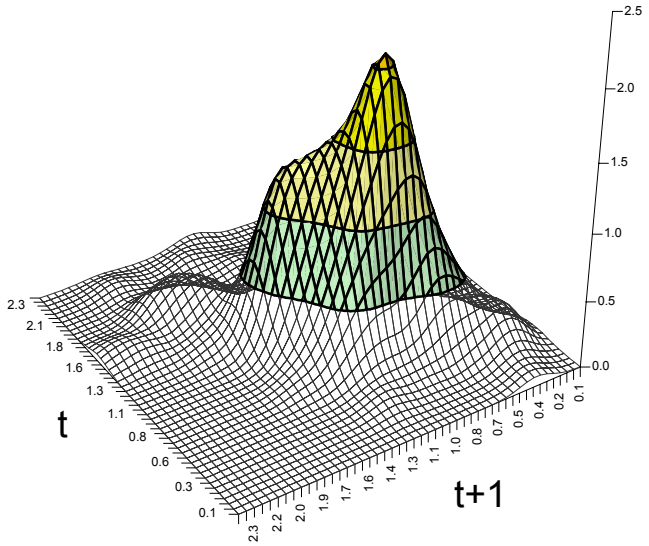
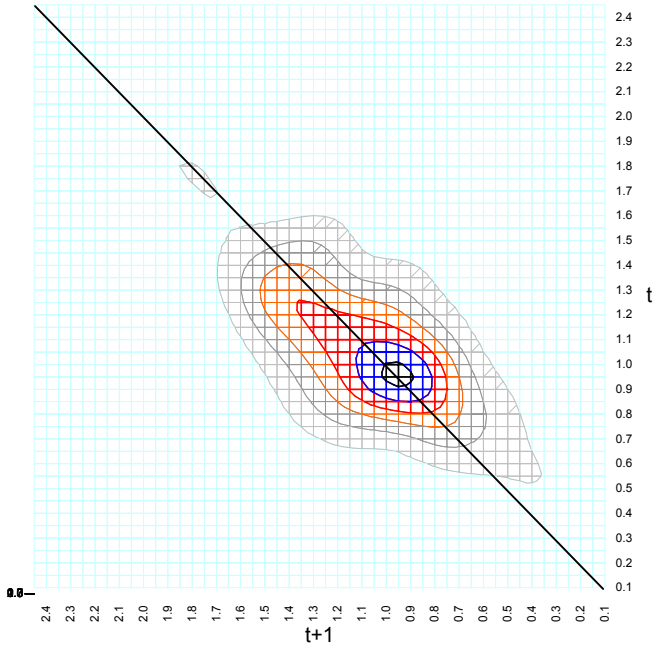


Figure 4

Kernel density estimates for the distribution of regional unemployment rates (relative to country average unemployment rates) over time, contour plot

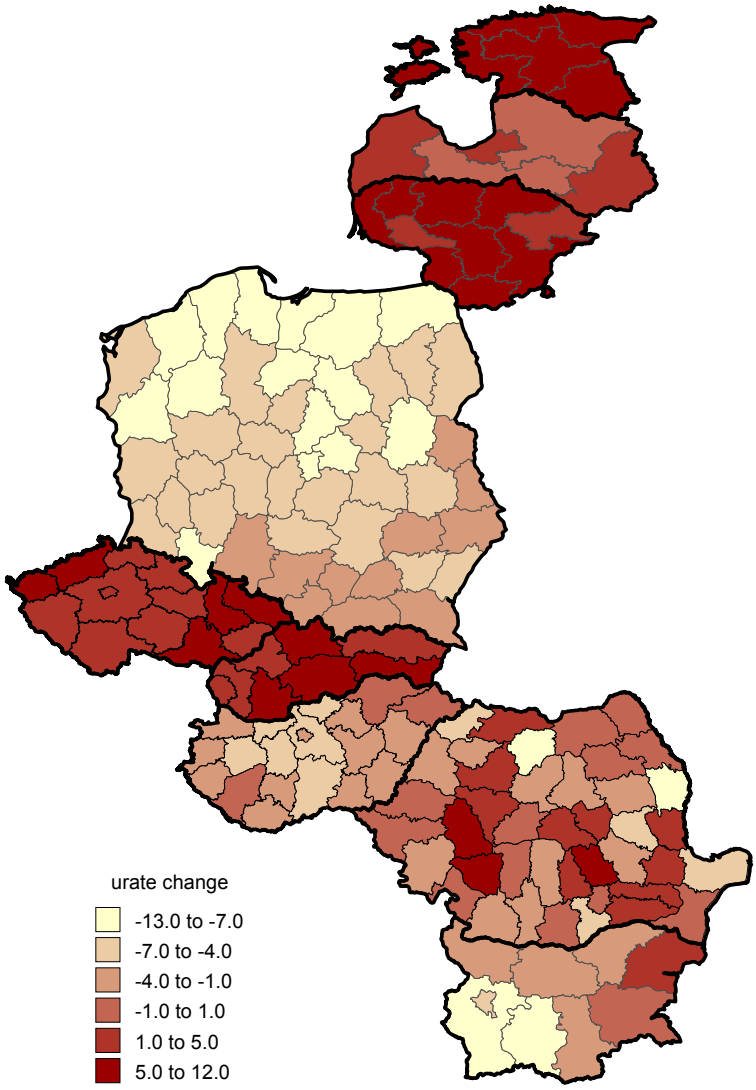


Therefore Maps 3 and 4 present the changes of the unemployment rates from 1993 to 2000 for the CEE regions; the first map gives the absolute change of the unemployment rate, and the second shows the change of a region's unemployment rate in relation to the change of the country's average unemployment rate.

Looking at Map 3 it can easily be seen that the Polish, Hungarian and Bulgarian regions in general showed a decline of unemployment, whereas in the other countries almost every region faced an increase in their unemployment rate.

Map 3

Regional changes in absolute unemployment rates 1993 to 2000 (Poland 1998)

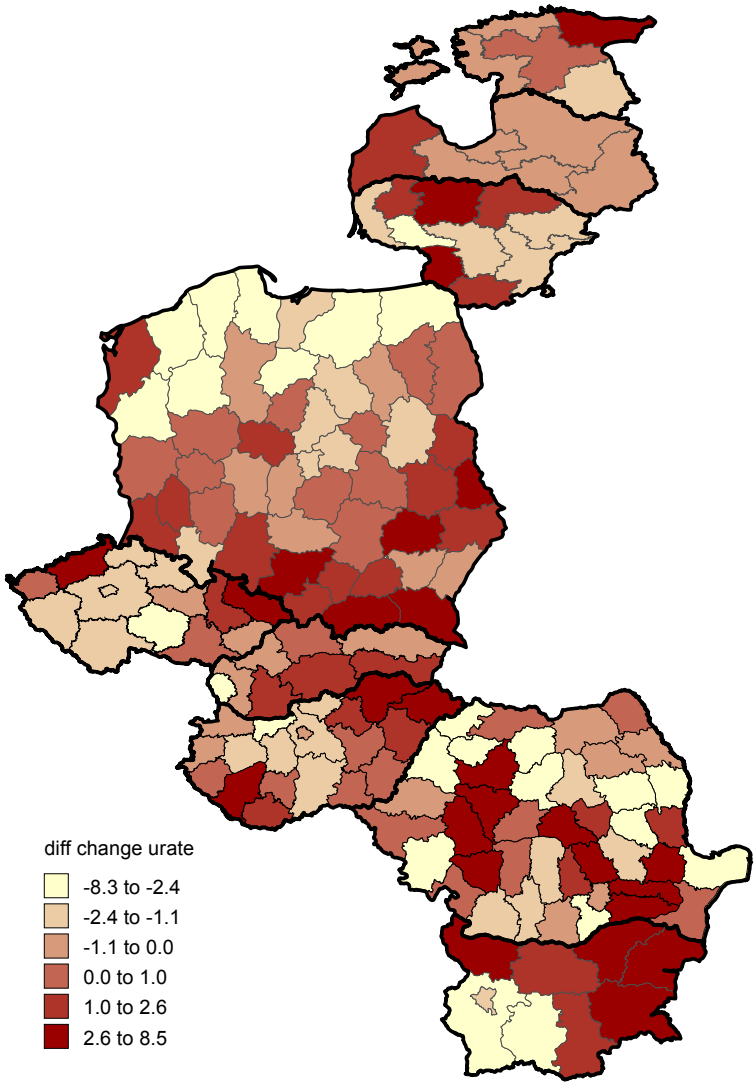


Although this is quite an interesting result seen from a cross-country analysis point of view, the fact that regions tend to follow closely a country trend is somewhat disturbing to regional analysis, as we want to dissect explicitly regional effects and not effects caused through a higher order.

Therefore the second map presents the relative change of the regional unemployment rates, thereby abstracting from country developments and thus allowing a closer look at the success of individual regions in fighting unemployment. From this second map it can be seen that regardless of whether a country had a decline or an increase in unemployment, there is a clear separation in each country of regions that performed quite well and others that show an unemployment development much below average.

Map 4

Regional changes in relative unemployment rates, 1993 to 2000 (Poland 1998)



As far as regions are concerned that had a below-average unemployment development, Map 4 reveals that they are –as a rule of thumb – located at the Eastern borders of their respective country. Yet as far as the well-performing regions are concerned, no clear pattern can be detected at first sight. In contrast to previous findings it even cannot be said that it were especially the capital cities that had the biggest (relative) decline in unemployment.

Hence, in order to find some regularities in regional unemployment developments, we have to rely again on regression analyses.

Basically the regression analysis on regional unemployment development is similar to the regressions above, since we use a couple of explanatory variables also appearing above. These are the degree of specialization in agriculture, industry and services, population density, distance to the West and a capital city dummies.

The main changes to above regressions are to be found in the choice of the endogenous variable that now is no longer the relative unemployment rate, but rather the change of the (absolute) unemployment rate (denoted by δu).

As additional exogenous variables are also included a measure for the initial state of unemployment in each region (using the relative unemployment rates in 1993), in order to get some sense of convergence or divergence of regional unemployment. Finally, we also put into our equations spatially lagged versions of the endogenous variable in the form of distance weighted average changes of neighbouring regions. This is done to check whether unemployment developments were similar in regions being close to each other.
Therefore our basic estimation models looks like this:

$$\delta u_r = \alpha_i + \beta X_r + \rho W_1 \delta u_{-r} + rur_{1993,r} + u_r$$

With δu_r standing for the (relative) change of the unemployment rate in region r (from year 1993 to 2000), αi are again country dummies, X_r contains a set of conditioning variables, $W_1 \delta u_{-r}$ is the distance weighted average unemployment rate of neighbouring regions and rur1993,r is a measure for the initial state of unemployment.

In our actual regressions we experimented with different variants of the distance weighted average unemployment rate of the neighbours, because we did not know exactly over which distance neighbouring effects might work; additionally we were not sure whether such effects work across national borders or not. Therefore we estimated several regressions, each using a different variant of the variable.

Regression results clearly show that regions that were relatively specialized in agriculture or in services had a more favourable development of unemployment than other regions. In the case of regions highly specialized in agriculture, though, it can be assumed that the good unemployment record reflects the fact that agriculture contains a lot of hidden unemployment.

As far as regions specialized in services are concerned the result is not that surprising since one could expect them to be among the most advanced (regional) economies[30] with the greatest potential to generate (or secure) employment.

The distance to the West variable also yielded very good results, showing highly significant coefficients with the expected sign. The estimations showed that, *ceteris paribus*, the farther from the West a CEE region is located, the lower is its per capita GDP and the higher is its unemployment rate compared to the other regions of the respective country. Unfortunately distance plays an important role in trade theory as well as for spillovers and for FDI. Thus it is not clear from the regressions through which of the three channels distance actually works. It can be assumed though that all three (trade, spillovers and FDI) make at least some positive contribution to economic development.

Furthermore our results also show that capital cities have an additional bonus over all other regions as their unemployment development is significantly better than those of all other regions. This result however is far from being surprising since in every country the capital cities are the economic centres, have the most developed economic structure and are also a prime target for foreign direct investment.

The negative (and significant) coefficient of the (relative) unemployment rate of the starting year indicates that – *ceteris paribus* – we would find in the CEE regions a convergence of unemployment rates.

Finally regression results indicate that there is a spatial correlation of unemployment developments, although results suggest that this correlation is confined to bordering regions only. Yet our results also show that this is independent of national borders. This reflects quite well the observation made elsewhere that there is an East-West differentiation in economic development in the CEE regions, with the more Western regions generally having an advantage over those regions being farther away from the EU (Western) borders.

[30] Referring to the stylized fact that the most advanced economies have also the highest shares in services employment.

Table 7

Regressions results, explaining factors for the changes in the regional unemployment rate

Variable					
agricultural specialisation	**-7.56*** **	**-7.70*** **	**-7.33*** **	**-7.32*** **	**-7.05*** **
	(2.21)	(2.21)	(2.24)	(2.20)	(2.20)
industry specialisation	-4.53	-4.70	-4.78	-4.64	-4.78
	(3.46)	(3.43)	(3.54)	(3.37)	(3.46)
services specialisation	**-7.37*** **	**-7.02** **	**-7.92*** **	**-6.58** **	**-7.03** **
	(2.79)	(2.82)	(2.80)	(2.81)	(2.81)
distance to west	**2.01*** **	**2.06*** **	**1.87*** **	**2.10*** **	**2.04*** **
	(0.61)	(0.61)	(0.61)	(0.62)	(0.62)
population density	0.67	0.59	0.78	0.58	0.66
	(0.50)	(0.50)	(0.51)	(0.50)	(0.50)
capital city	**-4.61*** **	**-4.69*** **	**-4.57*** **	**-4.73*** **	**-4.59*** **
	(1.19)	(1.19)	(1.20)	(1.19)	(1.19)
unemployment rate 1993	**-3.50*** **	**-3.61*** **	**-3.37*** **	**-3.60*** **	**-3.50*** **
	(0.80)	(0.81)	(0.78)	(0.81)	(0.79)
distance weighted unemployment rate (within border, distance weight = 1)	**0.06** **				
	(0.03)				
distance weighted unemployment rate (within border, distance weight = 0.5)		0.02			
		(0.02)			
distance weighted unemployment rate (within border, distance weight = 2)			**0.19** **		
			(0.08)		
distance weighted unemployment rate (cross border, distance weight = 1)				0.03	
				(0.02)	
distance weighted unemployment rate (cross border, distance weight = 2)					**0.15** **
					(0.07)
Adjusted R-squared	0.77	0.76	0.77	0.77	0.77
Akaike info criterion	4.89	4.90	4.87	4.90	4.87
Durbin-Watson stat	1.90	1.88	1.91	1.88	1.92

Country dummies included in each regression, but not reported here;
White Heteroskedasticity-Consistent Standard Errors in brackets;
*** significant at the 1% level; ** significant at the 5% level; * significant at the 10 % level.

Summary

In this paper we have analysed the significant disparities that exist among the CEE regions in GDP per capita as well as in unemployment. Not only are these disparities of significant size but we also found that they have been growing over time. This has resulted in a clear segmentation of regions into a small group of well-developed regions and a lagging group containing the vast majority of regions.

As explanatory factors for these developments we found that the legacies of the past, and the production structure have a major influence. Thus regions with inherited heavy industry were struck hard by the transformation process as well as those regions specialized in agriculture. Furthermore we also showed that regions that are closer to the Western borders (i.e. Western markets) generally have an advantage over other regions; the reason is the relatively short distance to potent markets that opens up business opportunities for domestic producers but also makes those regions preferred locations for FDI.

Above all we found capital cities to be the regions with the highest economic development potential. As a rule all CEE capital cities are not only at a much higher development stage than all other regions of the respective country, but are also (in an economic sense) growing faster than all other regions.

In conclusion, regional development in CEECs is characterized by only few, but very dynamic growth poles that are – with some exceptions – concentrated around the capital cities.

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Appendix

The definition of regions that is used in this paper follows the definition given by the statistical offices. Since all CEECs tried to make their regional division comparable to EU standards, the definition used here corresponds either to level two or level three of the European Nomenclature of Territorial Units for Statistics (NUTS).

Sources: regional data were either taken from the regional publications of the statistical offices in each CEEC or obtained directly from these statistical offices.

The time range, i.e. the observation period, includes in general the years from 1993 to 1998 in the case of GDP data and 1993 to 2000 for unemployment data; as far as GDP data is concerned for certain countries however the time range was for various reasons not available. As a consequence the time range has been shortened for the following countries: Bulgaria, Estonia, Hungary, Latvia, Lithuania and Slovakia.

In parts of this chapter we used distance weighted unemployment rates (or changes in unemployment rates) from neighbouring regions in order to find out whether regions close to each other correlate in their unemployment development. Therefore we took for each region the (changes in) the unemployment rates of its surrounding regions (excluding the base region), weighted them according to their distance from the base region and summed the weighted unemployment rates up to obtain the variable used in the regressions. Thereby we assumed that the influence from surrounding regions upon the base region becomes weaker the farther away these regions are, i.e. the spillovers from other regions decay as the distance to the base regions grows.

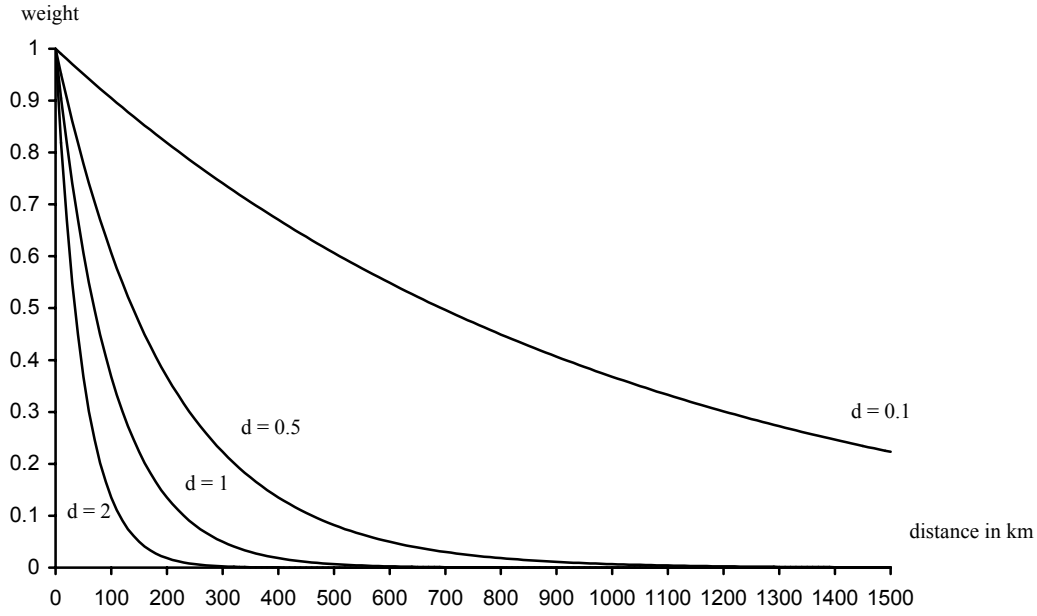
Throughout our regression we calculated the distance decay using the following formula: exp(d *(-dist/100)); with d being the distance decay parameter, and dist being distance in km. In our regression we set d to 0.5, 1 and 2, distance was taken as birds-fly distance from region to region. Figure 5 shows how the distance decay parameter works.

On the x-axis the distance in km is given, and on the y-axis the distance weights. Hence at a distance of 0 km the (hypothetical) weight for the unemployment rates of the neighbouring regions would be 1, i.e. this unemployment rate would be multiplied with 1. As distance increases the weight declines. We put in this figure four lines representing four distance decay parameters d. Thus, looking first at the line for d = 0.1 it can be seen that the distance weights decline very slowly, so that even regions being ca. 700 km away from the base region would have a weight of 0.5 in our calculations. Thus setting d to 0.1 would mean that regions far away from the base region are assumed to exert strong effects upon the base region. As this appears to be unrealistic we decided for practical purposes to set d to 0.5, 1 and 2 respectively. In the case of d being 1 and 2 weights decrease rapidly with

distance so that as a matter of fact with these parameters we mainly catch those regions being contiguous to the base region.

Figure 5

Distance decay in km, for d = 0.1, 0.5, 1 and 2



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