STUDIA OECONOMICA POSNANIENSIA 2018, vol. 6, no. 2

DOI: 10.18559/SOEP.2018.2.4

Joanna Średzińska
Poznań University of Life Sciences, Faculty of Economics and Social Sciences, Department of Economy and Economic Policy in Agribusiness
sredzinska@up.poznan.pl

DETERMINANTS OF THE INCOME OF FARMS IN EU COUNTRIES[1]

Abstract: The aim of the research was to identify determinants of the income of farms in the EU-15 as well as in Central and Eastern European countries and to assess how these determinants varied over time. The research was based on data from the FADN and it spanned the period from 2005 to 2013. Multiple regression was used to investigate the influence of selected variables on the income of farms. The analysis showed that apart from a wide range of similarities between farms in the EU-15 as well as in Central and Eastern European countries, there are also some differences between the determinants of their income. They usually refer to variables representing the production potential.

Keywords: income of farms, determinants of income, FADN, multiple regression.

JEL classiffication: Q14.

CZYNNIKI KSZTAŁTUJĄCE DOCHODY GOSPODARSTW ROLNYCH W KRAJACH UNII EUROPEJSKIEJ[2]

Streszczenie: Celem artykułu jest określenie czynników determinujących dochody gospodarstw rolnych w krajach UE-15 i Europy Środkowo-Wschodniej oraz próba oceny zmian tych czynników w czasie. Do realizacji powyższego celu wykorzystano dane z bazy FADN. Zakresem czasowym objęto lata 2005–2013. Do zbadania wpływu

[1] The project was financed from funds of the National Science Centre upon decision No. DEC-2012/05/B/HS4/04134.

[2] Projekt został sfinansowany ze środków Narodowego Centrum Nauki przyznanych na podstawie decyzji numer DEC-2012/05/B/HS4/04134.

wybranych zmiennych na dochód z gospodarstwa rolnego posłużono się regresją wieloraką. Przeprowadzona analiza wykazała, że poza szeregiem podobieństw między gospodarstwami krajów UE-15 i EŚW w zakresie czynników kształtujących dochód z gospodarstwa rolnego, występują też pewne różnice, a dotyczą one w szczególności zmiennych reprezentujących potencjał wytwórczy.

Słowa kluczowe: dochody gospodarstw rolnych, determinanty dochodów, FADN, regresja wieloraka.

Introduction

Income from agriculture is one of the basic measures of management efficiency (Felczak, 2014, p. 80). It is often studied by agricultural economists, because it is decisive not only to farm development but also to the quality of life in the farmer's family. Income gained by a farm should be sufficient to cover the actual costs of its operation, to provide remuneration for the work done by the farmer and family and for their own capital invested in the farm (Goraj & Mańko, 2009, p. 220). In all countries around the world agricultural producers' income is lower than income gained in other sectors of the economy. In spite of a broad spectrum of intervention instruments applied as part of the Common Agricultural Policy (CAP) the problem of income disparity can also be observed in most EU countries (Baer-Nawrocka, 2015, p. 183). For this reason agricultural income is continuously an area of interest for agricultural policy. According to Kołoszko-Chomentowska (2007, p. 241), the search for possibilities to increase agricultural producers' income should be preceded by an identification of determinants of this income. Due to the high variability of factors influencing the economics of farms' operation it is necessary to conduct regular research on the subject.

The determinants of agricultural income include both exogenic and endogenic conditions. According to Gołębiewska (2008, p. 91), under specific conditions (geographical location) success on the market is chiefly determined by internal forces. Likewise, according to Rembisz (2006, p. 15), producer-dependent factors have greater influence on income, especially the long-term one, because they affect improvement in production efficiency. This thesis was also assumed in this article, which focuses on endogenic factors.[3] However, as Baer-Nawrocka (2015, p. 184) proves, the amount of income gained by agricultural producers in the EU is also considerably determined by instru-

[3] It was also caused by the availability of data from the FADN, which provided necessary information for the research.

ments of the agricultural policy, especially by direct payments, which are a basic exogenic determinant. What is more, in nearly all new member-states income disparity was considerably reduced when these countries joined the EU. It resulted from the application of the CAP instruments in the agricultural sector in these countries. In view of this fact, it seems interesting to answer the question which factors determine agricultural income in the EU-15 and in the new member-states and whether they change over time. It is necessary to stress the fact that the current situation of farms in EU countries is the consequence of historical events. There were differences between structural transformations occurring in the western and eastern part of the EU.[4] This fact lets us suppose that different factors favour an improvement of the situation of farms in these two parts of the EU. As results show from the study by Średzińska & Poczta (2012, 211–218), there are different determinants of the financial situation in these groups of countries. Therefore, we can also postulate that there are different determinants of income gained by farms.

Having taken the abovementioned facts into consideration, the aim of this article is to identify determinants of the income of farms in the EU-15 and in the other countries belonging to the Community and to assess how these determinants vary over time.

Methods

Information provided by the Farm Accountancy Data Network (FADN) was used to achieve the goal of the study. The territorial range of the study comprised regions[5] identified in the EU countries for the FADN purposes, except Malta and Cyprus.[6] The research was conducted on two groups of countries, i.e. the EU-15 and new member-states from Central and Eastern Europe. The research spanned the period from 2005 to 2013,[7] which was divided into three three-year subperiods.[8]

[4] For more information see Poczta, Sadowski, & Średzińska (2008, pp. 42–43).

[5] The data were analysed in a regional rather than national approach in order to increase the number of cases in the regression analysis.

[6] Malta and Cyprus were not analysed due to the marginal significance of agriculture in these countries.

[7] The choice of the period for the research was largely caused by the availability of data. When the research was being conducted, the latest data available in the FADN database covered 2013.

[8] The division into three-year subperiods resulted from agriculture-specific high variability in prices and volume of production due to weather conditions and other exogenic factors. Data covering one-year periods may have a random nature, which might significantly distort

Due to the complexity of the research subject multiple regression[9] was used to identify the determinants of agricultural income. Income gained by a family farm (SE420[10]) was assumed as a dependent variable (Y). The following explanatory variables were selected on the basis of a substantive premise:[11]

- X_1 – total workload (AWU)[12] (SE010),
- X_2 – farmland area (FL) (ha) (SE025),
- X_3 – value of assets less value of land, permanent crops and production quotas (€) (SE436-SE446),
- X_4 – technical equipment used at work, measured with the value of fixed assets per full-time employee (€/AWU) (SE436/SE010),
- X_5 – technical equipment used in farmland, measured with the value of fixed assets per ha of farmland (€/ha) (SE436/SE025),
- X_6 – land used for work, measured with the farmland area per full-time employee (ha/AWU) (SE025/SE010),
- X_7 – current assets per ha, measured with the value of intermediate consumption per ha of farmland (€/ha) (SE275/SE025),
- X_8 – fixed assets per ha, measured with the value of depreciation per ha of farmland (€/ha) (SE360/SE025),
- X_9 – total production value (€) (SE131),
- X_{10} – crop production per ha of farmland (€/ha) (SE136),
- X_{11} – animal production per LU[13] (€/LU) (SE207),
- X_{12} – marketability of production (%) ((SE131-SE260-SE265[14])/SE131*100),
- X_{13} – percentage of costs of external factors (%) (SE365/SE420),
- X_{14} – operating activity subsidies (€) (SE606).

---

inference. The analysis of data covering three years enables at least partial elimination of this problem.

[9] The method was used by Poczta et al. (2009, pp. 17–30) to identify the determinants of income of farms of different agricultural types. The same methodology and similar assumptions were applied in this study.

[10] FADN symbols referring to variables are given in brackets.

[11] An overview of the literature, which justified the choice of explanatory variables, was made in the publications by Średzińska & Poczta (2012, pp. 46–49) and Poczta et al. (2009, pp. 18–19).

[12] Annual Work Unit – work conversion unit (equivalent to 2,120 hours of work in a year) (*Wyniki standardowe*…, 2014, p. 6).

[13] Livestock Unit – animal conversion unit.

[14] The FADN database does not provide information on sales revenue. Therefore, the total value of production less internal consumption and transfer to household was used as a sales revenue equivalent (cf. Gołaś, 2008, p. 76).

The variables listed above were statistically verified. Independent variables should be correlated with a dependent variable rather than other independent variables (Kot, Jakubowski, & Sokołowski 2007, p. 328). We followed the rule that the value of the correlation coefficient between explanatory variables should be lower than the value of the correlation coefficient between them and the explanatory variable (Stanisz, 2007, p. 76). Atypical observations which might distort the results of regression were eliminated from individual datasets by means of Cook's distances (Stanisz, 2007, p. 122; Czekaj, 2006, p. 11). In the FADN database mean values for groups are considered. Therefore, the model parameters were estimated by means of the weighted least-squares. Weights were equal to populations in the groups.[15] The models were substantively and statistically verified. The significance of the parameters of regression equations was verified with a t-test. The significance of the entire model was verified with a global F-test. As the variables assumed for the research had different measurement units, the values of beta coefficients rather than regression coefficients were interpreted. These are standardised model parameters, where the free term is equal to zero (Stanisz, 2007, pp. 43–45, 82). The goodness of fit of the models was assessed by means of a corrected coefficient of determination, which is recommended in multiple regression models (Kot et al., 2007, pp. 326–327).

Results

Table 1 shows the mean values of the variables which were found to be potential determinants of income from family farms in the EU countries. The data referring to the groups of countries under study (EU-15 and CEE) were divided into three-year periods.

During the period under study the income of a family farm in the EU-15 fluctuated from nearly €27,000 to nearly €35,000. The lowest value was noted in the 2008–2010 period, which can be explained with the economic crisis which was observed on the market at the time. This value was noted in farms with an average area of about 75 ha, employment of 2 AWU and considerable amount of assets, whose value, having been reduced by the value of land, permanent crops and production quotas, ranged from nearly €256,000 to slightly

[15] The European Commission does not provide information about the size of the sample in the FADN database. Therefore, the number of farms for which specific information was representative was used as a weight – this number is proportional to the size of the sample.

more than €318,000 during the period under analysis. These farms were characterised by very high values of technical equipment used in farmland, land used for work and fixed assets. These entities were also characterised by the high intensity of production, resulting from the value of current and

Table 1. Potential determinants of income of farms in EU countries between 2005 and 2013 (on average per farm)

Details	Symbol	EU-15			CEE		
		2005–2007	2008–2010	2011–2013	2005–2007	2008–2010	2011–2013
Total workload (AWU)	X_1	2.0	2.0	1.9	3.2	2.6	2.4
Farmland area (ha)	X_2	72.6	75.5	76.3	72.9	58.0	58.7
Value of assets less value of land, permanent crops and production quotas (thous. €)	X_3	255.7	282.6	318.1	160.1	118.6	138.6
Technical equipment used at work (thous. €/AWU)	X_4	190.9	216.6	244.8	37.0	42.2	55.9
Technical equipment used in farmland (thous. €/ha)	X_5	10.7	11.3	12.2	2.7	3.7	4.6
Land used for work (ha/AWU)	X_6	31.6	33.3	35.0	19.1	18.2	19.2
Current assets per ha (€/ha)	X_7	1530.2	1680.7	2029.1	735.4	764.3	803.4
Fixed assets per ha (€/ha)	X_8	383.3	421.9	457.3	153.1	155.7	174.9
Total production value (thous. €)	X_9	124.1	138.1	168.9	67.7	56.9	68.9
Crop production per ha of farmland (€/ha)	X_{10}	1923.6	2046.1	2323.8	590.8	671.3	793.7
Animal production per LU (€/LU)	X_{11}	1007.0	1009.8	1154.0	894.2	867.2	965.2
Marketability of production (%)	X_{12}	95.0	95.0	95.0	87.0	86.7	88.1
Percentage of costs of external factors (%)	X_{13}	17.0	16.7	15.9	16.0	17.2	17.1
Operating activity subsidies (thous. €)	X_{14}	26.7	28.6	29.4	14.9	15.3	16.3
Family farm income (thous. €)	Y	30.2	26.9	34.7	7.3	7.5	12.2

Source: The author's calculations based on http://ec.europa.eu/agriculture/rica/database/database_en.cfm.

fixed assets per ha. This production strategy resulted in high animal and crop productivity. The considerable scale of production combined with a high value of the marketability indicator (95%) give grounds for treating these farms as production enterprises, which chiefly use their own production resources. There was a small share of costs of external factors, which amounted to about 16–17%. The financial result was mostly determined by operating activity subsidies. Between 2005 and 2007 and between 2011 and 2013 they amounted to about 85–88% of income, whereas between 2008 and 2010 they surpassed its value by 6%.

During the period under study the average income in the Central and Eastern European countries ranged from €7,300 to €12,200 per farm. It was a few times less than the value of income gained by farms in the old EU member-states. However, it is necessary to stress the fact that the situation of the new member-states was improving systematically. Between 2005 and 2007 the average income of farms in the Central and Eastern European countries amounted to nearly 25% of the corresponding value noted in farms in the EU-15. However, between 2011 and 2013 this relation reached more than 35%. There were also noticeable changes in the workload of farms in the new member-states. The workload decreased from 3.2 to 2.4 AWU. The average farmland area also became reduced from about 73 to nearly 59 ha.[16] During the period under study the values referring to relations between factors of production in farms in the Central and Eastern European countries were much lower than the values referring to farms in the EU-15. It was especially noticeable in the value of fixed assets referring to work and land. However, it is noteworthy that the distance between the groups of countries under analysis was decreasing slowly but steadily. Farms in the Central and Eastern European countries were characterised by a much more extensive system of management. Intermediate consumption and depreciation per ha of farmland were about 2.5 times lower than the corresponding values noted in farms in the EU-15. It resulted in much lower productivity, especially from crops. There were also considerable differences in the extent to which farms were related to the market. The marketability indicator amounted to about 87–88% and it

[16] This observation should be interpreted with due care. During the period under analysis the EU was extended twice when Central and Eastern European countries joined the Community. This fact influenced some of the values under analysis. For example, having eliminated the data referring to regions in Romania and Bulgaria from the calculations, between 2011 and 2013 the average farmland area was about 92 ha. It points to the fact that during the period under analysis there were some favourable changes in the agrarian structure in the new EU member-states.

was a few percent lower than the corresponding value noted in farms in the old EU member-states. The share of costs of external factors of production amounted to about 16%-17% and was similar to the values noted in farms in the EU-15. Operating activity subsidies were an important determinant of income. They were decisive to the positive financial result as they were more than two times greater than the value of income between 2005 and 2010.

Table 2. Significant regression coefficients for the variable: income of farms in EU countries between 2005 and 2013

Details	Symbol	EU-15			CEE		
		2005–2007	2008–2010	2011–2013	2005–2007	2008–2010	2011–2013
Total workload (AWU)	X_1			0.08	–0.22		0.14
Farmland area (ha)	X_2				0.88	0.41	
Value of assets less value of land, permanent crops and production quotas (€)	X_3	–0.15			–1.26		
Technical equipment used at work (€/AWU)	X_4	–0.02	–0.01		0.10	0.19	
Technical equipment used in farmland (€/ha)	X_5						
Land used for work (ha/AWU)	X_6	0.07				0.28	0.33
Current assets per ha (€/ha)	X_7	0.08	–0.40	–0.29			
Fixed assets per ha (€/ha)	X_8	–0.29	–0.32	–0.19			–0,29
Total production value (€)	X_9	0.82	0.90	0.89	1.34	0.08	0.32
Crop production per ha of farmland (€/ha)	X_{10}	0.16	0.58	0.38	0.19	0.18	0.14
Animal production per LU (€/LU)	X_{11}	0.12				0.03	0.08
Marketability of production (%)	X_{12}	0.00	0.09	0.17		0.09	0.09
Percentage of costs of external factors (%)	X_{13}		–0.29	–0.23	–0.43	–0.11	–0.31
Operating activity subsidies (€)	X_{14}	0.08	0.03	0.09			0.25
Corrected coefficient of determination		0.55	0.52	0.75	0.77	0.76	0.94
Number of observations		309	306	312	65	93	87

Source: The author's calculations based on http://ec.europa.eu/agriculture/rica/database/database_en.cfm.

Between 2011 and 2013 the situation improved, but still it would have been impossible to gain a positive value of income without subsidies (the amount of subsidies was about 34% greater than the value of income).

Multiple regression models were constructed in order to identify the determinants of income of family farms in the EU countries and to investigate the strength and direction of influence of these determinants on the dependent variable. Table 2 shows the results of the investigations, including beta coefficients for statistically significant variables ($p = 0.05$), the value of the corrected coefficient of determination and the number of observations.

According to the structural parameters of the regression model constructed for farms in the EU-15, between 2005 and 2007 there were as many as seven determinants of income, relatively the most important of which was the scale of production (beta coefficient = 0.82), expressed with the production value. The financial result was also significantly affected by crop and animal productivity. The value of the dependent variable was also positively influenced by operating activity subsidies, production intensity, measured with the consumption of current assets per ha, and land used for work. Simultaneously, three determinants had a negative influence on income, relatively the most important of which were fixed assets per ha and the value of assets reduced by the value of land. As the beta coefficient value for variable X_7 was positive, we can conclude that it would have been necessary not only to reduce the value of assets but also change their structure by increasing the share of current assets. Between 2008 and 2010 the income of farms in the EU-15 was significantly affected by eight variables. Like in the previous period, the scale of production and crop productivity were relatively the most important variables (beta coefficients = 0.90 and 0.58, respectively). It is necessary to stress the fact that during that period the value of income could have been increased by reducing the intensity of production and decreasing the consumption of both fixed and current assets per ha. During that period income could also have been increased by reducing the costs of using external factors of production (beta = –0.29). Between 2011 and 2013 the increase in the income of farms in the old EU member-states was again most influenced by the increase in the scale of production and crop productivity. The signs of the other parameters of the regression equation remained unchanged, but the strength of their influence decreased (except the marketability of production and the value of operating activity subsidies).

Between 2005 and 2007 the income of farms in the Central and Eastern European countries was influenced by variables X_1, X_2, X_3, X_4, X_9, X_{10} and X_{13}, where variables X_1, X_3 and X_{13} had a negative impact, whereas the influence of

the other variables was positive. Thus, we can conclude that the income could have been increased by lowering the costs of external factors, decreasing the value of assets and reducing overemployment. As far as the sign of the parameter referring to the variable of technical equipment used at work is concerned (beta = 0.10), it must be stressed that there should have been a relatively greater reduction of labour resources rather than capital resources. Simultaneously, on average, farms with larger farmland areas gained a higher income. In view of this fact, it would have been necessary to change the relation between factors of production in this group of countries. Although between 2008 and 2010 the model for farms in the Central and Eastern European countries did not include variables X_1 and X_3, and the beta coefficient for variable X_2 was reduced, in comparison with the values noted for the other parameters, the increase in the farmland area proved to have relatively the most significant influence on the increase in income. Apart from that, the dependent variable was also relatively strongly influenced by fixed assets and land used for work. As results from the model describing the variability of income gained by farms in the new EU member-states between 2011 and 2013, four variables, i.e. X_6, X_8, X_9 and X_{13}, had the greatest and comparable influence on financial growth. The values of variables X_6 and X_9 were positive, whereas the other two variables were negative. Thus, we can conclude that the scale of production and the area of land used for work should have been increased, whereas the costs of external factors and the consumption of fixed assets per ha of farmland should have been reduced. It is noteworthy that the scale of production and the share of costs of external factors were also present in the regression equations constructed for farms in the Central and Eastern European countries covering the other two periods and they were characterised by relatively high significance. It is also necessary to stress the fact that the sign of the parameter referring to the workload variable was different than in the model constructed for this group of countries and spanning the period of 2005–2007. We could pose the thesis that there was some improvement in this aspect because during that period there was a considerable decrease in the value of labour resources per farm in the Central and Eastern European countries.

Conclusions

To sum up, we can say that in both groups of the EU countries under analysis the income of farms was positively influenced by the scale of production, productivity, the extent to which farms were related to the market (measured

with the marketability indicator) and operating activity subsidies. The financial results were negatively influenced by the value of assets per farm, the value of fixed assets per ha of farmland and the share of costs of external factors. However, farms in the EU-15 and those in the Central and Eastern European countries differed in the influence of their production potential on the income they gained. In the new EU member-states it is definitely necessary to reduce the workload in the production process and increase the area of farmland used for production. This conclusion confirms the common view that there is excessive workload and considerable fragmentation of farms in this group of countries. However, as far as the former factor is concerned, the situation seems to have improved. During the period under study the average workload in farms in the Central and Eastern European countries decreased. As results from the estimated regression models, between 2011 and 2013 the income situation of farms could even have been improved by an increase in this factor of production. It is also necessary to stress the fact that between 2005 and 2010 groups of countries under analysis differed in the technical equipment used at work. The income of farms in the EU-15 could have been increased by reducing the value of fixed assets per full-time employee, whereas in the Central and Eastern European countries – by increasing this ratio. It is also necessary to mention the fact that in the new EU member-states there was a noticeable positive influence of farmland area on income. It shows that the financial results were also indirectly positively influenced by subsidies. Likewise, in the EU-15 the statistically significant influence of subsidies on the income of farms gives grounds to think that their financial situation was also improved due to the increase in the area of farmland used. These variables exhibited a relatively strong correlation. It is noteworthy that the corrected coefficient of determination indicates that the models constructed for the Central and Eastern European countries were characterised by better goodness of fit than those for the EU-15. Thus, we can pose the thesis that in the old EU member-states the situation of farms is relatively better than in the Central and Eastern European countries and other determinants, which were not included in this study, have a relatively greater influence on the income of farms.

References

Baer-Nawrocka, A. (2015). Kwestia parytetu dochodów rolniczych w krajach Unii Europejskiej, In A. Czyżewski & B. Klepacki (Eds.), *Problemy rozwoju rolnictwa i gospodarki żywnościowej w pierwszej dekadzie członkostwa w Unii* Europejskiej (vol. IX). Warszawa: Wydawnictwo PTE.

Czekaj, T. (2006). Obserwacje odstające i wpływowe w analizie regresji – analiza dochodowości materialnych czynników produkcji w gospodarstwach rolnych. *Roczniki Naukowe SERiA, VIII, 5*.

Felczak, T. (2014). Czynniki kształtujące wartość uzyskiwanego dochodu z rodzinnego gospodarstwa rolnego. *Roczniki Naukowe SERiA, XVI, 4*.

Gołaś, Z. (2008). Uwarunkowania rentowności kapitału własnego w rolnictwie (Część 2). *Zagadnienia Ekonomiki Rolnej, 3* (316).

Gołębiewska, B. (2008). Zróżnicowanie wykorzystania zasobów produkcyjnych w rolnictwie krajów UE. *Roczniki Naukowe SERiA, X, 1*.

Goraj, L. & Mańko, S. (2009). *Rachunkowość i analiza ekonomiczna w indywidualnym gospodarstwie rolnym.* Warszawa: Difin.

http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Kołoszko-Chomentowska, Z. (2007). Metody oceny czynników kształtujących dochody z działalności rolniczej. *Roczniki Naukowe SERiA, IX, 1*.

Kot, S. M., Jakubowski, J. & Sokołowski, A. (2007). *Statystyka. Podręcznik dla studiów ekonomicznych*. Warszawa: Difin.

Poczta, W., Sadowski, A. & Średzińska, J. (2008). Rola gospodarstw wielkotowarowych w rolnictwie Unii Europejskiej. *Roczniki Nauk Rolniczych. Seria G – Ekonomika Rolnictwa, 95*, 1.

Poczta, W., Średzińska, J. & Mrówczyńska-Kamińska, A. (2009). Determinanty dochodów gospodarstw rolnych Unii Europejskiej według typów rolniczych. *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie – Ekonomika i Organizacja Gospodarki Żywnościowej, 76*.

Rembisz, W. (2006). Endogenne i egzogenne warunki wzrostu dochodów producentów rolnych. *Zagadnienia Ekonomiki Rolnej, 2* (307).

Stanisz, A. (2007). *Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny (Vol. 2. Modele liniowe i nieliniowe*). Kraków: StatSoft.

Średzińska, J. & Poczta, W. (2012). *Zróżnicowanie sytuacji finansowej gospodarstw rolnych w krajach Unii Europejskiej z Europy Środkowo-Wschodniej*. Poznań: Wydawnictwo Uniwersytetu Przyrodniczego.

Wyniki Standardowe 2013 uzyskane przez gospodarstwa rolne uczestniczące w Polskim FADN (Część I. Wyniki Standardowe). (2014). Warszawa: IERiGŻ-PIB.