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15 Research and development (R&D) activity in the Carpathian area

15.1 Introduction

This chapter is concerned with the role of innovation, particularly the main feature of R&D activity in the Carpathian area. It is based on the three main indicators of the Research and Development and spatial impact of the economic transformation on research and development. While in the early transition years, spatial differences were largely determined by FDI in manufacturing, the new directions of innovation have recently become the main driving force that differentiates economic space, although it is heavily concentrated in *urban agglomerations*. Preconditions for the innovation-led development are to a large extent jeopardised by the shallower innovation potential of (peripheral) regions and the dominant role of the capital cities' regions.

15.2 The economic significance of innovation in the transition economies of the Carpathian area

Innovation, and particularly R&D is considered to be a new policy tool for economic growth, and a large extent contributes to catching up in regional development. A great part of economic growth is attribute-able to technological improvement and innovation in wider sense, whereas capital accumulation explains only a smaller fraction of it. In the developed countries, 80% of the increase in productivity is due to some form of innovation. Innovation is vital in increasing the productivity of companies, improving export capacity, creating employment, and improving the level of services, in one word: increasing economic competitiveness. We use the term innovation to refer to the producing and transferring of new knowledge. Knowledge and access to it has become the driving force behind growth and competitiveness in advanced economies (*Gál,* 2005).

The ability to create, access and use knowledge is becoming a fundamental determinant of global and regional long-term development and competitiveness. Knowledge itself is considered to be one of the basic economic resources (*Drucker,* 1994). The knowledge-based economy (KBE), defined as becoming increasingly dependent and directly based on the production, distribution and effective use of knowledge and information. At the Lisbon Summit in March 2000, heads of state and government recognized the KBE as one of the highest priorities for the European Union. Moreover, they set a new goal – to become the

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most competitive knowledge-based society in the world by 2010 (European Commission 2002). This corresponds to a slightly wider concept of the information society (IS), which is defined as a form of social organization in which information generation, processing and transmission become the fundamental sources of productivity and power (*Castells,* 1996).

Despite policy progress, 85 times more is still spent on physical infrastructural projects in the EU, than on innovation. This is a more striking feature in the CEECs, where the infrastructural investments will remain of utmost importance for years, something that might have disadvantageous consequences. Expenditure on education as a share of GDP is more than 30 percent lower in the new member states than in the EU-15, and expenditure on R&D more than 5-6 times higher in the EU-15 than in the Visegrad Countries (*Lackenbauer,* 2004).

Until the early 1990s, innovation and technology policy was oriented towards the national growth target. Spatial implications existed only rarely, in relation to the geographical distribution of public support. In the era of the knowledge-based economy, innovation (as one of the primary sources of economic activity) is no longer limited to technological innovations only, but it is also linked to systemic and network approaches that emphasize the importance of spatial proximity and regionally organized production (*Koschatzky,* 2003). Recent research on innovation systems focuses not only on the technological and socio-economic dimension of innovation, but also on the spatial aspects of innovation-related interactions (*Cooke* et al. 1998). The significance of space in innovation is indicated by empirical research showing that the *production of new knowledge and innovation has a predominant tendency to concentrate and cluster spatially, almost exclusively in urban agglomeration with stronger research university basis*. Spatial concentrations in innovation are more significant than those in manufacturing (*Varga – Szerb,* 2002).

The research on innovation theory carried out in the 1990s aimed at finding a close correlation between regional development and technological change, and the relations with regional innovation potential (*Cooke* et al. 1998; *Tödtling,* 1999). For generation of competitiveness in regions, it is necessary that knowledge and innovation capacity can be transferred in a broad circle. For backward regions, the utilisation of the new economic possibilities offered by the information society can be a breakout point, thanks to increasing innovation capacities. Both research and development (R&D) and high-tech industrial activities are highly concentrated in the core regions of the EU. This reflects wide regional differences in access to knowledge and the ability to exploit it. Unless differences can be narrowed, it will be difficult to achieve the Lisbon strategy objective entailing the EU's becoming the most dynamic knowledge-based economy in the world. Answering this challenge, the EU is assuming that R&D and innovation have to be embedded in specific regional contexts (*Koschatzky,* 2003).

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The reality is that economies of less-favoured regions suffer from being isolated from the best international R&D networks and centres. SMEs in these regions, in particular, have difficulties in accessing the latest technological developments. This feature appears more striking in the case of the new member states of East-Central Europe, in which these disparities are not only greater but also very much influenced by the socio-economic transformation of the former communist countries during the 1990s. The transition to a market economy in the CEECs has had a strong impact on both the enterprise sector and the innovation performance of the countries. The restructuring of the enterprise sector has been led by foreign direct investment, which created a dual economy situation of highly pro ductive foreign enterprises on the one hand, and domestic firms with less potential to in-novate or competes on the other. The potential for their catching up based on new technologies is restricted severely by weak demand for R&D on the part of enterprises at the beginning of the transition. The early years of transformation were also characterised by a decline in research infrastructure and a mismatch of national innovations systems. Thus, innovation cannot be examined independently from the performance of the transition and post-transition economies as a whole (*Inzelt,* 1998).

Most of the countries in the Carpathian area (except Austria), like other CEECs, went through economic transformation from the centrally planned economic system to the market-led system, experiencing heavy losses in R&D expenditure. During the communist era, research and technological development was given a high political priority, particularly in certain special industrial sectors. R&D activities were mainly carried out in public industrial research centres. Although the activities of these research centres were dedicated to the support of the development in specific industrial branches, they resembled most 'Fordist' innovation systems, in that they had little interaction with industry. During the transition, R&D activities have diminished significantly on account of both public and private funding for R&D having been reduced drastically. The number of people employed in the sector decreased, following the halving of the number of R&D units. The dramatic decline in markets and restructuring of large firms that were the main customers for R&D led to a sharp decline in business R&D expenditure (BERD). In the CEECs the past decade has brought, not only the termination of applied research in large companies, but also a substantial decline in domestic solvent demand for modern technology applicable in production. This process was compounded not only by the closure of the large industrial R&D institutes, but also by the restructuring of the main profile of these institutes, as many of them sought out new sources of revenue in short-term services, rather than in long-term research projects. Nevertheless, some sur-veys indicate that the innovative capability of the Carpathian area's economies has been weakened to a

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lesser extent than has the ability of enterprises to utilize innovation effectively (*Inzelt,* 2002).

Innovation and technology transfer depend greatly on the willingness of companies to innovate – something, that can be measured by reference to the shares of innovative companies and of innovation expenditure in sales revenue. There is a close correlation between innovative efforts and the income-generating capabilities of companies and the innovation performance of firm's determined primarily by the efficiency of their own R&D activities (*Dőry,* 2000). The share of BERD is lower than the EU average, but certain countries in the Carpathian area (Austria, Czech Rep, Hungary, Poland) still have an advantage regarding its BERD relative to GDP, in comparison with Portugal and Greece.

The restructuring of the enterprise sector in the transition period was led by foreign direct investment. This created a dual-economy situation of highly productive and more innovative larger-sized foreign-owned enterprises on the one hand, and domestic firms with lower financial ability to innovate struggling to remain competitive on the other. The attracting of high-tech FDI in firms could have been expected to increase. The dual economic character is clearly indicated by the high share of multinational companies in the national exports.

The dramatic decline in markets and restructuring of large firms that were the main customers for R&D led to a sharp *decline in business R&D expenditure (BERD)* in all of the CEECs. The 1990s' decade brought not only the termination of applied research in large companies, but also a substantial decline in domestic solvent demand for activities of this research. This process was compounded not only by the closure of the large industrial R&D institutes, but also by the restructuring of the main profile of these institutes, as many of them sought out new sources of revenue in short-term services, rather than in long-term research projects (*Table 38*).

These trends are illustrated by fluctuations in R&D expenditure throughout the transition period, showing a sharp decline until 1996. The figure on R&D expenditure as a percentage of regional GDP is one of the most reliable elements of appraisal. The highest level of *R&D expenditure relative to GDP* was achieved in most of these countries in the late 1980s and early 1990s with the lowest rate being reached in the mid or the late 1990s. Since the millennium, R&D expenditure has stabilized and started to increase in the Carpathian countries. Taking the Austrian (2.23%) figure in 2004 as a benchmark the Czech Republic and Hungary reached the highest grade, 1.26 and 0.9 respectively. Poland and Slovakia are in middle rank position with 0.56 and 0.51 respectively. As we do not have figure for Serbia and Ukraine Romania with 0.39% performed the lowest expenditure relative to the GDP. The expenditure of the relative well performing Carpathian (Czech Rep., Hungary) countries as compared to GDP is about half and slightly more of the EU-15 average level, and is similar to levels in the cohesion

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Table 38

Innovation performance in the selected countries of the Carpathian area

Country	No. of publications in universities and R&D institutes, 2001		No. of European patents per 1 million inhabitant, 2000	Gross R&D expenditure as a percentage of GDP, 2002	Business R&D expenditure as a percentage of GDP, 2002	Share of government in R&D funding, %, 2002	Share of business sector in R&D funding, %, 2002	Share of foreign-owned enterprises within total BERD, %, 2001
	per 1 million USD	per 1 million inhabitants						
USA	594	52.8	309.1	2.67	1.9	8.8	68.2	15.0
OECD	406	–	83.0	2.26	1.5	11.0	63.9	–
EU15	460	–	126.0	1.93	1.2	13.0	64.4	–
Austria	441	67.2	158.9	1.93	1.1	6.4	63.6	–
Czech Republic	195	68.1	22.2	1.30	0.8	23.0	53.7	45.3
Poland	117	63.8	26.4	0.59	0.2	45.0	21.4	4.6
Hungary	195	107.2	29.8	1.02	0.4	33.0	35.5	79.0

Source: OECD STI Outlook, 2004.

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countries. Nevertheless, their figure was lower than the figures for Austria (2.23%) and Slovenia (1.78%), which are above or very close to the EU average.

R&D investment relative to GDP funded by the business sector – except in Austria and the Czech Republic – was low in the Carpathian area by international comparison. The highest proportion in business R&D expenditure (BERD) can be found in Austria and Czech Republic (2/3 of the total R&D expenditure), while the extremely low figure available for Poland (0.28%, while Hungarian, Slovakian and Romanian figure ranging between 0.4 and 0.53%. First of all BERD relative to GDP demonstrates business activities in generation of applied knowledge. In developed countries, the business sector dominates as a performer of R&D. The percentage of GERD performed by the business sector has reached 70% in the OECD countries, exceeding the 60% noted in the EU-15 (*Table 38*).

15.3 The regional structure of R&D

Over the transition period, there has been a rapid increase in the number of innovation-oriented small and medium size enterprises, which are less concentrated spatially and heavier needs are not necessarily concerned with high-tech industry developments. These new demands and the change of innovation paradigm, place greater emphasis on the establishment of a decentralised institutional network promoting knowledge and technology transfer. Needed in addition to the revitalisation of the traditional network of R & D institutions is a multi-polar innovation system with more actors, in which distribution-oriented 'knowledge bases' co-operate in a network. The types of resources involved in the field of innovation can include specific assets that are only available in a certain place and these assets usually depend on spatial proximity and concentration. The regional level is particularly appropriate for mobilizing a critical mass of partners able both to promote innovation and to implement it effectively at grass-roots level (*Cooke* et al. 1998). Synergies, or an innovative surplus, can arise from the shared knowledge of the local economic-social-cultural milieu, that promotes network linkages (*Tödtling,* 1994).

Emphasis is placed on territorial disparities as regards scientific and technological development in Hungary. What is clearly seen from other European countries is that R&D and innovation activities are highly concentrated in core regions. In the European Union, just eight regions account for over a quarter of R&D expenditure, while thirty are responsible for half. As might be expected, there is a similar concentration of patents, as half of all high-tech patents are being made granted in just thirteen core regions (European Commission 2004). Location factors of innovation processes have largely an agglom-eration-driven character, varying concerning existing spatial economic structures. The presence of a ‘criti-

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cal mass' of agglomeration in a metropolitan area is required if substantial economic effects of academic research are to be expected (*Varga,* 2003). While in centralized economies, market-oriented industrial R&D activities are mainly confined to a few urban agglomerations, other countries are characterised by a more decentralised distribution of R&D activities. *In the case of the Carpathian countries, the R&D employment and even more expenditure heavily concentrated into the central/capital city regions* (*Table 39*). Countries – irrespective of their spatial characteristics – have gained technological competitiveness in certain fields or are paying the price of still-existing regional inequalities. There are wide disparities be-tween regions in terms of BERD, of greatest relevance to the assessing of the contribution made by innovative efforts to achieve competitiveness. The question is rather whether economies can succeed in flexibly adjusting their spatial distribution of innovation activities to the challenges that global technological competition poses.

There are differences in individual concepts featured in literature, when it comes to the explanation of innovation and regional development. The new growth theory and spillover studies emphasize that a 'critical mass' of agglomeration in metropolitan areas is required to concentrate re-sources (proper funding, efficient research units and synergies) among institutions in R&D fields. According to the literature, large cities with 3 million inhabitants are able to provide infrastructure, highly-skilled labour, and technology & business services for efficient R&D (*Varga,* 2002). Other interpretations (such as the network and milieu-oriented theory), emphasize the importance of development of decentralized regional innovation networks and clusters. However, it is difficult to decide the seemingly rhetorical question of whether a highly- or less-concentrated dis-tribution of R&D potentials or to put it an-other way, the centralised or decentralized systems are more efficient. It is rather more important how economies can succeeding flexibly adjusting their spatial breakdown of innovation activities to the challenges of global technological competition. In the case for Hungary, it is obvious that the Budapest agglomeration can provide a certain critical mass of economies of scale in the concentration of R&D activities, and its pre-dominant role can not be questioned. Nevertheless, if preference is given to the development of competitive regions and di-minishing disparities, and when the national innovation centre is unable to support the needs as regards technological change in the regions and to establish a localized technology paradigm, a shift towards the preference for regionally-oriented regional policy measures is needed (*Koschatzky,* 2003) (*Table 39*).

The figure on R&D expenditure and its territorial distribution are one of the most reliable elements of appraisal. There is large *fluctuation in the absolute size of the R&D expenditure varying by country to country and regions to regions.*

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Table 39

Spatial concentration of R&D in selected countries (at least half of the R&D employees can be found in the following agglomerations)

USA 1995	Germany 1997	Italy 1995	UK 1995	France 1995	Czech Republic 1995	Hungary 2000
New Jersey, Essex 9% Boston 8% Los Angeles 7% Philadelphia 6% Detroit 4% Chicago 5% New York 4% San José 3% Washington 3%	Munich 12% Stuttgart 12% Darmsatdt 9% Rhine-Neckar 6% Berlin 4% Düsseldorf 4% Brunswick 3% Cologne 3%	Milano (Lombardy) 33% Turin (Piemonte) 24% Rome (Lazio) 10%	London (South East) 41% East England 11%	Paris (Île de France) 48% Rhône-Alpes 11%	Prague 32% Sredny Cechy 28%	Central Hungary 64% (incl. Budapest 59%)
9 regions 49%	8 regions 53%	3 regions 67%	2 regions 52%	2 regions 59%	2 regions 60%	1 region 64%

Source: Koshatzky (2003) and the author's calculations.

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The shift from the centrally-planned to the market economy, and especially the transformation of enterprises, had a dramatic impact, not only on R&D infra-structure, but also on innovation finance, as clearly measurable by the cycles of R&D expendi- ture. R&D is funded by various sources. The major division exists between the public and private funding. OECD classifications use four funding sector categories: governmental, business, non-profit and foreign. The govern-ment sector becomes the leading fin-ancier of R&D in those countries in which industry has been weakened by economic transformation; the role of other sectors is salient. It can be observed that the funding role of the Hungarian government sector has increased since 1990, although expenditure has decreased in real terms (*Inzelt,* 2002).

In terms of the spatial breakdown of the R&D expenditure within the Carpathian area large disparities can be observed between the most and the least developed countries, respectively Austria and Romania (Ukraine and Serbia ex-cluded). Data shown more than 30 times differences in the absolute figure on R&D expenditure between Austria and Romania. This development gap even more striking in the case of the most developed Wien metropolitan region and the worst preforming Świętokrzyskie region (546 times difference) (*Table 40*).

In terms of the *spatial breakdown of the R&D expenditure within the countries of the Carpathia Area* we can see a similar geographical distribution trend as is observed in the case of employees. The predominance of the capital city regions, indicating a strong concentration of innovation resources in the capital city, are very high in the case of those countries where the Carpathian area incorporates the capital city regions. The larges concentration can be found in the Hungarian and the Romanian case, with 64 and 59% GERD concentration respectively. In the case of Slovakia and Austria the GERD concentration into the capital city region is just below 50%. In the Polish or the Czech Carpathian areas have only shallower concentration in R&D expenditure. The Polish Carpathian area characterised by almost the far largest the intraregional differences. This gap pictures absolute domination of the Warsaw area over the rest of Poland although it is outside our case area. Małopolskie owes its second position to R&D indices – Kraków is the second biggest scientific and university center after Warsaw. It is the location to for biggest research centers established by transnational foreign companies (ABB, Motorola, Delphi). Although the next five regions are ahead of Małopolskie in regards to ICT firms development – it would be a misleading conclusion that Kraków R&D complex weakly translates into ICT development. Firstly because western part of Małopolskie contains some of the best Polish powiats in this respect and secondly – so many ICT firms from Silesia region (Śląskie) are linked to Kraków R&D. The worst regions are located, firstly, on Poland's eastern border, including Podkarpackie and, secondly in central-eastern Poland – Świętokrzyskie voivodship which was the last in all R&D indices.

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Table 40

Territorial distribution of R&D expenditure figures in the Carpathian regions (2004)

Region/country	R&D expenditure/ million EUR	Percentage of the country's total, %	Share of BERD in the total GERD, %
Austria	*5250*	*100.0*	*68*
Burgenland	29	0.6	86
Niederösterreich	327	6.2	93
Wien	2184	41.6	58
Czech Republic	*1100*	*100.0*	*64*
Jihovýchod	141	12.8	56
Střední Morava	58	5.3	83
Moravskoslezsko	69	6.3	80
Hungary	*721*	*100.0*	*41*
Közép-Magyarország	464	64.0	46
Közép-Dunántúl	43	6.0	47
Nyugat-Dunántúl	33	4.5	52
Észak-Magyarország	19	2.6	38
Észak-Alföld	59	8.1	43
Dél-Alföld	47	6.6	23
Poland	*1139*	*100.0*	*29*
Małopolskie	143	12.5	25
Śląskie	89	7.8	32
Podkarpackie	23	2.0	75
Świętokrzyskie	4	0.36	n.a.
Romania	*235*	*100.0*	*55*
Nord-Vest	8	3.4	53
Centru	11	4.9	95
Nord-est	13	5.3	58
Sud-Est	8	3.2	70
Sud – Muntenia	33	14.1	98
Bucureşti-Ilfov	138	58.7	42
Sud-Vest Oltenia	13	5.7	38
Vest	11	4.8	55
Slovakia	*174*	*100.0*	*49*
Bratislavský kraj	86	49.3	29
Západné Slovensko	47	26.7	81
Stredné Slovensko	21	12.2	69
Východné Slovensko	21	11.8	43

Source: Eurostat.

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In Hungary only the central region (including Budapest) is above the national average (1.8). This figure for Budapest exceeds 2%. This strong agglomeration of R&D activities into the capital city can be explained partly by the spatially-concentrated character of innovation in scale economies and partly by the long-standing tradition of scientific life in Budapest. Following the central region, the next largest figures can be found in the Great Plains regions, which incorporate the largest traditional university centres (their shares from total GERD (8.1–6.6%) is markedly larger than in the Transdanubian regions. In these latter regions, R&D potential is distributed more evenly among research bases, including a higher number of business units among those. This difference lays in the origins of funding. While public spending dominates in the eastern regions, in the more-developed western regions BERD is markedly higher.

In Romania and similarly in Slovakia one particular provincial region follows the large metropolitan concentration of the capital cities. In Romania Sud Muntenia characterised by the strong enterprise-led innovation activities in the chemical sector can be the right explanation for its almost 15% of GERD concentration, of which BERD is accounted for 98%. In the case of Slovakia the Zapadné region absorbs more than the quarter of the total GERD of which 81% is performed by the business sector, and quite a large extent by multinationals in the automotive sector relocated their own R&D units into the Carpathian area.

While public spending dominates in certain countries (Poland, Hungary, and Slovakia) and the larger metropolitan regions, concentrating large number of public research units in another's (Austria, Czech Republic) business sector R&D expenditure is markedly higher. This is also the case in their regions characterised by strong industrial agglomerations and in-house R&D units of their companies.

In studying the territorial structure of innovation characterized by the main R&D indicators during the transition period, we can note the dominance of a dual effect, namely decreasing demand and declining financial resources for R&D. Research and development fell into crisis in the early 1990s as a consequence of a decline in government spending on the sector, and particularly be-cause of the disintegration of large companies which had conducted their own research activities (*Papanek* et al. 1999). The difficulties of the sector reflected in the changes in the number of employees. The *number of employees in R&D institutions* peaked in late 1980s and then declined sharply to have more than halved by the mid-1990s.

The ratio of *research employment to the active population* was the highest in Austria (1.89) following by Hungary (1.19) and the Czech Republic (1.18). Contrast to these countries the lowest figures is available for Romania (0.4) and Poland (0.75). The regional distribution of active labour force in the R&D sector shows the sectoral characteristics of a particular region. Regions with strong metropolitan concentrations and well-developed innovation infrastructure have higher

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representation of R&D employees, than those peripheral (rural) regions without strong university knowledge basis. The highest figure allocated for the Wien (4.12), Bratistlavsky (3.18), the Central-Hungarian (2.12) and the Bucureşti (1.99) regions.

The lowest figures can be found in the cases of the most peripheral regions; most of them located in Romania (Sud East, Nord East, and Nord Vest) and in Poland (Świętokrzyskie), and their figures were below 0.2%. The Eastern Czech regions are characterised by a relatively higher percentage of R&D employment in percentage of active population. The ratio of research staff relative to the active population in Hungary reduced from 0.94 to 0.55% between 1988 and 1996, and has slowly risen back to 0.69% (by 2000) and increased further to 1.19 in 2004. Except the higher ranks of the Great Plain regions (0.9–1.06) the rest of the Hungarian regions of the Carpathian areas perform figures around 0.5%. The Great Plains regions of the largest university centres (South Great Plains, North Great Plains). The forerunner counties of Western Transdanubia lag behind in these terms and, paradoxically, the Northeastern region, the one most seriously hit by the structural crisis, has more R&D employees due to the presence of the originally engineering-based Miskolc University and research units in chemical industry.

As regards the regional distribution of innovation activities, a spatial contradiction exists. Taking the Hungarian example the North-west Hungary is characterised by a high level of industrial production, GDP per capita and business-oriented innovation, but at the same time university-, based R&D activities are rather weak. Its basic R&D indicators are not only below the national average, but they are shallow even in comparison with the less-developed eastern regions (*Dőry,* 2000). Paradoxically West Transdanubian region, while in the vanguard of economic development through the attraction of FDI, has weaker than expected R&D performance (especially in terms of input indicators) and institutional framework for research (lack of traditional universities). Although it is true that the strong FDI presence has not been accompanied by statistically-significant R&D activities in Nort-west Hungary, the industrial and innovative traditions, the concentration of multinationals into the high-technology sectors (especially the automotive industry) and the formation of one of the first high-tech clusters in Hungary (Pannon Automotive Cluster) have increased the innovation potential of the region. Local initiatives with governmental support have expanded the region's higher educational capacity in recent years, with a view to its catching up in the field of research and prospering co-operation with industry (*Grosz*, 2003).

Besides the statistically well-established *input indicators*, less reliable data is available in the f ield of *R&D outputs* (e.g. SMEs innovating in-house, SMEs' innovation expenditure, sales of new-to-market products, new capital raised/GDP, HR in S&T). The output indicators demonstrate the contribution of research

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achievement to the competitiveness of the economy. The number of patent applications and the *available human resources in Science & Technology*. Innovation-oriented economy cannot be developed without the required human resources, i.e. the supply of properly trained employees for the companies. The present industries in the region are generally characterized by the lack of properly trained employees, and consider vocational training far from adequate level regarding both its quality and content. The regional supply of training programmes cannot meet the demands of the labour market, as the vocational training system does not follow the changes in the economy.

Human resources in S&T as percentage of economically active population are one of the key indicators of human capital supply and potential of a particular region. The largest share of S&T employees can be found in the metropolitan regions where large agglomeration and concentrated knowledge basis could provide the appropriate pool of highly skilled labour and S&T graduates. The Bratislava, Wien and the Central Hungary regions provide the largest share of S&T employees, 47.6%, 46.5% and 41.7% respectively (this figure for Budapest is slightly above 50%!). The lowest figures are available for the Romanian peripheral regions (Nord Est, Sud Muntania and Sud Est) accounted around 15% and below. The average figure for the rest of the regions of Carpathian area is about 25%

Within the Carpathian area only the *Budapest agglomeration* could provide 2.7 million inhabitants, appropriate infrastructure to become a real knowledge pool for the Carpathian region. In the case for Hungary, it is obvious that the Budapest agglomeration can provide a certain critical mass of economies of scale in the concentration of R&D activities, and its pre-dominant role can not be questioned The traditional predomi-nance of Budapest in the economy has not diminished. Indeed, it has grown consider-ably since the change in regime. During the transition, Hungarian growth has been agglomeration-driven. The country's very high agglomeration-elasticity of growth is embodied by the dominant role of the capital city as the centre of innovation. Budapest is characterised by good infrastructural links, massive inflows of FDI and by a great number of joint ventures, which act as connections to international networks (*Bachtler* et al. 1999). Budapest has attracted tertiary activities, including innovation services. During the transition, the capital city was not only able to retain its advantage over the rest of the country, but in fact further increased it. Budapest became a bridgehead of Hungarian innovation, which overwhelming dominance in the innovation field is shown clearly by the main innovation indicators. There are several arguments concerning the predominant position Budapest holds within S&T. The key role of Budapest as the centre of innovation in economic transformation was rooted in the traditionally- centralized (path-dependent) structure of Hungarian science. It is based on its disproportionate size of agglomeration and reinforced by the lack of the

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autonomous and regionally embedded innovation centres outside Budapest. The geographical structure is a barrier, as innovation activities are highly concentrated: large gaps occur between Budapest and the countryside, between the Budapest–Vienna axis and the regions lagging behind, and between the largest knowledge centres and the remaining settlements.

15.4 Conclusion

Because of the goals of the Lisbon strategy, defined in 2000, the target shares of company sector in overall expenditures on R&D were set to 66% during the Barcelona summit in 2002. Following the yet unsatisfactory outputs of the *Lisbon agenda*, a new initiative was formed in 2005, bearing the name Lisbon partnership for growth and employment. In order to increase the efficiency of the so-far growth supporting efforts in the EU three priority areas of support were set, encompassing also knowledge and innovations for growth. Lisbon national reform programmes were created at the national level and the Lisbon program of the Communities was prepared at the EU level; all of them integrated for the first time into the common research and innovation policy (*Kadeřábková,* 2006).

Innovation is crucial to the integration and modernization process in the CEECs as well as in the Carpathian area. One of the biggest systemic failures of the transformation economies of East Central Europe was the mismatch between the different components of the innovation system, result-ing in a rapid decline in government support and industrial research during the transition period. The failure of the centrally planned model of innovation had been dissolved and the economic environment during the transition did not favour the structural re-organization of the system. The modernization of the NIS has created a good framework for the development of co-operation between the different spheres of innovation, but still fails to handle the problems of regional inequalities. While during the transition, spatial development was largely determined by FDI in manufacturing, in the post-transition period this main factor was augmented by new directions in innovation as an important factor differentiating economic space.

Although the capital city (metropolitan) regions of the Carpathian area, are undisputed leaders in many aspects of innovation, the rest of the Carpathian area is not its periphery. The picture is much more complicated than simple core-periphery model. The R&D activity indicators offer for other regions a chance to succeed. It seems that especially Niederösterreich, Małopolskie, Jihovychod, North Great Plain, Zapadne Slonvensko and Vest Romania have a potential for knowledge-based development. According to the big urban agglomerations in the CEECs – the metropolises are leaders of the economic transformations at the expense of the surrounding regions. There are positive spread effects in the radius

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of 30–50 kilometres but the more remote areas are deprived of the most active and qualified employees. This notion finds confirmation in what was presented above at micro-regional level, where good accessibility to education in metropolitan zones is reflected in the knowledge based economic development and R&D activities whereas in the more remote areas this relationship fades.

The future success of the Carpathian area depends largely on regionally based, knowledge-oriented economies, perhaps the most promising way to achieve modernization and catch up. The preconditions for the creation of this are largely jeopardised by the shal-lower innovation potential of the Carpathian regions outside the metropolitan regions, resulting in large geographical differences. Development of regional innovation policy will be of decisive importance in the modernization of the spatial structure of the Carpathian area, the improvement of regional competitiveness and the foster-ing of re-industrialization. The construction of a regional institutional system capable of developing the technological level of the regions is a prerequisite for integration into the globally- and regionally- organized knowledge economy.