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DETERMINANTS OF CHANGES IN WORK PROFITABILITY IN POLISH AGRICULTURE IN 2004-2013

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Abstract

The main purpose of this work is to analyse the changes in work profitability in Polish agriculture. The analysis is based on the Economic Accounts for Agriculture, i.e. the applicable in the EU harmonised financial statement, which enables the analysis of the economic situation in agriculture according to uniform rules. The basis for the research have been the proposed systems of work profitability indicators and factor analysis (the logarithm method). The research has proven that in the post-accession period work profitability in agriculture increased in real terms on annual average by about 4,47%, and in 2013 in comparison to 2004, work profitability was higher in real terms by almost 60%. In the light of the factor analysis the main determinant of changes in work profitability in the domestic agriculture was the increase in work productivity and production subsidies.

Key words**:** *economic accounts for agriculture, Poland, systems of indicators of work profitability in agriculture, work profitability in agriculture*

INTRODUCTION

The accession of Poland to the European Union (EU) and application of the Common Agricultural Policy (CAP) instruments to Polish agriculture fundamentally changed the conditions of the domestic agriculture.
The EU membership provides for unlimited access to a huge market, and, which is very important for agricultural producers, creates new opportunities to generate income due to the size of the EU market and subsidising agriculture under the CAP [2, 3, 4, 5,11].
The authors of this article have focused on the issue of profitability of agriculture after the accession to the EU, mainly considering its basic indicator, which is the agricultural entrepreneurial income per unit of employment.
The structure of the paper is as follows. The first part discusses the source materials and methodological assumptions. It presents a sequential calculation of generating income based on Economic Accounts for Agriculture [6] and the concept of systemic analysis of work profitability in agriculture.
The second part presents the results of empirical studies, which include:
an analysis of generating income, a systemic analysis of work profitability and a factor analysis of changes in the level of profitability of work in Polish agriculture in 2004-2013.

MATERIALS AND METHODS

In the analysis of profitability of work in agriculture there have been used the Economic Accounts for Agriculture (EAA), i.e. applicable in the EU harmonised financial statements enabling an analysis of the economic situation in agriculture according to uniform rules [6], published by EUROSTAT.
One of the main objectives of the EAA is monitoring agricultural income perceived in terms of: the value added (gross, net, at factor cost), the operating surplus and the net agricultural entrepreneurial income.
The sequence of the EAA, allowing accounts of the afore mentioned categories of income, is as follows [6]:

a) Formula	b) Components account
c)	**d) Output at producer price**
e) +	f) Subsidy on products
g) −	h) Taxes on products
i) =	j) **Output at basic prices**
k) −	l) Intermediate consumption
m) =	n) **Gross value added**
o) −	p) Fixed capital consumption
q) =	r) **Net value added**
s) −	t) Taxes on production
u) +	v) Subsidies on production
w) =	**x) Factor income**
y) −	z) Compensation of employees
aa) =	bb) **Operating surplus**
cc) +	dd) Interest received
ee) −	ff) Interest paid
gg) −	hh) Rent paid
ii) =	**jj) Enterpreneurial income**

In the EAA the net value added is a measure of the value created by all agricultural entities adjusted for depreciation. Moreover, it is a basic income category informing about the ability to bring new value in relation to incurred material costs, also regarded as an indicator of the quantity and quality of human capital [7, 9]. However, it should be noticed that the net value added in the agriculture sector, due to the **output pricing** in the base prices and the valuation of intermediate consumption in purchasers' prices, is adjusted for taxes on products, but includes the amount of subsidies for products. Reducing the net value added by the amount of other taxes on production and adding to it other subsidies for production, there is achieved another category of income – the value added at factor cost (income of the factors of production). This category of income is a measure of the value generated by the factors of production such as land, capital and labour; the labour factor is here presented in the form of all of the labour resources engaged in agricultural activities, i.e. it includes both agricultural entrepreneurs' own work as well as the hiring of labour. The occurrence of hired labour is reflected in the next category of income, which is the net operating surplus (mixed income). It measures the value generated by land, capital and unpaid labour, which is less than the value added at factor cost by the hired labour costs. The final component of the EAA account is the agricultural entrepreneurial income. Its value is calculated by adjusting the operating surplus for financial costs and revenues in the form of the balance of received and paid interest and lease costs. Agricultural entrepreneurial income is a synthetic measure of the level of remuneration for unpaid labour resources, remuneration of capital employed and pensions in respect of land ownership.

In the analysis of the dynamics of changes in various categories of the EAA account, the authors have used the average annual rate of change indicator. In practice, most commonly used in this case is the geometric mean, which is not always justified because, due to the ambiguous nature of the development trend of the studied phenomenon, its use may lead to erroneous interpretations. The geometric mean has a major drawback stemming from the inclusion in its construction of the computational value of the extreme years and omission of the values between those years. Considering the above, in assessing the dynamics of changes in various categories of the EAA account the authors have used the following measure, which accounts for all the observations (values) of the time series [10]:

$$r_g = \frac{-3m + [9m^2 + 24m(n-1) \times \left(\frac{1}{y_1}\sum_{t=1}^{n} y_t - n\right)]^{1/2}}{2m(n-1)} \times 100$$

where: $m=n(n+1)$, n - the number of observations (years), y - the value of the feature.

The presented above EAA account has been used to analyse the level, direction, dynamics and reasons for changes in work profitability in agriculture via constructing systems of indicators. A Systemic approach in the analysis of the studied phenomenon appears to be fully justified and is due to several reasons. Firstly, it results from a high level synthesis of the category of income and, secondly, the need to respect the primacy/inferiority of the EAA categories,

thirdly, from the key or secondary nature of these categories, fourthly, from creating opportunities for a casual analysis by constructing pyramids of indicators and the use of quantitative methods. In a systemic approach the indicator of work profitability in the agricultural sector may be presented as the following equation1:

$$\frac{DR}{ZN} = \frac{WB}{ZO} \times \frac{WN}{WB} \times \frac{WN - PD}{WN} \times \frac{DCZ}{WN - PD} \times \frac{NO}{DCZ} \times \frac{NO + SO}{NO} \times \frac{DR}{NO + SO} \times \frac{ZO}{ZN}$$

where:
DR/ZN – work profitability indicator [agricultural entrepreneurial income (DR)/number of unpaid employees (ZN)],
WB/ZO – labour productivity indicator measured by gross value added [gross value added (WB)/total number of employees (ZO)], WN/WB – indicator of costs of depreciation of fixed assets [net value added (WN)/gross value added (WB)],
(WN – PD)/WN – tax costs ratio [(net value added (WN) – taxes (PD))/net value added (WN)], DCZ/(WN – PD) – indicator of subsidies for agricultural production [**factor income** (DCZ)/(net value added (WN) – taxes (PD))], NO/DCZ – indicator of payroll expenses [operating surplus (NO)/**factor income** (DCZ)],
(NO + SO)/NO – indicator of financial income and expenses [(operating surplus (NO) + balance of received and paid interest (SO))/operating surplus (NO)], DR/(NO + SO) – indicator of cost of leases [agricultural entrepreneurial income (DR)/(operating surplus (NO) + balance of received and paid interest (SO))], ZO/ZN – indicator of structure of employment resource [total number of employees (ZO)/number of employees unpaid (ZN)].

In order to identify the causes of changes in the level of work profitability in agriculture the deterministic method has been used – the logarithm method. With a simplifying assumption that the synthetic indicator of work profitability in agriculture (W_1) from the period t_1 is a function of the product of only three factors, namely (x_1, y_1, z_1), tj.

$$W_1 = x_1 \times y_1 \times z_1,$$

and the synthetic indicator of profitability in agriculture (W_0) from the period t_0 is a function of the product of three factors (x_0, y_0, z_0), tj.

$$W_0 = x_0 \times y_0 \times z_0,$$

i.e., and at the same time it is a reference point for the changes, the procedure in the logarithmic method is as follows:

1.Calculation of the absolute deviation (ΔW) of the synthetic indicator of work profitability in agriculture:

$$\Delta W = W_1 - W_0 = x_1 \times y_1 \times z_1 - x_0 \times y_0 \times z_0$$

2.Calculation of partial deviations $(\Delta W_x, \Delta W_y, \Delta W_z)$ informing about the impact of the factor on changes of the synthetic indicator of work profitability in agriculture (W):

$$\Delta W_x = \Delta W \times \frac{\log \frac{x_1}{x_0}}{\log \frac{W_1}{W_0}}$$

$$\Delta W_y = \Delta W \times \frac{\log \frac{y_1}{y_0}}{\log \frac{W_1}{W_0}}$$

$$\Delta W_z = \Delta W \times \frac{\log \frac{z_1}{z_0}}{\log \frac{W_1}{W_0}}$$

1.

3. Comparison of the absolute deviation of the synthetic indicator of work profitability in agriculture (ΔW) with the sum of partial deviations of the factors – partial indicators of the system $(\Delta W_x, \Delta W_y, \Delta W_z)$, in order to

[1]The presented decomposition of the work profitability ratio does not exhaust all the possibilities. The author has also developed other alternative systems of the work profitability indicator which reveals, among others, the importance of productivity of expenditures, technical infrastructure of work and the importance of agricultural land resources and their intensity of use (land productivity and intensity of production), however, due to editorial limitations, these systems in this publication have been omitted.

verify the correctness of the conducted calculations according to the formula:

$$\Delta W = \Delta W_x + \Delta W_y + \Delta W_z$$

4.Substantive interpretation of partial deviations, i.e. determining the impact of changes of the factors (partial indicators of the system) on changes of the synthetic indicator of work profitability in agriculture: on the basis of partial deviations and/or on the basis of the percentage of individual deviations in the sum of partial deviations.

RESULTS AND DISCUSSIONS

Table 1 presents in a synthetic form the economic calculation for Polish agriculture in 2004-2013, i.e. the period from the moment of Polish accession to the EU and using the CAP instruments, together with the information on the level and structure of employment and work profitability measured by the relationship of agricultural entrepreneurial income per one unit of unpaid labour resources. The data in Table 1 indicate that the agricultural income, measured by the **output pricing** at producer prices, in real terms increased on average by 1.17%, and consequently, in 2013 (74.93 billion PLN) it was – as compared to 2004 (62.51 billion PLN) – higher by about 18%. In n a similar pace, due to a comparable dynamics of change in subsidies for products (19%) there increased in 2004-2013 the real agricultural income measured by the **output pricing** at base prices (on average per annum by 1.17%).

Table 1. The Economic Accounts for Agriculture– agriculture in Poland in 2004-2013 (real value in mld PLN)

Specification	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2013 / 2004 = 100	r_g in %
Output at producer price	62,51	56,80	57,53	68,03	66,75	62,28	64,61	75,75	77,53	74,93	117,9	1,17
Subsidy on products	3,58	3,75	4,52	4,20	3,73	4,71	4,40	3,61	2,74	2,99	83,4	1,19
Taxes on products	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-
Output at basic prices	66,09	60,56	62,05	72,23	70,49	66,98	69,01	79,36	80,26	77,92	119,9	1,17
Intermediate consumption	38,93	36,05	37,10	42,33	44,88	41,45	41,92	48,44	49,08	47,32	121,6	1,70
Gross value added	27,17	24,51	24,95	29,90	25,61	25,54	27,08	30,92	31,18	30,61	112,7	0,38
Fixed capital consumption	5,79	5,44	5,09	5,07	5,29	5,10	5,17	5,14	5,20	5,31	91,6	-1,76
Net value added	21,38	19,06	19,86	24,82	20,32	20,44	21,91	25,78	25,98	25,30	118,4	0,91
Taxes on production	1,41	1,42	1,24	1,39	1,40	1,29	1,05	1,11	1,96	1,98	140,6	0,19
Subsidies on production	4,35	4,77	6,21	7,20	7,82	9,85	10,65	12,74	10,79	11,45	263,4	12,79
Factor income	24,31	22,42	24,82	30,63	26,74	29,00	31,50	37,41	34,81	34,77	143,0	3,60
Compensation of employees	2,79	2,87	2,82	3,37	3,81	3,55	3,02	3,06	3,29	3,28	117,6	2,41
Operating surplus	21,52	19,55	22,01	27,26	22,93	25,46	28,48	34,35	31,52	31,49	146,3	3,75
Rent paid	0,35	0,35	0,39	0,43	0,43	0,39	0,39	0,41	0,25	0,41	116,3	1,49
Interest paid	0,88	0,99	1,17	1,20	1,18	1,16	1,15	1,11	1,09	1,07	121,6	4,05
Interest received	0,16	0,16	0,15	0,15	0,15	0,12	0,10	0,11	0,14	0,09	56,9	-3,42
Enterpreneurial income	20,45	18,36	20,60	25,78	21,46	24,03	27,04	32,94	30,31	30,10	147,2	3,72
Total agricultural labour input (mln AWU)	2,28	2,29	2,29	2,30	2,30	2,21	2,10	2,10	2,10	2,10	92,0	-0,59
Non-salaried agricultural labour input (mln AWU)	2,15	2,16	2,16	2,16	2,16	2,07	1,99	1,99	1,99	1,99	92,4	-0,59
Work profitability (tys.PLN/AWU)	9,51	8,49	9,53	11,96	9,96	11,60	13,60	16,56	15,24	15,14	159,2	4,47
The share of subsidies in income (%)	38,8	46,4	52,1	44,2	53,8	60,6	55,7	49,7	44,6	48,0	38,8	4,39

Source: own elaboration based on the Economic Accounts for Agriculture [11]

Favourable trends are also noticeable in the changes in the gross value added, the level of which in 2004-2013 increased from 27.17 billion PLN (2004) to 30.61 billion PLN (2013), i.e. by about 13%. Nevertheless, it is worth noticing that the average annual dynamics of change of the real gross value added (0.38%) was evidently lower than the dynamics of change in the real **output pricing** (1.17%). This means that in the period 2004-2013 the efficiency of intermediate consumption expenditures increased, which is confirmed by a slower rate of growth of these expenditures than the value added.Positive changes in the efficiency of agricultural income are also indicated by a positive net To a definitely greater extent than the net value added increased the income from factors of production calculated by adjusting the net value added for taxes on production and other subsidies for agriculture. A strong dynamics of change in this category of income was relatively less related to changes in taxation, since it was almost entirely due to the amount of the so-called other subsidies to the production obtained from the implementation of the CAP instruments. The accession of Poland to the EU resulted in a 2.6-fold real increase in the value of these subsidies in 2004-2013. These changes fundamentally determined the dynamics of change and the level of income of the factors of production. On average per annum in the post-accession period its real value increased by 3.6%, as a consequence of which, the income from the factors of production increased in real terms from 24.31 billion PLN (2004) to 34.77 billion PLN (2013), i.e. up to 43%.

In the post-accession period there was quite a clear growth in payroll expenses in the agricultural sector, which in real terms on average per annum grew by nearly 2.41%, and in 2013 – as compared to 2004 – were higher by 17.6%. Despite this trend payroll expenses constituted less and less in the income from the factors of production, which in turn resulted in a rapid increase of the operating surplus, stronger than the increase of the income from the factors of production. The data in Table 1 indicate that the real value of value added growth. These changes, however, need to be perceived in a wider context. On one hand, they can be regarded as beneficial, since the real net value added increased on average per year in 2004-2013 by 0.91%. The dynamics of change of this category, however, was greater than the dynamics of change of the gross value added (0.38% and 0.91%), which denotes a significant reduction in the degree of diminishing the value added due to depreciation costs. On one hand, in the context of economic calculation, it is a beneficial situation, on the other hand, it points to a progressive decapitalisation of fixed assets in agriculture, which is the result of weak dynamics of investment processes. the operating surplus in agriculture was at the end of the analysed period higher by as much as 46.3% (2013/2004). In the years 2004-2013 there were no radical changes in the level of financial costs and revenues and lease costs. Although financial costs and lease costs were higher after the accession, they reduced the operating surplus of agriculture to a relatively low extent. As a result of these conditions the dynamics of growth of the agricultural entrepreneurial income exceeded the dynamics of growth of the operating surplus, and the total agricultural entrepreneurial income in 2013, amounting to over 30 billion PLN, were higher in real terms respectively by 47.2% (2013/2004). Such a strong scale of changes resulted in a strong increase in work profitability in agriculture, measured by the ratio of agricultural entrepreneurial income to the number of unpaid workers. The data in Table 1 indicate that in 2004-2013 the rate of work profitability increased in real terms from 9.51 thousand PLN (2004) to 15.24 thousand PLN (2004) 15.4 thousand PLN (2005). These figures indicate a nearly 60% real increase in work profitability in agriculture. It should be emphasised that, apart from a significant real increase in incomes in agriculture, changes in agricultural employment had an impact on beneficial and dynamic growth in work profitability. In the analysed period there was a decrease of similar dynamics (0.59% on average per annum) in both total employment resources and employment resources

representing unpaid work. As stated above, changes in the efficiency of agriculture are determined by a number of external and internal factors. In relation to work profitability, these reasons may be seen in the results of the factor analysis, developed on the basis of a system of indicators accounting for the variability and the relations of individual EAA items described in the research methods of this article. Such an analytical approach allows to investigate the relationship between the ratio of the work profitability and the factors by which it is determined. Moreover, it also allows the concretisation of the strength and direction of the impact of these factors on the analysed variable [7, 10].

Table 2 presents the results of the factor analysis (the logarithmic method) of work profitability in agriculture for the years 2005-2013.

Table 2. Factor analysis of changes in work profitability (DR/ZN) in Polish agriculture in 2005-2013 years

Lata Years	$\frac{WB}{ZO}$	$\frac{WN}{WB}$	$\frac{WN-PD}{WN}$	$\frac{DCZ}{WN-PD}$	$\frac{NO}{DCZ}$	$\frac{NO+SO}{NO}$	$\frac{DR}{NO+SO}$	$\frac{ZO}{ZN}$	$\frac{DR}{ZN}$
value of ratios									
2004	11,90	0,79	0,93	1,22	0,89	0,97	0,98	1,06	9,51
2005	10,69	0,78	0,93	1,27	0,87	0,96	0,98	1,06	8,49
2006	10,89	0,80	0,94	1,33	0,89	0,95	0,98	1,06	9,53
2007	13,00	0,83	0,94	1,31	0,89	0,96	0,98	1,07	11,96
2008	11,14	0,79	0,93	1,41	0,86	0,95	0,98	1,07	9,96
2009	11,54	0,80	0,94	1,51	0,88	0,96	0,98	1,07	11,60
2010	12,89	0,81	0,95	1,51	0,90	0,96	0,99	1,06	13,60
2011	14,71	0,83	0,96	1,52	0,92	0,97	0,99	1,06	16,56
2012	14,84	0,83	0,92	1,45	0,91	0,97	0,99	1,06	15,24
2013	14,57	0,83	0,92	1,49	0,91	0,97	0,99	1,06	15,14
average 2005-2013	12,62	0,81	0,94	1,40	0,89	0,96	0,98	1,06	12,16
partial deviations									
2005/2004	-0,96	-0,10	-0,08	0,38	-0,13	-0,09	-0,02	-0,01	-1,01
2006/2005	0,16	0,21	0,11	0,44	0,15	-0,03	0,00	0,00	1,03
2007/2006	1,90	0,45	0,07	-0,21	0,04	0,08	0,02	0,07	2,43
2008/2007	-1,69	-0,50	-0,15	0,85	-0,41	-0,07	-0,04	0,00	-2,00
2009/2008	0,38	0,09	0,07	0,75	0,25	0,05	0,04	0,02	1,64
2010/2009	1,39	0,13	0,20	-0,03	0,37	0,05	0,02	-0,14	2,00
2011/2010	1,99	0,45	0,08	0,06	0,23	0,12	0,03	0,00	2,97
2012/2011	0,14	-0,01	-0,55	-0,72	-0,22	-0,02	0,07	0,00	-1,32
2013/2012	-0,28	-0,12	-0,05	0,44	0,00	-0,01	-0,08	0,00	-0,11
average 2005-2013	0,34	0,07	-0,03	0,22	0,03	0,01	0,01	-0,01	0,63
structure of partial deviations[1] (%)									
2005/2004	53,96	5,81	4,61	21,48	7,52	4,87	1,09	0,65	100
2006/2005	14,54	18,61	10,39	39,54	13,34	3,14	0,44	0,00	100
2007/2006	66,46	15,88	2,58	7,46	1,48	2,97	0,80	2,37	100
2008/2007	45,69	13,39	3,98	22,95	10,98	1,97	1,04	0,00	100
2009/2008	22,99	5,76	3,99	45,42	15,28	2,90	2,47	1,19	100
2010/2009	59,35	5,69	8,49	1,39	15,77	2,25	0,92	6,13	100
2011/2010	67,04	15,22	2,71	2,05	7,90	4,05	1,03	0,00	100
2012/2011	7,91	0,57	31,71	41,95	13,01	1,00	3,85	0,00	100
2013/2012	28,85	12,16	5,03	44,10	0,42	1,49	7,95	0,00	100
average 2005-2013	40,75	10,35	8,16	25,15	9,52	2,74	2,18	1,15	100

[1]partial structure of the partial deviations was calculated on the basis of the absolute values of partial deviation
Source: own elaboration

Their analysis leads to the conclusion that in real terms as the main sources of the positive direction of changes in work profitability in agriculture in the analysed years, measured by the agricultural entrepreneurial income, there should be regarded primarily two factors, i.e. labour productivity growth measured by the gross value added per person employed in agriculture in total [WB/ZO] and the increase in other agricultural subsidies [DCZ/(WN–P)]. In the light of the logarithmic method, changes in labour efficiency and production subsidies in 2005-2013 determined the variability of work profitability on average at 40.75% and 25.15%. Moreover, a rather large variability of the strength and direction of impact may be noted. In the analysed period the share of the variability of labour productivity and production subsidies in the variability of work profitability in the domestic agriculture fluctuated within a very wide range of respectively: 7.91-67.04% and 1.39-45.42%.

Work profitability was determined to a relatively lesser degree by changes in the cost of depreciation [WN/WB], taxes on production [(WN-PD)/WN] and payroll expenses [NO/DCZ]. In the period 2005-2013 the share of these factors in the variability of the real level of work profitability was approximately 8-10%. The data presented in Table 2 also indicate that the impact of other factors on changes in work profitability in agriculture was rather marginal. Analysis of partial deviations and their structures in the case of financial income and expenses [(NO + SO)/NO], leases costs [DR/(NO + SO)] and the rate of employment structure [ZO/ZN] indicates that on average in the post-accession period the variability of work profitability was shaped by these factor of no more than 3%. The data presented in Table 2 also indicate that the impact of other factors on changes in work profitability in agriculture was rather marginal. Analysis of partial deviations and their structures in the case of financial income and expenses [(NO + SO)/NO], leases costs [DR/(NO + SO)] and the rate of employment structure [ZO/ZN] indicates that on average in the post-accession period the variability of work profitability was shaped by these factor of no more than 3%.

CONCLUSIONS

In the post-accession period there was a rapid growth in the real level of work profitability in Polish agriculture. In the period 2004-2013 work profitability increased realistically from 9.5 thousand PLN/AWU to the level of 15.1 thousand PLN/AWU, i.e. by about 60%. In the light of the results of the logarithmic method, the main determinants of the variability of work profitability in domestic agriculture was mainly a positive direction of changes and the scale of variability of the real level of labour productivity and production subsidies. Nevertheless, from the point of view of development prospects, of fundamental importance for the further growth of economic and financial efficiency of agriculture will be mainly further progress in terms of labour productivity. The importance of subsidies will still be high, however, at the same time it will be stable in terms of its impact on the variability of profitability. This means therefore that without an acceleration of processes of structural changes aimed at increasing the size of the basic units of production in agriculture, downsizing and accelerating the pace of technical reconstruction of agriculture, opportunities for further growth of income seem unrealistic.

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