SMART WORKFORCE STRUCTURES VERSUS REGIONAL DEVELOPMENT IN EUROPEAN UNION COUNTRIES OF NEW ACCESSION (EU12)[1]

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Abstract:
The first objective of the hereby paper is to present dynamic analysis and assessment of workforce structure in EU12 countries based on structural and geographical shift-share analysis (SSA). Workforce structure in economic sectors, distinguished based on R&D work intensity, was the subject of diversification and transformations assessment. The second aim of the paper is to assess relations between smart specialization and economic cohesion by measuring both the intensity and direction of their mutual relations. The study was conducted among countries and NUTS-2 level regions of new accession from 2004 and 2007 (EU12).

Introduction

In 2010, the European Union approved the *Europe 2020 Strategy* [1] defining objectives aimed at providing support for member states to overcome economic crises successfully and ensure smart, sustainable and facilitating social inclusion development. The specified, by the strategy, smart development consists in knowledge-intensive economy and innovation development. It can be demonstrated that smart growth represents the set of instruments stimulating dynamic growth and therefore enhancing economic and social cohesion, which results in upgrading the inhabitants' standard of living. Smart specialization of workforce structure constitutes one of the instruments and components of this development.

Workforce in high-tech manufacturing and knowledge-intensive services presents the domain focused approach covering production and services defined as high-tech in line with criterion of R&D outlays volume against added value. This relation is defined as R&D intensity.

[1] The study was prepared within the framework of NCN nr 2011/01/B/HS4/04743 research grant entitled: *The classification of European regional space in the perspective of smart growth concept – dynamic approach* and constitutes a part of the series of analyses referring to these issues.

Shift-share analysis (SSA) enabled the decomposition of occurring changes into regional, structural and global effects as well as the identification of the, so called, allocation effect resulting in the classification of the studied countries with regard to combinations of local specialization and competitive advantages.

The performed research also allowed for the identification different kinds of workforce structure characterized by smart specialization (significant share of workforce in high-tech manufacturing sector or knowledge-intensive services sector) and the assessment of generated structural and competitive effects.

The third field of analysis is to provide the assessment of relations between smart specialization and economic cohesion by measuring the intensity and direction of mutual relations.

1. Research Procedure and Data

The domain focused approach in defining adequate measures of smart specialization is based on NACE – statistical classification of economic activities in the European Community. The division of high-tech sectors was first published in 1997 by OECD.

Prepared by *Eurostat* and OECD workforce structure in the cross section of the following activities types by R&D intensity levels became the basis for conducting analysis: high-tech manufacturing (HTM), mid-high-tech manufacturing, mid-low-tech manufacturing, low-tech manufacturing, knowledge-intensive services (KIS), less knowledge-intensive services (LKIS), other sectors.

Economic cohesion (*GDP*) is described by means of gross domestic product *per capita* in purchasing power standard (PPS). This indicator is regarded as a relatively good measure of economic result. For comparison these values were calculated per 1 inhabitant.

Statistical data were taken from Eurostat Internet database[2]. In the first part of the article the 12 EU countries were covered by the study. The research of relation which combine smart specialization and economic cohesion was conducted among 43 EU regions at NUTS-2 level of the new accession countries (EU12)[3].

The study was performed following three stages which covered:

[2] http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/.

[3] The study does not cover the following regions: Slovenian, Romanian, Malta, Cyprus, Estonia.

(1.) Applying classical and dynamic shift-share analysis and Esteban-Marquillas model using allocation effect[4] of workforce changes rate in EU12 countries to:
- specifying structural and regional effects of workforce number changes in sectors distinguished by R&D intensity,
- classification of EU12 countries by positive and negative change effects values: structural and competitive,
- classification of EU12 countries by components of allocation effects: specialization and competitiveness.

(2.) Constructing aggregate measures for smart specialization. Therefore the procedure of unitization with zero minimum and aggregate measures (AM) for composite variables was applied. This allowed for presenting each variable value in the range from [0; 1]. In the process of AM construction Euclidean distance and common growth pattern, defined for each variable, were used considering all regions in all studied years [7].

Two qualities were used to construct aggregate measure of the smart specialization (IS): workforce employed in knowledge-intensive services as the share of total employment (%) and workforce employed in high and mid-tech industry sectors as the share of total employment (%). The above variables characterize the scale of employment in enterprises implementing advanced technologies and knowledge as well as requiring ongoing investments into research and development. Therefore it may be stated that they result from market and competition pressure on the development of knowledge and innovation based activities.

(3.) Estimating panel, linear econometric models to describe relations which combine economic cohesion with smart specialization by means of applying panel data in (NUTS-2) regions of EU12 countries, which is presented in the form of the following model construction:

$$GDP_{it} = \alpha_i + \beta_l IS_{it} + \varepsilon_{it} \qquad (1.)$$

where: GDP_{it} - an aggregate describing economic cohesion in i-th region (i = 1, 2, ..., N) and (t = 1, 2, ..., T) t-th year, IS_{it} - variable for smart specialization in i-th region and t-th year, β_l - evaluations of parameters measuring the impact intensity and direction of smart specialization on economic cohesion, α_i constant in time individual effects for i-th region.

In order to estimate evaluations of β_l structural parameters of models adequate estimation techniques, typical for panel data[5], were applied.

[4] For more information about the listed methods check, among others, the following publications: [2], [3], [4], [5], [6].

LSDV (Least Squares with Dummy Variable) model was applied in the study. In the process of econometric models estimation certain problems related to meeting due assumptions, referring to the applied methods, may occur, e.g. autocorrelation, heteroskedasticity. In order to minimize their possible negative effects, in assessing the significance of structural parameters evaluation, robust standard errors (robust Arellando) were used. All estimations were performed in GRETL programme[6].

2. Shift-Share Analysis of Workforce in Economy Sectors Distinguished by R&D Intensity

Table 1 presents the decomposition of overall workforce growth rate, ranked by R&D activities intensity in the period of 2010/2008, preformed in line with the shift-share dynamic analysis rules. Therefore further analysis covered aggregated structural and competitive effects calculated based on the effects for the years 2009/2008 and 2010/2009. Countries were ranked by the declining values of aggregated structural effects.

In two of the analysed countries EU12, i.e. Malta and Cyprus, a positive aggregated structural effect was observed, which means that workforce structure in these countries had a positive impact on workforce size changes. In the countries characterized by positive structural effects the share of workforce in knowledge-intensive services ranged from over 35% in Cyprus to almost 40.5% in Malta.

Table 2 illustrates the classification of the EU12 countries with regard to positive and negative values of aggregated structural and competitive effects. The first group includes countries featuring positive influence of both structural and competitive factors on employment structure fluctuations, which indicates that workforce number changes in these countries may be more favourable for two reasons: because sectoral workforce structure has a positive impact on employment rate growth and also because economic sectors are characterized by higher dynamics of workforce size fluctuations than in other regions. This group covered 2 countries from EU12.

[5] For more information about the listed methods check, among others, the following publications: [8], [9], [10].

[6] www.kufel.torun.pl.

TAB. 1: **Dynamic shift-share analysis results of workforce number growth rate in economic sectors by R&D activities intensity in the period of 2010/2008**

No	Country	Net total effect (in %)	Structural effect (in %)	Competitive effect (in %)	Workforce share in KIS (HTM) in 2010 (in %)
Positive structural effect					
1.	Malta	4.90	0.31	4.59	40.49 (2.58)
2.	Cyprus	2.82	0.24	2.58	35.24 (0.20)
Negative structural effect					
3.	Latvia	-14.55	-0.34	-14.22	34.34 (0.38)
4.	Hungary	-0.22	-0.47	0.25	35.03 (2.77)
5.	Lithuania	-9.66	-0.56	-9.10	33.93 (0.32)
6.	Estonia	-11.12	-0.61	-10.50	35.25 (1.24)
7.	Slovenia	-0.81	-0.87	0.06	33.51 (1.76)
8.	Czech Republic	-0.09	-0.93	0.83	31.84 (1.49)
9.	Slovakia	-2.53	-0.94	-1.58	32.35 (1.46)
10.	Poland	3.34	-0.95	4.29	30.36 (0.78)
11.	Bulgaria	-6.89	-1.13	-5.77	28.86 (0.59)
12.	Romania	0.93	-1.86	2.79	19.95 (0.53)

Source: Author's estimations.

The second group, characterized by positive influence of only the structural factor does not include any country from the, so called, new EU accession. The third group, featuring positive influence on employment changes of only the competitive factor, covered 5 new EU accession countries, including Poland. The forth group lists countries in which both the employment structure and internal regional development determinants exerted negative influence on workforce number changes in the period of 2008-2010. It covers 5 of EU12 countries.

TAB. 2: **Classification of EU countries by positive and negative effect values: structural and competitive (dynamic SSA 2010/2008)**

Group	Criterion of division	Countries	Number of countries
I	effects: structural (+) competitive (+)	Malta, Cyprus	2
II	effects: structural (+) competitive (-)	-	0

III	effects: structural (-) competitive (+)	Hungary, Slovenia, The Czech Republic, Poland, Romania	5
IV	effects: structural (-) competitive (-)	Latvia, Lithuania, Estonia, Slovakia, Bulgaria	5

Source: Author's compilation.

Tables 3 and 4 present the classification of EU12 countries with regard to allocation component effects: smart specialization or its absence as well as the advantage or disadvantage of competitiveness in high-tech industry and knowledge-intensive services sectors, respectively.

TAB. 3: **Classification of EU12 countries by allocation effect components of workforce in HTM in 2010**

Definition	Countries	Components of allocation effect	
		specialization (workforce share in HTM in %)	competitiveness (growth rate of employment in HTM in country less in EU in %)
Reference area	EU	1.08	-8.48
Smart specialization Competitive advantage	Hungary	2.77	5.15
	Malta	2.58	6.54
	Slovenia	1.76	10.02
	Czech Rep.	1.49	6.76
	Estonia	1.24	8.86
Smart specialization Competitive disadvantage	Slovakia	1.46	-13.61
Absence of smart specialization Competitive advantage	Poland	0.78	7.14
	Romania	0.53	3.57
	Lithuania	0.32	1.27
Absence of smart specialization Competitive disadvantage	Bulgaria	0.59	-24.76
	Latvia	0.38	-7.39
	Cyprus	0.20	-40.5

Source: Author's estimations.

A country is characterized by workforce structure featuring smart specialization in high-tech industry sector (knowledge-intensive services) if workforce share in this sector is higher than EU average. On the other hand,

competitive advantage in high-tech industry sector (knowledge-intensive services) is present in the country in which employment changes rate in this particular sector is more favourable than sectoral changes rate in EU.

Based on the information presented in tables 3 and 4 the typology of workforce structure in EU countries was prepared with regard to smart specialization and the presence of competitive advantage, which was illustrated in table 5. As this analysis indicates, both smart specialization and competitive advantage, in both high-tech sectors in 2010, was characteristic for workforce structures in Malta. Two-sectoral absence of smart specialization and competitive advantage occurred in Bulgaria and Latvia.

TAB. 4: **Classification of EU12 countries by allocation effect components of workforce in KIS in 2010**

Definition	Countries	Components of allocation effect	
		specialization (workforce share in KIS in %)	competitiveness (growth rate of employment in KIS in country less in EU in %)
Reference area	EU	38.54	2.12
Smart specialization Competitive advantage	Malta	40.49	2.59
Smart specialization Competitive disadvantage	-	-	-
Absence of smart specialization Competitive advantage	Cyprus	35.24	0.67
	Hungary	35.03	0.61
	Slovenia	33.51	2.00
	Slovakia	32.35	2.04
	Czech Rep.	31.84	2.51
	Poland	30.36	6.12
	Romania	19.95	1.56
Absence of smart specialization Competitive disadvantage	Estonia	35.25	-3.90
	Latvia	34.34	-12.68
	Lithuania	33.93	-3.62
	Bulgaria	28.86	-5.16

Source: Author's estimations.

Single-sectoral smart specialization in high-tech industry sector, as well as competitive advantage in this sector was registered in Estonia, the Czech Republic, Hungary and in Slovenia. Single-sectoral smart specialization in knowledge-intensive services sector and competitive advantage wasn't present in this sector in 2010 in any country.

TAB. 5: **Typology of employment structure by smart specialization and competitiveness in 2010**

Smart specialization	Competitiveness			
	two-sector	single sector in HTM	single sector in KIS	absence
Two-sector	Malta	-	-	-
Single sector in HTM	The Czech Rep., Hungary, Slovenia	Estonia	Slovakia	-
Single sector in KIS	-	-	-	-
Absence	Poland, Romania	Greece, Italy, Lithuania	Spain, Cyprus, Austria	Bulgaria, Latvia, Portugal

Source: Author's compilation.

Poland and Romania were included in the group for which two-sectoral absence of smart specialization, as well as the occurrence of two-sectoral competitive advantage were identified which, while maintaining high employment rate growth in both high-tech sectors, may be the prognosis for workforce structure evolution in these countries towards smart specialization development.

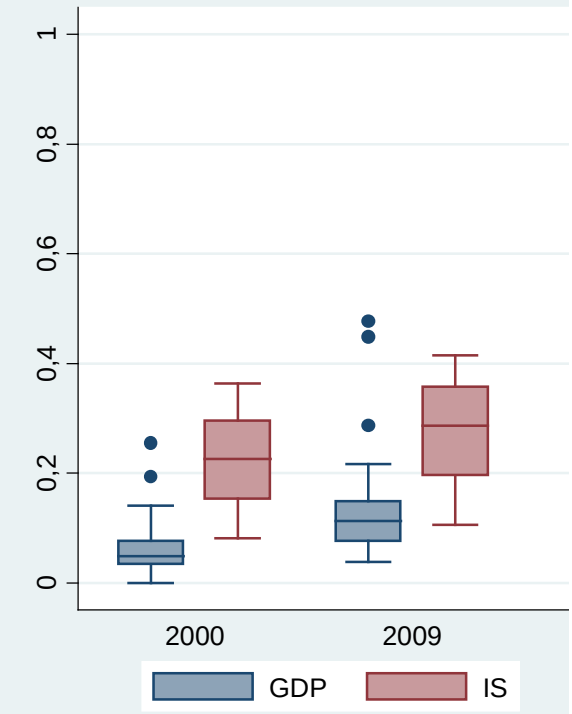
3. The Assessment of Smart Specialization Influence on Economic Cohesion in EU12 Regions

The strengthening of human capital, knowledge, science and innovation potential in a region results, in a long time perspective, in regional economic and competitive position strengthening.

The level of economic cohesion in EU12 regions is diversified in space (figure 1). If GDP aggregate in PPS is considered per 1 inhabitant it appears that the mean value for EU12 group in 2000 was at the level of 9311 and in

2009 – 15305. Major differences are observed in the level of growth regarding the Bulgarian (Yuzhen tsentralen, Severen tsentralen, Severozapaden, Severoiztochen, Yugoiztochen), Polish (podkarpackie, lubelskie) and Czech (Praha), Slovakian (Bratislavský kraj) regions.

FIG. 1: **The distribution of economic cohesion (GDP) and smart specialization (IS) measures in EU12 regions in the years 2000 and 2009**



Source: Author's compilation.

In 2000 Hungarian (Közép-Dunántúl, Nyugat-Dunántúl), Czech (Praha) and in 2009 Hungarian (Közép-Dunántúl), Czech (Jihozápad), Polish (pomorskie) regions were better prepared for smart growth idea implementation. The situation improved significantly in the area of the smart specialization (*IS*). *IS* median value in EU12 regions increased from 0.227 in 2000 up to 0.287 in 2009. Positive development is observed in the growing importance of knowledge-based economy sectors, in the analyzed period, regarding economic structure of EU12 regions.

Table 6 presents estimation results of model which allow for the assessment of smart specialization impact on economic cohesion for regions of the new EU accession countries (EU12).

TAB. 6: **Linear models estimations for smart specialization and economic cohesion for (NUTS-2) regions of the new EU accession countries (EU12) in the period of 2000-2009**

Specification	Parameter estimate [Arellano robust standard error]	Akaike information criterion	Test F (*p-value*)
IS	0.947*** [0.215]	-1215.38	40.26 (*0.000*)

*** significant at the level of 0.001. Arellano robust standard error is quoted in parentheses [].

Source: Author's compilation in GRETL programme.

In case of EU12 new accession regions smart specialization presented positive, statistically significant impact on economic cohesion. The regions featuring an increase in smart specialization by a unit are also characterized by improved economic cohesion by 0.9477 units *ceteris paribus* at each level of statistical significance.

Conclusions

The results of shift-share analysis show that the competitive effect of employment rate changes was of dominating importance, which allows to assess favorably the positive competitive effects of less wealthy EU12 countries, including Poland. The ongoing employment changes were related to economic crisis and their interregional diversification resulted mainly from internal conditions.

The global crisis resulted in the fact that the average employment rate changes in EU were negative and equal -2.31% in the period of 2010/2008. In the period of 2010/2008 the employment rate changes were better than average in UE in four UE12 countries i.e.: Malta, Cyprus, Poland and Romania. These changes resulted mainly from internal changes occurring in the analyzed countries (competitive effect).

10 analyzed countries from EU12 (excluding Malta and Cyprus) were characterized by a negative structural effect, which confirms that in these regions workforce structure had negative impact on employment rate changes. Negative competitive effect occurred in 5 EU12 countries, which means that their sectors were characterized by lower than average dynamics of changes as compared to other EU countries. This group covered following countries – Latvia, Lithuania, Estonia, Slovakia and Bulgaria.

Two-sector smart specialization was identified in Malta. This country was characterized by both higher share and better employment rate changes in

high-tech industry sectors and knowledge-intensive services than in EU. Bulgaria and Latvia were included in the group of countries which featured the absence of both specialization and competitiveness in high-tech sectors. Poland and Romania constituted the target group characterized by the absence of smart specialization and competitiveness in both high-tech sectors which may open an opportunity for smart specialization development in the future.

Smart specialization of regions influences development processes enhancing the improvement of economic cohesion. Therefore it represents the tool of regional policy aimed at ensuring dynamic and self-supporting regional development in a long-term perspective by strengthening their competitive advantage and, at the same time, intensifying economic and social cohesion. While analyzing the influence of smart specialization on economic cohesion in the cross-section of EU12 regions it was noticed that one of the key factor is represented by smart specialization which characterizes regional economy employment structure (workforce employed in knowledge-based economy sectors).

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