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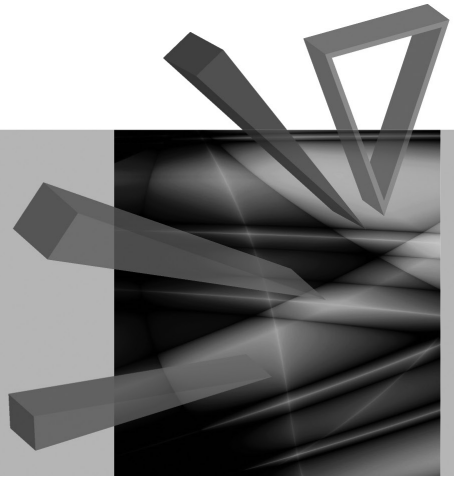

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Elżbieta Sobczak
Andrzej Raszkowski

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Elżbieta Sobczak
Wrocław University of Economics

TYPOLOGY OF EUROPEAN REGIONS VS. EFFECTS OF WORKFORCE CHANGES BY THE LEVEL OF RESEARCH AND DEVELOPMENT ACTIVITIES INTENSITY*

Summary: The objective of this study is to classify the European NUTS 2 level regions regarding structural, competitive and allocation changes in the workforce number and also to identify and characterize smart workforce structures related to the reference space, i.e. the regional area of the European Union member states. The shift-share analysis constituted the research tool applied in workforce number structural changes analysis in the European regional space in the period of 2008–2010.

Keywords: workforce structure, NUTS 2 European regions, shift-share analysis.

1. Introduction

In June 2010 the European Union adopted the Europe 2020 development strategy reflecting the long-term vision of a social market economy. This strategy defines the goals supporting EU member countries in their efforts focused on fighting economic crisis and providing smart and sustainable growth facilitating social inclusion. Smart growth, as defined in the strategy, consists in knowledge-intensive economy development and innovation [*Europe 2020. The Strategy...* 2010]. Among the qualities describing the determinants of knowledge-intensive economy development (KIE) and related to human resources, the following can be listed: workforce share in high and medium high-technology manufacturing and knowledge-intensive services in the total workforce number [Gaczek 2010, pp. 203–215]. Innovation referring to employment may result in workforce structure changes due to shifts from traditional to modern sectors. Both the

* 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.

direction and rate of human resources shifting decide about transformations in the nature of production and trade oriented specialization regarding countries and regions by defining their comparative and competitive position in international markets [Zielińska-Głębocka 2012, p. 62].

For the purposes of analysis covering both specialization and employment structural changes, the classification of economy sectors by R&D activities intensity is used [Wojnicka (ed.) 2006, p. 7; *Nauka i technika*... 2009, p. 259] also called technical intensity, calculated as the relation of expenditure on research and development activities against added value or total value of sector production [Zielińska-Głębocka 2012, p. 83].

The objective of the study is to classify European NUTS 2 level regions with regard to structural, competitive and workforce number changes allocation effects, as well as the identification and characteristics of smart workforce structures related to reference area, i.e. the regional space of the European Union member states. A shift-share analysis, called the classical analysis of Dunn shares shift, and the recurrence Barff and Knight dynamic model, represent research tools for workforce number structural changes analysis, in the European regional space, in the period of 2008–2010.

2. The research background

The classification of economy sectors by technological intensity is based on the Statistical Classification of Economic Activities in the European Community, commonly referred to as NACE, updated and changed in 2008. The names of high and medium high-technology manufacturing and knowledge-intensive services were changed and therefore in 2008 the comparability of statistical data was lost. For this reason it was accepted that the period of research will cover the years 2008–2010 (in line with NACE Rev. 2 classification).

The workforce structure constitutes the reference basis of the conducted analyses, in the cross-section of the following technological intensity sectors, prepared by Eurostat and OECD [*Nauka i technika*... 2009, pp. 294–295]:

1) HMHTM – High and medium high-technology manufacturing,
2) LMLTM – Low and medium low-technology manufacturing,
3) KIS – Knowledge-intensive services,
4) LKIS – Less knowledge-intensive services,
5) the remaining sectors.

The analysis covered 237 European regions selected following NUTS 2 (The Nomenclature of Territorial Units for Statistics) classification. Due to the unavailability of statistical data, the analysis does not cover the following regions: 1 Belgian, 1 Italian, 1 Dutch, 1 Austrian, 1 Finnish, 2 German, 3 Spanish, 5 British, 6 French (including 4 overseas ones) and 10 Greek regions. Information unavailability amounted to 1%. The statistical data originate from the Internet Eurostat database.

The structural-geographic analysis of the workforce was performed by the intensity of R&D activities in the European NUTS 2 regions having applied the classical Dunn shift-share analysis (SSA) [Dunn 1960, pp. 97–112; Perloff et al. 1960; Suchecki (ed.) 2010, pp. 162–168, 180–183], and the dynamic competitive model by Barff and Knight [Barff, Knight 1988, pp. 1–10]. The structural and regional effects of changes were defined as recurring every couple of years in the analyzed period, which was later aggregated in line with the Barff-Knight concept.

The shift-share analysis of workforce growth rate in NUTS 2 regions allowed for:

- the classification of EU regions regarding the positive and negative values of the aggregated effects of changes: structural and competitive (regional);
- the identification of human resources allocation effects resulting in the classification of the analysed regions regarding their local specialization and competitive advantages;
- the identification of regions featuring smart workforce structure.

3. The classification of EU regions regarding the positive and negative effects of workforce number changes in economy sectors

The classical equation of the shift-share analysis indicates that the interregional diversification of the average workforce number changes rate may represent the effect of two reasons: different regional workforce structures (structural effect of changes) as well as the diversification of dynamics of workforce number changes in high-tech intensity sectors characteristic for these regions (the competitive effect also referred to as the regional or geographical effect of changes).

Following the dynamic recurrence Barff and Knight model (a modified approach to classical shift-share analysis) [Barff, Knight 1988, pp. 1–10] the average workforce number changes rate in the period of 2008–2010 was decomposed in the regional research of the European NUTS 2 regions into two types of aggregated effects, structural and competitive. Figure 1 illustrates the relations occurring between aggregated structural effects and aggregated regional effects. Their analysis allowed for the classification of the European Union regions into groups regarding the positive or negative impact of aggregated structural and competitive effects on average workforce number changes rate in particular regions (see Table 1). The interdependence between aggregated structural and competitive effects does not occur.

A positive structural effect indicates that the workforce number changes rate, in a given region, was more favourable than in other regions regarding sector oriented employment structure present in this particular region. On the other hand, a positive competitive effect informs that the workforce number changes rate, in a given region, was higher compared to others, since the high-tech intensity sectors of this particular region were characterized by more favourable dynamics of workforce number changes rate than in the case of other regions.

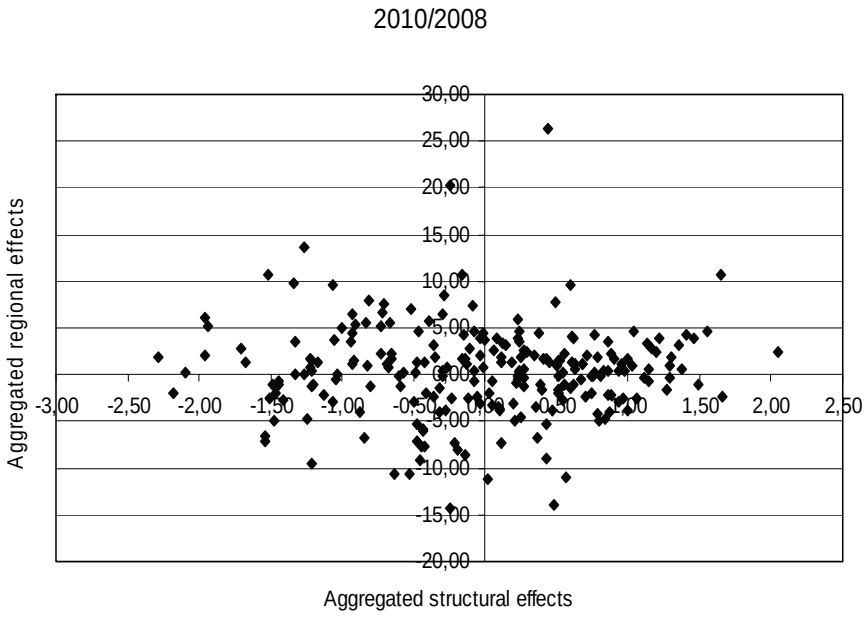

Figure 1. Aggregated structural effects vs. aggregated regional effects

Source: own elaboration.

Class I includes regions featuring the positive influence of both the structural and competitive effects on employment changes, which indicates that workforce number transformations in these regions were more favourable for two reasons: due to the workforce sector structure's positive impact on employment rate growth and economic sectors featuring the higher dynamics of workforce number changes than other regions.

This class covered 57 EU15 regions and 5 EU12 regions (Cyprus, Malta, Praha, Közép-Magyarország, Bucuresti – Ilfov).

Class II is characterized by the positive influence of the structural factor only, out of 61 regions included, of just one region from the country of the newly enlarged EU, i.e. Bratislavský kraj.

Class III, with the positive influence of just one regional factor on employment changes, covered the largest number of the new EU regions (29), including 14 Polish regions (excluding Łódzkie and Mazowieckie).

Class IV covered regions characterized by both employment structure and internal regional development determinants exerting a negative influence on workforce number changes in the period of 2008-2010. This class turned out to be the least numerous, since it included only 48 regions of which 21 originated from the EU12 countries.

Table 1. Classification of NUTS 2 regions by positive and negative values of aggregated structural and competitive effects

Class	Division criterion	Countries	Number of regions
I	Aggregated effects: structural (+) regional (+)	Great Britain 18(37/32)*, Germany 11(39/37), Belgium 10(11/10), France 9(22/16), Italy 2(21/20), Austria 2(9/8), Sweden 2(8), Luxembourg 1(1), The Netherlands 1(12/11), Finland 1(5/4)	62 EU15 57 EU12 5
		Cyprus 1(1), Malta 1(1), The Czech Republic 1(8) capital region, Hungary 1(7) region covering the capital city, Rumania 1(8) capital region	
II	Aggregated effects: structural (+) regional (–)	Great Britain 13(37/32), The Netherlands 10(12/11), France 7(22/16), Sweden 6(8), Denmark 5(5), Italy 5(21/20), Germany 4(39/37), Spain 4(19/16), Ireland 2(2), Finland 2(5/4), Greece 1(13/3), Portugal 1(7/4)	61 EU15 60 EU12 1
		Slovakia 1(4) region covering the capital city	
III	Aggregated effects: structural (–) regional (+)	Germany 16(39/37), Italy 9(21/20), Austria 6(9/8), France 4(22/16), Portugal 1(7/4), Great Britain 1(37/32)	66 EU15 37 EU12 29
		Poland 14(16), Rumania 6(8), The Czech Republic 5(8), Hungary 2(7), Slovakia 1(4), Slovenia 1(2) region covering the capital city	
IV	Aggregated effects: structural (–) regional (–)	Spain 12(19/16), Germany 6(39/37), Italy 4(21/20), Greece 2(13/3), Portugal 2(7/4), Finland 1(5/4)	48 EU15 27 EU12 21
		Estonia 1(1), Latvia 1(1), Lithuania 1(1), Bulgaria 6(6), Hungary 4(7), The Czech Republic 2(8), Poland 2(16), Łódzkie, Mazowieckie, Slovakia 2(4), Romania 1(8), Slovenia 1(2)	

* a(b/c) – a – number of NUTS 2 regions included in group, b – overall number of NUTS 2 regions in administrative division, c – number of analysed NUTS 2 regions.

Source: own elaboration.

4. The classification of NUTS 2 regions by the effects of workforce number allocation in high and medium high-technology manufacturing and knowledge-intensive services

The share and rate of the workforce number changes in high and medium high-technology manufacturing as well as knowledge-intensive services were analyzed in the studied regions. The identification of allocation effects regarding the workforce number and resulting in the classification of the regions under analysis, with regard to smart specialization and competition advantages, was performed in line with the concept defined by A. Malarska and B. Nowakowska [Malarska, Nowakowska 1992, pp. 75–85]. Tables 2 and 3 respectively present the effects of workforce number allocation in high and medium high-technology manufacturing (HMHTM) and knowledge-intensive services (KIS) in 2010. Four local

specialization and competitive advantage combinations are possible. It was assumed that a region is characterized by a specialized smart workforce structure if the share of workforce in high and medium high-technology manufacturing or in knowledge-intensive services in this region is higher than the average workforce share in the respective European Union sectors. If the rate of workforce number, in the region under analysis, changes in HMHTM or the KIS sector is higher than the average rate of workforce number changes in the respective EU sectors, then competitive advantages are present in that region.

53 NUTS 2 regions featuring smart specialization of workforce structure in 2010 and competitive advantages in the period of 2010/2008 were identified in high and medium high-technology manufacturing. German regions constituted the vast majority in this group (24 out of the 37 analysed German regions).

Table 2. The typology of regions regarding workforce number allocation effects in high and medium high-technology manufacturing in 2010

Workforce number allocation effects in high and medium high-technology manufacturing	Countries	Number of regions
Smart specialization of the region Competitive advantage	Germany 24(39/37)*, Italy 4(21/22), France 3(22/16), Belgium 3(11/10), Austria 3(9/8), Great Britain 3(37/32), Spain 1(19/6), Denmark 1(5), Ireland 1(2)	53 EU15 43 EU12 10
	Hungary 4(7), The Czech Republic 2(8), Poland 2(16), Slovenia 1(2), Romania 1(8)	
Smart specialization of the region Competitive disadvantage	Germany 9(39/37), France 4(22/16), Italy 4(21/20), Spain 3(19/16), Sweden 3(8), Great Britain 3(37/32), Finland 2(5/4),	41 EU15 28 EU12 13
	The Czech Republic 5(8), Slovakia 3(4), Poland 2(16), Romania 1(8), Slovenia 1(2), Hungary 1(7)	
Absence of smart specialization in the region Competitive advantage	Great Britain 7(11/10), Italy 7(21/20), Spain 6(19/16), The Nederlands 5(12/11), France 5(22/16), Austria 4(9/80), Germany 3(39/37), Finland 2(5/4), Sweden 2(8), Portugal 2(7/4), Greece 2(13/3), Luxembourg 1(1), Denmark 1(5)	55 EU15 47 EU12 8
	Poland 5(16), Romania 2(8), Hungary 1(7)	
Absence of smart specialization in the region Competitive disadvantage	Great Britain 19(37/32), France 8(22/16), Belgium 7(11/10), The Netherlands 6(12/11), Spain 6(19/16), Italy 5(21/20), Denmark 3(5), Sweden 3(8), Portugal 2(7/4), Ireland 1(2), Germany 1(39/37), Austria 1(9/8), Greece 1(13/3),	88 EU15 63 EU12 25
	Poland 7(16), Bulgaria 6(6), Romania 4(8), Hungary 1(7), Slovakia 1(4), Malta 1(1), Estonia 1(1), The Czech Republic 1(8), Lithuania 1(1), Latvia 1(1), Cyprus 1(1)	

* a(b/c) – a – number of NUTS 2 regions included in group, b – overall number of NUTS 2 regions in administrative division, c – number of analysed NUTS 2 regions.

Source: own elaboration.

Smart specialization and the competitive advantage in the HMHTM sector were characteristic for ten EU12 regions only, including two Polish regions (Opolskie and Lubuskie). Among the regions featuring the highest smart specialization level the following are listed: the German region of Stuttgart (18.16%), Hungarian Közép-Dunántúl (16.23%), German Niederbayern (16.01%) and Oberpfalz (15.94). The workforce share in high and medium high-technology manufacturing in 2010 in the EU was at the level of 5.58%. Definitely the largest number of regions – as many as 88 – were included in the group featuring the absence of smart specialization and competitive advantages.

Table 3. The typology of regions regarding workforce number allocation effects in knowledge-intensive services in 2010

Workforce number allocation effects in knowledge-intensive	Countries	Number of regions
Smart specialization of the region Competitive advantage	Great Britain 19(37/32), France 10(22/16), Germany 8(39/37), Belgium 5(11/10), Denmark 4(5), Sweden 3(8), The Netherlands 3(12/11), Finland 2(5/4), Luxembourg 1(1), Austria 1(8), Spain 1(19/16), Italy 1(21/20),	63 EU15 58
	The Czech Republic 1(8), Malta 1(1), Poland 1(16), Romania 1(8), Slovenia 1(2)	EU12 5
Smart specialization of the region Competitive disadvantage	Great Britain 12(37/32), Germany 11(39/37), The Netherlands 8(12/11), France 6(22/16), Belgium 5(11/10), Sweden 5(8), Ireland 2(2), Italy 2(21/20), Denmark 1(5), Finland 1(5/4), Greece 1(13/3), Portugal 1(7/4), Spain 1(19/16)	58 EU15 56
	Slovakia 1(4), Hungary 1(7)	EU12 2
Absence of smart specialization in the region Competitive advantage	Germany 8(39/37), Austria 7(9/8), Spain 6(19/16), France 1(22/16), Great Britain 1(37/32), Portugal 1(7/4)	55
	Poland 13(16), The Czech Republic 5(8), Hungary 4(7), Slovakia 3(4), Romania 3(8), Cyprus 1(1), Slovenia 1(2), Bulgaria 1(6)	EU15 24 EU12 31
Absence of smart specialization in the region Competitive disadvantage	Italy 17(21/20), Germany 10(39/37), Spain 8(19/16), France 3(22/16), Portugal 2(7/4), Greece 2(13/3), Finland 1(5/4)	61 EU15 43
	Bulgaria 5(6), Romania 4(8), Hungary 2(7), The Czech Republic 2(8), Poland 2(16), Estonia 1(1), Latvia 1(1), Lithuania 1(1)	EU12 18

* a(b/c) – a – number of NUTS 2 regions included in group, b – overall number of NUTS 2 regions in administrative division, c – number of analysed NUTS 2 regions

Source: own elaboration.

Smart specialization and competitive advantage in knowledge-intensive services were characteristic for the group covering 63 NUTS 2 regions which included only five EU12 regions (Praha, Malta, Mazowieckie, Bucuresti – Ilfov

and Zahodna Slovenija). British regions were the dominating ones among the EU15 regions. The workforce share in the EU KIS sector in 2010 amounted to 38.54% and with reference to the most specialized regions it was respectively: Stockholm (Sweden) – 59.47%, Hovedstaden (Denmark) – 58.93%, Luxembourg – 54.98%, Outer London (Great Britain) – 53.08%, Berkshire, Buckinghamshire and Oxfordshire (Great Britain) – 53%.

Table 4. NUTS 2 specialized regions and featuring competitive advantages in high and medium high-technology manufacturing and knowledge-intensive services

Country	Region	Specialization (% of workforce share)		Competitive advantage (excess of employment rate growth in a region over the rate of changes in EU in %)	
		HMTM	KIS	HMTM	KIS
European Union (reference area)		**5.58**	**38.54**	**–8.46**	**2.12**
Belgium	Prov. Antwerpen	7.99	43.88	4.02	4.88
	Prov. Oost-Vlaanderen	6.16	46.35	4.84	4.56
Germany	Kassel	12.97	42.17	42.18	9.23
	Saarland	10.96	41.88	129.44	4.35
	Thüringen	8.81	40.15	5.58	4.33
Denmark	Midtjylland	6.54	46.00	9.50	0.94
France	Alsace	10.46	41.69	15.65	7.45
Great Britain	Tees Valley and Durham	6.42	44.86	34.31	12.17
	Derbyshire and Nottinghamshire	6.73	45.04	5.66	0.93

HMTM – high and medium high-technology manufacturing, KIS – knowledge-intensive services.

Source: own elaboration.

In the group of regions featuring both the absence of smart specialization and competitive advantages in knowledge-intensive services, 43 EU15 and 18 EU12 regions were included with two Polish regions among them (Łódzkie and Opolskie).

Table 4 presents smart specialization regions featuring the competitive advantages in both sectors characterized by intensive outlays on R&D. Among 237 analyzed NUTS 2 regions, as few as nine regions representing five of the so called 'old' EU15 countries met these criteria. This group covered three German regions, two Belgian and two British, one Danish and one French region. These regions are characterized by a two-sector smart specialization and two-sector competitive advantages.

5. Conclusions

The global crisis resulted in a negative average rate of workforce number changes in the European Union in the period of 2010/2008 and showed the level of –2.27%. The application of dynamic shift-share analysis allowed for the decomposition of

factors responsible for employment changes in the European NUTS 2 level regions into structural and competitive (regional) effects. About 51% of the analyzed regions featured a negative structural effect, which indicates that the workforce structure in these regions exerted a negative effect on employment rate transformations. Negative structural effects (89.3%) were observed in 50 regions from the EU12 countries (out of 56 analyzed regions) and also in 64 regions originating from 181 EU15 (35.3%).

A negative competitive effect occurred in 46% of the regions, which means that adequate sectors were characterized by average lower dynamics of changes than in other regions. This group covered 22 out of 56 EU12 regions (39.3%) and 87 out of 181 EU15 regions (48%). In 14 Polish regions, negative structural and positive regional effects were recorded. In the Łódzkie and Mazowieckie regions both effects were negative, however, in the Mazowieckie region they were much closer to zero (–0.008 and –0.61).

Smart specialization and competitive advantages in high and medium high-technology manufacturing were characteristic for 53 NUTS 2 regions (22.4%), including 43 out of 181 EU15 regions (23.8%) and 10 out of 56 EU12 regions (17.9%). The workforce share and the rate of changes in the HMHTM sector exceeded the average EU rate.

More regions, as many as 63 (26.6%), feature smart specialization and competitive advantages in the knowledge-intensive services sector. Among them as many as 58 out of the 181 EU15 regions under analysis, were present (32%) and as few as five out of 56 (9%) of the EU12 regions.

There were also nine regions distinguished which presented smart workforce structures in both innovative economy sectors and also featured more favourable than the EU average rate of employment changes in the period of 2008–2010.

The occurring employment rate transformations were related to economic crisis, however, their interregional diversification resulted from both internal (competitive) and structural determinants. Analogous regional-structural research of workforce number by R&B outlays intensity in particular sectors should be continued as more statistical information is available and extended by comparative analyses referring to structural, competitive and allocation changes in particular sub-periods.

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TYPOLOGIA REGIONÓW EUROPEJSKICH A EFEKTY ZMIAN LICZBY PRACUJĄCYCH WEDŁUG POZIOMU INTENSYWNOŚCI PRAC BADAWCZO-ROZWOJOWYCH

Streszczenie: Celem opracowania jest klasyfikacja regionów europejskich NUTS 2 ze względu na efekty strukturalne, konkurencyjne i alokacji zmian liczby pracujących oraz identyfikacja i charakterystyka inteligentnych struktur pracujących w odniesieniu do obszaru referencyjnego, za jaki przyjęto przestrzeń regionalną państw członkowskich Unii Europejskiej. Narzędziem badawczym zmian strukturalnych liczby pracujących w europejskiej przestrzeni regionalnej w okresie 2008–2010 jest *shift-share analysis*.

Słowa kluczowe: struktura pracujących, regiony europejskie NUTS 2, analiza *shift-share*.