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Spatial Analysis Of Human Capital Structures

Abstract

The main purpose of this paper is to analyse the interdependence between labour productivity and the occupational structure of human capital in a spatial cross-section. Research indicates (see Fischer 2009) the possibility to assess the impact of the quality of human capital (measured by means of the level of education) on labour productivity in a spatial cross-section.

This study attempts to thoroughly analyse the issue, assuming that apart from the level of education, the course of education (occupation) can also be a significant factor determining labour productivity in a spatial cross-section.

The data used in this paper concerning labour force structure in major occupational groups in a regional cross-section comes from a Labour Force Survey. The data source specificity enables the assessment of labour force occupational specialisation at the regional level and the estimation of this specialisation at the subregional or county level.

An in-depth analysis of the occupational structure of the labour market in a spatial cross-section is an important theoretical and practical area of study necessary for the development of effective labour market policies and the education system.

Keywords: *labour market, occupational groups, labour productivity*

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1. Introduction

The main purpose of this paper is to analyse the interdependence between labour productivity and the occupational structure of human capital in a spatial cross section. Research indicates (see Fischer 2009) the possibility to assess the influence of the quality of human capital, measured by the level of education, on labour productivity in a spatial cross section.

The study attempts to thoroughly analyse the issue, acknowledging that it is not solely the level of education but also the course of education (occupation) likewise that may become a significant factor determining labour productivity in a spatial cross section.

This paper uses the data concerning labour force structure in major occupational groups in a province (NUTS2) cross-section, taken from a Labour Force Survey. The specificity of data source enables to assess a professional specialization of the labour force at a province (NUTS2) level and to estimate this specialization at the subregional (NUTS3) or county (NUTS4) level.

2. Specialisation and localisation by occupational groups

Analyses of the labour market occupational composition utilise the Polish Classification of Occupations and Specialisations congruous with the international ISCO-08 classification. The Polish classification is a hierarchical framework of occupational groups which currently identifies 10 major groups, 43 sub-major groups, 132 minor groups, 444 unit groups and 2366 occupations and specialisations.

The paper makes use of data from a Labour Force Survey across the provinces as well as the major and sub-major occupational groups. The table below presents the layout of the classification with names of occupational groups and their codes.

Table 1. ISCO-08 Code and occupational groups' names

ISCO 08 Code	Major group	ISCO 08 Code	Sub-major group
0	**Armed forces occupations**	01	Commissioned armed forces officers
		02	Non-commissioned armed forces officers
		03	Armed forces occupations, other ranks
1	**Managers**	11	Chief executives, senior officials and legislators
		12	Administrative and commercial managers
		13	Production and specialised services managers
		14	Hospitality, retail and other services managers

2	**Professionals**	21	Science and engineering professionals
		22	Health professionals
		23	Teaching professionals
		24	Business and administration professionals
		25	Information and communications technology professionals
		26	Legal, social and cultural professionals
3	**Technicians and associate professionals**	31	Science and engineering associate professionals
		32	Health associate professionals
		33	Business and administration associate professionals
		34	Legal, social, cultural and related associate professionals
		35	Information and communications technicians
4	**Clerical support workers**	41	General and keyboard clerks
		42	Customer services clerks
		43	Numerical and material recording clerks
		44	Other clerical support workers
5	**Service and sales workers**	51	Personal service workers
		52	Sales workers
		53	Personal care workers
		54	Protective services workers
6	**Skilled agricultural, forestry and fishery workers**	61	Market-oriented skilled agricultural workers
		62	Market-oriented skilled forestry, fishery and hunting workers
		63	Subsistence farmers, fishers, hunters and gatherers
7	**Craft and related trades workers**	71	Building and related trades workers, excluding electricians
		72	Metal, machinery and related trades workers
		73	Handicraft and printing workers
		74	Electrical and electronic trades workers
		75	Food processing, wood working, garment and other craft and related trades workers
8	**Plant and machine operators, and assemblers**	81	Stationary plant and machine operators
		82	Assemblers
		83	Drivers and mobile plant operators
9	**Elementary occupations**	91	Cleaners and helpers
		92	Agricultural, forestry and fishery labourers
		93	Labourers in mining, construction, manufacturing and transport
		94	Food preparation assistants
		95	Street and related sales and service workers
		96	Refuse workers and other elementary workers

Source: http://www.ilo.org/public/english/bureau/stat/isco/isco08/

Location quotients for major occupational groups in particular provinces (NUTS2) have been calculated in order to determine the specialisation and location of human capital (of the employed) across occupational groups (see Table 2).

Table 2. Location quotient[1] (LQ) by major occupational groups and provinces (NUTS2) in 2011 in Poland

NUTS2	Armed forces	Managers	Professionals	Technicians	Clerical workers	Service and sales workers	Agricultural workers	Craft workers	Operators	Elementary occupations
dolnośląskie	*0.48*	0.94	1.06	1.06	0.99	1.12	*0.45*	1.01	**1.28**	1.06
kujawsko-pomorskie	**1.75**	0.87	*0.75*	0.97	1.05	1.00	1.16	**1.22**	0.85	1.15
lubelskie	1.02	0.81	0.83	0.93	0.82	0.87	**2.32**	*0.79*	*0.68*	0.91
lubuskie	**3.04**	0.98	*0.80*	0.86	1.05	1.03	*0.35*	1.20	**1.25**	**1.77**
łódzkie	0.98	1.00	0.90	0.93	1.17	0.98	1.04	0.92	1.18	1.08
małopolskie	*0.40*	1.01	1.08	0.80	0.89	1.08	1.13	1.09	0.89	0.85
mazowieckie	1.12	1.14	**1.42**	1.14	1.14	0.87	0.90	*0.69*	*0.80*	0.87
opolskie	1.10	0.84	*0.77*	0.92	0.97	1.06	*0.74*	**1.27**	1.18	**1.32**
podkarpackie	0.95	*0.66*	*0.77*	0.95	*0.77*	0.93	**1.76**	1.05	1.15	*0.76*
podlaskie	*0.58*	*0.80*	0.83	0.83	0.85	1.04	**2.10**	0.86	*0.75*	0.85
pomorskie	**1.67**	0.99	1.11	1.16	0.99	1.02	*0.67*	1.06	0.94	0.88
śląskie	*0.12*	1.19	1.09	1.19	1.13	1.10	*0.24*	1.03	**1.24**	0.86
świętokrzyskie	*0.08*	1.01	*0.74*	*0.66*	*0.75*	0.84	**2.10**	1.13	0.83	0.99
warmińsko-mazurskie	**2.39**	0.92	0.81	1.09	0.87	1.05	*0.69*	**1.27**	1.06	1.18
wielkopolskie	0.91	1.08	0.86	0.89	0.96	1.03	0.95	1.16	0.99	1.19
zachodniopomorskie	**2.74**	1.01	0.84	1.05	1.02	1.15	*0.55*	1.08	1.06	**1.35**

(darker shade – localisation (specialisation), lighter shade – lack of localisation (specialisation)

Source: author's own calculations.

A brief analysis of the location quotient table leads to the conclusion that there exists a provincial specialisation in terms of occupation and that there occurs a concentration of people belonging to major occupational groups in particular provinces.

People employed within the Armed Forces occupational group (0) are most densely concentrated in the Lubuskie, Zachodniopomorskie and Warmińsko-Mazurskie provinces (LQ above 2). Conversely, they are least prevalent in the Świętokrzyskie and Śląskie provinces.

[1] A *location quotient* (LQ) is an analytical statistic that measures a region's specialisation relative to a larger geographic unit (see: Ekonometria przestrzenna, Suchecki B. (ed.) C.H.Beck, Warsaw 2010, p.135).

In the case of people categorised as employed in the managers group (1), clear location does not occur (merely a notable surplus in the Śląskie and Mazowieckie provinces). Provinces with a lower LQ for managers include Podkarpackie and Podlaskie.

For the professionals occupational group (2) it is the Świętokrzyskie and Kujawsko-Pomorskie provinces that have the lowest LQ. Professionals are more concentrated only in the Mazowieckie province.

Technicians and associate professionals (3) are not significantly concentrated in any province. Lower concentrations can only be observed in Świętokrzyskie province.

Similarly, with clerical suport workers (4) a lower location quotient is only true for the Świętokrzyskie and Podkarpackie provinces.

In the case of Service and Sales workers (5), it is impossible to pinpoint areas with an unusually high or low LQ – it is the occupational group characterised by the most even spatial distribution.

Skilled agricultural, forestry and fishery workers (6) are conspicuously concentrated in the following provinces: Lubelskie, Świętokrzyskie, Podlaskie (LQ over 2) and Podkarpackie (LQ of 1.76). Conversely, they are least prevalent in the Śląskie, Lubuskie and Dolnośląskie provinces (LQ below 0.5).

Craft and related trades workers (7) are located in the Opolskie, Warmińsko-Mazurskie and Kujawsko-Pomorskie provinces. It is the Mazowieckie and Lubelskie provinces that have low LQs for this group.

Plant and machine operators and assemblers (8) are concentrated in the Dolnośląskie, Lubuskie and Śląskie provinces, whereas they are less numerous in the Lubelskie, Podlaskie i Mazowieckie provinces.

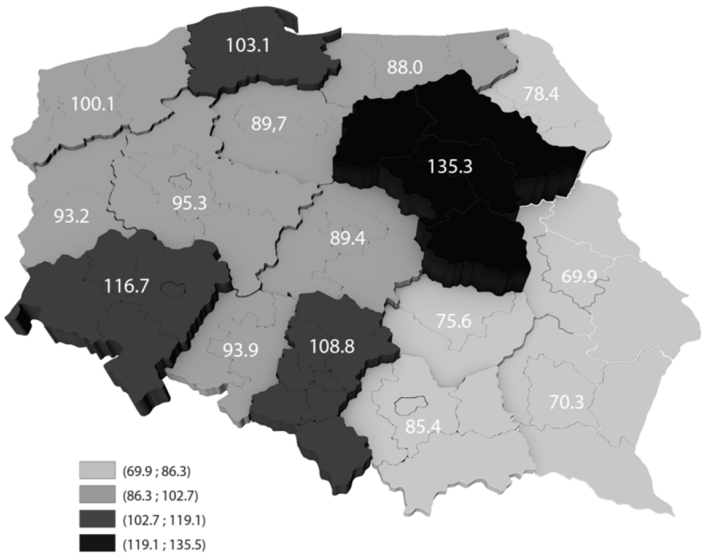
A high concentration of people belonging to the elementary occupations group can be observed in the Lubuskie, Zachodniopomorskie and Opolskie provinces, while the Podkarpackie province has a low LQ for this group.

An analysis of location quotients reveals that certain provinces specialise in specific occupational groups – the Mazowieckie province in the occupational group of professionals (2); the Dolnośląskie and Śląskie provinces in plant and machine operators and assemblers (8); the Lubelskie, Podkarpackie, Podlaskie and Świętokrzyskie provinces in skilled agricultural, forestry and fishery workers (6); the Kujawsko-Pomorskie and Warmińsko-Mazurskie provinces in crafts and related trades workers (7) as well as Armed Forces occupations (0); the Opolskie province in crafts and related trades workers (7) and elementary occupations (9); the Zachodniopomorskie province in elementary occupations (9) and Armed Forces occupations (0); the Pomorskie province in Armed Forces occupations (0). The Łódzkie, Małopolskie and Wielkopolskie provinces, on the other hand, do not possess occupational groups whose LQ exceeds 1.2 and thus lack specialisation.

3. Labour productivity and occupational structure

The next step involved conducting a comparative analysis of the relation between labour productivity (measured by means of Gross Value Added per employed person) and the occupational structure of the employed in terms of major occupational groups across provinces. The analysis was based on 2011 data due to the availability of regional accounts concerning Gross Value Added.

Figure 1. Gross Value Added (GVA) per employed person in 2011 NUTS2 (Poland=100)

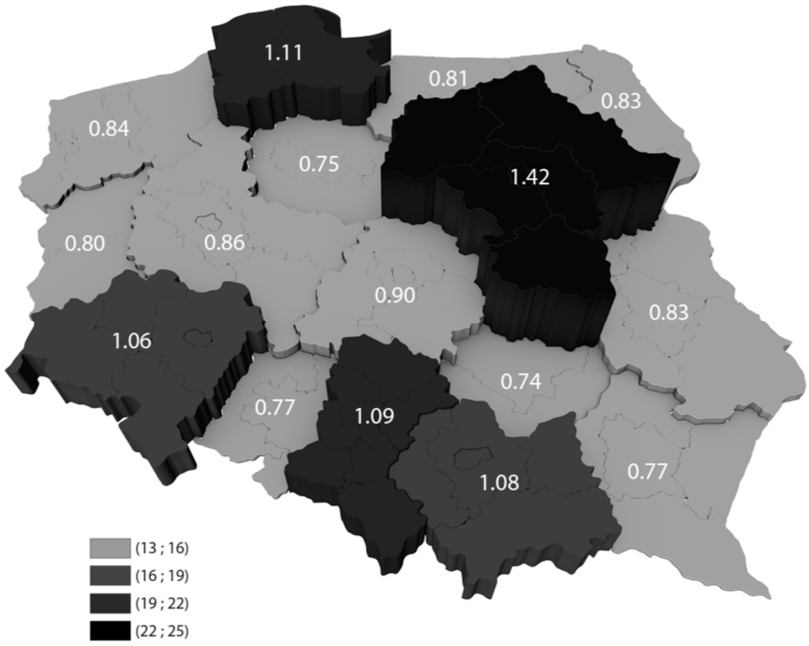


Source: author's own calculations.

The highest level of Gross Value Added per employed person (in relation to the country's average) in 2011 was reported in Mazowieckie (exceeding the country average by 35.3%). Other provinces with a value higher than the national average are Dolnośląskie, Śląskie and Pomorskie.

At the other extreme, with levels of GVA per employed person considerably below the country's average were the Lubelskie, Podkarpackie, Świętokrzyskie and Podlaskie provinces.

Figure 2. Share of Professionals (in %) and LQ (NUTS2) in 2011

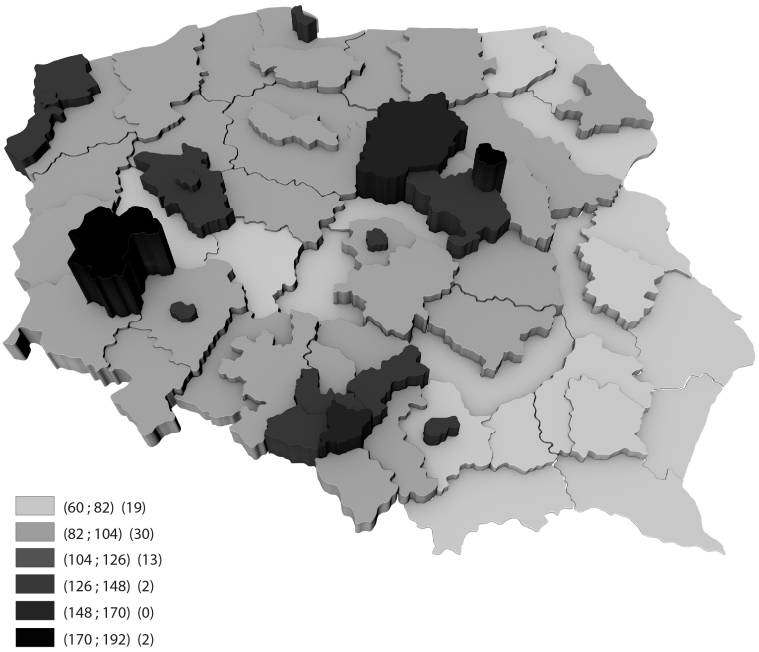


Source: author's own calculations.

The highest share (of people employed) in the occupational group of professionals (2) in 2011 was also recorded in the Mazowieckie province (LQ at 1.42). A high share of specialists (exceeding the country's average) was also reported in the Pomorskie, Śląskie, Małopolskie and Dolnośląskie provinces.

A lower share (well below the country's average) of people employed as professionals was recorded in all provinces with a conspicuously lower level of Gross Value Added per employed person (Lubelskie, Podkarpackie, Świętokrzyskie, Podlaskie) but also in the Kujawsko-Pomorskie and Opolskie provinces.

Figure 3. GVA per employed person in 2011 NUTS3 (Poland=100)



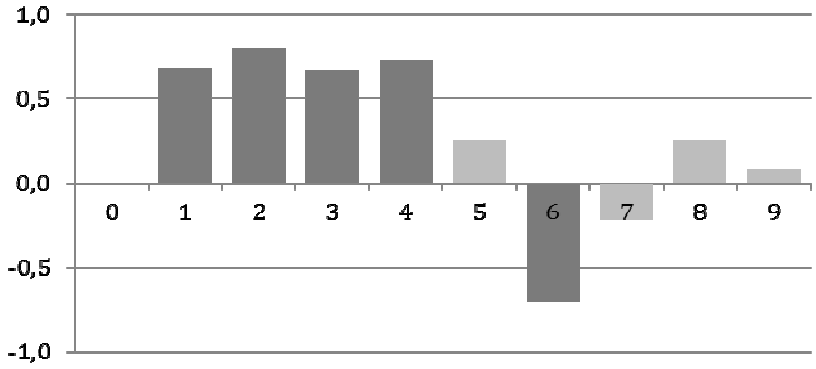
Source: author's own calculations.

An in-depth analysis of the level of Gross Value Added per employed person in the spatial cross-section indicates that the highest positive divergences from the country's average are found in the Legnica-Głogów subregion (copper mining area), the Warsaw subregion (capital city), the Tychy subregion (automotive industry), the Ciechanów-Płock subregion (petroleum industry). Values exceeding the average can also be observed in all subregions functioning as metropolitan areas.

The lowest level of GVA per employed person is found in the following subregions: Przemyśl, Krosno, Puławy and Chełm-Zamość, where agriculture is the dominating element of the region's economy.

The assessment of the strength of the correlation between the occupational structure of the employed and labour productivity in the provincial cross-section was conducted using the Pearson correlation coefficient.

Figure 4. Correlation coefficients (share of major occupational groups-GVA) NUTS2 in 2011



Source: author's own calculations.

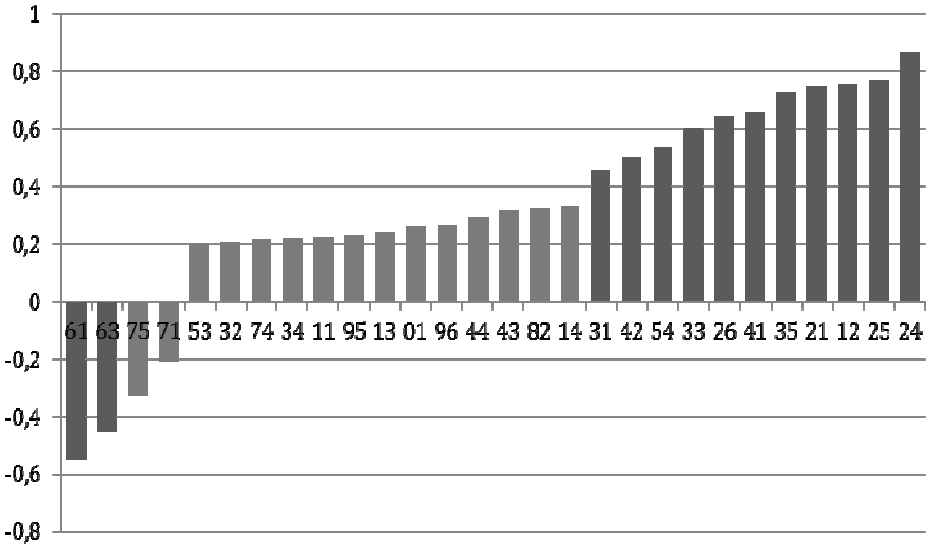
The highest positive value of the correlation coefficient determined for Gross Value Added per employed person and the share of the population employed in particular major occupational groups in the provincial cross-section was obtained for the major occupational group of Professionals (2). High values (of statistical significance) of the correlation coefficient were also observed for the following occupational groups: managers (1), technicians and associate professionals (3), clerical support workers (4).

A statistically significant negative correlation with Gross Value Added per employed person is present for those employed within the skilled agricultural, forestry and fishery workers group (6).

An in-depth analysis across the major occupational groups confirms a strong negative correlation (of statistical significance) for occupational groups associated with agriculture: market-oriented skilled agricultural workers (61) and subsistence farmers, fishers, hunters and gatherers (63). On the other hand, a noticeable positive correlation was observed for the following groups: business and administration professionals (24), information and communications technology professionals (25), administrative and commercial managers (12), science and engineering professionals (21), information and communications technicians (35), General and keyboard clerks (41), Legal, social and cultural professionals (26), business and administration associate professionals (33), protective services workers (54), customer services clerks (42), science and engineering associate professionals (31).

The chart below presents the values of correlation coefficients – statistically significant at the 5% level of significance (darker shade) and values ranging from 0.2 to -0.2 (lighter shade).

Figure 5. Correlation coefficients (share of sub-major occupational groups-GVA) NUTS2 in 2011



Source: author's own calculations.

4. Conclusions

The analyses conducted have confirmed the correlation between the occupational structure of the employed and the level of Gross Value Added per employed person in the provincial cross-section.

The highest influence on labour productivity in particular regions in this sense is exerted by the share of people employed within the occupational group of professionals (2). A positive influence (of statistical significance) has also been observed for the following occupational groups: managers (1), technicians and associate professionals (3), and clerical support workers (4).

The highest negative correlation was obtained for the share of major occupational group of skilled agricultural, forestry and fishery workers (6).

The share of people employed within the major occupational groups of Armed Forces occupations (0), service and sales workers (5), crafts and related trades workers (7), plant and machine operators and assemblers (8), elementary occupations (9) is not significantly correlated with Gross Value Added per employed person.

The analysis of correlations across the sub-major occupational groups facilitates the identification of areas capable of generating superior effects of labour force use. It is possible to indicate that outstanding labour productivity is mainly owed to the work of specialists and supporting groups. The aforementioned areas of high labour productivity comprise management (occupational groups 12, 24), engineering (occupational groups 21,31), ICT (occupational groups 25, 35), business support (occupational groups 26, 33, 41, 42, 54).

The results of analysis indicate that the highest labour productivity regions are characterised by a high share of employment in the following areas: management (staff, managers), engineering (engineers), ICT (computer scientists) and business services (lawyers, administration, customer service, security), which can be an important indication for educational policy (fields of study), labour market policies and supporting entrepreneurship.

The obtained results indicate a spatial diversity of labour productivity and the occupational structure of the employed. Intriguing results are also to be expected from detailed analyses, e.g. across occupational sub-groups (identification of occupational groups generating high labour productivity) or across subregions or counties (spatial analysis). However, due to shortage of statistical data, especially in the case of spatial analysis, such a venture is currently a tough challenge. An attempt at estimating the occupational structure of the employed populations across subregions (NUTS3) and counties (NUTS4) is the next step to be taken in this field.

References

Suchecki B. (ed.) (2010), *Ekonometria przestrzenna*, C.H.Beck, Warsaw.

Fischer M. M., Bartkowska M., Riedl A., Sardadvar S., Kunnert A., (2009), *The impact of human capital on regional labor productivity in Europe*, Letters in Spatial and Resource Sciences, October 2009, Volume 2, Issue 2-3, pp. 97-108.

Fischer M. M., Frohlich J. (2001), *Knowledge, Complexity and Innovation Systems*, Springer Verlag, Berlin Heidelberg.

Gajdos A., Żmurkow E. (2012), *Skilled Personnel Supply and The Prospects for Regional Innovative Development in Poland,* 'Comparative Economic Research, Central and Eastern Europe', Volume 15, No. 4/2012, WUŁ, Łódź, pp. 45-58.

Mincer J. (1997), *The Production of Human Capital and the Life Cycle of Earnings. Variations on a Theme, Journal of Labor Economics*, Vol. 15, No. 1, Part 2: Essays in Honor of Yoram Ben-Porath (Jan., 1997), pp. S26-S47.

Streszczenie

PRZESTRZENNE ANALIZY STRUKTURY KAPITAŁU LUDZKIEGO

Głównym celem opracowania jest analiza zależności produktywności pracy i struktury zawodowej kapitału ludzkiego w przekroju przestrzennym. Badania wskazują (por. Fischer 2009) na możliwość oceny wpływu jakości kapitału ludzkiego mierzonego poziomem wykształcenia na produktywność pracy w przekroju przestrzennym.

W opracowaniu podjęto próbę pogłębionej analizy problemu zakładając, że poza poziomem wykształcenia znaczącym czynnikiem różnicującym produktywność pracy w przekroju przestrzennym może być kierunek wykształcenia (zawód).

W opracowaniu wykorzystano dane dotyczące struktury pracujących według wielkich grup zawodowych w przekroju wojewódzkim pochodzące z Badania Aktywności Ekonomicznej Ludności (Labour Force Survey). Specyfika źródła danych pozwala na ocenę specjalizacji (lokalizacji) zawodowej siły roboczej na poziomie wojewódzkim oraz szacowanie tej specjalizacji na poziomie podregionalnym lub powiatowym.

Pogłębione analizy struktury zawodowej rynku pracy w przekroju przestrzennym stanowią ważny teoretycznie i praktycznie obszar badań niezbędny dla prowadzenia efektywnej polityki rynku pracy i systemu edukacji.

Słowa kluczowe: *rynek pracy, grupy zawodowe, wydajność pracy*