SPECIALIZATION IN SMART GROWTH SECTORS IN REGIONAL SPACE OF THE VISEGRAD GROUP COUNTRIES

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Abstract

The study discusses problems of regional specialization in smart growth sectors, i.e. separated according to technological advancement among which there are: high-tech, mid-high, mid-low and low-tech industries as well as knowledge-intensive services, less knowledge-intensive services and other sectors. The subject of research covers the structure of workforce in these sectors in NUTS 2 regions of the Visegrad Group member countries in the period 2008-2012. The purpose of the study is to identify the intensity of regional specialization, to classify regions in terms of the values of specialization indices and identification of regions characterized by higher workforce share in high and mid-high technology sector and also knowledge-intensive services comparing to EU 28. Regional specialization indices and multivariate data analysis methods, with particular emphasis on cluster analysis method, were applied in empirical studies. The choice of research problem is justified by the relevance of regional specialization in high-tech economic sectors, referred to as smart growth sectors, as the crucial factor of socio-economic development based on knowledge and innovation.

Key words: regional specialization, smart growth, workforce structure, Visegrad Group

JEL Code: C10, J21, R11

Introduction

The research of regional specialization originates from many streams of economic theory, such as e.g.: neoclassical theory, new theory of trade, new geographical economics. The neoclassical theory assumes that the liberalization of trade and the growing economic integration result in an increasing regional specialization facilitating better competition. In line with the new theory of trade companies concentrate in the regions characterized by the most favourable geographical location which could stimulate the growth of regional specialization. New geographical economics assumes that regional specialization results directly from the spatial agglomeration of economic activity (Brakman and Garretsen, 2003), (Martin and Sunley, 1996).

The analysis of regional specialization can be performed having taken into consideration the sector structure of economy. Currently the significance of economy sectors,

based on the implementation of knowledge and innovation, keeps growing (Bishop, 2008), (Aslesen & Isaksen, 2007). In 2010 the European Union adopted Europe 2020 development strategy, which defined goals facilitating the member states in ensuring, among others, smart growth consisting in the development of knowledge and innovation based economy. The study focuses on analysing workforce structure in economy sectors separated according to the intensity of research and development activities, also referred to as technological intensity defined as the relation of expenditure on R&D against added value or the total value of manufacturing sector. The regions separated in this way are referred to in the study as smart growth sectors since the distribution of workforce in these regions represents the basic determinant of smart growth in regional economy. The specialization in high-tech sectors, featuring higher workforce share in these sectors in a given region against the reference area, facilitates creating the competitive advantage of a region. Such approach presents an originality advantage, since traditionally the research covers four most important economy sectors among which the following are included: agriculture, industry, market and nonmarket services (vide (Włodarczyk, 2011a).

The study discusses the identification of regions characterized by the specialization in smart growth sectors. The diversification of regional specialization in selected sectors of economic activities, in the period 2008-2012, in regional space of Visegrad Group countries, was also covered by the performed assessment.

1 Information base and the applied research methods

The subject of research is workforce structure in smart growth sectors, selected in line with technological intensity, based on the European Classification of Economic Activities NACE from 1997, updated and amended in 2008. Due to the fact that in 2008 the definitions of high-tech industry sectors and knowledge-intensive services were also changed, the comparability of statistical data was lost. Therefore, it was adopted that the time range of conducted research covers the period 2008-2012 (according to Rev. 2 classification). The structure of workforce in the cross-section of the listed below R&D intensity sectors, prepared by Eurostat and OECD, constitutes the basis of performed analyses: high and medium high-technology manufacturing (*HMH*), low and medium low-technology manufacturing (*LML*), knowledge-intensive services (*KIS*), less knowledge-intensive services (*LKIS*), other sectors (*OTHER*).

The analysis covered 35 regions of Visegrad Group countries selected in line with NUTS 2 classification (The Nomenclature of Territorial Units for Statistics). The necessary statistical information was obtained from Eurostat data base.

The basic research tools applied for the assessment of regional specialization were the following ones: Lorenz curve, Gini, Isard, Theil specialization index, Krugman specialization indices (Krugman, 1991), RDI index (Relative Diversity Index)[1]. Each measure is characterized by different qualities, however, it should be observed that in practice they offer similar results, which is the consequence of analysing linear correlation coefficients of different indices values obtained for the same set of statistical data (Suchecki, 2010).

Regional specialization indices facilitate defining the level at which the regional structure of economic activities, in the studied region, differs from the structure of the adopted reference area (e.g. a group of regions, a country, a group of countries)[2]. Krugman specialization index was applied in the study and defined as the sum of absolute differences between sector shares of workforce in a particular NUTS 2 region representing V4 in the total workforce employed in this region against the total sector workforce share in the overall workforce number in the European Union calculated according to the formula (1):

$$K_r^* = \sum_{i=1}^{S} \left| u_i^r - u_{.i} \right| \qquad (1)$$

$$u_i^r = \frac{x_{ri}}{x_{r.}} \qquad (2)$$

$$u_{.i} = \frac{x_{.i}}{x_{..}} \qquad (3)$$

where: $r = 1,\ldots, R$ region number ($R = 35$), $i = 1,\ldots, S$ sector number ($S = 5$), x_{ri} – workforce number in r-th region and i-th sector, $x_{r.}$ – total workforce number in r-th region, $x_{.i}$ – workforce number in i-th sector of reference area (EU 28), $x_{..}$ – total workforce number in reference area (EU 28).

Krugman index of regional specialization represents a non-standardized measure. Higher index value informs about the occurrence of larger divergence between the regional and reference sector structure, which stands for higher intensity of regional specialization.

The analysis of regional specialization covering V4 is divided into 3 research stages:

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[1] More information about the characteristics of regional specialization measures and postulates referring to the ideal measure of specialization are presented, among others, in the studies by Overman and Combes (2004), Suchecki (2010) and Mikrut, Constantin, Dimian and Dimian (2007).

[2] Research results referring to regional specialization in the European Union countries can be found, among others, in the studies by Ezcurr, Pascual and Rapun (2006), Piras, Postiglione and Aroca (2012), Simonov and Tresl (2011).

1. The assessment of regional specialization applying Krugman indices for 35 regions of Visegrad Group countries, in the period 2008-2012, regarding the reference area defined as regional space of 28 European Union member states.

2. The classification of studied NUTS 2 regions, in terms of regional specialization indices values, by applying cluster analysis in the period 2008-2012.

The below presented matrix of Krugman regional specialization indices values constituted the classification basis of regions from V4 countries (vide formula (1)):

$$\mathbf{K} = \left[K_{rt}^{*}\right]_{(R \times T)} \qquad (4)$$

where: $t = 1,\ldots, T$ the analysed period number ($T = 5$), K_{rt}^{*} – Krugman regional specialization index for r-th region in t-th period.

The presented below consecutive steps of the applied procedure were performed[3]:

- specifying the diversification between the studied regions by applying the squared Euclidean square distance and the hierarchical classification using Ward method,
- defining the number of classes based on the classification results presented in the form of a dendrogram and the diagram of the node distance against the clustering stages,
- the classification of regions using k-means method.

3. The typology of NUTS 2 regions characterized by the specialization in smart growth sectors regarding the reference area (regional space of 28 EU).

2 The assessment of regional specialization in terms of sector workforce structure in Visegrad group countries in the period 2008-2012

The assessment of regional specialization in economy sectors requires specifying the reference structure, i.e. the one constituting the required reference basis. In the framework of regional specialization studies, covering V4 countries, it was assumed that this role will be played by workforce structure in the regional space of 28 European Union member states.

The workforce structure in the EU 28, in the period 2008-2012, was characterized by the dominance of workforce employed in knowledge-intensive services (about 38%), to be followed by less knowledge-intensive services (over 30%). Workforce share in high-tech and mid-high sectors presented the range from 5,6% to 6,0% in the studied period.

Picture 1 presents values of Krugman regional specialization indices determined in line with formula (1) and arranged according to the decreasing values calculated for 2012.

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[3] The review of information regarding distance measures and classification methods can be found, among others, in the studies by Anderberg (1973) and Hartigan (1975).

Table 1 presents the basic descriptive parameters facilitating the synthetic characteristics of indices values for regional specialization.

Fig. 1: Indices values of regional specialization in smart growth sectors in NUTS 2 regions of V4 countries in the period 2008-2012
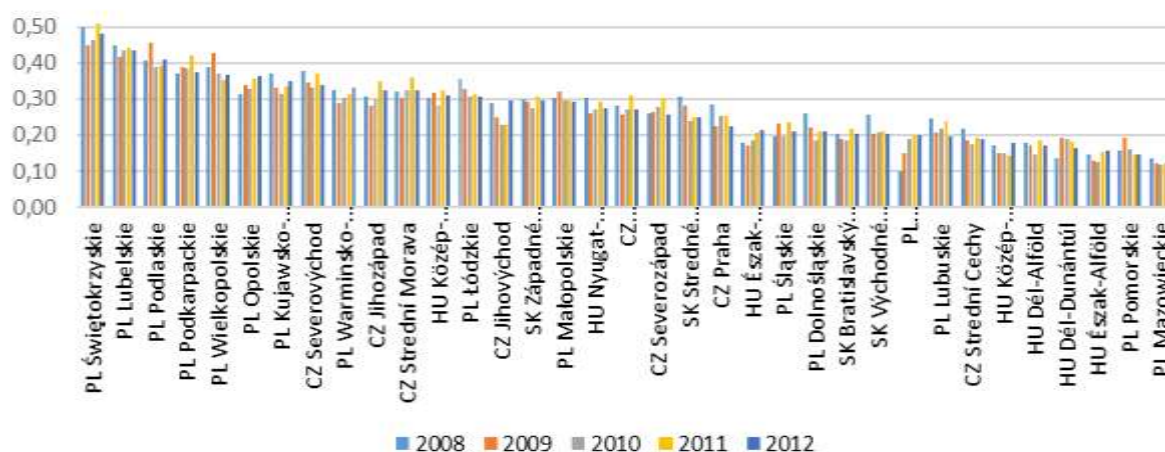
Source: authors' estimations and compilation based on Eurostat database.

Tab. 1: Descriptive parameters of regional specialization indices in smart growth sectors in NUTS 2 regions of V4 countries in the period 2008-2012

| Descriptive parameters	Years				
	2008	2009	2010	2011	2012
Min	0,10	0,12	0,12	0,12	0,13
Max	0,50	0,46	0,46	0,51	0,48
Range	0,40	0,34	0,35	0,39	0,35
Median	0,29	0,26	0,27	0,29	0,27
Variation coefficient in (%)	34,09	34,25	33,62	33,10	32,58

Source: authors' estimations based on Eurostat database.

The values of regional specialization indicators did not present any distinctive variations in time. In the course of analysed period a slight decrease in the variability area was observed, ranging from 0,4 in 2008 to 0,35 in 2012, as a result of minimum value increase and maximum value decrease of the specialization index. The variability of regional specialization indices values measured by the variability coefficient can be defined as significant. In 2008 the standard deviation constituted 34,9% of arithmetic mean, whereas in 2012 it fell to the level of 32,58%. Zachodniopomorskie region was characterized by the lowest regional

specialization in 2008, which was also true for Mazowieckie region in the period 2009-2012. The largest discrepancies between workforce regional structure and the EU 28 structure occurred in 2008 and 2010-2012 in Świetokrzyskie region, while in Podlaskie region it was recorded in 2009.

Picture 2 and table 2 illustrate the classification results of regions in V4 in terms of regional specialization indices values, in the period 2008-2012, obtained as a result of *k*-means method application.

Fig. 2: Mean values of regional specialization indicators in the selected classes of NUTS 4 regions in V4 countries
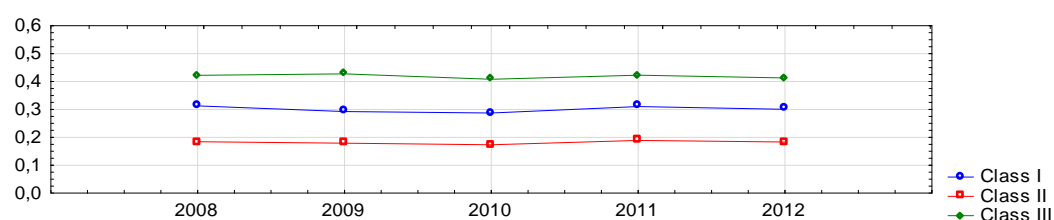
Source: authors' compilation in STATISTICA program.

Tab. 2: The classification of NUTS 2 regions in V4 countries in terms of regional specialization degree in the period 2008-2012

Classes of regions	Regional specialization degree	NUTS 2 regions	Number of regions
I	medium	CZ (6/8)* Severovýchod, Jihozápad, Strední Morava, Moravskoslezsko, Severozápad, Praha	16
		HU (3/7) Közép-Dunántúl, Jihovýchod, Nyugat-Dunántúl,	
		PL (5/16) Opolskie, Kujawsko-Pomorskie, Warmińsko-Mazurskie, Łódzkie, Małopolskie	
		SK (2/4) Západné Slovensko, Stredné Slovensko	
II	low	CZ (1/8) Strední Cechy	14
		HU (5/7) Észak-Magyarország, Közép-Magyarország, Dél-Alföld, Dél-Dunántúl, Észak-Alföld	
		PL (6/16) Śląskie, Dolnośląskie, Zachodniopomorskie, Lubuskie, Pomorskie, Mazowieckie	
		SK (2/4) Bratislavský kraj, Východné Slovensko	
III	high	PL (5/16) Świętokrzyskie, Lubelskie, Podlaskie, Podkarpackie, Wielkopolskie	5

where: * CZ (6/8) means that there are 6 out of 8 Czech regions in a given class; CZ, HU, PL, SK – the symbols of Czech, Hungarian, Polish and Slovak regions respectively.
Source: authors' compilation based on Eurostat database.

The division into three classes of NUTS 2 regions was obtained. The first and the second class, characterized by medium and low regional specialization degree respectively, include the regions of all V4 group countries. The largest class is the first one covering 45,7% of the analysed regions presenting medium regional specialization degree (average index values about 0,3). This class is dominated by the Czech and Polish regions. By far the least numerous is class three (14,3% of regions) covering the regions characterized by high regional specialization degree (mean values above 0,4). This class incudes Polish regions only, regarding which table 3 lists the mean sector values of deviations from workforce reference structure in EU 28 in the period 2008-2012. As it can be noticed, the workforce structure in highly specialized regions is different from the reference structure in terms of the significantly higher workforce share in the so-called other sectors (covering such areas of economic activity as: agriculture, hunting, forestry, fishing, mining, construction, electric energy, gas, water production and supply), as well as the lower workforce share in *KIS* sector, to be followed by *LKIS* one.

Tab. 3: Average values of deviations from EU 28 structure in particular smart growth sectors in the period 2008-2012 in the class of regions characterized by high regional specialization degree

Region	*HMH*	*LML*	*KIS*	*LKIS*	*OTHER*
PL Świętokrzyskie	-0,02	0,03	-0,15	-0,08	0,22
PL Lubelskie	-0,03	-0,01	-0,12	-0,07	0,22
PL Podlaskie	-0,03	0,02	-0,10	-0,06	0,17
PL Podkarpackie	0,00	0,05	-0,14	-0,08	0,16
PL Wielkopolskie	0,00	0,08	-0,14	-0,04	0,10

Source: authors' estimations based on Eurostat database.

Table 4 includes regions in which workforce share in high and mid-tech industry, or in knowledge-intensive services, was higher than the workforce share in these sectors in EU 28.

Tab. 4: NUTS 2 regions characterized by high and mid-high technology or knowledge-intensive services specialization

Years	Specialization in smart growth sectors		
	HMH	*KIS*	*HMH* and *KIS*
2008	CZ (7/8): Strední Cechy, Jihozápad, Severozápad, Severovýchod, Jihovýchod, Strední Morava, Moravskoslezsko; HU (5/7): Közép-Dunántúl, Nyugat-Dunántúl, Dél-Dunántúl, Észak-Magyarország, Észak-Alföld;	CZ (1/8): Praha; HU (1/7): Közép-Magyarország	SK (1/4): Bratislavský kraj

	PL (4/16): Śląskie, Dolnośląskie, Opolskie, Pomorskie; SK (3/4): Západné Slovensko, Stredné Slovensko, Východné Slovensko		
2009	CZ (7/8): Strední Cechy, Jihozápad, Severozápad, Severovýchod, Jihovýchod, Strední Morava, Moravskoslezsko; HU (5/7): Közép-Dunántúl, Nyugat-Dunántúl, Dél-Dunántúl, Észak-Magyarország, Észak-Alföld; PL (5/16): Śląskie, Lubuskie, Dolnośląskie, Opolskie, Pomorskie; SK (3/4): Západné Slovensko, Stredné Slovensko, Východné Slovensko	CZ (1/8): Praha; HU (1/7): Közép-Magyarország; PL (1/16): Mazowieckie; SK (1/4): Bratislavský kraj	–
2010	CZ (7/8): Strední Cechy, Jihozápad, Severozápad, Severovýchod, Jihovýchod, Strední Morava, Moravskoslezsko; HU (5/7): Közép-Dunántúl, Nyugat-Dunántúl, Dél-Dunántúl, Észak-Magyarország, Észak-Alföld; PL (4/16): Śląskie, Lubuskie, Dolnośląskie, Opolskie; SK (3/4): Západné Slovensko, Stredné Slovensko, Východné Slovensko	CZ (1/8): Praha; HU (1/7): Közép-Magyarország; PL (1/16): Mazowieckie; SK (1/4): Bratislavský kraj	–
2011	CZ (7/8): Strední Cechy, Jihozápad, Severozápad, Severovýchod, Jihovýchod, Strední Morava, Moravskoslezsko; HU (5/7): Közép-Dunántúl, Nyugat-Dunántúl, Dél-Dunántúl, Észak-Magyarország, Észak-Alföld; PL (5/16): Śląskie, Podkarpackie, Lubuskie, Dolnośląskie, Opolskie; SK (3/4): Západné Slovensko, Stredné Slovensko, Východné Slovensko	CZ (1/8): Praha; HU (1/7): Közép-Magyarország	SK (1/4): Bratislavský kraj
2012	CZ (7/8): Strední Cechy, Jihozápad, Severozápad, Severovýchod, Jihovýchod, Strední Morava, Moravskoslezsko; HU (4/7): Közép-Dunántúl, Nyugat-Dunántúl, Dél-Dunántúl, Észak-Magyarország; PL (3/16): Śląskie, Lubuskie, Dolnośląskie; SK (3/4): Západné Slovensko, Stredné Slovensko, Východné Slovensko	CZ (1/8): Praha; HU (1/7): Közép-Magyarország; PL (1/16): Mazowieckie	SK (1/4) Bratislavský kraj

Source: authors' estimations based on Eurostat database.

As it results from the analysis of data presented in tab. 4 the two-sector regional specialization occurred only in the Slovak metropolitan region of Bratislavský kraj in 2008 and in the years 2011-2012. The surplus share of workforce in knowledge-intensive services was significant and amounted to about 10 percentage points, whereas in case of high-tech and mid-high industry it did not extend 0,4 percentage point. It is characteristic that regional specialization in the knowledge-intensive services occurred only in metropolitan regions of V4 countries. In Praha and Közép-Magyarország regions, in each of the analyzed years, the workforce share in

KIS sector was higher than the respective structure indicator for EU 28. In Praha region this deviation was the largest at the level of about 11 percentage points. Mazowieckie region was only included in this group in the period 2009-2010 and in 2012 (surplus of about 1 percentage point). The vast majority of analyzed regions presented only the surplus of workforce share in high-tech and mid-high industry. This group covered seven out of eight Czech regions in the analyzed period (apart from Praha region), three of four Slovak regions (excluding Bratislavský kraj) and 3 out of 5 Polish regions (out of 16) and also 4 out of 5 Hungarian regions (out of 7).

Conclusions

The analysis of specialization in smart growth sectors, selected in terms of R&D intensity in NUTS 2 regions of V4, allows for presenting the following conclusions:

1. In the period 2008-2012 the analyzed regions showed significant, even though slightly decreasing, diversification of regional specialization in smart growth sectors. The variability coefficient of regional specialization indices amounted to over 32%.

2. Sector economic structures, and thus also workforce structures by smart growth sectors, are usually characterized by slow, evolutionary transformations in time and therefore the analyzed values of regional specialization indices presented relative stability in the studied period.

3. Five Polish regions presented high degree of regional specialization and were characterized by the significant dominance of workforce in the so-called other sectors covering, e.g. agriculture and construction. The deviations from workforce share in these sectors in EU 28 were very extensive in the range from 10 to 22 percentage points. These regions also showed much lower, than in EU 28, workforce share in knowledge-intensive services (the difference ranged from 10 to 15 percentage points).

4. In the analyzed period the workforce share in *HMH* or *KIS* sectors extended the relative share in EU 28 with regard to all Czech and Slovak NUTS 2 regions. Such situation did not occur in one Hungarian region Dél-Alföld and, depending on the studied year, in 10 up to 12 Polish regions.

Structural studies, covering also the analyses of regional specialization in economic sectors selected by technological advancement can constitute the basis for the identification of crucial factors and barriers of smart growth specified in the vision of Europe development till 2020.

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