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Skilled Personnel Supply and the Prospects for Regional Innovative Development in Poland

Abstract

The aim of this paper is to analyze the supply of highly qualified personnel in the context of prospects for the future innovative development of voivodships in Poland. Analysis of these problems and the relationship between them will be based on the studies on the educational profile of regions and on the analysis of potential trends and possibilities of creating a highly skilled labor force coming from higher education system, as well as on the research on the innovation level and profile of particular voivodships. Furthermore, analysis of possibilities and the level of knowledge diffusion will be conducted.

1. Introduction

New technologies and innovations are considered to be one of the most important factors in obtaining a competitive advantage, which leads to an economic growth, and thus to the improvement of socio-economic situation (Gaczek 2005, pp. 9-12). Simultaneously, there is a coexistence and mutual dependence noticed between the economic and educational development. Existence and the supply of well educated and highly qualified personnel determines scientific and technological progress, which is the source of deep changes in the economy (Grodzicki 2000, p. 22, 35).

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The main objective of the paper is to analyze the supply of highly qualified personnel in the context of prospects for the innovative development of voivodships in Poland. The paper covers identification and analysis of the regional education profiles, analysis of potentional trends and possibilities of creating a highly skilled labor force by a regional higher education system and research on the innovation level of voivodships. Furthermore, the analysis of the relationship between the supply of highly qualified personnel and the level of innovation has been conducted. Research was performed for years 2004–2010.

2. Education profiles

The analysis includes nine profiles, which are based on a groups of fields of education according to International Standard Classification of Education (ISCED 97).

Table 1. Education profiles according to International Standard Classification of Education

Education profiles	Groups of the fields of education according to ISCED 97
education	teacher training and education science
humanities science and arts	humanities arts
social science	social journalism and information social welfare
economy and law	law economy and administration
health	health
science	biology physical science mathematics and statistics computing
engineering and technology	engineering and engineering trades manufacturing and processing architecture and building environmental protection

services	personal services transport services security services
agriculture	agriculture, forestry and fishery veterinary

Source: own research based on http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm, (20.05.2012).

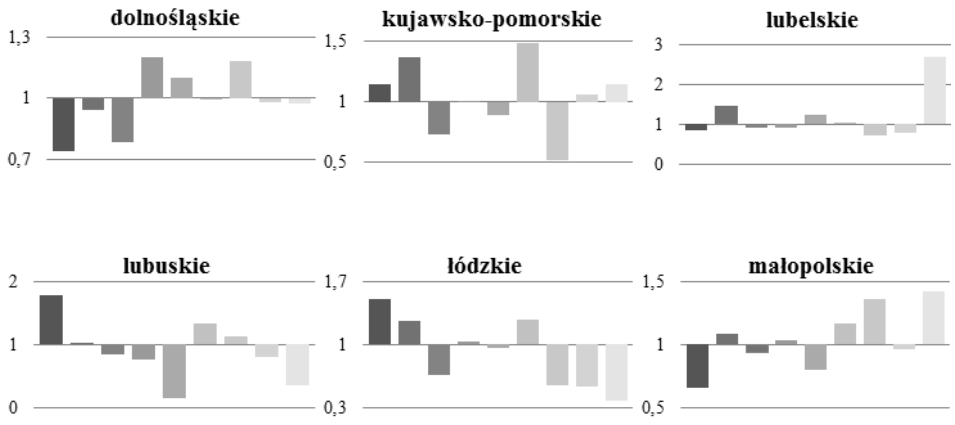
An identification of regional eductaion profiles has been conducted on the basis of location quotients calculated for the number of graduates in various fields of education (*i)* in particular voivodships (*v)*:

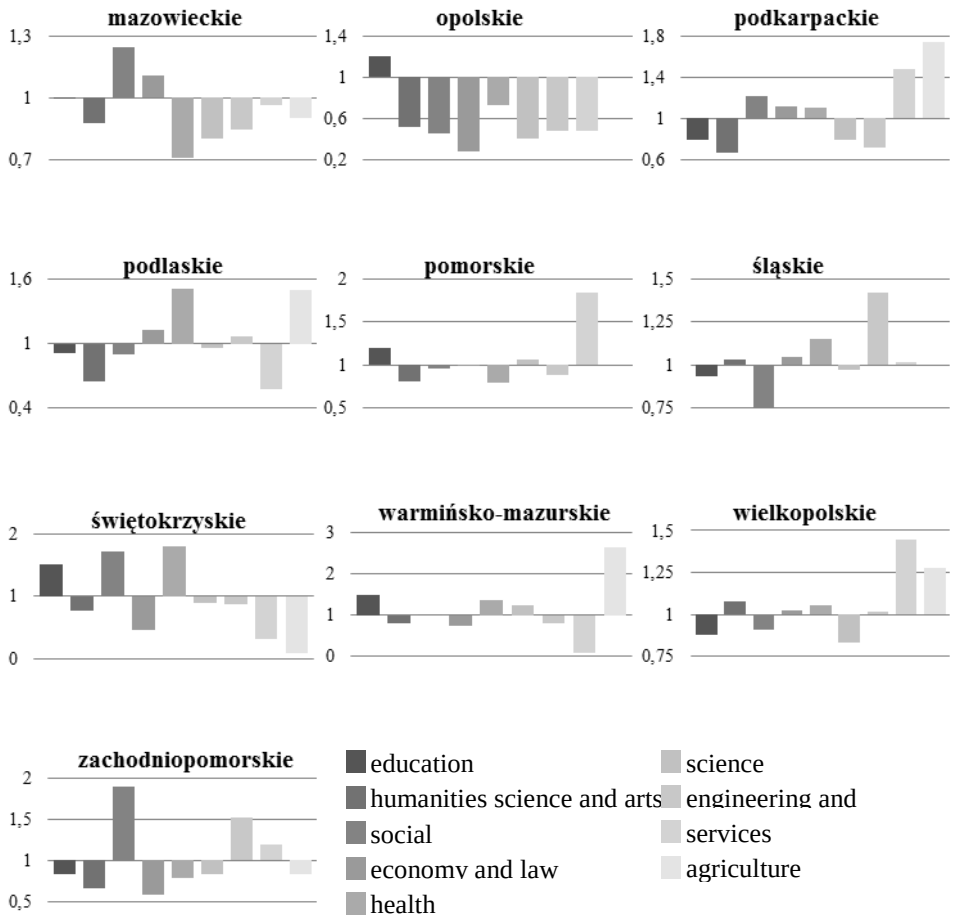
$$LQ_v^i = \frac{\text{Regional share of graduates in } i \text{ field of education}}{\text{National share of graduates in } i \text{ field of education}}$$

Value of location quotient greater than 1 indicates excess of share of the graduates of a particular field of education in the region in relation to the national average, while value less than 1 indicates shortage of this share.

The results presented in figure 1 confirms that the education profiles vary accross the regions.

Figure 1. Education profiles of voivodships in 2010





Source: own calculations using data from the Local Data Bank (http://www.stat. gov.pl/bdl).

What is more, those profiles are not constant over time. In most of regions the dominating profile of education have changed during the six years of analysis, which is marked in table 2 by arrows.

Table 2. Education profiles dominating in voivodships in 2004 and 2010

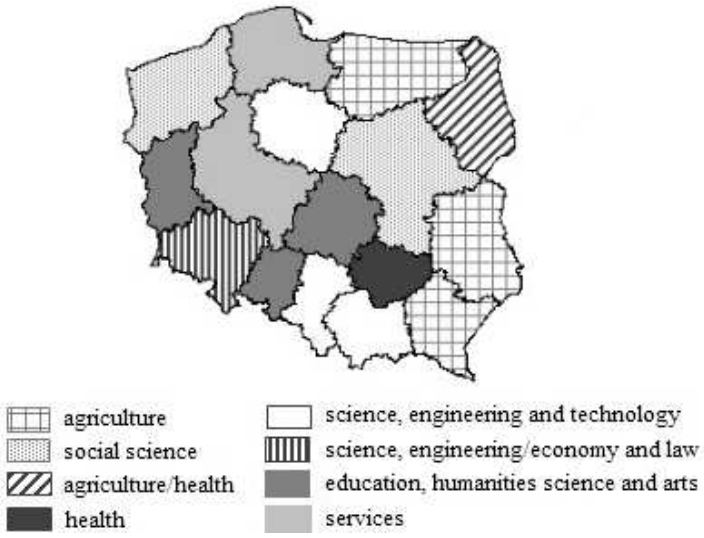
Voivodship	Dominant education profile in 2004		Dominant education profile in 2010
lubuskie	education		education
opolskie	agriculture	→	education
łódzkie	science	→	education
mazowieckie	services	→	social science
zachodniopomorskie	social science		social science
dolnośląskie	economy and law engineering and technology		economy and law engineering and technology
podlaskie	health agriculture		health agriculture
świętokrzyskie	social science	→	health
śląskie	services	→	science
kujawsko-pomorskie	education	→	science
małopolskie	agriculture	→	science
pomorskie	health	→	services
wielkopolskie	agriculture	→	services
lubelskie	agriculture		agriculture
podkarpackie	services	→	agriculture
warmińsko-mazurskie	services	→	agriculture

Source: own calculations.

According to the latest data (year 2010) voivodships are divided into seven main and two combined groups of profiles. A spatial location of those groups (figure 2) indicates that:

- science, engineering and technology profiles are dominating in the South of Poland while education,
- humanities science and arts profiles dominates in the south-west part of the country,
- profile connected with services is dominating in western and northern parts of the country,
- agriculture profile have a relatively highest share in the eastern Poland.

Figure 2. Spatial location of groups of education profiles in 2010



Source: own research.

3. Qualified personnel supply level

The next step of the analysis was determining the regional qualified personnel supply index, which has been done with use of linear arrangement method, where the aggregate measure (QPS_i) is a function of normalized values of input variables:

$$QPS_i = \frac{1}{m}\sum_{j=1}^{m} z_{ij} \text{ and } z_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}}, (i = 1,...,n,\ j = 1,...,m)$$

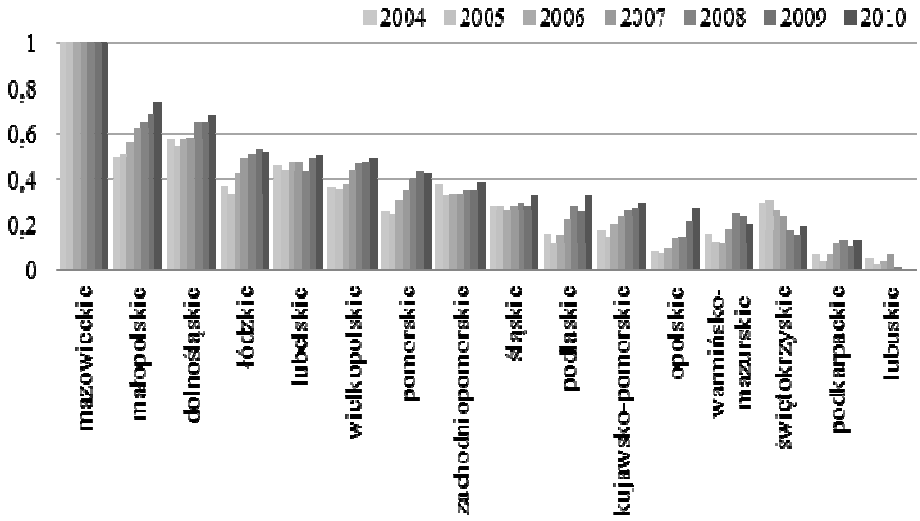
where z_{ij} is a normalized value of variable j in object i (voivodship) (Strahl 2008, p. 34). In order to increase the clarity of the results, index QPS_i have been normalized with the following formula:

$$QPS_i^{'} = \frac{QPS_i - QPS_{\min}}{QPS_{\max} - QPS_{\max}}, (i = 1,...,n)$$

Values of the index range from 0 to 1, where 0 indicates the lowest level of qualified personnel supply and 1 - the highest. Index is composed of four indicators:

- graduates per 1000 population aged 20-29,
- students (ISCED 5) per 10 thousand population aged 19-24,
- doctorate students (ISCED 6) per 1000 population aged 25-34,
- postgraduates per 1000 economically active population of working age.

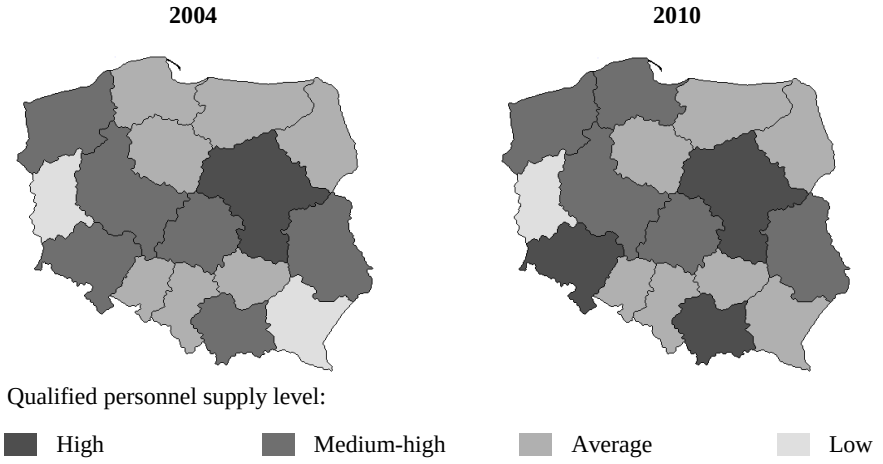
Figure 3. Qualified personnel supply level in voivodships over the years 2004-2010



Source: own calculations using data from the Local Data Bank (http://www.stat. gov.pl/bdl).

Value of the QPS'_i index have been increasing over the years 2004-2010 in most of regions and the highest growth occurred in opolskie, podlaskie and podkarpackie. Only in two voivodships – lubuskie and świętkorzyskie – value of index decreased. After dividing regions into four groups characterized by a different level of qualified personnel supply with use of the technique based on the arithmetic mean and standard deviation (Czupich 2009, p. 40) it can be clearly seen, that the level of supply is generally rising (figure 4).

Figure 4. Qualified personnel supply level in voivodships in 2004 and 2010



Source: own research.

4. Innovation level

Analysis of the innovation level basis on the innovation index, which has been determined with use of the same methodology as for the qualified personnel supply index. Selection of variables used in aggregate index was based mainly on the list of 25 indicators used in *the Innovation Union Scoreboard (IUS)* methodology (*European Innovation Scoreboard EIS* until 2009) and also on other analyses and publications on the subject of innovation.

Table 3. Indicators used in aggregate innovation index

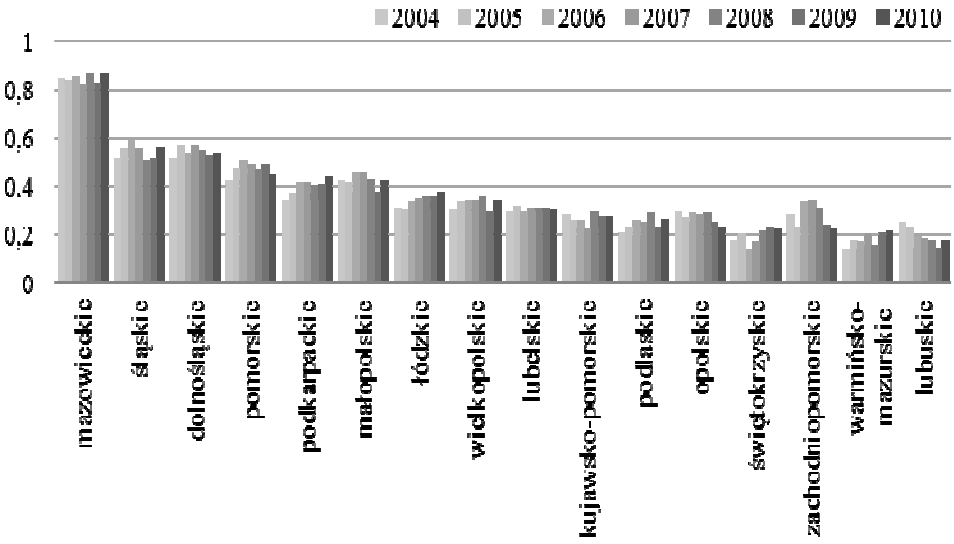
Main types of indicators	Indicators
Enablers	Human Resources in Science and Technology with higher education as a percentage of economically active population
	Percentage population aged 25-64 having completed tertiary education
	Population with higher educatiion (% of workforce)
	Percentage population aged 25-64 participating in life-long learning
	R&D expenditures (% of GDP)
Firm activities	R&D units per 100 thousand population
	R&D units in enterprises per 10 thousand enterprises
	Employed in R&D (in EPC) per 1000 economically active population
	Employed in R&D (persons) in manufacturing sector per 1000 employed in manufacturing sector

	Innovation expenditures (product and process innovation) of manufacturing enterprises per inhabitant
	Manufacturing enterprises introducting product and process innovations (% of all manufacturing enterprises)
	Number of patents applied for at the Polish Patent Officeper million population
Outputs	Firms using means of automation per 1000 firms form manufacturing sector
	Employment in medium-high & high-tech manufacturing (% of workforce)
	Employment in knowledge-intensive services (% of workforce)

Source: own research based on Innovation Union Scoreboard 2011, p. 10-11; Regional Innovation Scoreboard (RIS) 2009, p. 7-8; Regional Innovation Scoreboard 2012. Methodology report, p. 4-13.

The growth of the innovation level during the analyzed period is not so strong as the growth of qualified personnel supply index. Over the years 2004-2010 the biggest increase of the index occurred in łódzkie, podkarpackie, świętokrzyskie and warmińsko-mazurskie, while the bigest decrease in lubuskie and opolskie.

Figure 5. Innovation level in voivodships over the years 2004–2010

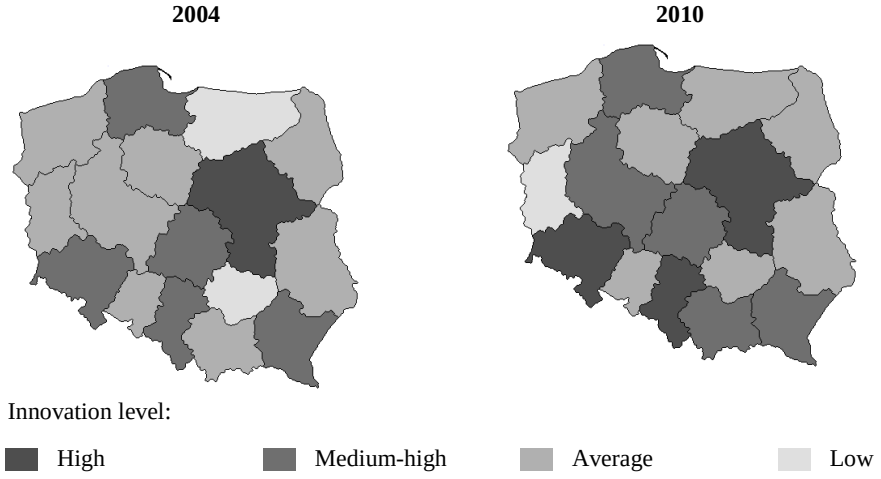


Source: own calculations using data from the Local Data Bank (http://www.stat. gov.pl/bdl) and Eurostat (http://epp.eurostat.ec.europa.eu).

Nevertheless, innovation level is also systematically rising - in year 2004 there was only one voivodship characterized by a high level of innovation, while

in 2010 there were already three highly innovative voivodships. Also the number of voivodships with medium-high level of innovativeness increased over the six years of analysis.

Figure 6. Innovation level in voivodships in 2004 and 2010



Source: own research.

5. Relationship between innovation and qualified personnel supply

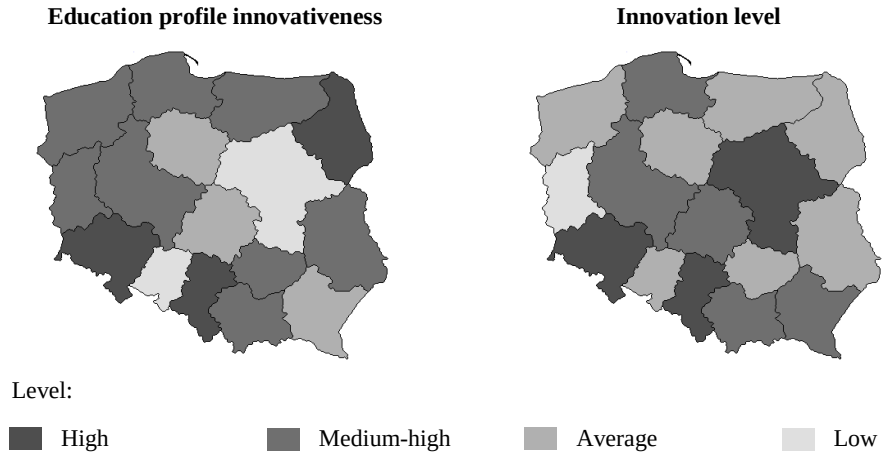
The analysis of relationship between innovation and qualified personnel supply, which is a key stage of research, covers an identification of education innovative potential, analysis of interdependence between innovation and qualified personnel supply and cluster analysis.

A level of innovativeness of particular regional education profiles was determined for year 2010 as the sum of shares of graduates in fields of study considered as a highly innovative, which are: health, science and engineering and technology. According to this, the highest innovative potential of education profile occurs in podlaskie, dolnośląskie i śląskie, and the lowest in mazowieckie and opolskie (figure 7, map on the left).

Comparison of these results with the level of innovation shows, that a high innovative potential of education profile does not correspond with the high level of innovation and, what is more, it is just the opposite. Therefore, there is a assumption that the relationship between these two characteristics is negative. It may indicate that the regional higher education system does not

boost a regional resources for innovation, and so there is a low or limited knowledge diffusion to R&D units or business sector form education system.

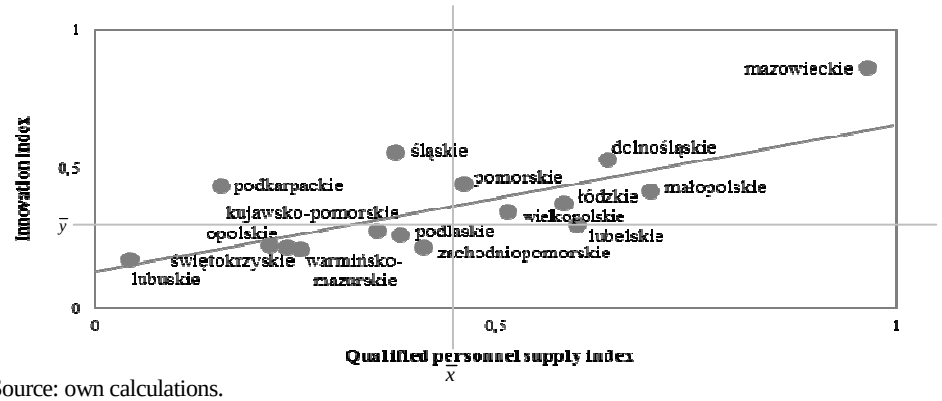
Figure 7. Innovative potential of education profile and innovation level in 2010



Source: own research.

On the other side, a scatter plot of innovation and qualified personnel supply indexes (figure 8) implies a positive association between those two characteristics – small values of one index tend to associate with small values of the other one and, similarly, large values of both indexes also tend to associate. Moreover, a positive value of correlation coefficient (r=0,75) confirms relatively strong relationship between those two characteristics.

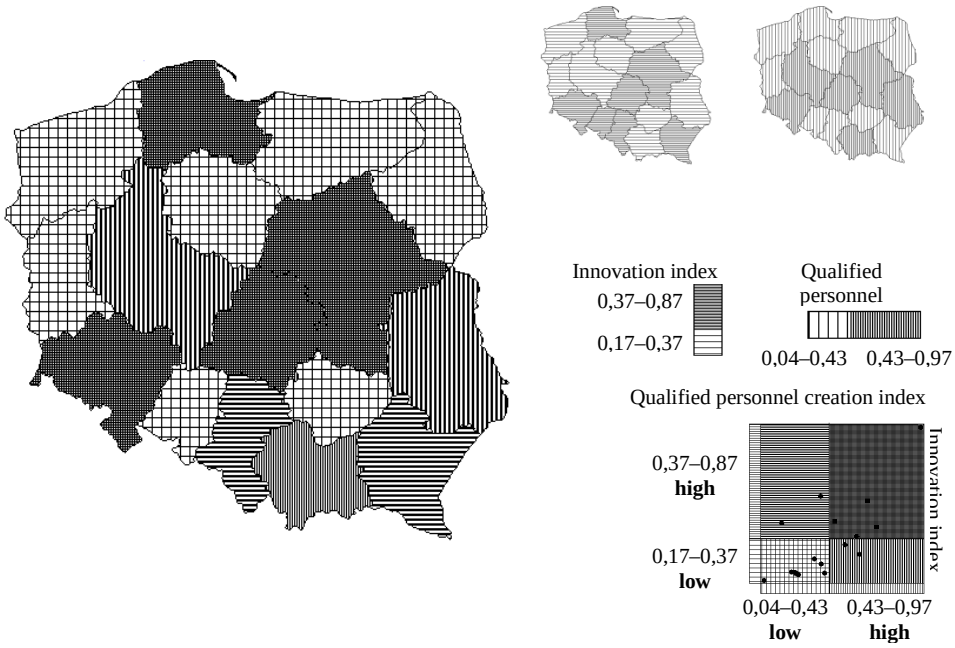
Figure 8. Spatial analysis of interdependence between innovation and qualified personnel supply in 2010



Source: own calculations.

Results of scatter plot analysis are presented on a bivariate map (figure 9), where two variables (indexes) are displayed on a single map by combining two different color scales (or different patterns) (Leonowicz).

Figure 9. Innovation and qualified personnel supply level in voivodships in 2010



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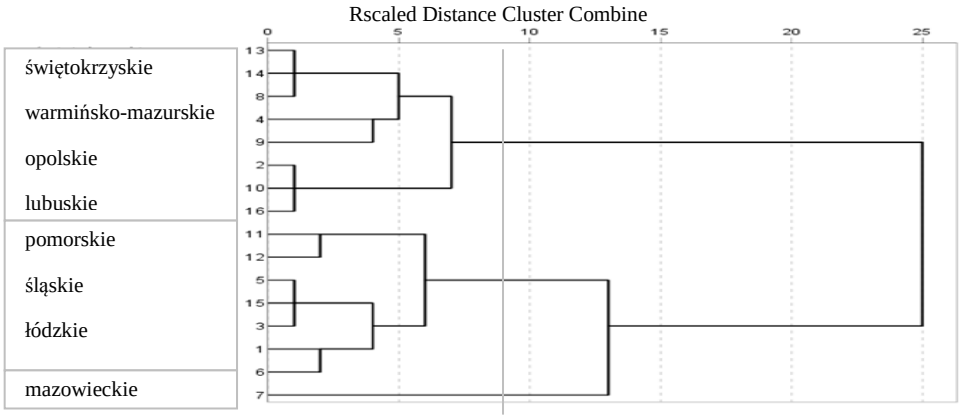
Source: own research.

Values of innovation index are marked with horizontal lines and qualified personnel creation index with vertical lines. Regions marked with patterns assigned to the first and third quarter of the chart are characterized by low or high level of both characteristics, and those marked with patterns from second and fourth quarter indicates the coexistence of low values of one index and high values of the other one. As can be seen in figure 9, a positive relationship between analyzed phenomena confirms.

In the last step cluster analysis have been conducted, where Ward's method and the Euclidean distance have been used. A large gap between joining at the distance from approximately 7 to 13 indicated a three-cluster solution (figure 10). What is more, this classification is generally consistent with the results of scatter plot analysis.

Figure 10. Cluster analysis - dendogram using Ward's Method



Source: own calculations using *IBM SPSS Statistics 19*.

6. Conclusion

As a conclusion to this research it should be noted, that education profiles vary accross regions of Poland and are not constant, but changes over time. Secondly, results of research confirms, that both qualified personnel supply and innovation level tend to increase in most of voivodships. Analysis of the relationship between these two characteristics provides two main conclusions: there is no correspondence between innovative potential of education profile and level of innovation, which leads to assume that the regional higher education system does not boost a regional innovation resources and the knowledge diffusion is low or limited, but on the other side there is a relatively strong positive relationship between the level of innovation and qualified personnel supply.

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Streszczenie

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Celem niniejszego opracowania jest analiza podaży wykwalifikowanej kadry w kontekście perspektyw przyszłego rozwoju innowacyjnego województw w Polsce. Analiza powyższych zjawisk oraz związku między nimi przeprowadzona zostanie m.in. na podstawie badania profilu edukacyjnego województw oraz analizy potencjalnych kierunków i możliwości kreowania zasobów pracy wysoko wykwalifikowanej, pochodzących ze szkolnictwa wyższego, a także badania profilu innowacyjnego oraz poziomu innowacyjności poszczególnych województw. Jednym z elementów analizy będzie również badanie możliwości i poziomu dyfuzji wiedzy ze środowisk naukowych do gospodarki.