DE GRUYTER
OPEN

ECONOMETRICS. ADVANCES IN APPLIED DATA ANALYSIS
Year 2018, Vol. 22, No. 1
ISSN 1507-3866
e-ISSN 2449-9994

EMPLOYMENT AND ECONOMIC ENTITIES IN THE POLISH FINANCIAL SECTOR FROM 2005-2016

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DOI: 10.15611/eada.2018.1.06
JEL Classification: C13, E24, G20

Abstract: The article analyzes employment in the financial sector and entities conducting financial, insurance or other activities. The aim of this study is to examine employment in the financial sector at the level of provinces and registered entities of this sector using multidimensional methods of statistical analysis. The results of the classification indicate the geographical division of the country in terms of the number of financial and insurance companies. However, the high slope of the directional coefficient means a very strong, growing tendency for the Mazowieckie voivodship, characterized by a much slower trend for the Dolnośląskie, Pomorskie and Śląskie voivodships. In fact, for most of the provinces, trends indicate a statistically significant, negative development trend for the analyzed phenomenon from 2005-2016.

Keywords: financial sector, employment, economic entities, k-means method, trends.

1. Introduction

The maturity of the market economy is determined by the level of development of the market institutions responsible for the efficiency of market processes [Czekaj 2008]. Therefore financial markets are one of the most important components of the socio-economic system of every country [Dębski 2012; Smyczek 2012]. Market institutions are organisations through which various market streams flow, from producers to end users and vice-versa. The nature of such streams is closely connected with the market type. The labour and the financial markets are closely interrelated. According to the human capital theory, the labour market is very receptive as long as salaries and wages do not begin to decline [Blaug 1995]. The development of the financial sector and its determinants can be dependent on the market development level. A different role will be played by such development factors as good governance and quality of services, and a different role will be played by economic growth and trade openness [Thai-Ha Le, Jungsuk Kim, Minsoo Lee 2016].

The economic changes occurring in a society generate a number of sectoral adaptations [Baszyński 2007]. The development trend for the banking sector in Poland over the last decade was upward, except for the crisis years 2009-2010. In many regions, that situation was reflected by a change in the number of employees and establishments in that sector. However, after a time of growth, the labour market in the Polish banking sector has recently begun to decline.

Currently, the situation of the labour market in the financial and insurance sectors is unsteady, due to its characteristics [Banaszczak-Soroka 2014]. Most organisations have suspended development projects related to employment growth until they note a clear upward trend in the Polish economy [Sopoćko 2015]. Positive signals for employment in financial and insurance institutions include: improving macroeconomic indicators, i.e. an increase in GDP; declining unemployment; and increasing average gross remuneration – all of these raise hopes for a revival of the entire sector. The rate of employment in financial institutions is unquestionably affected by advanced technologies and their increasing use in almost every aspect of our lives. New services based on IT solutions are also dynamically being introduced to financial institutions. Online banking is a system where financial settlements take place, excluding the circulation of hard-copy documents, and the bank communicates with its clients via data transmission [Chmielarz 1999]. The essence of online banking is the possibility of using banking services regardless of time or place [Porębska-Miąc 2000]. Therefore an online banking is perceived two-dimensionally; as a group of online banking service distribution channels and as the possibility to create completely new products that expand the bank's product range [Świecka 2007].

Many authors juxtapose online banking with traditional banking and single out a group of features that characterise online banking. The most significant features include no necessity to be present at the bank in person, the possibility to use a banking service at any time, no intermediation of the bank's personnel and an automatic decision-making process.

The reason for changes in employment in the financial sector are often restructuring the operating costs of banking institutions and intensification of labour. This entails the consolidation of banks and thus a reduction of employment resulting from the need to close banks. Technological changes in the provision of banking services and customer service considerably contributed to limiting the demand for labour in the financial sector. Of the greatest significance are online banking and mobile banking. Of relevance is also the development of modern smart institutions where human resources are not needed or needed to a minimum extent. Yet another, indirect, cause of changes in employment may be the economic and legal condition of banks, influenced e.g. by Basel III. The introduction of those measures may jeopardise the operation of cooperative banks which are weak when it comes to capital, but compliant with economic standards [Garbowski 2015]. Legal regulations should take into account the capitalisation of banks, forms of organisation and the core intended purpose of the products of such banks.

2. Prospects of development of online banking in Poland

The increased interest in online banking in Poland results chiefly from the benefits of alternative banking service distribution channels and of the development of technology, which indirectly makes recipients participate in ongoing change. In trying to attract clients, banks regularly extend their range of products with a rich portfolio of additional financial services, i.e. insurance and investment services. As data presented by the Polish Banking Association suggest, 2016 was the fifth year in a row in which employment in the banking sector fell. It mainly involved the further development of online banking and the closing of bank branches, the need to reduce costs and mergers of banks. At the end of 2016, commercial banks, cooperative banks, and subsidiaries of credit institutions employed 168,839 people – 2,097 fewer than the year before. However, it was yet another year when bank head offices noted an employment growth – now up to 76,392 people employed (an increase of 2,055 people) and an employment decline was noted mostly in bank branches (a decrease of 4,210 employees).

The purpose of this research is to analyse the employment in the financial sector at the level of voivodeship in 2005 to 2015 and clustering voivodships in terms of entities' numbers in 2009 and 2016. This time period and moments are relevant in terms of economic comparison, considering that Poland has been a Member State of the EU for over ten years now. Multivariate statistical analysis methods were applied in the research, especially the non-hierarchical clustering method, the descriptive statistical method and linear regression. The article consists of three main parts. The first part discusses employment in general in financial and insurance companies operating in Poland, also divided by voivodeships. The second part is an overview of the changes in the employment structure in the sector analysed for individual voivodeships and discusses the development trends in employment. The third part presents a division of voivodeships into clusters by the number of entities varied according to the types of economic activity classified in PKD. The final part of the paper is a summary of the research results.

3. Employment in the Polish financial sector

The analysis of employment in the financial and insurance sector was based on the total number of employees in financial and insurance companies presented in section K of the Polish Classification of Business (PKD). Descriptive statistics of the groups allowed for the temporal distribution of employment under discussion. Table 1 illustrates a summary of the main measures of employment distribution in the financial sector in individual voivodeships and in Poland overall, compiled on the basis of data for the period from 2005 to 2015.

Table 1. Spatial diversification of employment in the Polish financial and insurance sector in 2005-2015

Statistics / Voivodeship	Average (person)	Min. (person)	Max. (person)	Coefficient of variance (%)	Coefficient of skewness
Poland	271,929	244,010	285,751	4.96	–1.15
Poland (without the Mazowieckie voivodeship)	160,870	151,190	173,300	3.61	0.54
Dolnośląskie	24,969	19,560	28,649	9.89	–0.81
Kujawsko-Pomorskie	8586	7833	9683	6.65	0.58
Lubelskie	10,096	7798	12,142	15.08	–0.06
Lubuskie	3225	2970	3598	6.11	0.90
Łódzkie	12,419	11,746	13,695	4.42	0.82
Małopolskie	16,927	12,750	20,119	12.39	–0.73
Mazowieckie	111,062	84,183	125,582	12.59	–0.96
Opolskie	3250	2693	3818	12.46	0.24
Podkarpackie	5492	4934	6480	8.38	1.00
Podlaskie	4396	3728	4940	9.55	–0.66
Pomorskie	17,830	15,767	21,220	9.92	0.63
Śląskie	23,285	21,885	25,499	5.01	0.29
Świętokrzyskie	3177	2774	3908	10.14	1.14
Warmińsko-Mazurskie	4081	3303	4987	15.07	–0.13
Wielkopolskie	16,165	14,870	17,287	5.17	0.01
Zachodniopomorskie	6970	6054	8227	12.07	0.57

Source: own analysis based on data of the Central Statistical Office of Poland.

The average number of employees in financial, insurance and pension institutions and other entities facilitating financial activities in Poland over the period under analysis amounted to slightly more than 270,000 people. It was characterised by very low volatility (V_S = 4.96%) and a strong negative asymmetry of the distribution of annual employment, which means that for most years of the period under analysis the employment was above average. The greatest number of employees employed in the financial sector was noted in the Mazowieckie voivodeship – the employment in that region was a few or even a dozen or so times greater than in other voivodeships. The reason for this is a strong concentration of financial institutions and companies supporting such institutions located in Warsaw – the financial centre of Poland. When analysing the average employment in individual voivodeships, except for the Mazowieckie voivodeship, it should be noted that regions of south-western Poland, specifically the Dolnośląskie, Śląskie, Małopolskie, Wielkopolskie voivodeships, but also the Pomorskie voivodeship, were characterised by relatively high employment, i.e. over 15 thousand employees on average during the year. The lowest average employment, slightly above 3 thousand people, were noted in the Świętokrzyskie, Lubuskie and Opolskie voivodeships.

4. Employment trends in the financial sector

An analysis of the changes in employment is an extremely important aspect of every sector, including the financial sector as well. In the next part of the research, trends in employment in the financial sector among the voivodeships were analysed as well as trends in the number of workers in that sector in individual voivodeships. In 2005--2015, in all of the voivodeships except for the Mazowieckie voivodeship, employees of financial institutions constituted a small percentage (a few per cent) of total employment. Table 2 illustrates those changes.

Table 2. Percentage share of financial and insurance sector employment in total employment in individual voivodeships over 2005-2015

Years / Voivodeship	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dolnośląskie	8.02	8.66	9.47	10.14	9.80	9.75	8.79	8.49	8.98	9.10	9.65
Kujawsko-Pomorskie	3.49	3.35	3.22	2.98	2.81	2.83	2.84	3.12	3.24	3.47	3.47
Lubelskie	4.64	4.78	4.56	4.30	3.75	3.56	3.39	3.27	2.99	2.94	2.91
Lubuskie	1.47	1.29	1.25	1.27	1.15	1.16	1.11	1.13	1.06	1.09	1.12
Łódzkie	5.11	5.10	4.85	4.85	4.28	4.18	4.19	4.40	4.48	4.52	4.41
Małopolskie	7.26	6.76	6.43	5.51	6.10	7.14	6.62	6.53	6.59	4.57	5.11
Mazowieckie	34.50	35.79	36.58	38.69	40.68	42.43	44.06	43.95	43.33	44.04	43.67
Opolskie	1.56	1.50	1.44	1.30	1.17	1.12	1.08	1.03	1.00	1.04	1.00
Podkarpackie	2.66	2.28	2.21	2.17	1.84	1.91	1.88	1.85	1.88	1.81	1.84
Podlaskie	2.02	1.90	1.83	1.68	1.37	1.33	1.33	1.58	1.62	1.62	1.61
Pomorskie	6.46	6.56	6.83	7.08	7.09	5.60	5.82	6.07	6.09	7.61	6.96
Śląskie	8.97	8.75	8.46	8.30	9.14	8.30	8.53	8.60	8.66	8.37	8.17
Świętokrzyskie	1.47	1.32	1.29	1.38	1.10	1.09	1.07	1.06	1.04	1.04	1.03
Warmińsko-Mazurskie	2.04	1.90	1.81	1.56	1.57	1.52	1.43	1.18	1.19	1.19	1.23
Wielkopolskie	7.02	6.78	6.63	6.10	5.71	5.74	5.58	5.54	5.62	5.38	5.54
Zachodniopomorskie	3.31	3.28	3.14	2.71	2.44	2.35	2.28	2.20	2.22	2.21	2.26

Source: own analysis based on data of the Central Statistical Office of Poland.

In 2015, when compared to 2005, an increase in the percentage of financial and insurance sector employees was noted in three voivodeships: the Dolnośląskie (+1.63 pp, 20.3%), Mazowieckie (+9.17 pp, 26.6%), and Pomorskie (+0.5 pp, 7.7%) voivodeships. The rest of the voivodeships noted a relative decrease in employment in the sector analysed. An increase in employment in the Mazowieckie voivodeship concurred with a decrease in employment in the rest (the majority) of the voivodeships. In 2015, employees of financial, insurance or related companies located in the Mazowieckie voivodeship constituted around 44% of total employment in that sector in Poland. The lowest percentage of employees in the financial sector was in the Lubuskie, Opolskie, Świętokrzyskie, and Warmińsko-Mazurskie voivodeships. The

Table 3. Employment in the Polish financial and insurance sector from 2005-2015

Statistics / Voivodeship	Average rate of change (%)	Trend function and prediction
Poland	0.96	$\hat{y}_t = \underset{(t=34.36^{***})}{255640.0} + \underset{(t=2.47^{**})}{2714.9}t;\ R^2 = 0.40;\ y^P_{2016} = 288218.8;\ V_{2016} = 4.7\%$
Poland (without the Mazowieckie voivodeship)	–0.55	$\hat{y}_t = \underset{(t=53.47^{***})}{167329.0} - \underset{(t=2.47^{**})}{1076.5}t;\ R^2 = 0.37;\ y^P_{2016} = 154406.5;\ V_{2016} = 3.7\%$
Dolnośląskie	2.85	$\hat{y}_t = \underset{(t=14.36^{***})}{22994.1} + \underset{(t=1.39)}{329.1}t;\ R^2 = 0.18$
Kujawsko-Pomorskie	1.01	$\hat{y}_t = \underset{(t=25.28^{***})}{7887.2} + \underset{(t=2.53^{**})}{116.5}t;\ R^2 = 0.42;\ y^P_{2016} = 9284.9;\ V_{2016} = 6.2\%$
Lubelskie	–3.66	$\hat{y}_t = \underset{(t=35.67^{***})}{12823.7} - \underset{(t=-8.57^{***})}{454.5}t;\ R^2 = 0.89;\ y^P_{2016} = 7368.8;\ V_{2016} = 8.9\%$
Lubuskie	–1.74	$\hat{y}_t = \underset{(t=39.32^{***})}{3513.8} - \underset{(t=-3.66^{***})}{448.1}t;\ R^2 = 0.60;\ y^P_{2016} = 2935.5;\ V_{2016} = 5.6\%$
Łódzkie	–0.51	$\hat{y}_t = \underset{(t=34.7^{***})}{12778.9} - \underset{(t=-1.11)}{60.0}t;\ R^2 = 0.12$
Małopolskie	–2.53	$\hat{y}_t = \underset{(t=12.91^{***})}{18248.6} - \underset{(t=-1.06)}{220.2}t;\ R^2 = 0.11$
Mazowieckie	3.36	$\hat{y}_t = \underset{(t=17.19^{***})}{88310.9} + \underset{(t=5.01^{***})}{3791.8}t;\ R^2 = 0.74;\ y^P_{2016} = 133812.2;\ V_{2016} = 7.1\%$
Opolskie	–3.43	$\hat{y}_t = \underset{(t=54.09^{***})}{3993.7} - \underset{(t=-11.38^{***})}{123.8}t;\ R^2 = 0.94;\ y^P_{2016} = 2507.2;\ V_{2016} = 5.4\%$
Podkarpackie	–2.69	$\hat{y}_t = \underset{(t=35.49^{***})}{6230.7} - \underset{(t=-4.75^{***})}{123.1}t;\ R^2 = 0.71;\ y^P_{2016} = 4752.7;\ V_{2016} = 6.8\%$
Podlaskie	–1.34	$\hat{y}_t = \underset{(t=16.81^{***})}{4689.0} - \underset{(t=-1.19)}{48.9}t;\ R^2 = 0.13$
Pomorskie	1.71	$\hat{y}_t = \underset{(t=14.11^{***})}{16599.7} + \underset{(t=1.18)}{205.1}t;\ R^2 = 0.13$
Śląskie	0.02	$\hat{y}_t = \underset{(t=28.53^{***})}{22581.6} + \underset{(t=1.00)}{117.3}t;\ R^2 = 0.10$
Świętokrzyskie	–2.57	$\hat{y}_t = \underset{(t=26.11^{***})}{3661.6} - \underset{(t=-3.91^{***})}{80.7}t;\ R^2 = 0.63;\ y^P_{2016} = 2692.4;\ V_{2016} = 9.6\%$
Warmińsko-Mazurskie	–4.04	$\hat{y}_t = \underset{(t=48.44^{***})}{5212.5} - \underset{(t=-11.8^{***})}{188.5}t;\ R^2 = 0.94;\ y^P_{2016} = 2949.8;\ V_{2016} = 6.7\%$
Wielkopolskie	–1.41	$\hat{y}_t = \underset{(t=81.49^{***})}{17643.3} - \underset{(t=-7.71^{***})}{246.3}t;\ R^2 = 0.87;\ y^P_{2016} = 14687.1;\ V_{2016} = 2.7\%$
Zachodniopomorskie	–2.86	$\hat{y}_t = \underset{(t=40.93^{***})}{8469.5} - \underset{(t=-8.19^{***})}{249.9}t;\ R^2 = 0.88;\ y^P_{2016} = 5470.8;\ V_{2016} = 6.96\%$

Note: R^2, y^P_{2016}, V_{2016} correspond respectively to the coefficient of determination, the prediction of employment in the financial sector, and the relative error of *ex ante* prediction.

The average rate of change calculated as $(\overline{t}_G - 1) \times 100\%$ where $\overline{t}_G = \sqrt[n-1]{y_n / y_1}$.***, **, * – statistically significant coefficient at the significance level of $\alpha = 0.01; 0.05; 0.1$ respectively.

Source: own analysis.

share of employment in the financial sector in those voivodeships, when compared to employment in that sector in Poland overall fluctuated at around 1% and the trend was downward.

The time series for the number of employees employed in individual voivodeships, linear trend functions and the average rate of change were also estimated and are illustrated in Table 3.

Data for the entire country show a statistically significant, growing trend in employment in the financial sector. However, its relatively high positive slope is determined by a very strong, growing trend for the Mazowieckie voivodeship, with a much slower trend for the Dolnośląskie, Pomorskie and Śląskie voivodeships. However, the value of the slope for the trend determined without the Mazowieckie voivodeship points to a significant negative trend in the number of employees employed in the financial and insurance sector as shown in Figure 1.

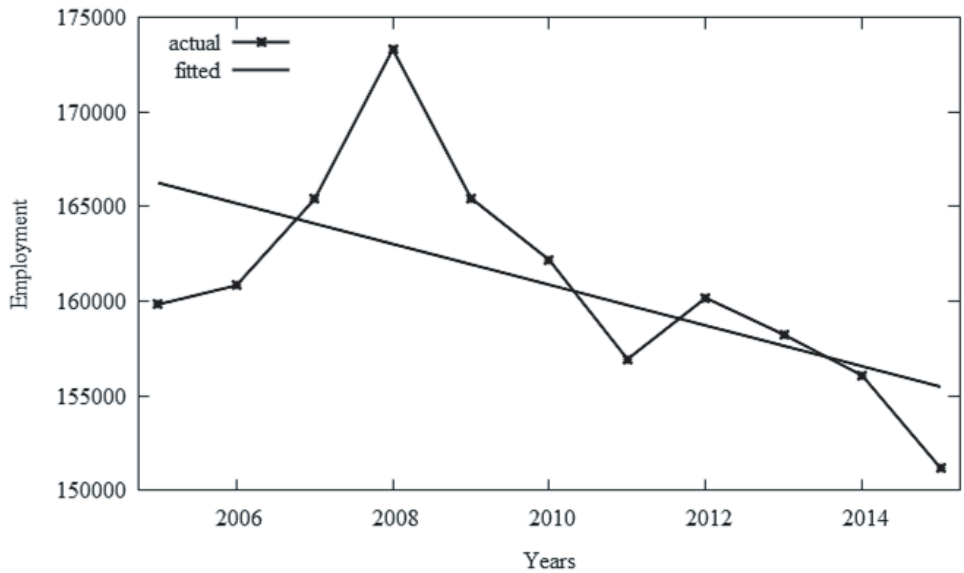

Figure 1. Actual and fitted values of employment in the financial sector in Poland without Mazowieckie voivodeship in the period 2005-2015

Source: own research.

The largest decrease in employment was in the years 2009-2011, that is the period of economic crisis in the world. The negative slope coefficient of the above trend function arises from the negative trends achieved for the following voivodeships: Lubelskie, Lubuskie, Opolskie, Podkarpackie, Świętokrzyskie, Warmińsko-Mazurskie, Wielkopolskie and Zachodniopomorskie voivodeships. The coefficients of determination (R^2) of the statistically significant slopes of the linear trends show

a good fit or an average fit between those functions and the empirical data [Dziechciarz (ed.) 2012]. The average rates of change confirm the predicted directions of development trends and mean that for voivodeships characterised by a downward trend in employment in the financial sector, the annual decline in employment is between 0.51% in the Łódzkie voivodeship and 4.04% in the Warmińsko-Mazurskie voivodeship. In addition, for statistically significant trends in employment in the financial and insurance sector, the predictions for 2016 with relative *ex ante* errors were determined. The predictions for all the chosen voivodeships and the whole country were burdened with errors below 10%.

5. Geographical diversity of economic entities in the Polish financial sector

The preliminary statistical analysis of employment revealed that its level is different in individual regions of Poland. To better describe this phenomenon, it seems advisable to spatially cluster regions consisting of voivodeships with employment at a similar level and of similar structure in the financial and insurance sectors. However, those regions were clustered based on the number of registered entities in the sector, which is a direct determinant of employment. The voivodeships were clustered and a comparison was made for 2009 and 2016. The choice of moments for comparison was determined by the availability of related data and by the provision of a maximum time series in order to observe the changes in financial sector development in the context of the number of entities operating in that sector. In particular, diagnostic variables constituted the number of entities operating in three groups of the financial sector divided by the type of economic activity according to PKD. They include: group 64 – financial service activities except for insurance and pension funding (A); division 65 – insurance, reinsurance, and pension funding, except for compulsory social security (B); and group 66 – activities auxiliary to financial services, insurance, and pension funding (C). The first group comprises: monetary intermediation; activities of holding companies; activities of trusts, funds, and similar financial entities; as well as other financial service activities, except for insurance and pension funding. The second group comprises insurance and reinsurance. Group C consists of institutions engaged in financial management, activities ancillary to insurance and funding activities, and financial services. Table 4 presents the structure of the number of entities in individual groups.

Based on the analysis of the number of financial entities, one may conclude that an increase in the number of entities rendering financial services for the years being compared was noted in 14 voivodeships and an increase in the number of insurance companies and pension funds was noted in 13 voivodeships. For activities ancillary to financial service activities, a decrease in the number of related entities was noted in all the voivodeships. In addition, the data presented indicate the highest percentage

Table 4. Number and share of financial and insurance sector entities in individual voivodeships in 2009 and 2016

Years/PKD / Voivodeship	2009						2016					
	A		B		C		A		B		C	
v.	number	%	number	%	number	%	number	%	number	%	number	%
Poland	20,219	15.5	1058	0.8	109,345	83.7	27,179	21.8	1283	1.0	96,181	77.2
Dolnośląskie	1839	16.7	45	0.4	9114	82.9	2704	24.6	71	0.6	8217	74.8
Kujawsko--Pomorskie	1275	18.3	67	1.0	5612	80.7	1291	20.9	69	1.1	4818	78.0
Lubelskie	850	15.0	41	0.7	4781	84.3	822	16.3	65	1.3	4163	82.4
Lubuskie	558	16.5	42	1.2	2785	82.3	580	20.0	51	1.8	2269	78.2
Łódzkie	1182	15.6	62	0.8	6310	83.6	1382	19.9	82	1.2	5472	78.9
Małopolskie	1371	13.6	61	0.6	8657	85.8	1931	20.0	92	1.0	7596	79.0
Mazowieckie	4363	19.0	288	1.3	18,275	79.7	7738	30.3	327	1.3	17,510	68.4
Opolskie	323	9.2	45	1.3	3134	89.5	380	12.3	43	1.4	2669	86.3
Podkarpackie	461	10.1	17	0.4	4077	89.5	562	13.8	49	1.2	3450	85.0
Podlaskie	420	12.8	15	0.5	2847	86.7	550	18.3	20	0.7	2442	81.0
Pomorskie	1047	11.8	39	0.4	7751	87.8	1424	16.8	61	0.7	6987	82.5
Śląskie	2605	15.5	78	0.5	14,111	84.0	3184	21.4	110	0.7	11,558	77.9
Świętokrzyskie	473	13.4	33	0.9	3035	85.7	481	15.9	41	1.4	2499	82.7
Warmińsko--Mazurskie	526	13.6	49	1.3	3288	85.1	581	16.6	46	1.3	2867	82.1
Wielkopolskie	1884	16.1	117	1.0	9669	82.9	2576	22.4	108	0.9	8841	76.7
Zachodniopomorskie	1042	14.9	59	0.8	5899	84.3	984	16.8	48	0.8	4814	82.4

Note: PKD groups: A – financial service activities except for insurance and pension funding; B – insurance, reinsurance, and pension funding, except for compulsory social security; C – activities auxiliary to financial services, insurance and pension funding.

Source: own analysis based on data of the Central Statistical Office of Poland.

of institutions operating activities ancillary to financial, insurance, and pension funding services (C), although it declined on average for all of Poland – from 83.7% to 77.2% of the total number of economic operators over the years under analysis. One should note that the highest percentages in that group were in the Opolskie and Podkarpackie voivodeships and the lowest was in the Mazowieckie voivodeship. The lowest percentage of the number of financial sector companies (around 1%) was noted in group (B) related to insurance, reinsurance and pension funding. In the case of that group, for the years compared, the highest percentages of economic operators were noted in the Lubuskie, Mazowieckie, Opolskie, and Warmińsko-Mazurskie voivodeships. On the other hand, the percentage of companies operating financial service activities (A) in 2009 in Poland was 15.5% and it increased to 21.8% of all such institutions by 2016. Relatively, most entities in that group in the years compared were noted in the Mazowieckie voivodeship and the fewest were in the Opolskie voivodeship.

The voivodeships were clustered based on selected diagnostic features using cluster analysis algorithms. For clustering, the k-means method (a non-hierarchical clustering method) was applied. First of all, this method requires making an arbitrary decision about the number of clusters into which the original set of objects are to be grouped [Dziechciarz, Walesiak 2000; Walesiak, Gatnar (eds.) 2009]. Another problem is the identification of initial centroid averages, i.e. the initial centres of clusters[1]. The fundamental idea behind this method is such an allocation of taxonomic units to *k* groups that minimises variability in the clusters created and maximises the variability among them. The objects (voivodeships) should be moved among the clusters to achieve the greatest level of significance of the analysis of variance (variations) (ANOVA). High variability among the highlighted clusters and relatively low variability in the clusters testify to the adequate clustering of the voivodeships by the variables analysed. The results of F-statistics illustrated in Table 5 show that all the variables, both in 2009 and 2016, effectively discriminate the clusters at a level of significance of 0.05.

Table 5. Results of the analysis of variations of discriminant variables in 2009 and 2016

Variable	Analysis of variance for the variables for 2009					
	intergroup variation	df	intragroup variation	df	statistic *f*	value *p*
A	14,152.960	3	2161.601	12	26.18	0.000
B	34.023	3	27.289	12	4.98	0.017
C	275,692.700	3	13,003.350	12	84.80	0.000
Variable	Analysis of variance for the variables for 2016					
	intergroup variation	df	intragroup variation	df	statistic *f*	value *p*
A	49,358.670	3	1110.316	12	177.81	0.000
B	71.880	3	2220	12	129.50	0.000
C	237,934.400	3	14,650.540	12	64.96	0.000

Source: own analysis.

In this way, it was possible to arbitrarily identify four clusters. Voivodeships grouped into four clusters include objects similar to each other in terms of the features under analysis (entities in groups 64, 65, and 66). The 2009 classification of voivodeships is illustrated in Table 6.

In 2009 the cluster with the greatest average number of economic operators in the said three groups of the financial sector (cluster 3) included the Mazowieckie and Śląskie voivodeships. Those values exceed several times the corresponding values in the remaining clusters and can be interpreted as the main financial centres of Poland.

[1] When selecting initial centres of the clusters for the research, the distances between all the objects are sorted and objects with constant intervals are then chosen as initial centres of the clusters.

Table 6. Clusters of the voivodeships and their descriptive statistics for 2009

Cluster	Entities of the cluster in 2009	Variable	Descriptive statistics of entities belonging to the cluster		
			average (entities)	standard deviation (entities)	coefficient of variance (%)
1	Kujawsko-Pomorskie, Lubelskie, Łódzkie, Zachodniopomorskie	A	1087.3	184.9	17.0
		B	57.3	11.3	19.8
		C	5650.5	646.6	11.4
2	Dolnośląskie, Małopolskie, Pomorskie, Wielkopolskie	A	1535.3	399.7	26.0
		B	65.5	35.6	54.3
		C	8797.8	811.3	9.2
3	Mazowieckie, Śląskie	A	3484.0	1243.1	35.7
		B	183.0	148.5	81.1
		C	16,193.0	2944.4	18.2
4	Lubuskie, Opolskie, Podkarpackie, Podlaskie, Świętokrzyskie, Warmińsko-Mazurskie	A	460.2	83.1	18.1
		B	33.5	14.6	43.5
		C	3194.3	470.1	14.7

Source: own research.

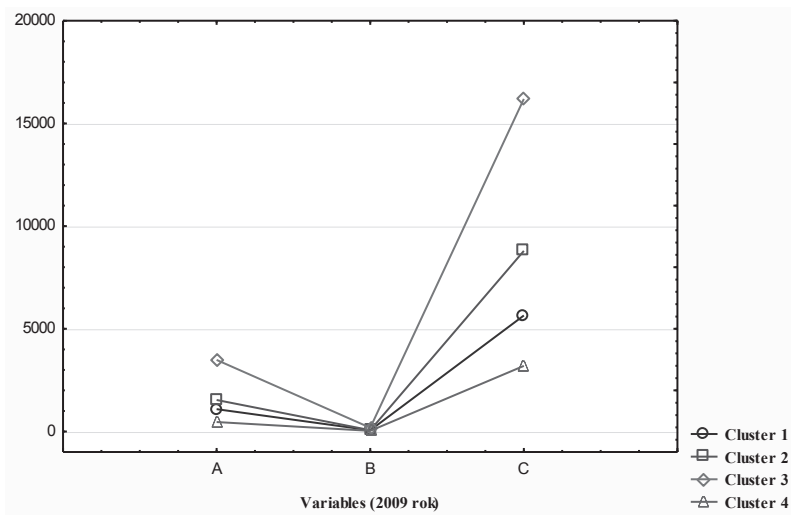

Figure 2. Average number of entities in three groups of PKD for the clusters in 2009

Source: own research.

Figure 2 presents the average number of entities in three PKD groups under section K for each cluster in 2009.

Cluster 2 is a concentration of areas of the western and southern parts of Poland, specifically of the Dolnośląskie, Małopolskie, Pomorskie and Wielkopolskie voivodeships. That cluster is characterised by the relatively high average number of financial companies, especially of those operating activities ancillary to financial services. Cluster 1 is a group of four voivodeships: Kujawsko-Pomorskie, Lubelskie, Łódzkie and Zachodniopomorskie. The standard deviation values and the variance coefficient value for the number of financial companies for 2009 indicate a slight regional diversity among those voivodeships. On the other hand, cluster 4 is a group of voivodeships with the lowest average number of entities under analysis. It comprises such voivodeships of eastern Poland as the Podkarpackie, Podlaskie, Świętokrzyskie and Warmińsko-Mazurskie voivodeships as well as the two smallest voivodeships of western Poland, the Lubuskie and Opolskie voivodeships. The average number of financial institutions operating financial service activities, excluding insurance and pension funding of activities, in that cluster is more than two or three times lower compared to the average number of entities calculated for clusters 1 and 2, and more than seven times lower when compared to cluster 3.

The classification results achieved for 2016 and the average values for the clusters for that year are presented in Table 7 and Figure 3. Those results show a similar geographical division of financial and insurance companies according to population

Table 7. Clusters of the voivodeships and their descriptive statistics for 2016

Cluster	Entities of the cluster in 2016	Variable	Descriptive statistics of entities belonging to the cluster		
			average (entities)	standard deviation (entities)	coefficient of variance (%)
1	Kujawsko-Pomorskie, Lubelskie, Łódzkie, Pomorskie, Zachodniopomorskie	A	1180.6	264.2	22.4
		B	65.0	12.3	19.0
		C	5250.8	1075.3	20.5
2	Dolnośląskie, Małopolskie, Śląskie, Wielkopolskie	A	2598.8	516.4	19.9
		B	95.3	18.1	19.0
		C	9053.0	1745.6	19.3
3	Mazowieckie	A	7738.0	0.0	0.0
		B	327.0	0.0	0.0
		C	17,510.0	0.0	0.0
4	Lubuskie, Opolskie, Podkarpackie, Podlaskie, Świętokrzyskie, Warmińsko-Mazurskie	A	522.3	78.8	15.1
		B	41.7	11.2	27.0
		C	2699.3	420.5	15.6

Source: own research.

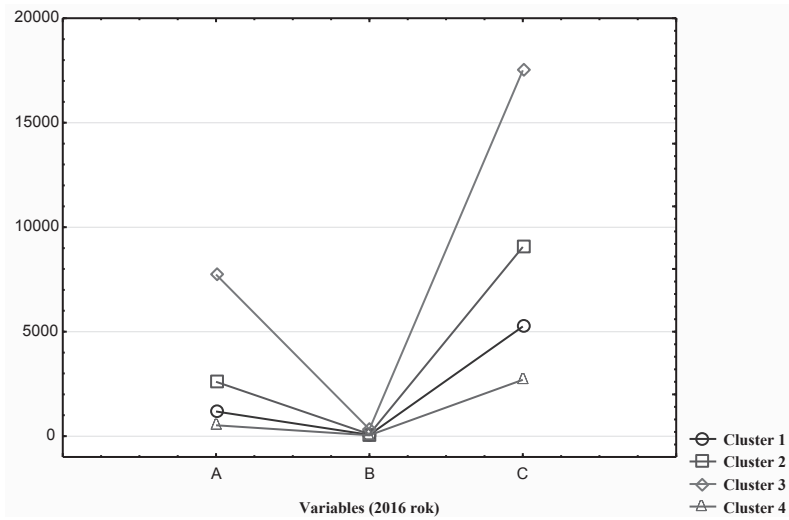

Figure 3. Average number of entities under three groups of PKD for the clusters in 2016

Source: own research.

noted in the analysis for 2009. Cluster 3 isolated the Mazowieckie voivodeship as a stand-alone region, the biggest cluster of companies in the sector analysed in the country. The second cluster in terms of average employment in the groups of PKD under consideration was cluster 2, comprising voivodeships in south-western Poland. Cluster 1 includes voivodeships of central Poland and coastal voivodeships. The average employment in the financial and insurance sector here was lower than for clusters 2 and 3. Cluster 4, mainly comprising voivodeships of eastern Poland, was identical in its composition to 2009. That cluster noted a decline in the average number of entities in group (66) of the financial sector and an increase in groups (64 and 65).

Since clusters 1, 2, and 3 slightly changed their composition over the years under analysis, it is inadvisable to compare the average number of companies among them. However, one has to note an increase in the average number of entities in all the groups of the financial and insurance sector for clusters 2 and 3 as well as an increase in the average number of entities in groups 64 and 65 along with its decrease in group 66 of PKD under section K observed in cluster 1.

In addition, due to the fact that the number of financial and insurance entities – depending on the group – in the Mazowieckie voivodeship was between 16% and 28% of the total number of operators in that sector in Poland, the voivodeships were classified without the Mazowieckie voivodeship in the analysis performed with the use of the *k*-means method. Those studies are not presented in this paper. The clustering results for the years compared were very similar to each other in terms of the cluster composition. The Śląskie voivodeship became the leader and formed a separate cluster 3.

6. Conclusions

The research suggests that over the analysed years, the total number of entities operating in the financial and insurance sector in Poland declined by about 6 thousand entities. The decline covered mostly companies operating activities ancillary to financial, insurance and pension funding services. The percentage of that group of PKD (C) in 2016 was above 77% of all the companies operating in the entire sector. Over time, the regional diversity in the number of economic operators in the financial sector has increased. The Mazowieckie voivodeship noted the greatest increase – the percentage of financial companies operating there increased by more than 11 pp (over 77%). The main agglomerations of southern and western Poland also are characterised by a high concentration of such companies and it is on the increase. Changes in the number of operating financial entities affect the employment level in such entities. For a majority of the voivodeships, the trends show a statistically significant, negative development trend in the phenomenon under analysis. For the voivodeships with a downward trend in employment in the financial sector, the annual decline in employment is between 0.51% and 4.04%.

Decreasing employment, caused by fewer people being employed in the financial sector, triggered economic changes, the outcome of which were regulations of the Polish Financial Supervision Authority resulting in the slower evaluation of credit requests by banks. The lower employment level in the Polish financial sector could also be a result of the development of online banking or the broadly understood development of information technologies in the banking sector. In addition, of significance is the increasingly higher social awareness of online banking as well as the introduction of new cashless payment solutions. Reductions in employment are also an effect of numerous changes in the ownership of financial entities. The consolidation of companies resulting in mergers of departments may lead to fewer jobs.

Striving to cut costs and facing competition, also from non-banking entities, will affect the further development of online banking. Taking into consideration the trends that can be observed in the worldwide markets, the Polish financial sector has introduced a lot of changes entailing e.g. the improvement of operations and customer relations hence they are not threatened so much by competition from economic operators characterised by a more traditional approach to the distribution of banking services. In Poland, there is a different situation due to the very innovative character of the banking business and continuous attempts to improve customer service. The introduction of mobile banking may be named as an example of the above in the banking sector. It should be assumed that the oncoming years will be marked by a steady progress in promoting mobile banking in the banking sector. Technological advancement and a change of the mentality of clients will be decisive factors in the development of banks in this regard. Nowadays, development is so rapid that sometimes it is difficult to identify trends in banking services which will become popular and natural in a few years. Striving towards modernity must be accompanied by ensuring high standards of services provided, especially in terms of cyber-security.

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ZATRUDNIENIE I PODMIOTY EKONOMICZNE W POLSKIM SEKTORZE FINANSOWYM W LATACH 2005-2016

Streszczenie: W artykule przeanalizowano zatrudnienie w sektorze finansowym i podmiotach prowadzących działalność finansową, ubezpieczeniową lub inną. Celem niniejszego opracowania jest zbadanie zatrudnienia w sektorze finansowym na poziomie województw oraz zarejestrowanych podmiotów tego sektora z wykorzystaniem wielowymiarowych metod analizy statystycznej. Wyniki klasyfikacji wskazują na geograficzny podział kraju pod względem liczby firm finansowych i ubezpieczeniowych. Jednak wysokie nachylenie współczynnika kierunkowego oznacza bardzo silną, rosnącą tendencję dotyczącą województwa mazowieckiego, charakteryzującą się znacznie wolniejszym trendem dla województw dolnośląskiego, pomorskiego i śląskiego. W rzeczywistości w odniesieniu do większości województw trendy wskazują statystycznie istotny, negatywny trend rozwojowy dla analizowanego zjawiska z lat 2005-2016.

Słowa kluczowe: sektor finansowy, zatrudnienie, podmioty gospodarcze, metoda k-średnich, trendy.