

Econometric and Cluster Analysis of Potential and Regional Features of The Labour Market of Poland

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Introduction

One of the actual problems of economic integration for the EU-member countries candidates is the problem of the analysis and coordination of the local labour markets. As was marked in the documents of the European Union (March, 2003) for the countries which are going to become new members of the EU, it is necessary to decide the number of basic tasks [Ciechański, 2003]. Poland, actively preparing for joining the EU, has developed the JAP program, in which the directions of employment strategy were precisely formulated within the framework of the European employment strategy.

However, as the analysis of the labour market condition of Poland has shown many problems of the labour market after joining the EU still require urgent solution. So, for the period of 2003–2004 the rate of unemployment increased, the economic activity of the population decreased a little, there are disproportions in the labour market caused by the regional, social and demographic reasons. In this connection it is necessary to carry out the analysis of the common tendencies and to reveal the influence of the mentioned factors on the regional labour markets in Poland. The estimation of the regional labour markets condition by a number of social and economic indexes allows to distinguish the homogeneous groups—clusters. The study of clusters of the labour markets in view of their territorial arrangement and administrative mechanism of the country is necessary for the formation of effective regional policy for the solution of employment problems based on the specificity of the regions of each cluster. In the given work the following tasks were set: to investigate with the help of econometric methods the tendency of employment and factors influencing efficiency of labour potential use in regions of Poland; to construct and to carry out the cluster analysis of the regional labour markets.

1. Character of the tendencies of the labour market in Poland for the period of 2003–2004. The current regional disproportions

As it is mentioned in a number of works [Korenik, 2003; *Nierówności...*, 2003–2004; *Poland...*, 2004] the labour market is a complex social and economic system. The functioning of its indexes is influenced not only by social and economic forces, but also by political, natural, geographical and historical factors. All these factors influence the branch specificity of regions, structure of population employment and the character of labour reproduction and qualification potential. Owing to these reasons the disproportions in the development of regions are observed and they should be taken into account when developing the employment policy.

Briefly we shall consider the common tendencies of the Polish labour market and a few of regional features on the example of some administrative districts—voivodships [Korenik, 2003]. As follows from the data [Korenik, 2003; www.stat.gov.pl], the highest indexes of unemployment rate are marked for Warmia-Mazuria district, the lowest—for Mazovia district. In cities the unemployment indexes are much lower, than in the rural regions. The analysis of the unemployment structure shows, that the highest unemployment rate is observed among the groups of the young able-bodied population of 15–19 and 20–24 years old [*Poland...*, 2004; www.stat.gov.pl]. The study of unemployment indexes among the men and women has shown that the highest unemployment rate exists among women. Besides the unemployment rate essentially differs in groups of population with a different educational level; the highest rate is in the group with primary and secondary education, the lowest is in the group with higher education.

We investigate above mentioned tendencies describing the labour market conditions, and the influence of various factors determining regional specificity of employment by means of econometric methods.

2. Research of the factors influencing the condition and tendencies of the labour market by means of the econometric analysis

Let's carry out the analysis of the tendencies of unemployment rate in Poland for the period of 1990–2002 [Korenik, 2003]. On the whole the tendency of significant growth of the registered unemployment rate is marked; however the change of unemployment rate demonstrates cyclic character (figure 1).

For the trend analysis, describing the growth of unemployment rate in Poland, the non-linear exponential function was chosen, such as:

$$s_b_t^* = a_0 + a_1 e^{a_2 t}$$

In view of parameters estimations the given model of trend looks as follows:

$$s_b_t^* = 12.26 + 0.0913 \cdot e^{0.3533 \cdot t}, R = 0.696$$

For the analysis of a cyclic component of the unemployment rate we shall calculate values of the residuals:

$$d_s_b_t = s_b_t - s_b_t^*$$

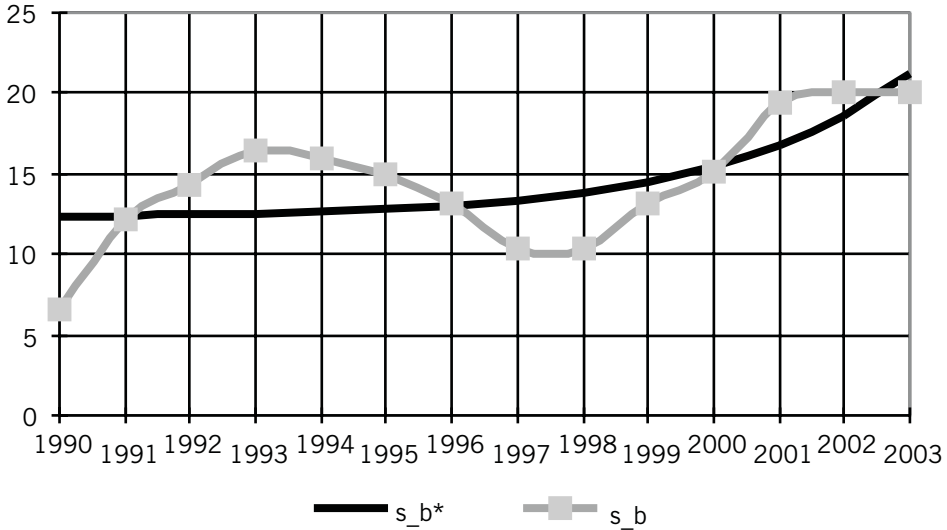


Fig. 1.

Unemployment rate in Poland for the period of 1990–2003

Source: www.stat.gov.pl.

From the diagram of the residuals for the model it can be seen that residuals character is not random. The characteristic waves of the cyclic process which has caused the growth of unemployment rate in comparison with the trend of 1990–1993, 1998–2001 and the recession of unemployment rate in comparison with the trend of 1994–1997, 2002–2003 are observed.

It is obvious that the waves of the cycle were connected with the influence of certain economic and political factors. For the analysis of the cyclic component by the data of the retrospective period we can use polynomial of 5-th degree, which gives a high enough effect of approximation. It is necessary to note that due to purposeful measures of labour market regulation based on the European strategy of employment, the unemployment rate could be stabilized in 2002 and 2003. According to calculations the unemployment rate in 2003 was below expected by 1,6 %.

Using statistical data, describing the indexes of unemployment rate for each month, in all administrative districts—voivodships for the period of 2002–2004, we shall carry out the econometric analysis of the common tendencies. Examples of the dynamics of unemployment rate for Poland and for one of the individual administrative districts (Świętokrzyskie voivodship) are given in figure 2 and figure 3.

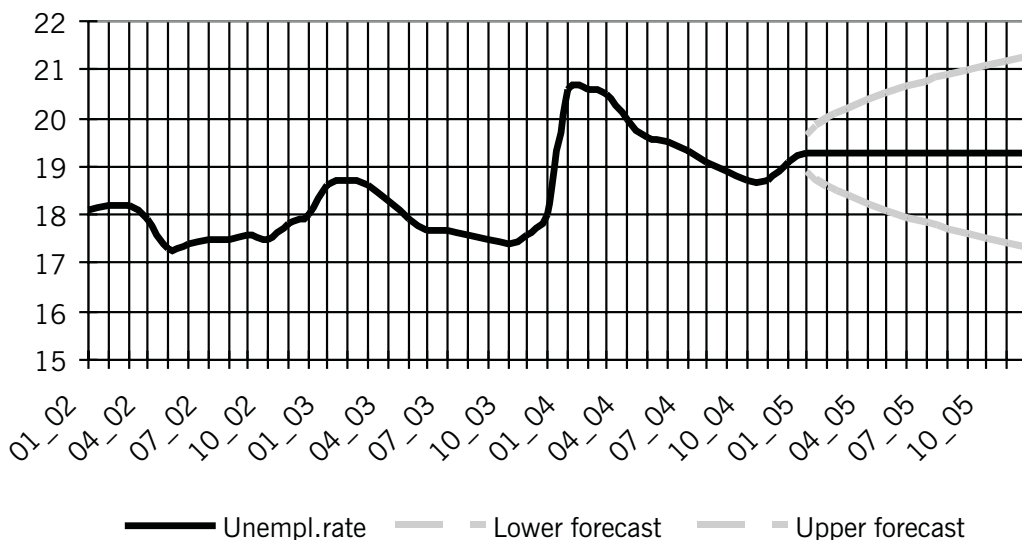


Fig. 2.
Dynamics of unemployment rate for Poland in 2002–2004 by month
 Source: www.stat.gov.pl.

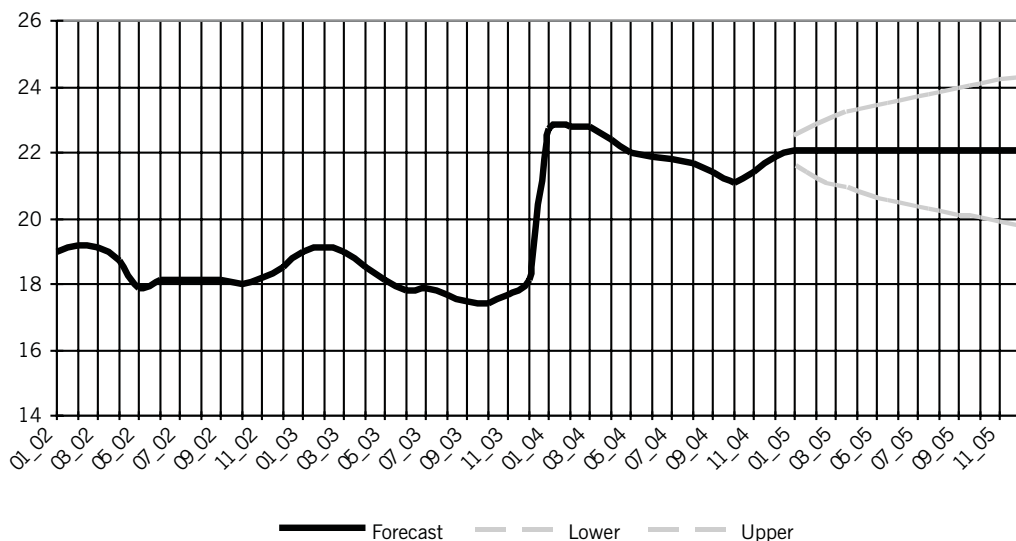


Fig. 3.
Dynamics of unemployment rate for Świętokrzyskie voivodship in 2002–2004 by month
 Source: www.stat.gov.pl.

As we can see from figures 2 and 3 the unemployment rates increased during the period of 2004. We can observe the jump of these indexes especially in the beginning of 2004, i.e. some months before and after joining the EU. This effect can be caused by the influence of external factors and economic expect-

tations. For the research of these effects in all voivodships we use models of moving average with intervention. This model looks as follows:

$$\Delta u_{-} r_t = \varepsilon_t + a_1 \cdot \varepsilon_{t-1} + b \cdot \omega_t$$

$$\text{where } \omega_t = \begin{cases} 0, & t < 24 \\ 1, & t \geq 25 \end{cases}$$

In this model $\Delta u_{-} r_t$ —first differences for unemployment rates in period t , ε_t —irregular component for model, ω_t —variables which indicate the intervention influence, a_1 and b —are parameters of the model. For all voivodships in Poland in time series of unemployment rates a permanent abrupt impact pattern simply implies that overall mean of the times series shifted after intervention. The overall shift is denoted by ω . For majority of voivodships we used the first differences for unemployment rates, except Mazowieckie, Wielkopolskie and Zachodniopomorskie voivodships where we used the second differences of unemployment rates for the model.

The calculations were carried out by using a package of the statistical programs STATISTICA and are given in tab. 1.

Tab. 1.

Results of construction of models of moving average with intervention

Number of voivodship	Voivodship	Estimation of parameter a_1	Estimation of parameter b for intervention	MS Residual
1	Dolnośląskie	-0.59331	1.785739	.06651
2	Kujawsko-Pomorskie	-0.59339	2.165786	.09030
3	Lubelskie	-0.49306	3.774241	.06831
4	Lubuskie	-0.45427	1.962863	.09325
5	Łódzkie	-0.45835	2.634766	.07198
6	Małopolskie	-0.45568	2.57881	.05060
7	Mazowieckie	-0.84596	1.913749	.03269
8	Opolskie	-0.6106	2.41858	.07575
9	Podkarpackie	-0.98244	3.973871	.05941
10	Podlaskie	-0.3843	3.126672	.06872
11	Pomorskie	-0.52782	1.473936	.06006
12	Śląskie	-0.46122	1.575505	.03337
13	Świętokrzyskie	-0.45228	4.463029	.07235
14	Warmińsko-Mazurskie	-0.63768	2.64294	.10197
15	Wielkopolskie	-0.90697	1.737906	.08089
16	Zachodniopomorskie	-0.94086	1.946585	.15877
	Poland	-0.4843	2.474433	.05325

According to the calculations all estimations of parameters in the models are statistically significant, and the residuals of the model are small. The received estimations of parameters at intervention show various reaction of the regional labour markets to changes of external conditions. The given models allow us to make a conclusion, that the intervention connected with a sharp jump of unemployment rate with following stabilization on this high level took place in February 2004. Thus, it is necessary to carry out a detailed analysis of causes and effects of this phenomenon and to find out which factors have affected the sharp growth of unemployment rate in 2004.

In order to investigate the unemployment tendencies in the context of the system approach, it is necessary to study in detail the employment structure in regions (administrative districts, provinces, etc.), to indicate the factors determining the potential of the local labour markets and their distinctive features. It needs additional information and can be continued in more detail researches.

But one of the factors which influences the various values of unemployment rates jump in voivodships is different regional industrial potential. We can investigate the regional features and industrial potential in voivodships analyzing the panel data of gross domestic product (GDP) during the period of 1995–2000. By means of econometric analysis we constructed the econometric models that reflect the influence of lagged values and fixed regional effects on gross domestic product indexes in voivodships in Poland. This model looks as follows:

$$y_{jt} = r_{-}c_j + \beta \cdot y_{j,t-3} + \varepsilon_{jt}$$

where y_{jt} —is gross domestic product share for voivodship number j in period t , $r_{-}c_j$ —is parameter which reflects the fixed regional effect for voivodship number j and means the minimal constant value of gross domestic product share for voivodship, β —is parameter which indicates the influence of lagged values of gross domestic product share, ε_{jt} —is $IID(0, \sigma_\varepsilon^2)$.

The calculations were carried out by using a package of the econometric programs Eviews and are given in tab. 2.

Tab. 2.

Results of constructed model GDP share for voivodship

Dependent Variable: $Y?$
Method: Pooled Least Squares
Sample(adjusted): 1998 2000
Included observations: 3 after adjusting endpoints
Number of cross-sections used: 16
Total panel (balanced) observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y?(-3)	0.478134	0.109540	4.364918	0.0001
Fixed Effects				
_R1-C	4.025656			
_R2-C	2.745578			
_R3-C	1.978814			
_R4-C	1.220603			
_R5-C	3.202235			
_R6-C	3.977745			
_R7-C	11.27755			
_R8-C	1.158309			
_R9-C	2.058503			
_R10-C	1.187269			
_R11-C	3.020991			
_R12-C	6.633819			
_R13-C	1.424976			
_R14-C	1.432264			
_R15-C	5.056171			
_R16-C	2.249854			
R-squared	0.999145	Mean dependent var.		6.275000
Adjusted R-squared	0.998704	S.D. dependent var.		4.600717
S.E. of regression	0.165644	Sum squared resid.		0.850573
Durbin-Watson stat	2.719000			

Further we can investigate the influence of fixed industrial potential in voivodships and their competitiveness level on intervention unemployment rate indexes.

For values of competitiveness level of voivodships we used the data from [Korenik, 2003] and presented them as dummy variables. It should be noted that four groups of competitiveness level were given by the researchers [Korenik, 2003]. Some voivodships which specialized in agriculture such as Opolskie, Lubuskie, Świętokrzyskie and Podlaskie were included in group 1 with lower competitiveness level. Most advanced voivodships which specialized in modern industry, market and financial sphere, such as Dolnośląskie, Małopolskie, Mazowieckie, Śląskie were included in group 4 with highest competitiveness level. Other voivodships were included in group 2 and in group 3.

As the econometric model we used the following dependence:

$$\hat{b}_j = \frac{\alpha_0}{(1 + \alpha_1 \cdot r_{-c_j} + \phi_1 \cdot d_{1j} + \phi_2 \cdot d_{2j} + \phi_3 \cdot d_{3j})}$$

where \hat{b}_j —is adjusted parameter estimation for unemployment rate intervention for voivodship number j , r_{-c_j} —is minimal constant value of gross domestic product share for voivodship, d_{1j} , d_{2j} , d_{3j} —are values for dummy variables which indicate the competitiveness level of voivodship number j , α_0 , α_1 , ϕ_1 , ϕ_2 , ϕ_3 —are parameters of the model. It should be noted that 3 dummy variable from 4 possible dummy variables are not correlated.

According to our econometric researches we obtain the following model:

$$\hat{b}_j = \frac{4438365}{(1 + 0.242973 \cdot r_{-c_j} + 0.19415 \cdot d_{1j} + 0.144777 \cdot d_{2j} + 0.007183 \cdot d_{3j})}, R = 0.51707$$

Thus, it is possible to show, that the higher the regional fixed share GDP of a voivodship the lower was the jump of parameters of unemployment. On the other hand a higher level of competitiveness of a voivodship stimulated the reduction of non-profitable enterprisers and influenced an increasing jump of unemployment. Both factors (regional fixed share GDP of a voivodship and the level of competitiveness) give more complicated effect in description of unemployment jumps in different regions of Poland. The influence of regional fixed shares GDP on values of jump of unemployment is stronger than the level of competitiveness.

For example, lower jumps of unemployment rate were observed in Dolnośląskie, Wielkopolskie, Mazowieckie, Pomorskie, Śląskie voivodships where regional fixed shares of GDP were significant. Higher jumps of unemployment rate were observed in Świętokrzyskie, Podkarpackie, Podlaskie and Lubelskie voivodships where regional fixed shares of GDP were small.

Then let's carry out such an analysis on an example of the regional labour markets in the districts of Poland by means of the econometric analysis. For construction of econometric models the data describing social and economic development of regions and employment structure in administrative districts and administrative centers of these districts in 2000 were used.

The character of employment structure of the population is in many respects determined by special features of employment in the cities—administrative centres of voivodships, their current economic and geographical potential. In this connection the analysis of employment structure and dynamics in the cities—administrative centres of Polish voivodships is carried out. So, in 2000 in comparison with 1995 for almost all the cities the number of those engaged in all spheres of economy decreased (rates of growth were less than 100%), with the exception of Warsaw (104.8%) and Bydgoszcz (100.7%). At the same time, in individual sectors of economy, the rates of growth differed essentially. So, despite the regional differences in all the cities—administrative centres of voivodships the rates of growth in 2000 in comparison with 1995 were the lowest in industry (less than 100%).

Practically constant (100%) and even higher (more than 100%) were the rates of growth in the sectors of economy connected with market and non-market services. This dynamics has affected small shifts in employment structure of the population in the cities—administrative centres of voivodships of Poland in 2000. There were also changes in the structure of the enterprises located on the territory of the cities—the centres of voivodships. In the majority of the cities the slight positive tendency of increase of the number of enterprises in all spheres of economy was observed, especially in industry, private sector and the sphere of the real estate service, firms connected with scientific and consulting activity.

Let's carry out the analysis of dynamic changes in employment structure. First of all we shall determine the influence of growth rates changes of the enterprises in the sphere of industry, market services and non-market services on employment growth rates. The calculations of growth rates in 2000 and 1995 were carried out. The linear dependence was used as a model:

$$\tau_z^t = b_1 \cdot \tau_{1,t}^p + b_2 \cdot \tau_{2,t}^p + b_3 \cdot \tau_{3,t}^p$$

where τ_z^t is an index of growth rate of those employed in economy on the whole, $\tau_{1,t}^p$ is an index of growth rate of the enterprises in industry, $\tau_{2,t}^p$ is an index of growth rate of enterprises in the sphere of market services, $\tau_{3,t}^p$ is an index of growth rate of the enterprises in the sphere of non-market services, b_1, b_2, b_3 are parameters of regression.

As a result of the calculations the following econometric model was received:

$$\tau_2^p = 0.018322 \cdot \tau_{1,t}^p + 0.912707 \cdot \tau_{2,t}^p + 0.006782 \cdot \tau_{3,t}^p, R = 0.998$$

On the basis of econometric model analysis it was shown, that the estimations of the parameters for growth rates of enterprises in the sphere of market services were statistically significant.

The number of those employed in economy (Z_t) is defined by the following model:

$$Z_t = \gamma_{1,t} Z_{1,t} + \gamma_{2,t} Z_{2,t} + \gamma_{3,t} Z_{3,t}$$

where $\gamma_{1,t}, \gamma_{2,t}, \gamma_{3,t}$ are the corresponding ratio (shares) of those employed in industry, in the sphere of market services and in the sphere of non-market services, $Z_{1,t}, Z_{2,t}, Z_{3,t}$ are the corresponding number of those employed in an industry, in the sphere of market services and in the sphere of non-market services.

On the basis of the econometric analysis the existence of close linear dependence between the corresponding shares of those employed in different

sectors of economy and shares of the enterprises of these sectors was shown. The constructed models of dependence look as follows:

$$\gamma_{1,t} = k_{1,t} \cdot \delta_{1,t} + \xi_{1,t}$$

where $\gamma_{i,t}$ is share of employed in the period t in sector of economy number i , $k_{i,t}$ is a parameter of linear regression for the corresponding equation, $\delta_{i,t}$ is a share of the enterprises in the period t in sector of economy number i , $\xi_{i,t}$ is irregular component for econometric model. The results of constructed econometric models are given in tab. 3.

Tab. 3.

The characteristics of ratio dependence models of those employed in different sectors of economy from structure of the enterprises in economy of Poland

Year	Sector of economy	Value of the estimations for parameter $k_{i,t}$	t-statistics for $k_{i,t}$	Correlation (R)
2000	industry	1.800030	25.9871	0.9876
	market services	0.484405	33.3056	0.9924
	non-market services	5.209491	21.5356	0.9821
2001	industry	1.659105	24.6569	0.9863
	market services	0.525559	31.7502	0.9916
	non-market services	4.147478	36.1106	0.9935

The received models can be used for planning the structural changes of employment in economy, for the analysis of balance of indexes of the labour market condition. On the basis of the received models it is also possible to show the role of development of the market services enterprises having the greatest influence on employment rates growth in economy.

Let's carry out the analysis of influence of employment factors in the cities—administrative centres of voivodships on a ratio of gross domestic product (GDP) formation. The character of distribution of the voivodships share (in %) in formation of a total product of the country depends on regional (economic, demographic, natural) features of administrative—territorial units of Poland. The comparative analysis of distribution of voivodships share in GDP formation shows sufficient stability of indexes, i.e. for five years the essential changes in indexes values have not taken place. The only exception is Mazovia district, where the increase of value by 3.6% was observed, Wielkopolskie voivodship, where the increase rate has made 0.9%, and reduction of Śląskie voivodship share in GDP formation by 1.9 %.

As the level of development of administrative centers of voivodships in many respects determines the level of economic potential of these regional areas, we shall analyze the common mechanism of influence of employment

structure and enterprises structure of economy sectors in the cities—administrative centers on the formation of a share of administrative district in regional production of GDP.

The econometric research made has shown, that it is possible to use the following dependence as a model:

$$\ln y_t = c_0 + \left(\frac{\gamma_{1,t}}{\delta_{1,t}} \right)^{c_1} + \left(\frac{\gamma_{2,t}}{\delta_{2,t}} \right)^{c_2} + \left(\frac{\gamma_{3,t}}{\delta_{3,t}} \right)^{c_3}$$

where y_t is the share of a district (voivodship) in GDP formation (in %), c_0 , c_1 , c_2 are estimations of parameters of econometric model, $\gamma_{1,t}$, $\gamma_{2,t}$, $\gamma_{3,t}$ are corresponding shares of employed (in %) in the cities—administrative centers of voivodship in industry, in the sphere of market services and in the sphere of non-market services; $\delta_{1,t}$, $\delta_{2,t}$, $\delta_{3,t}$ are corresponding shares of the enterprises (in %) in the cities—administrative centers of voivodship in industry, in the sphere of market services and in the sphere of non-market services.

In view of parameters estimations the model looks as follows:

$$\ln y_t = 1.015836 + \left(\frac{\gamma_{1,t}}{\delta_{1,t}} \right)^{-3.2052} + \left(\frac{\gamma_{2,t}}{\delta_{2,t}} \right)^{1.991574} + \left(\frac{\gamma_{3,t}}{\delta_{3,t}} \right)^{-0.724053}, \quad R = 0.596$$

The given model allows to explain an interesting effect of balance changes structure of the employed and the structure of the enterprises in economics of the cities—administrative centers of voivodships on GDP formation. So, for the increase of the contribution to a GDP share the constituent models

with negative parameters estimations of $\frac{\gamma_{1,t}}{\delta_{1,t}}$ and $\frac{\gamma_{3,t}}{\delta_{3,t}}$ should be less than 1. It

means, that the share of the employed in industry should not exceed the share of the industrial enterprises among all others in voivodship economy, and in a simple way the share of the employed in non-market services should not exceed a share of this type of the enterprises. For the component determining the contribution of the market services sphere, the reverse dependence is observed. That is, to increase the contribution to a share of GDP the share of the employed in the market services sphere should outstrip a share of the enterprises of this sphere.

Let's also carry out the econometric analysis of influence of concentration employment share and concentration enterprises share in the cities—administrative centers of voivodships on GDP formation share. As the additional factors having, undoubtedly, great influence on regional GDP formation share in such indexes as a share of the expenditures of administrative district on research activity and development, share of firms in administrative district, specializing in high technologies were used. With this purpose some models were constructed and their general view is given below.

1. Model of GDP share estimation in administrative district (y) in relation to such factors, as a share of enterprises concentration (x_2 , %) in the city—ad-

ministrative center of voivodship and share of the charges of voivodship expenditures on research activity and development (x_4 , %).

$$y = \hat{y}_0 v_2^{x_2} v_4^{x_4}$$

In the given model \hat{y}_0 is the value of the minimal share in GDP formation for voivodship given as a parameter of the model, v_2 and v_4 are estimations of model parameters.

2. Model of estimation of enterprises concentration share (x_2 , %) in relation to the concentration share of the employed (x_1 , %) in the cities—administrative centers of voivodship.

$$x_2 = w_0 x_1^{w_1}$$

In the given model w_0 and w_1 —are estimated parameters.

3. Model of estimation of expenditure share of the voivodship on research activity and development (x_4 , %) in relation to the share of firms in the voivodship, specializing in high technologies.

$$x_4 = r_0 x_1^{r_1}$$

In the given model r_0 and r_1 —are estimated parameters.

On the basis of the data on regions of Poland in 2000 the following econometric models were received and their characteristics are given in tab. 4.

Tab. 4.

The characteristics of constructed econometric models

Number	Model	Correlation	Explained variance (%)
1	$y = 4.761672 \cdot 1.001131^{x_2} \cdot 1.032269^{x_4}$	$R = 0.83$	68.9%
2	$x_2 = 1.175193 \cdot x_1^{0.927196}$	$R = 0.989$	97.9%
3	$x_4 = 0.48707 \cdot x_3^{1.285304}$	$R = 0.987$	96.3%

The received models have high enough factors of correlation and are convenient for interpretation of influence of development level of the cities—administrative centres of voivodship on parameters of corresponding GDP share formation.

Thus, as a result of the made econometric analysis the influence of major factors on structure of employment in the voivodship and the role of the cities—administrative centres of voivodships in formation of the labour market and level of production was shown.

3. Definition of cluster in the regional labour markets

Let's carry out the division of the labour markets potential of administrative centers of Polish districts—voivodships on homogeneous groups—clusters by means of the cluster analysis. Cluster analysis which used the k-means method was realized in package STATISTICA.

As the initial data the indexes of the enterprises number (2001) in the cities—administrative centers were used in such spheres as private sector; industry; construction; services and repair; transport, trade and communication; service of the real estate and firms, science, etc.

Let's define the number of enterprises in private sector as x_1 ; the number of enterprises in industry as x_2 ; the number of enterprises in the sphere of construction as x_3 ; the number of enterprises in the sphere of services and repair as x_4 ; the number of enterprises in the sphere of trade and communication as x_5 ; the number of enterprises in the sphere of a science, service of the real estate and firms as x_6 .

As a result of the analysis 5 clusters were received. The characteristics for clusters are given in tab. 5.

Tab. 5.

Means and means squared deviations of formed clusters

Number of clusters	Mean						Standard deviation					
	\bar{x}_1	\bar{x}_2	\bar{x}_3	\bar{x}_4	\bar{x}_5	\bar{x}_6	σ_{x_1}	σ_{x_2}	σ_{x_3}	σ_{x_4}	σ_{x_5}	σ_{x_6}
1	85607	10147.2	8616	27767.7	7027	17549.2	5738.32	2526.57	1359.11	2054.7	860.62	3440.35
2	56802.5	6495.5	6504.5	16820	4956	13216	3606.95	1731.70	847.82	2063.33	206.47	1251.57
3	241367	24259	23025	77465	22404	52293	0	0	0	0	0	0
4	37852.5	3451.2	3663.7	13474.5	3277	6979.2	4344.20	968.92	520.28	1621.39	342.73	1440.17
5	18540.8	1678.8	1954.1	6477.1	1442.1	3884.2	4755.11	492.21	556.80	1703.11	434.93	723.32

For the best interpretation of the results, the data describing the number of enterprises in various sectors were ranked and the corresponding ranks were shown. The higher the value of the index is, the lower is the value of its rank.

The results of ranking by sample are submitted in tab. 6.

The first cluster included such cities as Kraków, Wrocław, Łódź, Poznań. The study of indexes of the enterprises number in the chosen sectors of economy has shown that in the cities included in the first cluster the enterprises in all spheres of economy are characterized by high enough values. The ranks for elements of the 1-st cluster change in a range from 2 up to 6.

The second cluster included such cities as Szczecin and Gdańsk, which also have high values of concentration of the enterprises of all spheres of economy.

The individual third cluster is formed by Warsaw and it is characteristic for many metropolitan cities. Here the highest parameters of concentration of the enterprises in all spheres are observed.

The fourth cluster included such cities as Bydgoszcz, Katowice, Lublin, Białystok. The number of the enterprises in these areas is on an average level, the ranks change in a range from 8 up to 12.

The fifth cluster included such cities as Kielce, Toruń, Olsztyn, Rzeszów, Opole, Gorzów Wielkopolski and Zielona Góra. In these cities the lowest values of the enterprises concentration are observed.

Tab. 6.

Results of ranks for clusters elements

Number of clusters	Administrative centers of voivodships	Private sector	Construction	Trade	Transport, public edition, communication	Sphere of the real estate service, consulting activity and science
		Rang	Rang	Rang	Rang	Rang
1	Kraków	2	3	2	2	3
	Wrocław	3	2	4	4	2
	Łódź	4	6	3	3	6
	Poznań	5	4	5	5	4
2	Szczecin	6	5	6	6	5
	Gdańsk	7	7	7	7	7
3	Warszawa m.st.	1	1	1	1	1
4	Bydgoszcz	8	8	8	8	9
	Katowice	9	11	9	11	8
	Lublin	10	10	10	9	10
	Białystok	11	9	11	10	12
5	Kielce	12	12	12	12	13
	Toruń	13	13	13	13	15
	Olsztyn	14	14	15	18	14
	Rzeszów	18	17	14	17	16
	Opole	15	15	16	15	11
	Gorzów Wlkp.	16	16	18	14	17
	Zielona Góra	17	18	17	16	18

For example let's analyse the positions of an administrative center—town Kielce in Świętokrzyskie voivodship among other elements of the 5-th cluster. As we can see from the results of ratings town Kielce occupies the best positions as for the number of enterprises from different spheres of economy

among other cities—administrative centres. However, for detail analysis of the position of town Kielce among other cities of this cluster we shall calculate deviations of enterprises number in various spheres of economy from mean values in the fifth cluster. As we can see from the calculations all deviations are positive, i.e. the enterprises number in each sector is higher than mean value of cluster. The greatest positive deviations in the enterprises number are marked for the private sector and high enough for sectors of trade and communication, which testifies the characteristic specialization of the administrative centre of Świętokrzyskie voivodship.

Then we shall carry out the analysis of results of splitting the cities—administrative centres by indexes of the aggregated structure of population employment and by indexes of the aggregated structure of the enterprises.

For realization of the cluster analysis we shall use the following parameters: $\gamma_{1,t}, \gamma_{2,t}, \gamma_{3,t}$ are corresponding ratios, i.e. shares of the employed population in the cities—administrative centres of voivodships in industry, in the sphere of market services and in the sphere of non-market services; $\delta_{1,t}, \delta_{2,t}, \delta_{3,t}$ are corresponding ratios, i.e. shares of enterprises number in industry, in the sphere of market services and in the sphere of non-market services.

The results of splitting of the cities of administrative centres by employment structure are given in tab. 7 and by enterprises structure are given in tab. 8.

Tab. 7.

The characteristics of clusters by the employment structure

Number of clusters	Mean			Standard deviation		
	$\bar{\gamma}_1$	$\bar{\gamma}_2$	$\bar{\gamma}_3$	σ_{γ_1}	σ_{γ_2}	σ_{γ_3}
1	33.1	37.8	28.6	1.76	1.31	0.68
2	31.6	41.5	26.1	2.1	1.4	2.8
3	28.9	35.7	34.5	0.7	1.5	2.8
4	40.0	33.2	26.2	2.0	1.3	2.0
5	24.8	54.1	20.7	0	0	0

Tab. 8.

The characteristics of clusters by the enterprises structure

Number of clusters	Mean			Standard deviation		
	$\bar{\delta}_1$	$\bar{\delta}_2$	$\bar{\delta}_3$	σ_{δ_1}	σ_{δ_2}	σ_{δ_3}
1	20.5	72.5	6.4	0.6	0.97	0.54
2	24.5	69.5	5.5	0.14	0.49	0.35
3	17.7	74.3	7.3	0.6	1.0	0.7

As for the structure of employment the first cluster included the following cities—administrative centres of voivodship: Gdańsk, Kielce, Kraków, Łódź, Olsztyn. The first cluster can be characterized as rather balanced by the

structure of employment, with prevalence of employment of the population in market services sphere.

The second cluster comprises such cities, as Katowice, Poznań, Szczecin, Wrocław, Zielona Góra. This cluster has rather a large average share of population employed in industry, but the share of the employed in market services sphere considerably prevails. The third cluster included such cities as Białystok and Opole by structure of employment. Here too we observe the balanced enough indexes of employment structure, but the employment in the sphere of services (market and non-market) prevails. The fourth cluster included such cities, as Bydgoszcz, Gorzów Wielkopolski, Rzeszów and Toruń. In this cluster the greatest share of employed falls on industry, then the indexes of employment in the sphere of market and non-market services follow. The fifth cluster included Warsaw, with the highest share of the employed in the market services sphere, while indexes of employment in industry and in non-market services sphere are low.

Similar results were also received when splitting into clusters cities by the enterprises structure. The first cluster included such cities as Warsaw, Bydgoszcz, Kielce, Kraków, Poznań, Szczecin, Toruń and Wrocław. The second cluster included Gdańsk, Łódź. The third cluster included the following cities: Białystok, Gorzów Wielkopolski, Katowice, Lublin, Olsztyn, Opole, Rzeszów and Zielona Góra.

Let's carry out the analysis for Kielce by its positions in the corresponding clusters and show deviations from mean values.

As can be seen from calculations Kielce has positive deviations from mean values for indexes of the employment share in industry. The share of the employment in market services is lower than mean values in the cluster. At the same time the share of the enterprises in non-market services is higher, than mean values in the cluster, and share of the enterprises industry and the sphere of market services are lower than mean values in the cluster.

Thus, one of the possible tasks for Kielce is the necessity to increase both shares of employment in the market services and share of these enterprises. It will promote greater competition and higher quality of service.

4. Conclusions

The performed econometric analysis has allowed to study the current tendencies in indexes of unemployment for Poland and regions, in particular, to reveal the common rules determining the condition of the labour market in administrative regions of Poland, to investigate the influence of the factors determining regional features of employment. By means of the cluster analysis the homogeneous groups of cities—administrative centres of regions in Poland were formed. In fact, the administrative centers of voivodships have great influence on the character and special features of economic and social development of corresponding districts of the country. The results of the given research show opportunities of using modern statistical methods for

the substantiation of the current problems, for development of the strategic plans on coordination in the labour market both in the country as a whole and in individual districts.

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