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Social efficiency of employment in three sectors — a comparison of Polish regions

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Abstract

Research background: Regions that are able to use their resources in the most efficient way could be perceived as valuable benchmarks when shaping socio-economic policy. The concept of efficiency, however, may be related not only to pure economic categories but to social goals as well. The economic and social spheres overlap and often have some common origins, among which, the sectoral structure of employment seems to be an important one.

Purpose of the article: The aim of the study was to compare the social efficiency of employment in three sectors in Polish voivodeships. Not only were we evaluating the relative performance of each region, but we were also paying attention to the efficiency of engagement of human resources in the agricultural, industrial and service sectors.

Methods: We adopted the DEA method to assess the social efficiency of Polish regions. We have evaluated social cohesion concerning its two output dimensions: positive, which may be described by social activity, and negative, which may be reflected in the form of social exclusion stemming from material sources. We took into account the level of employment in agricultural, industrial and service sectors as inputs in the model and thus focused our attention on the three sectoral structure of the regional economies. Our model assumed non-radial developmental paths and was input oriented (NR-CCR). The data described the 16 Polish voivodeships in the year 2015, and were extracted from the Central Statistical Office of Poland's databases.

Findings & Value added: The research conducted indicates that Polish regions which were the most efficient in terms of social integration were simultaneously those with the best economic results in terms of GDP per capita. The highest social efficiency level was charac-

teristic for employment in the service sector, while agriculture was placed at the lowest level. The same pattern was revealed when social activity and the danger of poverty were considered separately. Thus, structural development appears to be favourable for regional economies also in terms of social cohesion, which is a factor often neglected in the literature.

Introduction

A category of efficiency may be understood as the relationship between outputs and inputs (e.g. Kaasa, 2016, p. 12), and it is often analyzed in terms of material goals. An economic attitude to the concept of efficiency usually creates a starting point for calculations of productivity with a monetary value. When analysing country or regional economies, the researchers use gross value added or gross domestic product to reveal outputs from resources' engagement. They calculate total factor productivity (TFP) or labour productivity and their changes in time to form conclusions about the prospects for convergence. This kind of view is represented by many researchers who are focused on the problems of regional development. Among them, one can also find authors who deal with issues of structural changes in employment connected with modernisation processes (e.g. O'Leary & Webber, 2015; Maudos *et al.*, 2000; Sassi, 2011). In fact, research studies of this type have their common theoretical origins in earlier three-sectoral concepts created by Fisher (1935), Clark (1940) and Fourastié (1949).

However, progress and development cannot be reduced to a material dimension alone and thus the efficiency concept should also be adopted to measure some social results. Modernization may raise prosperity levels but also increase inequality. The impact of modernization could, therefore, be positive — bringing opportunities and wealth at least to some people — or negative — as an adjustment to any new social order induces stress. Either type of influence alters the degree of individual life satisfaction (Abbott *et al.*, 2016, p. 654, 668) as well as conditions favouring social cohesion. Nevertheless, social results of structural modernization in terms of distributive and relational cohesion are usually neglected. Hence, this papers examines some of the social effects of the distribution of labour between three sectors: agriculture, industry and services. An aim of the study is to compare the social efficiency of employment in the three sectors in Polish voivodeships. It evaluates the relative performance of each region, but also assesses the social results of the engagement of human resources in each sector and thus evaluates modernization by adopting cohesive criteria.

An aim of achieving social cohesion is specified as a key policy goal in the European Union. The attitude to the issue of social cohesion at the European level is directed by the definition of the Council of Europe which states that social cohesion is the capacity of a society to ensure the welfare of all of its members, minimizing disparities and avoiding polarization (*New Strategy...*, 2010, p. 2). Social cohesion is perceived as the glue that keeps the members of a social system together (a family, an organization, a neighbourhood, or society as a whole) (Dekker & Bolt, 2005, p. 2448). Most authors claim that enhancing cohesion includes reducing economic and social disparities and strengthening existing connections and relationships (Hulse & Stone, 2007, p. 112), or in other words: enhancing equity and harmonizing the relationships between different social groups (Andrews, 2014, p. 705). In this way, both the distributive (economic) and relational (structural) dimensions of social cohesion are specified (e.g. Loktiewa, 2016, pp. 148–150). A broader social quality model includes four theoretically derived fields: socio-economic security, social cohesion, social inclusion and social empowerment. However, these fields also take into account the structural features of the social environment (policies, economic conditions, social structure and social cohesion) and the agency of people within the system (empowerment, inclusion) (Abbott *et al.*, 2016, p. 659). These classifications of social effects may be adopted to evaluate the results of modernization, allowing for the clarification of outputs when assessing social efficiency.

This research uses two aspects of the social results of employment: distribution of incomes (relative poverty) and engagement in social activities (participation in social organizations). These dimensions are also present in the social quality model as in the research about social cohesion. The first reveals a movement towards equity, broad inclusion and security in terms of economic conditions, while the second represents an active attitude of people who share common goals and feel empowered to pursue activities favourable to the whole community. Both aspects may be supported by employment, as it allows people to avoid monetary marginalisation as well as creating a sense of personal capability and relational inclusion resulting in social solidarity. We attempt to establish to what extent the engagement of the working population with the three sectors allows them to fulfil these goals in the Polish regions.

The research focuses on the performance of 16 Polish voivodeships, which may be treated as relatively homogenous units. However, we attempt to identify the regions that gain the best social results and can therefore create a benchmark for the others. Based on the experience of the leaders it

is possible to suggest an optimal structural solution and shape an industrial policy.

The analysis is conducted for the year 2015 and an evaluation of the extent of modernization is conducted in a comparative way. It assumes a typical pattern of the sectoral shift as described in the three sectoral theory (from agriculture to industry and then to services). The relative results of each sector allow for conclusions to be drawn concerning social benefits induced by the process of modernization .

The paper is organised as follows; in the next section, the research methodology is described in a more detailed way, the third section presents the results of the research and a discussion and the final section presents the conclusions reached.

Research methodology

The paper uses the DEA (Data Envelopment Analysis) method as proposed by Charnes, Cooper and Rhodes (1978) to compare the social efficiency of sectoral employment in the Polish regions. As the aim is to compare social results for each sector we adopt a non-radial model NR-CCR, which allows for different multipliers (θ) for each input.

The data in our model includes three inputs (x_{nj}) and two outputs (y_{rj}). Inputs are specified as employment per 100 population in sector n (agriculture, industry and services) in the 16 Polish voivodeships (j) in the year 2015. Output in r dimension of cohesion is specified as: in the distributive dimension — 100% minus the percentage of the population (%) in danger of living in relative poverty in the voivodeships and in the relational dimension — the number of foundations and social organizations registered in REGON per 1000 inhabitants in the voivodeships.

The model assumes:

$$\frac{1}{3} \sum_{n=1}^3 \theta_{no} \rightarrow \min$$

$$\sum_{j=1}^{16} \lambda_{oj} y_{rj} \geq y_{ro}$$

$$\sum_{j=1}^{16} \lambda_{oj} x_{nj} \leq \theta_{no} x_{no}$$

$$\theta_{no} \leq 1$$

$$\lambda_{oj}, \theta_{no} \geq 0.$$

The λ and θ parameters were calculated with the use of the EMS application. θ is a general indicator of the efficiency of employment. The value of 100% is adopted by fully efficient areas (voivodeships). The closer to 0% is the value the lower share of the empirically observed employment results in the observed level of social outputs.

λ is a weight of an object's technology in terms of common technology and may be used to calculate an optimal structure of inputs based on benchmark performance.

Indicator S is also used to determine the intensity of the scale of effects:

$$S = \frac{L-1}{L+1}, \text{ where } L = \sum_{j=1}^{16} \lambda_{oj} \text{ and } S \in < -1; 1 >.$$

If $S < 0$, an object experiences the inefficiency of a small scale. If $S > 0$, an object experiences the inefficiency of a big scale.

Moreover, as the main issue under consideration was specified as the intersectoral differences in efficiency, there were calculated indicators of substitution for each pair of inputs and a general indicator of substitution of inputs z . The z indicator is defined as the geometric mean of the indicators of substitution for each pair of inputs (considering the values not less than 1).

The statistical data were derived from the Central Statistical Office of Poland's databases available on-line: the Local Data Bank (GUS, 02.12.2016, 27.03.2017) and STRATEG (GUS, 03.12.2016). The employment data are based on the Labour Force Survey. To minimize the distortion caused by the different sizes of the regions the number of employees was related to the size of the population. Thus, the input indicators reflect, in addition to the importance of each sector, also the demographic conditions of each region and the situation in the labour market (influencing unemployment and economic inactivity).

Moreover, as in the model outputs should take the form of desirable results (their growth must reflect a favourable change) we used a modification of the original rate of poverty in the form of its complement to 100%.

We thus assumed that in a cohesive society there are not many people gaining incomes at a level lower than 60% of the median and suffering from economic exclusion. We also used the relative number of not-for-profit organizations as a proxy of participation in social activities, which reflects solidarity with others and an individual sense of empowerment. Hence, in a cohesive society more social organizations are expected to function.

Realizing the aim of the study, we calculated the relative efficiency scores of each voivodeship, adopting the model in which the outputs were specified by two variables and called it compound social cohesion. We identified benchmark regions and compared the average efficiency score of each sector to evaluate the degree of modernization. We used the indicators of substitution to indicate its direction enhancing cohesiveness. We also calculated the efficiency scores considering two models in which we adopted only one output: the first model covered the relational dimension and the second model reflected the distributive dimension of social cohesion. Comparison of the results allowed for the formation of a conclusion about the prevailing mechanism of the creation of social cohesion through employment in each sector.

Results and discussion

Table 1 presents the results of a comparison of the social efficiency of sectoral employment in the Polish voivodeships. The calculation uses the main model assuming two outputs and thus allows for the assessment of compound social results. The results of the adoption of the supplemental models (evaluating the distributive and relational dimensions of social cohesion separately) are shown in Table 2.

The social efficiency of the Polish regions reaches an average of 79% of the optimal level for the group. However, considering separately both of its dimensions, social participation reveals better results (78%) than economic inclusion connected with poverty (72%). This comparison shows that employment is more efficient in the context of a social activity than it is in terms of income. In other words, it suggests that employment supports an engagement in voluntary activities connected with participation in social networks to a greater extent than it enhances economic conditions helping to avoid poverty. Thus, the more important barrier for social cohesion in the Polish regions may be found in economic circumstances and is therefore a problem of the working poor.

The compound evaluation of the cohesive efficiency of employment indicates 5 regions that achieve optimal results. The group is constituted by

the richest voivodeships, namely: mazowieckie, śląskie, wielkopolskie, zachodniopomorskie and dolnośląskie. Thus, a recipe to strengthen social cohesion appears to have much in common with measures to leverage a higher level of production per capita. This supports the view about the mutual strengthening interrelations between these phenomena, however, it does not prejudge their succession. Are people more active in affluent regions because they have already met their basic needs, or do more active societies become wealthier? Does poverty reduce productivity due to poor investment in human capital, limited availability to financial markets, a lack of motivation and a passive attitude to life, or do rich societies use the instruments of the welfare state to effectively reduce the danger of the type of social exclusion that tends to have an economic background? These questions have been left unanswered, however, as both directions of influence seem to be equally possible. Nevertheless, we may generally conclude that in Poland the rich regions are simultaneously the most socially cohesive ones. Thus, any activity supporting one of these phenomena should also be favourable for the other.

Moreover, one of the poorest regions — świętokrzyskie, appears to be the least efficient one in terms of social cohesion. In świętokrzyskie only 56% of the currently employed population is efficiently engaged. This fact additionally supports the pattern of mutually enhancing relations between GDP per capita and social results. The rank correlation between GDP p.c. in the year 2015 (GUS, 27.03.2017) and the compound social cohesion results is 0.68 and confirms this conclusion.

The 5 efficient regions also gain the best results in the dimension of social participation alone, however, concerning the poverty dimension only śląskie and zachodniopomorskie are fully efficient. Once again, this emphasizes the difficulties connected with the economic conditions of cohesion. In fact, a rank correlation of GDP p.c. and the results in the distributive dimension is only 0.4, while for the relational dimension it reaches 0.64.

Although 5 regions are fully efficient in terms of the compound social cohesion, only zachodniopomorskie is a real benchmark for other voivodeships. It is also a benchmark when considering the dimension of social participation separately and the main benchmark (for all 14 inefficient regions) in terms of the poverty dimension. Thus, features of employment in zachodniopomorskie should be tracked in order to find the best way to enhance social cohesion. The region is a deindustrialized one, with a share of employment in the service sector reaching 62%, industry has a 30% share while only 8% work in agriculture. Other than mazowieckie, it is the voivodeship with the highest proportion of the labour force in services. How-

ever, the sectoral structure of employment in mazowieckie is less developed as agriculture engages a relatively high share of total employment, reflecting the polarized labour situation within the region.

Comparing the cohesive efficiency of employment in different sectors, it is possible to conclude that modernization has socially favourable results. As a modern shift in employment is demonstrated by the labour movement from agriculture and industry into the service sector, this may enhance social cohesion because the service sector achieves the highest level of efficiency followed by industry and then agriculture. This pattern is observed concerning both dimensions of social cohesion taken separately as well as in compound terms. However, efficiency of employment is higher when two-dimensional cohesion is assessed, rather than when the empowerment field or the distributive one are considered separately. Moreover, the latter dimension is characterized by poorer results induced by employment in all three sectors, which is not the case with the former. Thus, it may be stated that no matter where people are employed, it has an influence on their general social activity more than it allows them to reduce the risk of poverty. Nevertheless, this factor enhances a sense of general social inclusion.

Employment in the service sector allows the population to achieve an average level of social efficiency of 90% and the results are not significantly differentiated between the voivodeships. The best performance is observed in the 5 affluent regions that are fully efficient (mazowieckie, śląskie, wielkopolskie, zachodniopomorskie, dolnośląskie). On the other hand, łódzkie is the least efficient voivodeship and 30% of its service employment is wasted where social yields are concerned.

The higher efficiency of service employment may be attributed to the empowerment dimension rather than to the distributive one, however, as the differences in the latter area are not as pronounced. Moreover, while there are 5 efficient regions concerning empowerment, their number is reduced to 2 (śląskie and zachodniopomorskie) when considering poverty. Particularly in mazowieckie, service employment fails to significantly reduce the danger of poverty, as the efficiency score is the lowest of all regions and in fact reaches only 60%. In the empowerment dimension łódzkie is characterized by the lowest efficiency level of 65%.

The best results in the service sector may be explained by their classical features specified by a strong need to participate in interpersonal relationships while serving and the predominant role of interactions within the service process. This may induce the general prosocial activity of the employees who in turn more willingly participate in activities undertaken by non-profit organizations. Moreover, the results also suggest that service employment promotes the limitation of poverty the most. This may be con-

nected with the inclusive character of the heterogenic service sector that creates workplaces which are also inclusive for manual workers who are less well educated and professionally qualified as well as for women or the young and the old who are more commonly discriminated against. Employment may also give them an opportunity to earn more and thus to avoid poverty and material exclusion. Unemployment or economic passivity is the alternative- these problems push them into exclusion.

An engagement in the other sectors also produces positive social gains, however, they are generally less pronounced. Industrial employment allows workers to achieve an average level of compound social efficiency of only 83%. There are 5 efficient regions (as previously stated), and the worst example (łódzkie) achieves the efficiency level of only 64%. The same average level of efficiency is to be found in the empowerment field separately, again with łódzkie as the worst performer, and the same group of leaders. Considering the distributive dimension, the average efficiency is just slightly lower (82%), śląskie, lubuskie, zachodniopomorskie, dolnośląskie and pomorskie can be specified within the group of efficient regions and świętokrzyskie is at the lower end of the efficiency rank, followed by łódzkie. Mazowieckie and especially wielkopolskie lose their leading position revealing important inefficiencies connected with poverty.

The poorest efficiency scores may be attributed to agriculture. An average of 36% employment in this area does not bring about any social gains when assessing the compound cohesion. The least efficient region is świętokrzyskie and it is followed by lubelskie and podlaskie. In these voivodeships about 77-79% of agricultural employment does not enhance social cohesion. This is connected with over-employment in the agricultural sector, hiding the real level of unemployment and thus inducing low incomes that do not protect workers from poverty. Generally, the agricultural character of the regions is associated with their comparably low level of socio-economic development.

Moreover, the distributive efficiency of the agriculture is especially low and achieves results of only 48%. Świętokrzyskie, lubelskie and podlaskie are once again the worst performers. Śląskie and zachodniopomorskie are the only fully efficient voivodeships, and in these regions the share of agricultural employment is the lowest. In the empowerment dimension, the efficiency of agricultural employment reaches 64%. The worst inefficiencies are found in the same poor voivodeships. Thus, the social inefficiency of agriculture overlaps in both dimensions, especially in the less developed regions.

Another important observation may be derived from comparisons of intraregional sectoral efficiency scores. It is possible to conclude that as ag-

gregate inefficiency grows, the differences in efficiency scores between sectors also grows. Lubuskie, as the only slightly inefficient region is characterized by sectoral variation of 13%. On the other hand, świętokrzyskie, lubelskie and podlaskie experience pronounced intersectoral differences (45-46%). This suggests that the regions with the worst social problems should improve the sectoral structure of employment by focusing their attention on the least efficient sector. To be more precise, the observation for these regions proves that in order to improve social efficiency it is necessary to reduce employment in agriculture. As a general rule, however, some exceptions may be found as well. In pomorskie and lubuskie, where a high aggregated efficiency is achieved along with a low variation between sectoral scores, agriculture gains the best results and the strongest problems are concentrated in industry. In fact, the results in either one of the voivodeships are influenced by the low share of agriculture in employment and also the notable share of industry.

The research also proves that not only the sectoral distribution of employment plays a role in enhancing social efficiency. A level of employment per capita, resulting from the rate of economic activity and demographic features, is also crucial. The S indicator, which shows an intensity of scale efficiency, assumes negative values for most of the regions (warmińsko-mazurskie is the only exception). This reveals that the low level of employment decreases social efficiency. The numerous group of the unemployed or the economically passive negatively influences social cohesion in terms of both empowerment and participation as well as the material exclusion connected with relative poverty. The most pronounced small scale inefficiencies may be found in podlaskie and świętokrzyskie, these voivodeships have to deal with essential social problems. The prevailing negative values of the S indicator are also found in both the social dimensions taken separately. As the distinctive pattern was observed in warmińsko-mazurskie, it is worth mentioning that in the region the general problem of unemployment and economic inactivity influences social efficiency. Firstly, it strongly increases the level of relative poverty. Secondly, it creates patterns of social behaviour focused on not-for-profit activity, which helps to create and enhance some professional experience and participation in professional networks that may be perceived as the capital of individuals to be used in the labour market. This may be a positive trend in terms of building the potential of socio-economic development of the region. However, the positive value of the S indicator may result from overemployment in agriculture and this interpretation stresses the need for structural changes in warmińsko-mazurskie.

As the social efficiency of employment in the three sectors appears to differ, it is appropriate to specify some desirable directions of structural changes that would be favourable in terms of social gains. Table 3 presents indicators of the substitution of employment in the three sectors in pairs as well as an aggregate indicator of the substitution of inputs (z).

The general pattern of structural change in the Polish regions that could enhance social cohesion may be described by the conclusions of the three sectoral theories for developed countries. The shift from agriculture into the service sector is mainly needed, followed by the movement from agriculture into industry. The decrease in industrial employment in favour of the service sector is also necessary, however, this substitution does not have to cover such numerous group of employees. Generally, about 25% of employment should be substituted to improve social results.

The most important structural changes are required in podlaskie, podkarpackie, lubelskie and świętokrzyskie voivodeships, which are also the poorest ones. The shifts are evaluated at a level of nearly 150% of current employment. In all of these 4 regions the labour force should move from agriculture into both industry and services. However, while in podkarpackie and świętokrzyskie there is a need to limit employment in industry in favour of services, lubelskie and podlaskie require industrialization even to the detriment of services. Nevertheless, the deagrarian trend seems to be the most important revealing the early level of structural development of these poor regions.

Conclusions

The research conducted allows one to conclude that the results of the modernization of the three sectoral structures of employment in the Polish regions are favourable to social cohesion. The best social results are gained when employing people in the service sector, while employment in agriculture appears to be the least efficient. This assertion is confirmed in both the distributive and relational dimensions of cohesion as well as in compound terms.

Moreover, it is possible to conclude that the most affluent regions are simultaneously the most cohesive ones. Thus, the same measures might be used to strengthen social cohesion and to increase the level of GDP per capita. Deindustrialization and deagrarianization seem to constitute trends favourable to regional development. Nevertheless, the comparisons suggest that a high share of service employment is not enough to balance social losses connected with agrarian over-employment. Hence, the developmen-

tal path in Polish regions should follow a pattern described in the three sectoral theories with a phase of industrialization.

Another interesting point revealed by the research is that in the Polish regions, distributive problems are more important than problems associated with social participation. It is worth noting that an essential barrier to social cohesion is highlighted by the poor results of employment in limiting relative poverty. This pattern may be connected with the problem of over-employment in agriculture.

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Annex

Table 1. Efficiency scores of sectoral employment in terms of compound social cohesion in the Polish regions in 2015

voivodeship	benchmarks	θ_{agr}	θ_{ind}	θ_{ser}	θ	CV	S
1 łódzkie	11 (0.98)	40%	64%	70%	58%	23%	-0.01
2 mazowieckie	0	100%	100%	100%	100%	0%	
3 małopolskie	11 (0.96)	54%	81%	90%	75%	20%	-0.02
4 śląskie	0	100%	100%	100%	100%	0%	
5 lubelskie	11 (0.97)	23%	87%	75%	61%	45%	-0.02
6 podkarpackie	11 (0.94)	39%	81%	95%	72%	33%	-0.03
7 podlaskie	11 (0.91)	23%	89%	88%	67%	46%	-0.05
8 świętokrzyskie	11 (0.90)	21%	67%	79%	56%	45%	-0.05
9 lubuskie	11 (0.99)	96%	69%	85%	83%	13%	-0.01
10 wielkopolskie	0	100%	100%	100%	100%	0%	
11 zachodniopomorskie	11	100%	100%	100%	100%	0%	
12 dolnośląskie	0	100%	100%	100%	100%	0%	
13 opolskie	11 (0.97)	59%	68%	92%	73%	19%	-0.02
14 kujawsko-pomorskie	11 (0.94)	41%	74%	86%	67%	28%	-0.03
15 pomorskie	11 (0.97)	83%	67%	75%	75%	8%	-0.02
16 warmińsko-mazurskie	11 (1.04)	50%	89%	98%	79%	27%	0.02
	mean	64%	83%	90%	79%		
	CV	48%	16%	11%	20%		
	min	21%	64%	70%	56%		
	max for inefficient DMUs	96%	89%	98%	83%		

Note:

θ - a relative efficiency score (subscripts: agr, ind, ser stand for: agriculture, industry, services; an indicator without any subscript reveals a general efficiency score calculated as the mean efficiency of the three sectors); CV – a coefficient of variation; S – an intensity of scale efficiency indicator (positive values – inefficiencies of a big scale; negative values – inefficiencies of a small scale)

Source: own calculations based on statistics from the Central Statistical Office of Poland available in STRATEG (GUS, 03.12.2016) and Local Data Bank (GUS, 02.12.2016) databases.

Table 2. Efficiency scores of sectoral employment in terms of the relational and distributive dimensions of social cohesion in the Polish regions in 2015

	The relational dimension										The distributive dimension									
	voivodeship	benchmarks	θagr	θind	θser	θ	VC	S	benchmarks	θagr	θind	θser	θ	VC	S					
1 łódzkie	11 (0.91)	0	37%	59%	65%	53%	23%	-0.05	11 (0.98)	40%	64%	70%	58%	23%	-0.01					
2 mazowieckie	11 (0.96)	0	100%	100%	100%	100%	0%	0	11 (1.00)	41%	87%	60%	63%	30%	0.00					
3 małopolskie	11 (0.97)	0	54%	81%	90%	75%	20%	-0.02	11 (0.91)	52%	77%	86%	72%	20%	-0.05					
4 śląskie	11 (0.94)	0	100%	100%	100%	100%	0%	3	100%	100%	100%	100%	100%	0%	0					
5 lubelskie	11 (0.91)	0	23%	87%	75%	61%	45%	-0.02	11 (0.90)	21%	81%	69%	57%	45%	-0.05					
6 podkarpackie	11 (0.90)	0	39%	81%	95%	72%	33%	-0.03	11 (0.88)	37%	75%	89%	67%	33%	-0.06					
7 podlaskie	11 (0.90)	0	23%	89%	88%	67%	46%	-0.05	11 (0.91)	23%	89%	88%	66%	46%	-0.05					
8 świętokrzyskie	11 (0.99)	0	21%	67%	79%	56%	45%	-0.05	11 (0.85)	20%	63%	75%	52%	45%	-0.08					
9 lubuskie	11 (0.92)	0	96%	69%	85%	83%	13%	-0.01	4 (0.84)	45%	100%	89%	78%	30%	-0.02					
10 wielkopolskie	11 (0.85)	0	100%	100%	100%	100%	0%	11 (0.89)	14	100%	100%	100%	100%	28%	-0.06					
11 zachodniopomorskie	11 (0.97)	0	100%	100%	100%	100%	0%	4 (0.73)	11 (0.26)	73%	100%	91%	88%	13%	-0.01					
12 dolnośląskie	11 (0.85)	0	56%	64%	88%	70%	19%	-0.04	11 (0.97)	59%	68%	92%	73%	19%	-0.02					
13 opolskie	11 (0.97)	0	37%	67%	77%	60%	28%	-0.08	11 (0.94)	41%	74%	86%	67%	28%	-0.03					
14 kujawsko-pomorskie	11 (1.04)	0	83%	67%	75%	75%	8%	-0.02	4 (0.90)	34%	100%	78%	71%	38%	-0.04					
15 pomorskie	11 (1.04)	0	50%	89%	98%	79%	27%	0.02	11 (0.84)	40%	72%	79%	64%	27%	-0.09					
16 warmińsko-mazurskie	11 (1.04)	0	64%	83%	88%	78%	27%	0.02	11 (0.84)	40%	72%	79%	64%	27%	-0.09					
mean			64%	83%	88%	78%	27%			48%	82%	84%	72%							
VC			49%	18%	13%	21%	21%			49%	17%	13%	19%							
min			21%	59%	65%	53%	53%			20%	63%	60%	52%							
max for inefficient DMUs			96%	89%	98%	83%	83%			73%	89%	92%	88%							

Source: own calculations based on statistics from the Central Statistical Office of Poland available in STRATEG (GUS, 03.12.2016) and Local Data Bank (GUS, 02.12.2016) databases.

Table 3. Indicators of the substitution of inputs enhancing the social efficiency of employment in the Polish regions in 2015

voivodeship	agr(ind)	agr(ser)	ind(ser)	ind(agr)	ser(agr)	ser(ind)	z
1 łódzkie	0.62	0.56	0.91	1.61	1.77	1.10	1.46
2 mazowieckie	1	1	1	1	1	1	
3 małopolskie	0.67	0.60	0.89	1.49	1.66	1.12	1.40
4 śląskie	1	1	1	1	1	1	
5 lubelskie	0.26	0.30	1.16	3.81	3.29	0.86	2.44
6 podkarpackie	0.49	0.41	0.84	2.04	2.42	1.18	2.46
7 podlaskie	0.26	0.26	1.01	3.86	3.81	0.99	2.46
8 świętokrzyskie	0.31	0.26	0.84	3.20	3.79	1.18	2.43
9 lubuskie	1.38	1.13	0.81	0.72	0.89	1.23	1.24
10 wielkopolskie	1	1	1	1	1	1	
11 zachodniopomorskie	1	1	1	1	1	1	
12 dolnośląskie	1	1	1	1	1	1	
13 opolskie	0.88	0.64	0.73	1.14	1.56	1.37	1.35
14 kujawsko-pomorskie	0.55	0.48	0.87	1.82	2.09	1.15	1.64
15 pomorskie	1.23	1.11	0.90	0.81	0.90	1.10	1.15
16 warmińsko-mazurskie	0.56	0.51	0.91	1.79	1.97	1.10	1.57
Poland*	0.77	0.72	0.93	1.30	1.39	1.07	1.25

Note:

*indicators of substitution of inputs calculated based on the average efficiency scores for the 16 regions

Source: own calculations based on statistics from the Central Statistical Office of Poland available in STRATEG (GUS, [http, 03.12.2016](http://03.12.2016)) and Local Data Bank (GUS, 02.12.2016) databases.