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## AVAILABILITY OF LAND RESOURCES IN INDIVIDUAL FARMS IN POLAND AND CONVERGENCE OF THE FARM'S INCOME AFTER POLAND'S ACCESSION TO THE EU\*

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**Abstract.** The aim of the article is to determine whether, after the Polish accession to the EU, there were trends for convergence/divergence income of individual farms from areas with different or similar equipment in the land factor (quantitative and qualitative). The study included individual farms FADN in different regions in Poland. The analysis were based on data from the statistical publications of the Central Statistical Office of Poland as well as accounting information on income from agricultural activity in individual farms covered by the Polish FADN. It has been proven that the equipment in the land factor is the determinant of leveling the value of agricultural income (convergence) between farms from areas with similar equipment in this factor.

**Keywords:** land factor, income from agricultural activities, convergence

### INTRODUCTION

Land is the key determinant of production potential in agriculture. Already the physiocrats believed it to be the main source of rent for the productive class (land owners), viewed as the only class that creates new value in the economy. According to them, the rent was the

farm's income for the use of a non-renewable natural resource (Blaug, 2000). This means land rent, defined as the remuneration (surplus) for the sole fact of owning and using land for agricultural purpose. Afterwards, the theory of land rent was developed as a part of classical economics by A. Smith, T. Malthus and D. Ricardo (Czyżewski, 2009, 2013). Today, on foot of what was said by Wilkin (2015) and Brodzińska (2009), it could be concluded that land continues to be the key (and indispensable) input for the agricultural production. Wilkin writes that “agricultural land was and will be an extremely important and scarce productive, natural and cultural resource. Preserving the land continues to be an important responsibility.” In turn, Brodzińska (2009) believes that other resources (labor and capital) are decisive only for the utilization level of land. Therefore, despite the progress in agriculture, land remains an essential and scarce productive input. Irrespective of the agricultural production system (extensive or intensive farming), it is still impossible to decouple the agriculture from land and environmental conditions. The agriculture sector is not the sole but the most important user of land due to spatial nature of production processes and large farming areas (Baer-Nawrocka and Mrówczyńska,

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2007; Maśniak, 2010). Unlike most of other productive inputs, agricultural land is not mobile: it cannot be moved between various locations on the earth. According to Czyżewski and Kułyk (2014), the immobility of land needs to be compensated with financial support for the agriculture. They also believe that (2015) “today, the agrarian issue means primarily the consequence of the immobility of land; the difficulties in capital accumulation; the farms’ ability to generate a margin; and the incomplete accounting of rent.” As demonstrated by the above, the availability of land resources is one of the key determinants for the spatial location and profitability of agricultural production. The farm’s area is considered to be the basic determinant of the farmer’s income. Gołębiewska and Szymańska (2005) surveyed a sample group of Polish FADN farms (a comparative analysis for 1991 and 2001). As shown by the results, the farms with higher agricultural incomes own a much larger than average area of agricultural land and demonstrate lower rates of employment per 100 ha of agricultural land. This was also confirmed in subsequent studies by other authors. For instance, Sass (2015) used the example for FADN farms from the Kujawsko-pomorskie voivodeship to demonstrate that the highest growth of income in 2004–2011 was recorded by farms with the highest increase in land area. Bórawski and Lewczuk (2008) identified a considerable variation of economic performance in FADN farms from the Mazowsze and Podlasie regions (in 2004–2006). According to the observations, the economic performance indicators (economic size in ESU, gross added value, family farm income, income per full-time non-salaried employee) tend to improve as the farm’s area grows. Therefore, in various types of farms in specific EU member countries, the area of agricultural land is the key positive determinant of income levels (Poczta et al., 2009). These findings further emphasize the priority of land over other productive inputs in the development of the economic situation of farms in the EU. According to the results of studies cited above, the availability of land resources could be a determinant for the convergence of farms, which means similar levels of income. In the most general terms, convergence is defined as “approximation” or “similarity” of various socio-economic aspects in the countries under comparison. The “economic convergence” was introduced to the economic literature by R. Barro and X. Sala-Martin in the context of the macroeconomic growth theory (Malaga, 2004). In this paper, the farm’s income is used to

measure the convergence trend, having in mind that the income is the key determinant of the economic situation of a farm. It represents the basic economic objective and is critical for the survival of traditional farms (Zegar, 2003). The level of income makes the difference between commercial and subsistence farms (is decisive for the capital accumulation rate). Therefore, it is particularly important as it represents a value comparable to disposable incomes (Czyżewski and Kryszak, 2015). The purpose of this paper is to determine whether Poland’s accession to the EU was followed by the emergence of a trend of converging/diverging incomes of individual farms located in areas with a different (or similar) availability of land resources. This paper advances a hypothesis that Poland’s accession to the EU was followed by an increased differentiation (divergence) of agricultural incomes of individual farms located in regions (voivodeships) with a different availability of land resources. Meanwhile, there was an equalization (convergence) of incomes earned by farms in areas with a similar availability of land resources.

## RESEARCH METHODOLOGY

To identify the areas with different and similar patterns of land availability, the Ward’s clustering method was employed, based on Euclidean distance. The Polish voivodeships (regions) were grouped based on data on the quantity and quality of land in specific voivodeships, as provided in the 2002 general agricultural census. The indicators and measures of the availability of land resources are presented in Table 1. Having identified the clusters of regions with similar availability of land resources, the next step was to assess the differentiation of income levels reported over the 2004–2012 period by individual farms located in these areas. This was done with the use of data on the agricultural incomes earned by individual farms who hold accounts within the FADN agricultural accounting system. The timeframes for the analyses was the period from 2004 to 2012. The study spanned over all Polish voivodeships, focusing on individual farms who held FADN accounts in each year of the survey period. The material scope of the study was the level of agricultural incomes. The  $\sigma$ -convergence was used to assess the convergence/divergence of incomes of individual FADN farms within and between region clusters with similar availability of land resources. The presence of  $\sigma$ -convergence means

a decreasing variation of data between initially different entities (Malaga, 2004). The concept of  $\sigma$ -convergence is an attempt to explain the long-term trends of disparity in wealth within a certain group of countries. The standard deviation of natural logarithms of wealth measures (usually, per capita GDP) at a certain moment  $t$  is a widely adopted measure of dispersion within a group of countries.  $\sigma$ -convergence exists when the standard deviation of natural logarithms of the adopted wealth measure within a group of countries tends to fall over time. Otherwise, divergence is observed. In accordance with the methodology used in this paper, convergence means the equalization of income levels in farms from voivodeships belonging to the same cluster (similar availability of land resources) or in farms from different clusters, representing areas with different availability of land resources. The calculations were based on the following formula:

$$\sigma_t = \sqrt{\sum_{i=1} (\ln y_{it} - \ln \bar{y}_t)^2} \quad (1)$$

with:

$i$  – voivodeship index,

$y_{it}$  – value of agricultural income earned by individual FADN farms in voivodeship  $i$  in year  $t$ ,

$\bar{y}_t$  – average level of agricultural income in the group (cluster) of voivodeships considered in year  $t$ .

## RESULTS OF THE STUDY

Table 1 shows the distribution of values of all three criteria used to delimit the areas demonstrating similar and different availability of land resources based on the Ward's method.

A qualitative assessment of the availability of land resources is illustrated by the indexation rate of agricultural production area. It allows to represent the following features of the agricultural realm with a single number: quality and agricultural usability of soils, climate conditions affecting the agriculture, water conditions and land relief (Klepacki, 1997). The higher is the score, the better is the availability of land resources and the better are the properties of land. Based on the above, it may be concluded that the best availability of land resources, in qualitative terms, is demonstrated by individual farms from the Opolskie voivodeship while the worst patterns are observed in the Podlaskie voivodeship. In quantitative terms, the available land resources in farms from various Polish voivodeships were illustrated by the

share of agricultural land of individual farms in the total area of agricultural land in the voivodeship, and by the average size of an individual farm (in ha). The lowest value of the above criterion was recorded in the Zachodniopomorskie and Lubuskie voivodeships while the highest value was observed in the Łódzkie voivodeship. As regards the average size of an individual farm (in ha), there was definitely a greater differentiation, with barely 3.5 ha in the Podkarpackie voivodeship and as much as nearly 17 ha in the Warmińsko-Mazurskie region. Taking all three criteria (standardized due to different units) into account, the Ward's cluster analysis allowed to identify two voivodeship clusters with similar levels of available land resources (see Fig. 1). The first cluster was composed of the following voivodeships: Podlaskie, Mazowieckie, Łódzkie, Śląskie, Podkarpackie, Świętokrzyskie, Małopolskie and Lubelskie. The second cluster included the Zachodniopomorskie, Warmińsko-Mazurskie, Wielkopolskie, Pomorskie and Kujawsko-Pomorskie voivodeships. In view of the findings of the analysis, individual farms from the Lubuskie, Opolskie and Dolnośląskie voivodeships were excluded from the convergence test. According to the results of the Ward's analysis, they were not clustered with any other region. Therefore, the levels of land resources available to farms located in these areas were incomparable to those recorded in other voivodeships.

The average indexation rate of agricultural production area was only slightly better in cluster B than in cluster A (67.1 compared to 65.5). Meanwhile, individual farms from voivodeships contained in both clusters differed in terms of the share of individual farms' agricultural land in the total area of agricultural land in the voivodeship concerned, and in terms of the average size of individual farms (ha). As regards the first criterion, the average share was as high as over 95% in cluster B, compared to 80% in cluster A. The average size of individual farms (ha) was nearly 2.5 times larger in cluster B than in cluster A (13.64 ha compared to 5.8 ha). The income situation of individual farms from the identified clusters was tested for convergence based on information collected by the Polish FADN. The author realizes that it would be better to use information on the profitability of all individual farms from specific voivodeships during the period under consideration. However, this data is unavailable. Note also that information collected by the Polish FADN is actually the only source of microeconomic financial and accounting

**Table 1.** Criteria for the delimitation of areas of similar and different furnishing of individual farms in Poland in land factor  
**Tabela 1.** Kryteria delimitacji obszarów o podobnym i odmiennym wyposażeniu gospodarstw indywidualnych w czynnik ziemi w Polsce

Voivodeship Województwo	The indexation rate of agricultural production area Wskaźnik waloryzacji rolniczej przestrzeni produkcyjnej w punktach	Part area of individual farms in the total agriculture area Udział powierzchni UR gospodarstw indywidualnych w powierzchni UR ogółem	The average size of an individual farm (ha) Przeciętna wielkość gospodarstwa indywidualnego (ha)
Dolnośląskie	74.9	78.8	10.3
Kujawsko-Pomorskie	71	89.5	12.6
Lubelskie	74.1	95.4	6.3
Lubuskie	62.3	67.1	8.8
Łódzkie	61.9	98.3	6.5
Małopolskie	69.3	96.8	3.2
Mazowieckie	59.9	97.3	7.2
Opolskie	81.4	71.5	8.9
Podkarpackie	70.4	91.1	3.5
Podlaskie	55	96.7	10.9
Pomorskie	66.2	80.5	12.6
Śląskie	64.2	90.2	4
Świętokrzyskie	69.3	97.9	4.9
Warmińsko-Mazurskie	66	79.3	16.9
Wielkopolskie	64.8	83.9	10.8
Zachodniopomorskie	67.5	67.0	15.3

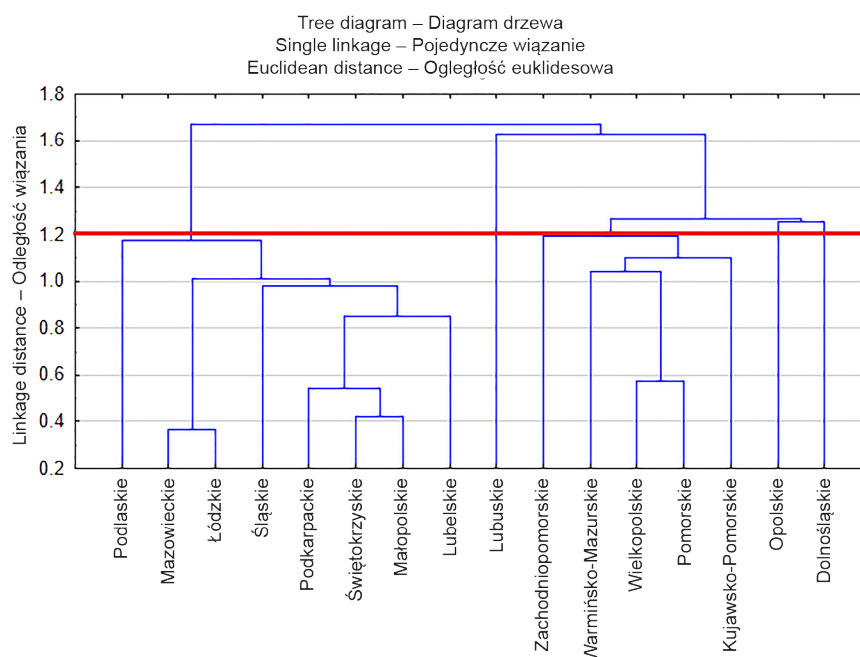
Source: own elaboration based on: GUS, 2003a, 2003b, 2014; Witek, 1993.

Źródło: opracowanie własne na podstawie: GUS, 2003a, 2003b, 2014; Witek, 1993.

data enabling the analysis of convergence as planned in this study. The highest agricultural income was reported in FADN farms from the Lubuskie region, followed by the Opolskie region (see Table 2). As they were not clustered with any other voivodeship, it could be concluded that individual farms from these regions experienced a different availability of land resources. The reason was the relatively low share of the individual farms' agricultural land in the total area of agricultural land and the medium size (compared to other voivodeships) of farms in ha (cf. Table 1).

The definitely lowest incomes were recorded in FADN farms located in the Małopolskie and Podkarpackie voivodeships which also demonstrated the smallest size of farms (ha) compared to other regions. These

voivodeships were included in cluster A where the average income per individual FADN farm in 2004–2012 was 30% less than in cluster B (PLN 53,901 compared to PLN 77,135 on average over the entire period under consideration). Note also that the disparity of incomes between these clusters was moderate, especially having regard to the much larger differences in the size of farms between clusters A and B. As already mentioned, the average figures in cluster B were as much as 2.5 times higher than in cluster A. Such a small disparity in incomes could result from the structure of the Polish FADN sample, as the economic strength of the farms covered was above the regional average (Czyżewski and Kryszak, 2015).



**Fig. 1.** Agglomerations of voivodeship with different furnishing in the land factor  
Source: own elaboration based on: GUS, 2003a, 2003b, 2014.

**Rys. 1.** Skupienia regionów (województw) różniące się wyposażeniem w czynnik ziemi  
Źródło: opracowanie własne na podstawie: GUS, 2003a, 2003b, 2014.

According to the study, after Poland's accession to the EU, there was a reduction in the disparity of incomes earned by FADN farms in both clusters. While cluster B demonstrated a greater convergence, the income disparity within that cluster was smaller than in cluster A already in 2004, as confirmed by the lower standard deviations in this group of regions. In cluster A, a slight divergence of income amounts could be observed only in 2005. However, the disparity decreased in each of the subsequent years of the period concerned. In cluster B, the incomes have demonstrated a consistent convergence trend (against the 2004 baseline) since 2005. In 2012, the standard deviation in this group of regions was only 0.13 (compared to 0.21 in 2004, see Table 3).

When comparing 2004 and 2012 data, it can be concluded that the range of income disparity between FADN farms from various regions remains relatively stable. An important interregional convergence process was observed in 2011. However, it was followed by a divergence of the farm's income situations. As a consequence, the level of income disparities between farms

from cluster A and cluster B almost went back to square one. Thus, it cannot be concluded that an interregional convergence trend was observed throughout the period under consideration. The years of convergence on an annual basis (2006, 2008) were followed by a divergence of income levels (2007, 2009). In contrast, there was a convergence trend in clusters A and B, i.e. in groups of voivodeships demonstrating similar levels of availability of land resources. The strongest convergence of incomes in FADN farms was recorded in cluster B which demonstrated a better availability of agricultural land resources than regions in cluster A. This illustrates that the availability of land resources to individual farms could be a determinant for the convergence of individual farms. Therefore, only the second part of the hypothesis advanced in this paper was adopted: Poland's accession to the EU was followed by an increased differentiation (divergence) of agricultural incomes of farms located in regions (voivodeships) with a different availability of land resources. Meanwhile, there was an equalization (convergence) of incomes earned by farms in areas with

**Table 2.** Average agricultural income of individual farms in FADN regions and agglomerations in 2004–2012 (PLN)

**Tabela 2.** Wartości przeciętnych dochodów z działalności rolniczej indywidualnych gospodarstw rolnych FADN w poszczególnych województwach oraz skupieniach w latach 2004–2012 (zł)

Voivodeship Województwo	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average Średnia
Dolnośląskie	47 089	41 291	54 775	72 908	63 216	47 538	103 039	121 992	127 088	75 437
Kujawsko-Pomorskie	62 617	54 780	68 701	73 448	78 011	73 520	94 850	110 762	120 728	81 935
Lubelskie	28 068	24 341	36 055	48 313	43 307	39 311	68 678	79 324	85 797	50 355
Lubuskie	58 639	103 542	73 468	102 983	74 071	93 506	125 265	124 175	148 575	100 469
Łódzkie	32 766	38 105	44 485	47 075	41 825	37 934	64 297	68 727	64 760	48 886
Małopolskie	24 824	25 923	36 440	43 839	30 776	35 531	42 608	54 608	56 475	39 003
Mazowieckie	35 410	41 430	48 393	53 456	47 946	43 160	65 118	75 284	70 173	53 375
Opolskie	61 365	49 609	64 436	92 771	79 417	72 555	114 081	165 744	161 123	95 678
Podkarpackie	22 380	23 977	33 446	39 178	33 041	32 482	43 831	59 122	70 885	39 816
Podlaskie	42 702	52 221	64 795	66 856	64 878	59 846	84 430	104 472	89 753	69 995
Pomorskie	56 965	52 713	69 174	78 441	61 782	59 032	99 660	98 052	104 729	75 616
Śląskie	48 678	4 818	65 166	75 528	63 970	51 041	68 061	87 803	100 699	67 085
Świętokrzyskie	45 028	53 531	65 697	69 238	51 954	54 673	71 892	83 073	69 169	62 695
Warmińsko-Mazurskie	36 805	50 632	59 499	78 414	53 621	53 154	79 963	95 941	110 778	68 756
Wielkopolskie	53 635	59 867	69 879	69 965	61 730	68 031	88 105	91 859	95 094	73 129
Zachodniopomorskie	58 618	66 793	71 915	100 459	66 949	74 344	104 034	101 107	131 936	86 239
Średnia	44 724	48 848	57 895	69 554	57 281	55 979	82 369	95 128	100 485	68 029
Skupienie A	34 982	37 793	49 310	55 435	47 212	44 247	63 614	76 552	75 964	53 901
Skupienie B	53 728	56 957	67 834	80 145	64 418	65 616	93 323	99 544	112 653	77 135

Source: own elaboration based on data from Polish FADN.

Źródło: opracowanie własne na podstawie danych Polskiego FADN.

**Table 3.** The coefficients of  $\sigma$ -convergence between FADN farms from areas with different (between agglomerations) and with similar (within the agglomerations) furnishing in the land factor

**Tabela 3.** Współczynniki  $\sigma$ -konwergencji pomiędzy gospodarstwami FADN z obszarów o odmiennym (pomiędzy skupieniami) i podobnym (w ramach skupień) wyposażeniu w czynnik ziemi

Years Lata	2004	2005	2006	2007	2008	2009	2010	2011	2012
Between agglomerations – Pomiędzy skupieniami									
	0.30	0.29	0.23	0.26	0.22	0.28	0.27	0.19	0.28
Within the agglomerations – W ramach skupień									
A	0.29	0.33	0.29	0.24	0.27	0.22	0.24	0.21	0.19
B	0.21	0.11	0.07	0.14	0.14	0.15	0.10	0.07	0.13

Source: own elaboration based on individual data of FADN farms.

Źródło: obliczenia własne na podstawie indywidualnych danych rachunkowych gospodarstw FADN.

a similar availability of land resources, as demonstrated by the analyses. However, this study does not provide a basis for concluding that an increased differentiation (divergence) of agricultural incomes of individual farms located in regions (voivodeships) with a different availability of land resources has been observed since 2004. This paper proves that the interregional disparity of income levels remained relatively stable.

## SUMMARY

For the agriculture, land is the most important productive input. Due to specific features of land, today's agrarian considerations focus on compensating for the consequences of immobility of land with financial support for the agriculture sector. The availability of land resources is one of the key determinants for the spatial location and profitability of agricultural production. As emphasized by the promoters of the location theory, i.e. A. Lösch (1940) and A. Weber (1909), the spatial differentiation of activities is a way for the society to use the best natural resources and values. This is especially true for the agriculture, because of the sole fact that agricultural activities depend on natural resources. These assertions are supported, for instance, by the outcomes of numerous studies demonstrating that the farm's area is a basic factor with a positive effect on the farmers' incomes. Moreover, according to the results of analyses covered by this paper, the availability of land resources could be a determinant for the convergence of the income situation of farms located in areas with similar availability of land resources. That trend was not observed in the case of individual farms located in areas with different availability of land resources. The disparity of their income levels remained relatively stable throughout the period under consideration (2004–2012). Therefore, the analyses suggest that the availability of land resources is not only a determinant for the spatial location and profitability of agricultural activities, but may also be decisive for the convergence or increasing differentiation of incomes earned by farms located in areas with similar or different availability of land resources. While these findings are the reason behind the spatial differentiation of agriculture, they also mean that a progressing convergence of agricultural activities could be expected in areas with similar availability of land resources (in qualitative and quantitative terms) to the farms. Note however that the quantity and quality

of the human factor and of physical capital might also be of importance to this issue. This stresses the need for further analyses to address these findings.

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## WYPOSAŻENIE W ZIEMIĘ INDYWIDUALNYCH GOSPODARSTW ROLNYCH W POLSCE A KONWERGENCJA ICH DOCHODÓW PO AKCESJI POLSKI DO UE

**Streszczenie.** Celem artykułu jest próba odpowiedzi na pytanie, czy po przystąpieniu Polski do UE wystąpiły tendencje do konwergencji/dywergencji dochodów gospodarstw indywidualnych z obszarów o odmiennym bądź podobnym wyposażeniu w czynnik ziemi (w ujęciu ilościowym i jakościowym). Badaniem objęto gospodarstwa indywidualne FADN poszczególnych województw w Polsce. Analizy przeprowadzono na podstawie danych pochodzących z publikacji Głównego Urzędu Statystycznego RP, a także informacji rachunkowych dotyczących dochodów z działalności rolniczej w indywidualnych gospodarstwach rolnych objętych systemem Polskiego FADN. Udowodniono, że wyposażenie w czynnik ziemi stanowi determinantę wyrównywania poziomu dochodów z działalności rolniczej (konwergencji).

**Słowa kluczowe:** czynnik ziemi, dochody z działalności rolniczej, konwergencja

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