18. Competitive and uncompetitive regions in transition economies: the case of the Visegrad post-socialist countries

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18.1 INTRODUCTION

During the last few years research in regional economics has shown an eager interest in regional competitiveness. Increasingly, the aims of policy have also focused on improving regional competitiveness. The notion of regional competitiveness can be seen as defining that of economic growth. However, one can often observe that proposals for improved competitiveness combine traditional economic policy means derived from endogenous growth theories with regional policies, primarily place-based economic development strategies. Thus, there is a great need for synthesizing regional competitiveness and endogenous growth theories and also providing an empirical framework for policy-oriented analyses.

Competitiveness has today become a widely used and popular concept as one of the consequences of globalization processes. It signifies the inclination and skill to compete, and the ability to gain and permanently maintain position in the competition, which is indicated primarily by successfulness (measured in some way) and the ability to succeed. The competitiveness of countries or regions refers to successes to date, as well as to recent economic growth, and also envisions the ability to develop in the near future. Competitiveness has become the favourite term not only of academic studies but also of regional political documents. Due to its broad theoretical and economic policy background, various approaches have emerged on the concept and interpretation of competitiveness (Annoni and Dijkstra, 2013; Bristow, 2010; Camagni, 2002; Gardiner et al., 2004; Huggins et al., 2013).

From an economic point of view, the competitiveness of territorial units – that is, countries and regions – can be measured by their total factor productivity (Krugman, 1994). Porter (2008, pp. xiii–xiv) states that 'competitiveness arises from the productivity with which firms in a location can use inputs to produce valuable goods and services. The productivity and prosperity possible in a given location depend not on what industries its firms compete in, but how they compete'.

In regional studies it is generally accepted that the competitiveness of regions and cities is more than the productivity of inputs. It essentially incorporates regional economic development, as a result of which the average standard of living in the region improves (Camagni and Capello, 2010; Huggins et al., 2014; Malecki, 2002; Zenka et al., 2014). Competitiveness of regions and cities may be described by the widely recognized definition of Storper (1997, p. 20): 'The ability of an (urban) economy to attract and maintain firms with stable or rising market shares in an activity while maintaining or increasing standards of living for those who participate in it'. The European Competitiveness Reports also adopt this approach (European Commission, 2008, p. 15): 'competitiveness

is understood to mean a sustained rise in the standards of living of a nation or region and as low a level of involuntary unemployment as possible'.

The regional competitiveness approach is characterized as being a 'dual concept' (Huggins et al., 2014, p. 28), 'that explains relative differences in rates of economic development across regions, as well as an understanding of the future economic growth trajectories of regions at a similar stage of economic development'. According to endogenous growth theories, the present and future level of the knowledge base, research and development (R&D), innovation milieu, clusters and networks, human capital, trust, and so on are crucial in the improvement of regional competitiveness.

The theoretical and practical studies dealing with the investigation of regional competitiveness can be classified under three main topics, which are built upon one other in an integrated, complex approach to competitiveness (Barkley, 2008; Lengyel and Szakálné Kanó, 2012): (1) How can we define competitiveness and the factors that influence it (conceptualization)? (2) By what indicators can competitiveness and its factors be measured (operationalization)? (3) How can regional competitiveness be improved (regional policy)?

Based on the literature discussed above, the acknowledged schools concerned with the competitiveness of regions consider competitiveness as sustained economic growth which also takes account of the social and ecological factors of development in some way. It may be concluded that competitiveness exceeds the common interpretation of economic growth, incorporating some main endogenous features of social progress and sustainable development, but still holding a more economic perspective. The standard understanding of regional competitiveness is: economic growth which derives both from the improvement of labour productivity and the high level of employment, and in which growth improves the standard of living and well-being of the region's population. Competitiveness and its causes in transition economies have become a research question of outstanding importance in the Central European post-socialist countries, because there is a considerable gap within the European Union between longer-term members and those countries joining in 2004.

In section 18.2 this chapter provides an overview of the definition and distinct frames of interpretation of regional competitiveness. As a next step, it focuses on the models of competitiveness and proposes a renewed pyramid model of regional competitiveness as a synthesis of endogenous regional growth theories. In an empirical application, the chapter analyses the competitiveness of 93 Nomenclature of Units for Territorial Statistics (NUTS) 3 level regions of four Central European countries (the Czech Republic, Hungary, Poland and Slovakia) with the help of the pyramid model and a regional competitiveness function based on this model. The data and methods used are laid out in section 18.3. Section 18.4 presents the results of this analysis. The conclusions of the chapter are then outlined in section 18.5.

18.2 REGIONAL ENDOGENOUS GROWTH AND COMPETITIVENESS

Since the notion of regional competitiveness can be seen as refining that of sustainable economic development, it can often be observed that proposals for improved competitiveness combine traditional means of endogenous growth with strategies based on regional

policies. There are a number of attempts to define the model of regional competitiveness (Aiginger et al., 2013; Huggins, 2003; Gardiner et al., 2004; Porter, 2007). Studying the elements of economic growth, Porter (2007) interpreted the factors affecting the quality of life, standard of living and welfare, as the objective of the improvement of competitiveness. This is dependent upon the income per capita, which is determined by labour productivity and the utilization of the workforce (essentially, employment).

Kitson et al. (2004) also measure regional competiveness using the three related indicators: productivity, employment and standard of living. According to the authors, competitiveness is influenced by both hard and soft elements. The hard elements consist of measurable economic, demographic, infrastructural and other factors, while soft elements are associated with quality aspects and other hard-to-measure characteristics. In systematizing the sources of a region's competitive advantages they highlight six factors, in case of which the frame of interpretation is provided by the concept of 'capital': productive capital, human capital, social-institutional capital, cultural capital, infrastructural capital, and intellectual and creative capital.

Stimson et al. (2009) suggest a new conceptual model framework for regional endogenous development, where the dependent variable is measured by two indicators: the change of employment or income, and the changing of the employment-based location quotient (LQ). Explanatory variables include the availability of resources, estimated by 13 indicators; and market fit, measured by four indicators. In addition the model incorporates further indicators to consider the quality of leadership, institutions and entrepreneurship as well.

Aiginger (2006) defines competitiveness as 'the ability of a country or location to create welfare' (p. 161). He classifies two types of approaches to the measurement and conceptualization of competitiveness: outcome (output) evaluation and process evaluation. Outcome competitiveness, as a sort of welfare function, can be traced back to three factors: income per capita, a set of social and distributional indicators and a set of ecological indicators. While the factors of process competitiveness are: physical capital (K), labour (L), technical progress (TFP), capabilities (C), institutions (I) and trust (T). He proposes a four-level method to measure and operationalize competiveness.

Huggins and Thompson (2013) compile a three-factor model to prepare the United Kingdom Local Competitiveness Index, which differentiates between input, output and outcome factors. Input factors include economic activity rates, business start-up rates, number of businesses per capita, proportion of working-age population with NVQ Level 4 or higher, and proportion of knowledge-based businesses. Output factors relate to how these inputs are used to generate economic outputs captured by gross value added (GVA) per head at current basic prices, labour productivity and employment rates. The final group, outcome factors, are those associated with the standard of living benefits felt by the population through gross weekly pay and unemployment rates.

In the case of the World Competitiveness Index of Regions (WCIR) for the inputs Huggins et al. (2014) classify fourth-wave (employment in automotive and mechanical engineering, number of managers, per capita expenditures on R&D, and so on) and fifth-wave (employment in information technology and computer manufacturing, employment in biotechnology and chemicals, and so on) knowledge capital.

The original pyramid model of regional development and competitiveness seeks to provide a systematic account of the standard means of competitiveness and to describe

the drivers of improved competitiveness (Lengyel, 2004, 2009; Lengyel and Rechnitzer, 2013a). This model has been adopted by many scholars (Gardiner et al., 2004; Komlósi and Fujii, 2012; Parkinson et al., 2006; Thissen et al., 2013), since 'this model is useful to inform the development of the determinants of economic viability and self-containment for geographical economies' (Pike et al., 2006a, p. 26). As can be perceived in the pyramid model, 'more recent analytical review[s] [have] sought to identify the interrelated factors that drive competitiveness' (Pike et al., 2006b, p. 112).

The renewed pyramid model is established on the basis of the inputs–outputs–outcomes relationships, similarly to three-factor models (Figure 18.1):

- Outcomes are the standard of living, the prosperity and well-being.
- Outputs are the revealed competitiveness indicators (*ex post* indicators): labour productivity, employment rate, and so on.
- Inputs-1 are drivers of competitiveness with a direct and short-term influence on economic output; in the renewed pyramid model there are five categories (*ex ante* indicators).
- Inputs-2 are long-run sources of competitiveness with an indirect impact on outputs and inputs-1; in the renewed pyramid model there are two levels with eight categories.

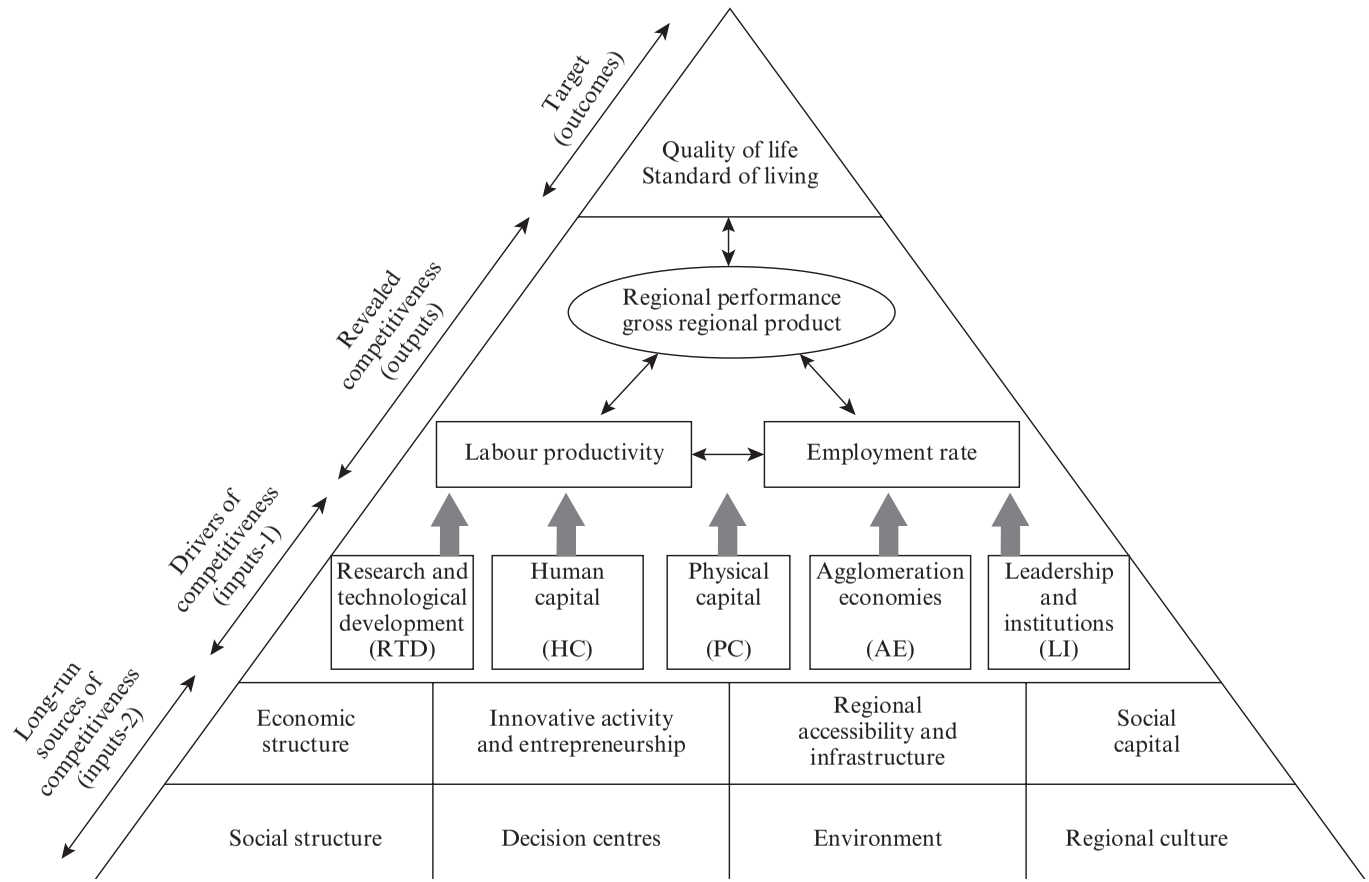
In order to investigate the relations between output indicators of revealed competitiveness (RC) and drivers of competitiveness (inputs-1), we intend to introduce the regional competitiveness function (RCF):

$$RC = \mathrm{f}(RTD, HC, PC, AE, LI) \tag{18.1}$$

where *RTD* is the research and technological development (technical process); *HC* is human capital (labour); *PC* is physical capital; *AE* are agglomeration economies (and regional specialization); and *LI* represents leadership and institutions. To test the RCF, we first calculated the value of revealed competitiveness (outputs); afterwards we analysed it with multivariate linear regression to determine to what extent drivers of competitiveness (inputs-1) are able to explain the value of revealed competitiveness. Our multivariate linear regression model:

$$RC = \beta 0 + \beta 1\ RTD + \beta 2\ HC + \beta 3\ PC + \beta 4\ AE + \beta 5\ LI + \varepsilon \tag{18.2}$$

The basic premise of the pyramid model is that we assume that there is a relationship between inputs-1 and outputs (revealed competitiveness). The *RCF* is an extension of regional growth concepts from the latest work on endogenous growth research. The traditional factors of endogenous growth theories are involved in the model: capital (*PC* as *K*), labour (*HC* as *L*) and technical progress (*RTD* as *TFP*). Moreover, agglomeration economies (*AE* and regional specialization), emphasized by smart specialization strategies are also included in the renewed pyramid model's inputs, and leadership and institutional effects (*LI*) emphasized by new endogenous development theories (Huggins et al., 2013).



Sources: Based on Lengyel (2000, 2004, 2009) and Gardiner et al. (2004).

Figure 18.1 The renewed pyramid model of regional competitiveness

18.3 DATABASE AND METHODOLOGY

This chapter tests the renewed pyramid model; at the same time we analyse the competitiveness of the regions of four countries: the Czech Republic, Hungary, Poland and Slovakia. These four post-socialist countries joined the European Union in 2004; they have similar economic structures resulting from their history and geographical proximity. Besides testing the pyramid model, our research aims to classify the regions by type based on their competitiveness and analyse the factors forming the particular types. Regional competitiveness studies tend to be relative: that is, we mostly compare the competitiveness of the chosen regions to each other.

We have selected the county – that is, the NUTS 3 level – as the territorial unit of our study. In the Eastern and Central European countries motorway networks have been only partially constructed. This means that urbanization processes are also belated compared to Western European countries. This means that the NUTS 3 territorial level is closer to the actual spatial structure of the economy than NUTS 2 regions. In all four countries the capital cities constitute a separate county, which we handle collectively with the neighbouring counties representing their agglomeration, but we also combine seven further urban counties of Poland (Appendix Table 18A.1). Thus the chapter analyses 13 counties in the Czech Republic, 19 counties in Hungary, 54 counties in Poland (Nowicki, 2012) and seven counties in Slovakia, giving 93 counties in total. The average population of the developed territorial units is 690 000 people, the smallest county has a population of 200 000, while the largest has a population of 3 280 000.

We analyse the three levels of the pyramid model and their relations, similarly to the three-factor regional competitiveness framework of Huggins et al. (2013) (Appendix Table 18A.2). Outcomes are measured with three indicators: disposable income per capita (*DI*), the unemployment rate (*UR*) and GDP per capita, in purchasing power standard (PPS) (*GP*). In order to define a common outcomes index principal component analysis is utilized. The common index contains 67.6 per cent of the information from the three indexes (KMO test 0.486; components: *DI* 0.83; *UR* −0.672; *GP* 0.942).

The outputs (revealed competitiveness) are measured utilizing three indicators: labour productivity (*LP*), employment rates (*ER*) and gross value added (*GVA*) per capita (GA), measured in euros. Again principal component analysis is used to develop a common output index. It contains 75 per cent of the information from the three indexes (KMO test 0.425; components: *LP* 0.851; *ER* 0.754; *GA* 0.977).

The RCF refers to the connection between the output as the dependent variable and the indicators of input-1 as explanatory variables. In the renewed pyramid model we distinguish five input-1 factors. For four of the input-1 factors relevant data are available in all four countries, allowing them to be captured in a comparable manner. In order to measure the drivers of competitiveness we used several indicators for each input-1 factor. An overall factor measure was generated for each using principal component analysis (Appendix Table 18A.2):

The RTD principal component, research and technological development (technical process), uses two indicators: patent applications to the European Patent Office (EPO), and the presence of research employment. It compresses 79 per cent of the information of the two indicators (KMO test 0.51; components: 0.89). The HC principal component, human capital (labour) again is based on two indicators, students in higher education

institutes, and the proportion of the population with tertiary education. It contains 85 per cent of the information of the two indicators (KMO test 0.51; components: 0.919). The PC principal component, physical capital, is based on a single indicator, gross fixed capital formation. The AE principal component, agglomeration economies (and regional specialization), uses three indicators: population density, share of town population and GVA per capita in PPS. It compresses 62.4 per cent of the information of the three indicators (KMO test 0.666; components in order: 0.76, 0.814 and 0.794).

The above-mentioned four principal component factors as explanatory variables were used in multivariate linear regression, where *RC* was considered a dependent variable. The estimated relationship is given by (heteroskedasticity-robust standard errors in parentheses):

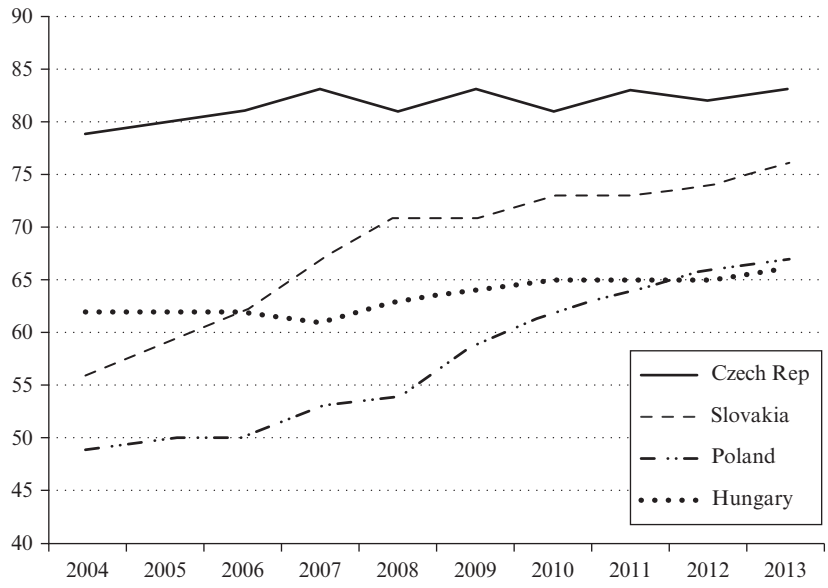
$$\underset{}{RC_i} = \underset{}{+ 0.279\ RTD_i} \underset{(0.086)}{- 0.091\ HC_i} \underset{(0.085)}{+ 0.193\ PC_i} \underset{(0.012)}{+ 0.618\ AE_i} \underset{(0.059)}{+ e_i} \qquad (18.3)$$

The model meets the standard regression assumptions with residuals following a normal distribution (Doornik–Hansen test, p-value = 0.151); variables are free of multicollinearity, so that the variance inflation factors (VIF) are all less than 2.5; and it fulfils linearity and specification tests (with p-values of 0.197 and 0.700).

In the counties of the four examined countries, the revealed competitiveness is influenced substantially by two inputs: agglomeration economies, and research and development. Evidently other factors may also have a significant effect on the competitiveness of counties, not only the factors based on the pyramid model; for example, the migration of young graduates to Western Europe, the economic policy of each country (budget deficits, indebtedness, and so on), their monetary policy (out of the four studied countries, only Slovakia is a member of the eurozone), and their regional development policy.

18.4 EMPIRICAL RESULTS

In these post-socialist countries the competitiveness of regions is strongly influenced by the economic performance of the national economies as a whole, and changes in this (Lengyel and Leydesdorff, 2011; Lengyel and Rechnitzer, 2013b; Nevima, 2012). The gros domestic product (GDP) per inhabitant of the four countries has evolved differently from 2004 onwards, following accession to the European Union (EU). The economies of two countries have grown dynamically, and those of the other two countries have displayed relative stagnation (Figure 18.2). The relative positions of the Czech Republic and Hungary within the EU have hardly changed over almost a decade; that is, substantive convergence has not taken place. The Czech GDP per capita has fluctuated at between 80 and 85 per cent of the EU average, while the Hungarian economy has always remained within the limits of 62–66 per cent of the EU average. On the other hand, Slovakian and Polish economic output over this period has increased dynamically, by 20–25 percentage points, thereby the earlier differences between the four countries decreased by 2013. The different development trajectories can be explained by economic policy differences, but also the efficiency of the grants arriving from the EU Structural Funds in improving and serving the regional competitiveness has differed greatly.



Source: Eurostat, table_tec00114.

Figure 18.2 GDP per capita, PPS, per cent (EU28=100)

The economic output of regions is also affected by the settlement structure of the countries. Institutions and service provider organizations within national networks are generally concentrated in metropolitan regions, exploiting agglomeration economies (Figure 18.3). The economic output of the 12 city regions with a population of at least 1 million is outstanding. At the same time, the economic performance of the remaining 80 regions is much weaker (Legnicko-Głogowski is an outlier). They constitute a distinct group with a population of 200 000–800 000 and output per capita of €10 000–€20 000 (PPS GDP per capita). This represents between 40 and 75 per cent of the €26 600 PPS EU-28 average. These regions are essentially the regions in need of the EU's convergence support. Only six counties have unit output above the EU-28 average: the four capital counties and two additional Polish counties (Poznan and Legnicko-Głogowski).

Analysis is conducted with regard to the competitiveness of counties, relying on the pyramid model, on the basis of the principal components of the different index groups of inputs-1. The statistical explanatory power of the principal component calculated based on the outcomes indexes is not strong enough, however, we consider that the revealed competitiveness (RC) principal component calculated based on the output can be taken as the basis for further analyses.

The regression analysis indicated that the RC is actively affected by the principal component of agglomeration economies (AE factor), which can be captured by the size of the population and spatial concentration of the regions (Figure 18.4). It is indeed observable that the larger regions have higher RC values, but the size of this correlation can only be considered medium (linear correlation 0.76). However, it can be stated categorically that in the counties with lower RC the agglomeration effects are also low.

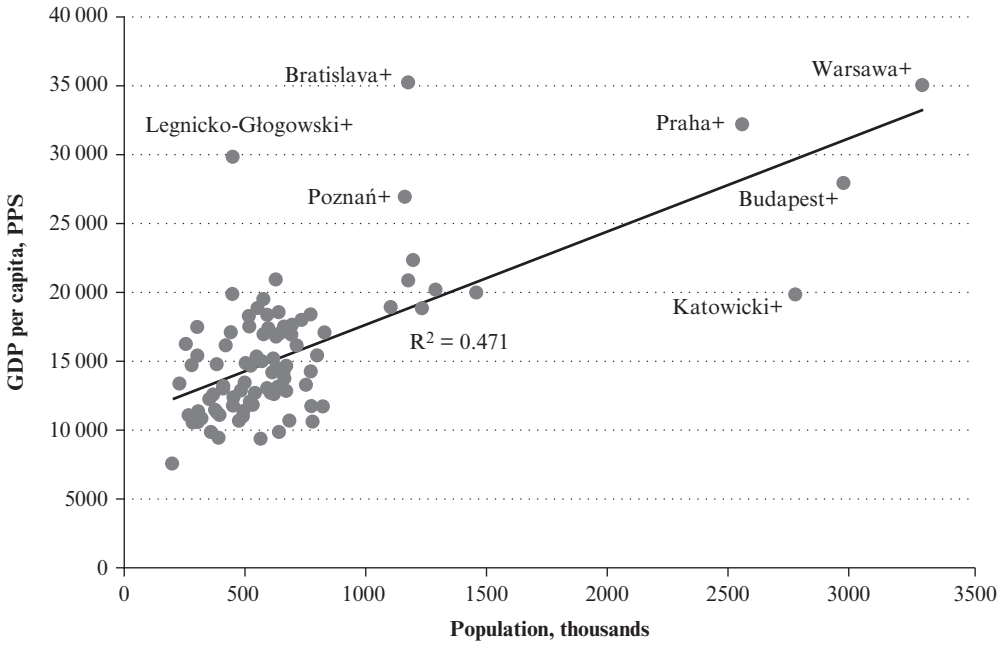


Figure 18.3 GDP per capita (PPS) and population of counties (thousand persons), 2012

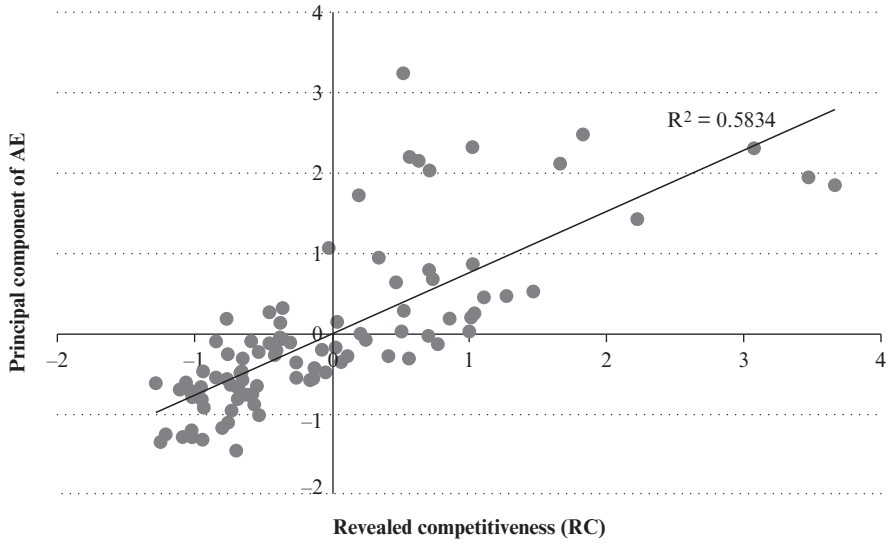


Figure 18.4 Revealed competitiveness (RC) and principal component of AE

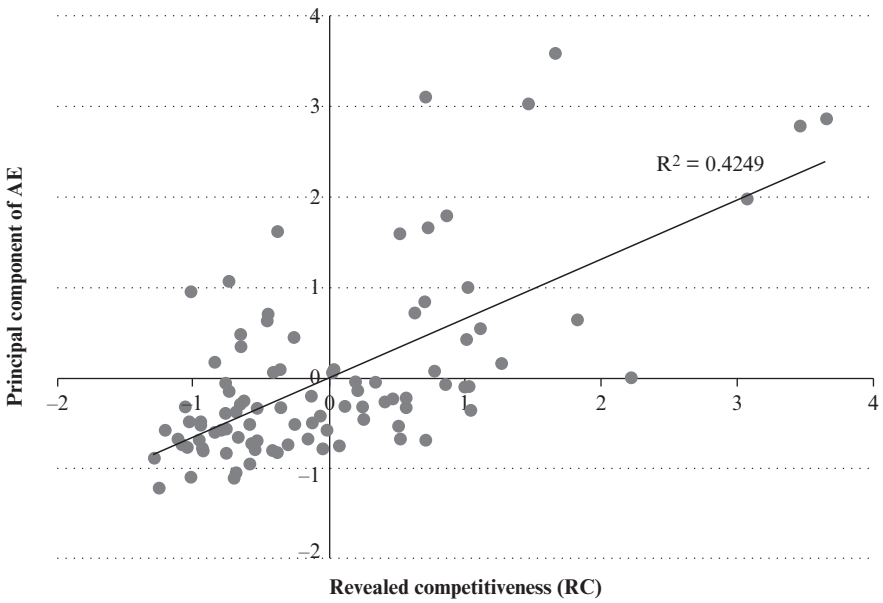


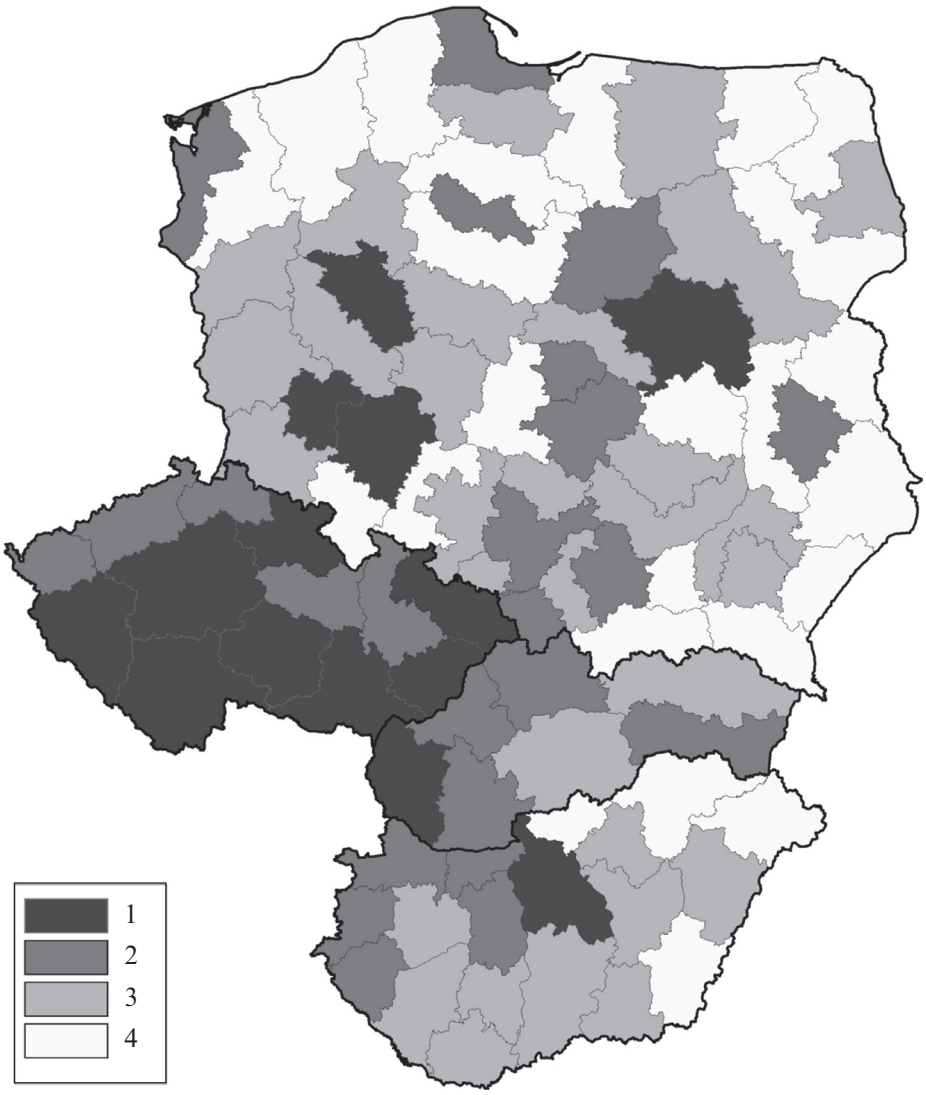
Figure 18.5 Revealed competitiveness (RC) and principal component of RTD

In the regression analysis the other relevant explanatory variable was research and development (RTD) (Figure 18.5). In this case the correlation with RC is lower (linear correlation 0.65), patenting activity is found in counties with weaker competitiveness and there remains employment in R&D within these regions, probably due to the researchers in higher education. It also shows that the more competitive counties are also characterized by stronger research and development activity.

Based on the RC values we categorized the counties in four groups (Figure 18.6): (1) strong competitive counties, of which there are 14 such counties: eight Czech counties, the other three capital counties and three more Polish metropolitan regions; (2) rising competitive counties are those counties connected to metropolitan regions, close to the German and Austrian markets; there are 24 counties in this group of which five are Czech, four are Slovakian, five are Hungarian, and ten are Polish; (3) weak competitive counties include two Slovakian, nine Hungarian and 20 Polish counties; (4) uncompetitive rural counties account for the remaining four Hungarian and 20 Polish counties.

The competitiveness types of counties are also organized spatially, along a west–east gradient, with the exception of Poland, where the more competitive regions are located in a more mosaic-like pattern. It is probable that the competitive economy first emerged in the metropolitan growth poles in the rapidly expanding Polish economy. With the exception of the Polish border, there are counties with similar competitiveness level on the borders of the other three countries. This can be contrasted with an outcome measure: unemployment.

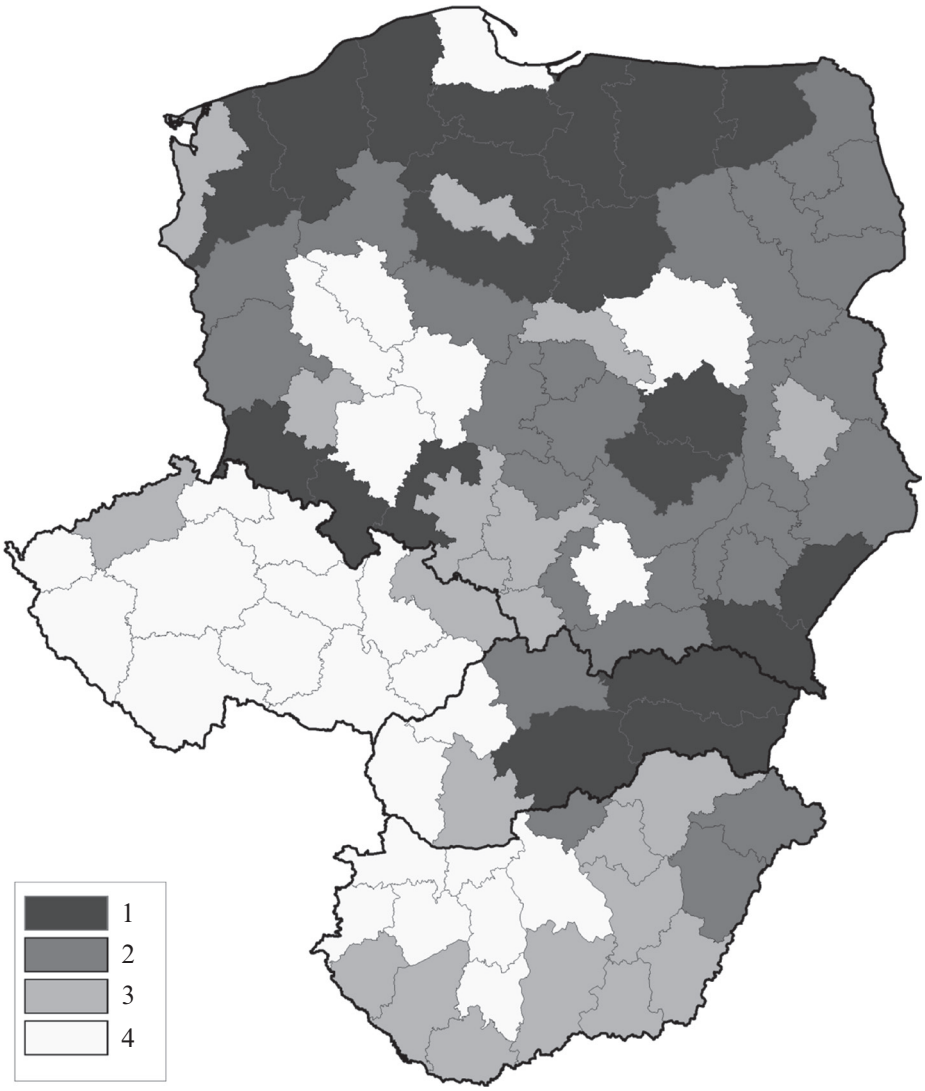
The unemployment rate is increasingly higher towards the east, in addition to those Polish counties which are located in the northern and border regions of the country



Note: 1 = strong; 2 = rising; 3 = weak; 4 = uncompetitive.

Figure 18.6 Types of counties by revealed competitiveness (RC)

(Figure 18.7). It can also be observed that in the Czech, Slovakian and Hungarian counties close to the Austrian border the unemployment rate is low, while it is high in the eastern Slovakian counties relatively distant from the Austrian border. It should be noted that the metropolitan regions of the Czech, Slovakian and Hungarian capitals are located close to the western part of their countries, and there are no metropolitan cities in the eastern part of these countries.



Note: 1 = ≥17.0%; 2 = 16.9–13.5%; 3 = 13.4–10.0%; 4 = ≤9.9%.

Figure 18.7 Unemployment rates of counties, 2013

The four types developed based on the RC are also distinct according to the indexes related to the levels of the pyramid model. According to Michael Porter's competitive development stages theory (Annoni and Dijkstra, 2013; Porter 1990), the four types are characterized as summarized in Table 18.1, and discussed in more detail below:

Table 18.1 Main indicators of counties by competitiveness types

Indicator	Unit	Total	Strong	Rising	Weak	Uncomp
Disposable income of households per capita	thousand PPS per capita, 2013	8.5	9.5	8.8	8.4	7.7
GDP per capita	thousand PPS per capita, 2012	15.6	24.4	17.6	13.5	11.1
Unemployment rate	%, 2013	13.4	8.2	11.0	13.9	18.1
Employment rate	%, 2013	57.0	68.8	60.8	54.0	50.0
Labour productivity	thousand GDP per capita, PPS, 2012	41.1	53.5	43.7	38.4	34.9
Population	thousand persons, 2013	687.1	1285.0	744.3	527.3	487.4
Population change	%, 2011/2001	98.4	102.9	99.8	97.2	96.0
Patent, EPO	per 100 000 persons	2.3	4.3	2.9	1.6	1.4
Researchers	%, 2013	0.4	0.7	0.4	0.3	0.3
Qualified employees	tertiary education, %, 2013	17.1	19.9	17.8	16.6	15.5
Students	per 1000 persons	24.7	45.9	33.9	20.5	8.5
Employed in agriculture	%, 2013	14.3	4.1	6.9	15.7	25.9
Employed in industry	%, 2013	30.5	33.8	34.3	30.0	25.3
Employed in services	%, 2013	55.2	62.0	58.7	54.4	48.9

Note: See details of indicators in Appendix Table 18A.2.

1. Strong competitive counties (14 counties), as potential innovation-driven regions. Incomes are much higher than the average of the four countries, such that the GDP per capita is almost one and a half times the average level. The employment rate and labour productivity, as well as the proportion of graduates and researchers, are also high. Many people study in these counties' universities. In these regions unemployment is low, the population is high and increasing, and the proportion of people employed in services and industry is high.
2. Rising competitive counties (24 counties), as efficiency-driven regions. Incomes, the unit GDP, labour productivity, employment rate, number of patents, and proportion of graduates and researchers are only slightly above the average of the four countries. The unemployment rate is also found to be high. The population of the counties is around the average for these countries and slightly decreasing over time. The proportion of people employed in manufacturing sectors is high.
3. Weak competitive counties (31 counties), as transitioning from resource-driven to efficiency-driven regions. Incomes, the unit GDP, labour productivity, employment rate, number of patents, proportion of graduates and researchers are slightly lagging the average of the four countries. The unemployment rate is high, whilst the population of the counties is around the average and decreasing at a rapid pace. In these counties the proportion of the population employed in agriculture and manufacturing sectors is high.
4. Uncompetitive counties (24 counties), as resource-driven rural regions. Incomes, the unit GDP, labour productivity, employment rate, number of patents, proportion of

graduates and researchers significantly lag behind the average of the four countries. The unemployment rate is high, the population of the counties is around the average and rapidly decreasing. The proportion of people employed in agriculture is high.

18.5 CONCLUSIONS

This chapter has studied the relative competitiveness of the counties at the NUTS 3 territorial level in four Central and Eastern European post-socialist countries based on the renewed pyramid model of regional competitiveness. The pyramid model, in a similar fashion to the three-factor model, follows the inputs–outputs–outcomes logistical framework. The renewed process of the model aimed to incorporate the new findings of regional endogenous growth theories, thereby including the agglomeration economies signifying spatial concentration.

The empirical study used relevant data to represent the majority of the model elements. In the model testing process indexes were developed from the connected indexes applying principal component analysis, of which the revealed competitiveness (RC) index expressing output meets the statistical requirements. The relations between the RC index and the inputs was expressed by a regional competitiveness function (RCF). This function was tested with regression analysis; thereby it could be shown that the revealed competitiveness is affected by research and technological development, as well as agglomeration economies in a statistically verifiable way.

Based on the RC, four types of the counties were differentiated according to their competitiveness. These types can also be described in accordance with Michael Porter's typology: strong competitive counties, as potential innovation-driven regions (metropolitan city-regions); rising competitive counties, as efficiency-driven regions (with strong manufacturing sectors); weak competitive counties, as transitioning from resource-driven to efficiency-driven regions; and uncompetitive counties, as resource-driven rural regions.

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APPENDIX

Table 18.A1 Codes and names of the NUTS 3 regions (counties)

Code	Counties	Code	Counties
CZ010	Praha+ Středočeský	PL22A	Katowicki+ Bytomski+ Gliwicki + Sosnowiecki+ Tyski
CZ031	Jihočeský	PL311	Bialski
CZ032	Plzeňský	PL312	Chełmsko-zamojski
CZ041	Karlovarský	PL314	Lubelski
CZ042	Ústecký	PL315	Puławski
CZ051	Liberecký	PL323	Krośnieński
CZ052	Královéhradecký	PL324	Przemyski
CZ053	Pardubický	PL325	Rzeszowski
CZ063	Vysočina	PL326	Tarnobrzeski
CZ064	Jihomoravský	PL331	Kielecki
CZ071	Olomoucký	PL332	Sandomiersko-jędrzejowski
CZ072	Zlínský	PL343	Białostocki
CZ080	Moravskoslezský	PL344	Łomżyński
HU101	Budapest+ Pest	PL345	Suwalski
HU211	Fejér	PL411	Pilski
HU212	Komárom-Esztergom	PL414	Koniński
HU213	Veszprém	PL415	M. Poznań+ Poznański
HU221	Győr-Moson-Sopron	PL416	Kaliski
HU222	Vas	PL417	Leszczyński
HU223	Zala	PL422	Koszaliński
HU231	Baranya	PL423	Stargardzki
HU232	Somogy	PL424	M. Szczecin+ Szczeciński
HU233	Tolna	PL431	Gorzowski
HU311	Borsod-Abaúj-Zemplén	PL432	Zielonogórski
HU312	Heves	PL514	M. Wrocław+ Wrocławski
HU313	Nógrád	PL515	Jeleniogórski
HU321	Hajdú-Bihar	PL516	Legnicko-Głogowski
HU322	Jász-Nagykun-Szolnok	PL517	Wałbrzyski
HU323	Szabolcs-Szatmár-Bereg	PL521	Nyski
HU331	Bács-Kiskun	PL522	Opolski
HU332	Békés	PL613	Bydgosko-Toruński
HU333	Csongrád	PL614	Grudziądzki
PL113	M. Łódź+Lódzki	PL615	Włocławski
PL115	Piotrkowski	PL621	Elbląski
PL116	Sieradzki	PL622	Olsztyński
PL117	Skierniewicki	PL623	Ełcki
PL121	Ciechanowsko-płocki	PL631	Słupski
PL122	Ostrołęcko-siedlecki	PL633	Trójmiejski+ Gdański
PL127	M. Warszawa+ Warszawski-wschodni+ Warszawski-zachodni	PL635	Starogardzki
PL128	Radomski	SK010	Bratislavský+ Trnavský
PL213	M. Kraków+ Krakowski	SK022	Trenčiansky
PL215	Nowosądecki	SK023	Nitriansky
PL216	Oświęcimski	SK031	Žilinský
PL217	Tarnowski	SK032	Banskobystrický
PL224	Częstochowski	SK041	Prešovský
PL225	Bielski	SK042	Košický
PL227	Rybnicki		

Table 18.A2 Indicators of empirical analysis by renewed pyramid model

Indicators of outcomes		
Name	Denomination	Source
Disposable income per capita, DI	Real adjusted gross disposable income of households per capita (recalculated by wages of counties), PPS, 2013	Eurostat, Statistical Office of V4 Countries
Unemployment rate, UR	Registered unemployment rate of age group 15–64, %, 2013	Statistical Office of V4 Countries
GDP per capita, GP	GDP at current market prices by NUTS 3 regions [*nama_10r_3gdp*], recalculated by PPS, 2012, and Population on 1 January by broad age group, sex and NUTS 3 region [*demo_r_pjanaggr3*], 2012	Eurostat
Indicators of outputs		
Name	Denomination	Source
Labour productivity, LP	Gross domestic product (GDP) at current market prices by NUTS 3 regions [*nama_10r_3gdp*], million euro, 2012, and employed persons, 2012	Eurostat, Statistical Office of V4 Countries
Employment rate, ER	Employment rate of age group 15–64, %, 2013	Statistical Office of V4 Countries
Gross value added (GVA) per capita, euro, GA	Gross value added at basic prices by NUTS 3 regions [*nama_10r_3gva*], 2012, million euro, and Population on 1 January by broad age group, sex and NUTS 3 region [*demo_r_pjanaggr3*], 2012	Eurostat
Indicators of inputs-1		
Research and technological development, RTD		
Name	Denomination	Source
Patent applications to the EPO	Patent applications to the EPO by priority year by NUTS 3 regions [*pat_ep_rtot*], 2010+ 2011+ 2012 per 100 000 persons	Eurostat
Researchers	Percentage of employed persons, %, 2013	Statistical Office of V4 Countries
Human capital (labour), HC		
Name	Denomination	Source
Students	Students of higher education institutes, full-time, per thousand population, 2013	Statistical Office of V4 Countries
Qualified population with tertiary education	Population by educational attainment (according to the LFSS), 15+ years, %, 2013	Statistical Office of V4 Countries
Physical capital, PC		
Name	Denomination	Source
Gross fixed capital formation	Gross fixed capital formation (GFCF, formerly gross domestic fixed investment), 2010+ 2011 +2012 in per cent of GDP, %	Statistical Office of V4 Countries

Table 18.A2 (continued)

Agglomeration economies (and regional specialization), AE		
Name	Denomination	Source
Population density	Population density, persons/km^2, 2013	Statistical Office of V4 Countries
Share of town population	Share of town population, %, 2013	Statistical Office of V4 Countries
GVA per capita, PPS	Gross value added at basic prices by NUTS 3 regions [*nama_10r_3gva*], 2012, recalculated by PPS, and Population on 1 January by broad age group, sex and NUTS 3 region [*demo_r_pjanaggr3*], 2012	Eurostat
Other indicators		
Name	Denomination	Source
Population change	Number of population in 2011 per 2001, %	Statistical Office of V4 Countries
Employment in agriculture	Agriculture, forestry and fishing, %, 2013	Statistical Office of V4 Countries
Employment in industry	Industry and construction, %, 2013	Statistical Office of V4 Countries
Employment in services	Market and non-market services, %, 2013	Statistical Office of V4 Countries