RELATIONS BETWEEN INPUT EFFICIENCY AND FINANCIAL SITUATION OF AGRICULTURAL COMPANIES

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Abstract

The research defines the input efficiency and estimates relations between factors of efficiency and financial situation of agricultural companies. In 2005--2013, the input efficiency of agricultural companies was low which was illustrated by insufficient profitability. An increase in investments did not result in a substantial improvement in return on capital. It was stated that the highest impact on financial situation of companies had the labour factor, while capital and land factors were of lesser importance. The efficiency of capital use was highly related to assets' capacity of agricultural companies, although labour and land were strongly connected to sales revenue and operating profit.

Keywords: Efficiency, input, agricultural company, principal component analysis, canonical analysis.

JEL codes: G32, Q14, Q12.

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Introduction

A farm is a technical and production unit which has a specific organisational structure and is geared towards the manufacture of agricultural products using three production factors, i.e. land, labour and capital (Ziętara, 1998). In this paper, these factors will be referred to as inputs. Unlike the farm, an agricultural company is an entity identified not only economically but, above all, legally and oriented towards the commercial nature of production (Manteuffel, 1984). The economic and legal independence of the agricultural company results in a need for compete on the market, self-financing and providing the required rates of return to its owners (Ziętara, 2008). Consequently, the decisions made by managers of agricultural companies should contribute to the growth, development and gaining profit in a longer term (Krajewski, 2008). The intended effects can be achieved through the efficient use of inputs, which are currently one of the main factors determining the international competitive capacity (Gołaś and Kozera, 2008). In agriculture, the land factor is of particular importance as a non-renewable and limited resource where the production activity is located (Wasilewski and Wasilewska, 2008). Capital and labour factors also play an important role. Capital is necessary to launch and ensure the continuity of the production process and labour inputs allow to create value in a form of agricultural products. In general terms, the efficiency results from proper management of these resources, i.e. from acting in a way preventing their waste (Samuelson and Nordhaus, 1995). In turn, the efficiency of the organisation as a whole can be seen through the prism of the concept of economic efficiency, i.e. ability to achieve specific outputs at the lowest possible inputs or to achieve the highest possible output from the given quantity of inputs (Szymańska, 2010). The efficiency is a complex category and often identified with effectiveness, efficacy, performance and productivity, and its precise definition depends on the context in which it is measured (Pyszka, 2015).

In the paper, the financial efficiency is understood as the degree of achieving the company's objectives, with a particular emphasis on maximising its value. These objectives are achieved by maximising the benefits of involving equity capital in assets expressed in absolute and relative values (Kulawik, 2008).

It should be stressed that the changes in inputs and the efficiency of their use can be a determinant to assess the financial situation and can allow for predicting agricultural development (Gołębiewska, 2008). With regard to the particular agricultural company, the recognition of relationships between the efficiency of using manufacturing factors and the financial situation allows to build an effective strategy for achieving the objectives assumed. The efficiency measurement methods are based on the indicator, parametric and non-parametric approach (Szymańska, 2010). A commonly used method for measuring the financial efficiency is ratio analysis, whose subject are relationships between specific financial volumes from the point of view of their interrelations (Zaleska, 2002). In this context, the efficiency of using resources can be assessed by means of indicators illustrating the ratio of obtained economic effects to inputs expressed by a value or quantity measure.

In assessing the economic efficiency of companies from the agribusiness sector, financial analysis tools are also widely applicable (Kulawik, 2008). The studies on inputs and the efficiency of their use in agriculture were carried out as part of comprehensive analyses of their use (Bernacki, 1982; Bud-Gusaim, 1988; Wasilewski and Wasilewska, 2008; Szymańska, 2010; Kołoszko-Chomentowska, 2011; Felczak and Domańska, 2012; Baer-Nawrocka and Markiewicz, 2013; Kołodziejczyk, 2014) or in relation to the productivity of selected resources (Klepacki, 2004; Klepacki and Gołębiewska, 2005; Gołaś and Kozera, 2008).

Objective and methods of studies

The objective of the study is to determine the level of efficiency of using inputs and to recognise their relationships with the financial situation of agricultural companies. The studies were carried out using the database of the Institute of Agricultural and Food Economics –   National Research Institute, containing financial statements of agricultural companies using the land from the resources of the Agricultural Property Agency[1] (APA), i.e. APA companies which had purchased or leased land from the APA. The study period covered the years from 2005 to 2013. In the analysed period, the number of surveyed agricultural companies ranged from 145 to 172[2].

Assessment in the analysed period covered the values of financial indicators describing the efficiency of using land, capital and labour in agricultural companies (Table 1). The rate of evolution of financial indicators was assessed using weighted average variables, which are the calculation formulas of the adopted indicators. In order to verify the relationships between inputs and the financial situation of agricultural companies, tools for multi-dimensional principal component analysis and canonical analysis[3] were applied. The distribution of independent and dependent variables was described based on individual observations of financial indicators for individual companies. The indicators describing the efficiency of using inputs in agricultural companies were grouped as part of principal component analysis, which allowed to detect the structure and overall relations among those indicators, as well as to present and classify the analysed objects in new spaces defined by the grouping of variables.

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[1] Since September 2017, the Agricultural Property Agency and the Agricultural Market Agency were replaced by the National Support Centre for Agriculture.

[2] 2005 – 156 companies; 2006 – 160; 2007 – 157; 2008 – 154; 2009 – 145; 2010 – 144; 2011 – 170; 2012 – 172; 2013 – 167.

[3] Calculations were made using the Statistica package.

Indicators describing the efficiency of using inputs in agricultural companies

Economic resource	Structure of the financial indicator	Symbol
Land	$\dfrac{Sales\ revenues}{Utilised\ agricultural\ area}$	X_1
	$\dfrac{Sales\ profit/loss}{Utilised\ agricultural\ area}$	X_2
	$\dfrac{Net\ profit/loss}{Utilised\ agricultural\ area}$	X_3
	$\dfrac{Investment\ inputs}{Utilised\ agricultural\ area}$	X_4
	$\dfrac{Net\ fixed\ assets}{Utilised\ agricultural\ area}$	X_5
Capital	$\dfrac{Sales\ revenues}{Equity}$	X_6
	$\dfrac{Sales\ profit/loss}{Equity}$	X_7
	$\dfrac{Net\ profit/loss}{Equity}$	X_8
	$\dfrac{Investment\ inputs}{Equity}$	X_9
	$\dfrac{Net\ fixed\ assets}{Equity}$	X_{10}
Labour	$\dfrac{Sales\ revenues}{Number\ of\ employees}$	X_{11}
	$\dfrac{Sales\ profit/loss}{Number\ of\ employees}$	X_{12}
	$\dfrac{Net\ profit/loss}{Number\ of\ employees}$	X_{13}
	$\dfrac{Investment\ inputs}{Number\ of\ employees}$	X_{14}
	$\dfrac{Net\ fixed\ assets}{Number\ of\ employees}$	X_{15}

Source: own study.

As a result of using principal component analysis, aggregated factors explaining the diversification in the efficiency indicators for using inputs in the analysed population of agricultural companies were defined[4]. The aggregated factors were described using new unobservable variables (principal components), which are a linear combination of initial variables (financial indicators) (Stanisz, 2007):

[4] In the further part of the study, the factors extracted under principal component analysis are defined as efficiency factors.

$$Z_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1p}x_p,$$

where:

Z_1 − efficiency factor,

x_1, x_2, x_p − efficiency indicators,

a_{11}, a_{12}, a_{1p} − coefficients determined by initial variables.

The relationships between the extracted efficiency factors and variables describing the financial situation of agricultural companies were defined based on canonical analysis. The use of canonical analysis allowed to understand the relationships between two sets of variables (Z and Y), one of which was used to explain the differences between the variables from the other set. The idea of canonical analysis consists in examining a correlation between the constructed canonical variables being weighted sums of the variables from the first and second set (Stanisz, 2007):

$$U_1 = a_1Z_1 + a_2Z_2 + ... + a_pZ_p,$$
$$V_1 = b_1Y_1 + b_2Y_2 + ... + b_pY_p$$

where:

U_1, V_1 − first canonical variable for the set Z and Y,

Z_1, Z_2, Z_p − variables of the first set,

Y_1, Y_2, Y_p − variables of the second set,

$a_p\ i\ b_p$ − canonical weights of the variables of the first and second set.

The weights for two sets of variables are selected so that the new weighted variables are intercorrelated to the maximum. The greater is the absolute value of the weight, the greater is the contribution of the original variable from the set to the specified canonical variable. The canonical weights can be interpreted in a similar way as the beta coefficients in multiple regression analysis.

The number of the extracted canonical variables is equal to the minimum number of variables in one of the analysed sets. As a set of exogenous variables, analysis adopted the efficiency factors defined under principal component analysis, while the variables regarding the financial situation were defined as a set of endogenous variables (Table 2).

Table 2

Endogenous variables describing the financial situation of agricultural companies

Variable	Symbol
Investment inputs	Y_1
Fixed assets	Y_2
Sales revenues	Y_3
Sales profit/loss	Y_4
Net profit/loss	Y_5

Source: own study.

Study results

Table 3 presents the indicators representing the efficiency of using agricultural area (UAA). The ratio of sales revenues to the utilised agricultural area (X_1) in 2005--2013 increased from PLN 5.8 thousand/ha of UAA to PLN 9.6 thousand/ha of UAA, i.e. by 65.5%. Despite the increased efficiency of land use in the analysed period, the ratio of sales profit/loss to the unit of utilised agricultural area (X_2) showed different trends. Agricultural companies obtained a positive sales result only in 2005--2007 and in 2010, which, with growing revenues, may point to the higher growth rate of direct costs. On average, in 2005-2013, the loss on sale amounted to PLN 0.1 thousand/ha of UAA, however, this value was underestimated due to the fact that direct payments were not included. Only at the level of net profit that includes other operating revenues the efficiency of using UAA has slightly improved (X_3). The lowest ratio of net profit to UAA was recorded in 2008 (PLN 0.5 thousand/ha of UAA), while in subsequent years the efficiency in this regard was improving and in 2012 it was at the level of PLN 1.3 thousand/ha of UAA.

Table 3

Efficiency of using agricultural areas of agricultural companies (PLN thousand/ha of UAA)

Ratio	Years									Average
	2005	2006	2007	2008	2009	2010	2011	2012	2013	
X_1	5.8	6.4	7.1	6.9	6.7	7.5	8.4	9.3	9.6	7.8
X_2	0.2	0.1	0.2	-0.3	-0.5	0.1	-0.2	0.0	-0.1	-0.1
X_3	0.6	0.7	1.1	0.5	0.7	1.2	1.2	1.4	1.2	1.0
X_4	0.9	1.1	1.1	1.3	1.3	0.8	1.8	1.5	1.5	1.3
X_5	4.7	5.9	6.4	7.1	7.7	7.5	8.9	9.4	10.2	7.8

Source: own study.

The average value of investments per UAA (X_4) in 2005-2013 was PLN 1.3 thousand/ha of UAA, whereas in 2005-2009 the investment inputs of agricultural companies were growing. In 2010, the value of investment inputs decreased, which could result from the deteriorated efficiency of land use in 2008-2009. However, this phenomenon was of individual character, as in 2011 the X_4 indicator rose to the highest level, i.e. PLN 1.8 thousand/ha of UAA. Along with increased investment inputs, the value of fixed assets (X_5) increased. In 2005-2013, the land/fixed asset ratio in agricultural companies increased from PLN 4.7 thousand/ha of UAA to PLN 10.2 thousand/ha of UAA, i.e. by 17%.

Table 4 provides indicators of the efficiency of using capital in agricultural companies. The ratio of sales revenues to equity capital (X_6) in 2005 was 101.4% and by 2013 it decreased by 34.7%.

Efficiency of use of capital in agricultural companies (%)

Ratio	Years									Average
	2005	2006	2007	2008	2009	2010	2011	2012	2013	
X_{16}	101.4	89.1	85.8	84.1	77.7	73.0	70.3	72.0	66.7	80.0
X_7[a]	2.8	0.8	2.3	-3.7	-5.7	0.7	-1.8	-0.2	-0.7	-0.1
X_8[b]	10.7	9.4	13.3	5.8	8.0	12.1	10.0	10.4	8.2	9.8
X_9	14.9	15.1	12.8	15.5	15.2	7.3	14.8	11.2	10.3	13.0
X_{10}	81.5	82.5	78.0	86.0	89.6	72.7	74.6	72.6	71.1	78.8

[a] The variable Sales profit/loss/Equity is the indicator of profitability of equity on the basic operating activity.
[b] The variable Net profit/loss/Equity is the indicator of profitability of equity of agricultural companies.
Source: own study.

In the analysed period, managers of agricultural companies dynamically increased the value of equity capital and this increase significantly exceeded the growth rate of sales revenues. The profitability of equity capital at the level of operating activity was highly diversified in the analysed period. The lowest value of the X_7 indicator was recorded in 2008-2009, in which equity capital generated operating loss from 3.7% to 5.7%. In the same period, the profitability of equity capital (X_8) was also lower than the average and was at the level from 5.8% to 8%. The highest level of profitability of this capital in agricultural companies was recorded in 2007 (13.3%) and 2010 (12.1%). In the following years, the profitability of equity capital in agricultural companies was gradually reduced. Owing to the remaining operating revenues, the profitability of this capital in 2005-2013 was positive and was at the level of 9.8%, on average. The dynamic increase in the value of equity capital in agricultural companies contributed to lowering the ratio of investments to this source of financing (X_9). The lowest value of this indicator was found in 2010, where managers of companies, after two years of worse operating results, slightly reduced investment expenses. In 2011-2013, the ratio of investment inputs to equity capital decreased by 4.5%, which could have been linked to the elimination of co-financing for investments under the Rural Development Programme for 2007-2013.

The ratio of fixed assets to equity capital (X_{10}) in 2005-2013 was, on average, 78.8%. The highest level of this indicator was recorded in 2009 when, as a result of the decreased value of sales revenues, managers significantly reduced the value of working assets.

Table 5 shows the efficiency indicators for using labour resources in agricultural companies in 2005-2013. As sales revenues increased, their ratio to the number of employees (X_{11}) increased.

Efficiency of use of labour resources in agricultural companies (PLN thousand/FTE)

Ratio	Years									Average
	2005	2006	2007	2008	2009	2010	2011	2012	2013	
X_{11}	151.7	165.9	196.3	197.8	202.3	234.5	236.0	268.0	273.7	220.1
X_{12}	4.2	1.5	5.2	-8.7	-14.8	2.4	-6.0	-0.8	-2.8	-2.1
X_{13}	15.9	17.5	30.4	13.6	20.8	38.8	33.4	38.9	33.6	28.1
X_{14}	22.4	28.0	29.4	36.4	39.6	23.5	49.8	41.9	42.4	36.2
X_{15}	122.0	153.7	178.4	202.3	233.3	233.7	250.3	270.6	292.1	222.0

Source: own study.

While in 2005 revenues per one employee in agricultural companies were PLN 151.7 thousand, in 2013 this amount was PLN 273.7 thousand, i.e. it increased by 80.4%. This points to a significant improvement in the efficiency of human labour inputs. As regards the ratio of sales profit/loss to the number of employees (X_{12}), the trends were ambiguous. In 2009, the loss on operating activity per one employee was PLN 14.8 thousand. In 2005-2013, the ratio of net profit ratio to one employee (X_{13}) was much more favourable and averaged PLN 28.1 thousand/employee. Investments implemented in agricultural companies contributed to a significant increase in the efficiency of using human labour. The ratio of net profit/loss to the number of employees in 2005 was PLN 15.9 thousand/employee and by 2013 it increased by PLN 17.7 thousand/employee. The value of investments per one employee (X_{14}) increased in the analysed period. In 2005-2010, along with increased investment inputs, managers of companies reduced employment, which could result from modernisation of existing production processes and contributed to increasing the level of the X_{14} indicator. Since 2011, agricultural companies have gradually increased employment which, with high investment inputs, contributed to higher than average level of investment inputs per one employee. The scale of investments in fixed assets is presented by the ratio of fixed assets to the number of employees in agricultural companies (X_{15}), which increased from PLN 122 thousand/person in 2005 to PLN 292.1 thousand/person in 2013, i.e. by 139.4%.

In order to identify the relationships and trends in the efficiency of using inputs of agricultural companies, the next stage of the studies applied the statistical tools of multidimensional data analysis. On the basis of principal component analysis, the efficiency factors explaining the diversification in the financial indicators of agricultural companies were described and then the canonical model was constructed to specify the relationships between the defined factors and financial situation of the analysed entities.

At the first stage of analysing principal components, the eigenvalues of the covariance matrix for efficiency factors of agricultural companies were calculated (Table 6). This made it possible to identify the contribution of the extracted factors to

explaining the total variance of all indicators determining the efficiency of using inputs. Factor 1 explained 26.3% of the total variance of efficiency indicators and factor 2 – 15.2% of the variance. The cumulative variance explained by factors 1-6 was 78.6%. It should be stressed that the contribution of the remaining efficiency factors to explaining the variability was within the range of 0.4-5.5% of the variance, which attested to their minor importance in assessing the analysed phenomenon.

Table 6

Eigenvalues of the covariance matrix for efficiency factors of agricultural companies

Number of the factor	Parameter			
	Eigenvalue	% of the total variance	Cumulative eigenvalue	Cumulative %
1	3.940613	*26.27076*	3.94061	26.2708
2	2.275990	*15.17327*	6.21660	41.4440
3	2.033812	*13.55875*	8.25042	55.0028
4	1.506331	*10.04221*	9.75675	65.0450
5	1.132680	*7.55120*	10.88943	72.5962
6	0.898104	*5.98736*	11.78753	*78.5835*
7	0.822262	5.48175	12.60979	84.0653
8	0.656361	4.37574	13.26616	88.4410
9	0.497179	3.31453	13.76333	91.7556
10	0.388424	2.58949	14.15176	94.3451
11	0.288450	1.92300	14.44021	96.2681
12	0.209346	1.39564	14.64955	97.6637
13	0.196370	1.30913	14.84592	98.9728
14	0.090485	0.60323	14.93641	99.5761
15	0.063590	0.42394	15.00000	100.0000

Source: own study.

A graphical confirmation of the thesis about the significance of factors is the Cattell's scree plot, which allows to visualise the contribution of the individual factors in explaining the variance of variables (Fig. 1) (Stanisz, 2007). According to the classical interpretation of the plot, principal component analysis should include the factors on the left from the point after which there is a slight decrease in the explained variance (factorial scree – in this case after factor 5).
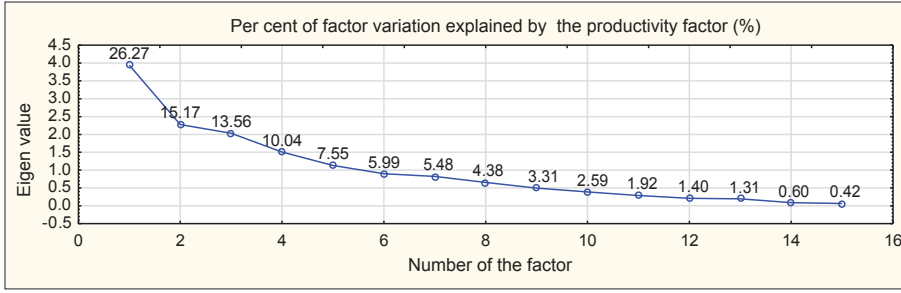
Fig. 1. Cattell's scree plot for the efficiency factors of agricultural companies.
Source: own study.

The next step of the studies was to analyse the coefficients of principal compo-nents informing about the way and impact of the individual financial indicators on the extracted efficiency factors (Table 7).

Table 7

Coefficients of principal components for financial indicators describing the efficiency factors of agricultural companies

Variable	Factor Z_1	Factor Z_2	Factor Z_3	Factor Z_4	Factor Z_5	Factor Z_6
X_1	-0.335143	0.084588	-0.208414	*0.856109*	-0.028116	0.065345
X_2	-0.597395	-0.344357	-0.281603	0.015646	-0.393728	0.282042
X_3	-0.676394	-0.368972	-0.240354	0.056615	-0.295820	0.262796
X_4	-0.410548	0.579199	0.287245	0.101750	-0.409740	-0.018216
X_5	-0.399803	0.355362	0.349650	0.543014	0.072341	-0.205195
X_6	-0.025625	0.328324	*-0.788441*	0.227836	0.191894	0.000238
X_7	-0.381849	-0.350448	0.029336	0.014365	-0.367935	-0.707828
X_8	-0.216924	0.134156	*-0.737791*	-0.191826	0.098849	-0.395443
X_9	-0.112037	*0.654789*	-0.148601	-0.256972	-0.428328	0.151216
X_{10}	-0.086366	*0.689150*	-0.420530	-0.209946	0.083931	0.002969
X_{11}	*-0.733967*	-0.012215	0.048545	0.171759	0.403071	0.105833
X_{12}	*-0.815390*	-0.245345	-0.089271	-0.208066	0.066191	-0.048879
X_{13}	*-0.801718*	-0.221410	-0.008734	-0.335770	0.263051	0.075392
X_{14}	-0.448812	0.446935	0.350902	-0.243480	-0.068707	-0.002139
X_{15}	-0.651326	0.301591	0.386319	-0.144569	0.320928	-0.056918

Source: own study.

Only the first efficiency factors explaining the vast majority of variability in the financial indicators of agricultural companies were assessed. The greatest impact on the Z_1 factor was that of the X_{11}, X_{12} and X_{13} indicators, characterised by the efficiency of using labour resources of agricultural companies. Given the significant share of this factor in explaining the variance of variables, this means that the labour efficiency indicators differentiated the population of agricultural companies to the greatest extent. The Z_1 factor can be interpreted as a synthetic measure of efficiency of using labour resources in agricultural companies. An exemplary equation explaining the evolution of the Z_1 factor can be formulated as follows[5]:

$$Z_1 = -0.4108X_{12} - 0.4039X_{13} - 0.3697X_{11} - 0.3407X_3 - 0.3281X_{15} - 0.3009X_2 - 0.2261X_{14} - 0.2068X_4 - 0.2014X_5 - 0.1924X7 - 0.1688X_1 - 0.1093X_8 - 0.0564X_9 - 0.0435X_{10} - 0.0129X_6$$

The Z_2 factor was most susceptible to the impact of the capital involvement efficiency indicators in the asset aspect (X_9 and X_{10}). In turn, the Z_3 factor was affected by the capital involvement efficiency indicators in the income aspect (X_6 and X_8). The Z_4 factor reflected the efficiency of using land resources as it was conditional upon the X_1 indicator. The Z_5 factor was, to a comparable extent, related to various efficiency variables and, therefore, could not be clearly assessed. On the other hand, the Z_6 factor had a relatively lower contribution to explaining the variance and interpretation of this factor was ignored.

At the next stage of the studies, the correlations between the analysed efficiency indicators for using resources and principal components were described. To do this, the factorial loads of the individual variables were specified (Table 8). The signs of the factorial loads are only important in this meaning that the variables with the opposite signs of the loads affect the principal component in the opposite way (Stanisz, 2007). In general, analysis of the factorial loads confirmed the conclusions from interpreting the coefficients of principal components for the factors. The Z_1 factor was characterised by the highest correlation coefficient with the variables of using the labour resource (X_{11}, X_{12}, X_{13}). The Z_1 factor has been determined as the labour efficiency. The Z_2 and Z_3 factors showed the strongest relationships with the efficiency indicators for involved capital (with the X_9 and X_{10} and X_6 and X_8 variables, respectively). The Z_2 factor was called the capital efficiency – asset aspect, and the Z_3 factor – the capital efficiency – income aspect. The Z_4 factor had the highest correlation with the X_1 variable, and therefore it was called the land efficiency. Owing to the lower eigenvalues, the interpretation of the 5 and 6 factors was abandoned.

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[5] $Z_2 = 0.4568X_{10} + 0.4340X_9 + 0.3839X_4 + 0.2963X_{14} - 0.2446X_3 + 0.2356X_4 - 0.2323X_7 - 0.2283X_2 + 0.2176X_6 + 0.1999X_{15} - 0.1626X_{12} - 0.1468X_{13} + 0.0889X_8 + 0.0560X_1 - 0.0081X_{11}$

$Z_3 = -0.5529X_6 - 0.5173X_8 - 0.2949X_{10} + 0.2709X_{15} + 0.2461X_{14} + 0.2452X_5 + 0.2014X_4 - 0.1975X_2 - 0.1685X_3 - 0.1461X_1 - 0.1042X_9 - 0.0626X_{12} + 0.0340X_{11} + 0.0206X_7 - 0.0061X_{13}$

$Z_4 = 0.6975X_1 + 0.4424X_5 - 0.2736X_{13} - 0.2094X_9 + 0.1856X_6 - 0.1711X_{10} - 0.1695X_{12} - 0.1563X_8 + 0.1400X_{11} - 0.1178X_{15} + 0.0829X_4 + 0.0461X_3 + 0.0128X_2 + 0.0117X_7$

$Z_4 = -0.4025X_2 - 0.3900X_4 + 0.3787X_{11} - 0.3700X_3 - 0.3457X_7 + 0.3016X_{15} - 0.2780X_3 + 0.2472X_{13} + 0.1803_6 + 0.0929X_8 + 0.0789X_{10} + 0.0680X_5 - 0.0650X_{14} + 0.0622X_{12} - 0.0265X_1$

Factorial loads of the financial indicators describing the efficiency factors of agricultural companies

Variable	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6
X_1	-0.335143	0.084588	-0.208414	*0.856109*	-0.028116	0.065345
X_2	-0.597395	-0.344357	-0.281603	0.015646	-0.393728	0.282042
X_3	-0.676394	-0.368972	-0.240354	0.056615	-0.295820	0.262796
X_4	-0.410548	0.579199	0.287245	0.101750	-0.409740	-0.018216
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X_6	-0.025625	0.328324	*-0.788441*	0.227836	0.191894	0.000238
X_7	-0.381849	-0.350448	0.029336	0.014365	-0.367935	-0.707828
X_8	-0.216924	0.134156	*-0.737791*	-0.191826	0.098849	-0.395443
X_9	-0.112037	*0.654789*	-0.148601	-0.256972	-0.428328	0.151216
X_{10}	-0.086366	*0.689150*	-0.420530	-0.209946	0.083931	0.002969
X_{11}	*-0.733967*	-0.012215	0.048545	0.171759	0.403071	0.105833
X_{12}	*-0.815390*	-0.245345	-0.089271	-0.208066	0.066191	-0.048879
X_{13}	*-0.801718*	-0.221410	-0.008734	-0.335770	0.263051	0.075392
X_{14}	-0.448812	0.446935	0.350902	-0.243480	-0.068707	-0.002139
X_{15}	-0.651326	0.301591	0.386319	-0.144569	0.320928	-0.056918

Source: own study.

Canonical analysis has been used to determine the relationships between the extracted efficiency factors and the variables describing the financial situation of agricultural companies. In the first place, the statistical significance of the defined canonical variables has been assessed based on the chi-squared test (Table 9) (Stanisz, 2007). The values of the p coefficient ($p<0.05$) indicate the significance of four extracted canonical variables. The highest correlation factors between the aggregate weighted values of the variables in each set and the weights took place for the first and second canonical variable (0.6821 and 0.6355, respectively). This attests to the decisive significance of these variables in explaining the relationships between the efficiency factors and the financial situation of agricultural companies.

Chi-squared test of the canonical variables describing the efficiency and financial situation of agricultural companies

Removed root[a]	Canonical R	Canonical R-sqare	χ^2	df	p	Primary lambda
0[b]	0.682124	0.465293	2190.023	25	0.000000	0.213547
1	0.635454	0.403802	1301.990	16	0.000000	0.399371
2	0.511926	0.262069	568.366	9	0.000000	0.669864
3	0.300955	0.090574	137.278	4	0.000000	0.907759
4	0.042821	0.001834	2.603	1	0.106643	0.998166

[a] Root or canonical variable.
[b] "0" means that in this row we do not delete any canonical variable.

Source: own study.

For the purpose of determining the canonical weights, the exogenous variables (efficiency factors) and the endogenous variables (balance-sheet and resulting values) were grouped in two sets, the left – for the Z variables (factors) and the right – for the Y variables (balance sheet and resulting values). The canonical weights were characteristics of the way and value of the impact of the individual efficiency factors and balance sheet and resulting values on the canonical variables. Based on the results included in Tables 10 and 11, we can describe a model of the relationship between the variable sets for the efficiency and financial situation of agricultural companies for:

the first canonical variable:

$U_1 = -0.2326Z_1 + 0.6851Z_2 + 03899Z_3 - 0.3647Z_4 - 0.4379Z_5$
$V_1 = 1.2750Y_1 - 0.0024Y_2 - 0.7512Y_3 + 0.1313Y_4 - 0.3474Y_5$

the second canonical variable:

$U_2 = -0.7833Z1 - 0.2780Z_2 - 0.2839Z_3 + 0.1970Z_4 - 0.4356Z_5$
$V_2 = 0.2131Y1 - 0.3142Y_2 + 0.4402Y_3 + 0.9894Y_4 - 0.1895Y_5$

the third canonical variable:

$U_3 = -0.1297Z_1 - 0.4514Z_2 + 0.0219Z_3 - 0.8756Z_4 + 0.1108Z_5$
$V_3 = -0.3254Y_1 + 0.3645Y_2 - 1.5082Y_3 - 0.2833Y_4 + 1.3897Y_5$

the fourth canonical variable:

$U_4 = -0.435320Z_1 - 0.125725Z_2 + 0.711930Z_3 + 0.209643Z_4 + 0.493857Z_5$
$V_4 = -0.639493Y_1 + 2.136312Y_2 - 0.980297Y_3 + 0.426055Y_4 - 0.372807Y_5$

The obtained values of the canonical weights indicate that the greatest contribution to explaining the first canonical variable in the U_1 sum of the left set was that of the Z_2 factor *capital efficiency – asset aspect* (0.6851), while the second canonical variable in the U_2 sum was to the greatest extent explained by the Z_1 factor *labour efficiency* (-0.7833). The third canonical variable (U_3) was affected by the Z_4 factor *land efficiency* (-0.8756). The fourth (U_4) and fifth (U_5) variables were more susceptible to the impact of the Z_3 factors *capital efficiency – income aspect*.

Table 10

Canonical weights of the efficiency factors of agricultural companies

Variable	Canonical weights, left set				
	Root 1	Root 2	Root 3	Root 4	Root 5a
Z_1	-0.232553	*-0.783279*	-0.129684	-0.435320	-0.355065
Z_2	*0.685097*	-0.278004	-0.451349	-0.125725	0.483564
Z_3	0.389878	-0.283874	0.021944	*0.711930*	*-0.509985*
Z_4	-0.364372	0.197047	*-0.875613*	0.209643	-0.133260
Z_5	-0.437939	-0.435632	0.110849	0.493857	*0.601874*

[a] Canonical variable 5 is statistically insignificant.

Source: own study.

Table 11

Canonical weights of the variables for the financial situation of agricultural companies

Variable	Canonical weights, right set				
	Root 1	Root 2	Root 3	Root 4	Root 5
Y_1	1.*275057*	0.213047	-0.32540	-0.639493	-0.23477
Y_2	-0.002364	-0.314199	0.36453	*2.136312*	0.29878
Y_3	*-0.751166*	0.440186	*-1.50820*	*-0.980297*	-0.25879
Y_4	0.131317	*0.989414*	-0.28333	0.426055	*0.72569*
Y_5	-0.347439	-0.189524	*1.38967*	-0.372807	-1.03270

Source: own study.

In the V sums of the right set, the first canonical variable (V_1) was to the greatest extent shaped by the Y_1 variable investment inputs (1.2750) and the Y_3 variable sales revenues (-0.7512). The second canonical variable (V_2) was affected by the Y_4 variable sales profit/loss (0.9894) and the third (V_3) – by the Y_3 variable sales revenues (-1.5082) and Y_5 variable net profit/loss (1.3897). The fourth canonical variable (V4) was shaped by the Y_2 variable fixed assets (2.1363) and Y_3 variable sales revenues (-0.9802). Summing up, it can be concluded that the greatest contribution to explaining the canonical variables in the Y sums of the sets was that of resulting categories, while the impact of the balance-sheet variables was at a moderate level. Given the distribution of the weights among the individual variables in both sets, it should be concluded that the efficiency of using labour and land (characterised by the U_2 and U_3 variables) was to a greater extent related to revenues and financial results of agricultural companies (V_2 and V_3 variables), while the efficiency of capital involvement (U_1 and U_4 variables) showed stronger dependences on the financial situation of those entities (V_1 and V_4 variables).

Analysis of the factorial loads of the variables confirmed the conclusions from the characteristic of the canonical weights. The factorial loads determine the strength of the correlations among the roots and the variables being analysed. It should be stressed that, due to the lack of correlation (orthogonality) among the efficiency

factors, the specific canonical weights of the left set of variables were also the correlation factors (factorial loads) among those variables and roots (Table 10). In the case of the variables for the financial situation, the factorial loads are shown in Table 12. For the first canonical variable, the largest factorial load was reached by the Y_1 variable investment inputs (0.6445), for the second root – Y_4 variable sales profit/loss (0.9635), for the third canonical variable – Y_3 variable sales revenues (-0.4940), and for the fourth variable – Y_2 variable fixed assets (0.6361). This attested to the strongest relations between the efficiency of capital involvement and the value of investment inputs, as well as the efficiency of using labour and land resources and the results of agricultural companies.

Table 12

Factorial loads of the variables for the financial situation of agricultural companies

Variable	Factorial loads, right set				
	Root 1	Root 2	Root 3	Root 4	Root5
Y_1	*0.644514*	0.251581	-0.246450	0.171600	-0.656601
Y_2	0.092328	0.134450	-0.301598	0.636112	-0.691230
Y_3	-0.199279	0.328410	*-0.494011*	0.236338	*-0.743325*
Y_4	-0.039505	*0.963546*	0.225107	0.088219	0.107531
Y_5	-0.097633	0.576509	0.250751	0.147800	-0.757222

Source: own study.

In addition, for each canonical variable the extracted variance and redundancy were calculated (Table 13 and 14).

Table 13

Extracted variance of the canonical variables in the set of the efficiency factors of agricultural companies

Root Factor	Extracted variance (shares), left set	
	Extracted variance	Redundancy
Root 1	0.200000	0.093059
Root 2	0.200000	0.080760
Root 3	0.200000	0.052414
Root 4	0.200000	0.018115
Root 5	0.200000	0.000367

Source: own study.

The extracted variance is an average of the factorial loads' squares for the analysed set. This parameter determines the percentage of variance, on average, explained by the given canonical variable in this set of variables (Stanisz, 2007). Owing to the lack of correlation among the efficiency factors, all canonical variables explained 20% of the overall variance in the set of those factors. The redundancy rate describes the percentage of average variance in the given set, as explained

by the canonical variable based on the variables from the second set (Stanisz, 2007). In this set, the first canonical variable explains only 9.3% of variance of the set of efficiency factors and the second canonical variable – 8.1%, knowing the variables of the financial situation.

Table 14

Extracted variance in the set of the variables for the financial situation of agricultural companies

Root Variable	Extracted variance (shares), right set	
	Extracted variance	Redundancy
Root 1	0.094946	0.044178
Root 2	0.290001	0.117103
Root 3	0.101859	0.026694
Root 4	0.103914	0.009412
Root 5	0.409281	0.000750

Source: own study.

In the right set, it was found that the second canonical variable explains 29% of variance of the set of variables, the first variable – 9.5% of variance, and each of the remaining variables more than 10% of variance. The fifth canonical variable was characterised by the lack of statistical significance and was, therefore, not interpreted. The redundancy of the second canonical variable was at the level of 11.7% and of the first variable – 4.4%. Summing up, it can be concluded that the analysed efficiency factors to a small extent explained the variance of the variables for the financial situation of agricultural companies.

Table 15 provides a summary of canonical analysis of the analysed variables of agricultural companies.

Table 15

Summary of canonical analysis of the efficiency factors and capital and assets situation of agricultural companies

N=1425	Summary of canonical analysis, canonical R: .68212 Chi^2(25)=2190.0 p=0.0000	
	Left set	Right set
Number of variables	5	5
Extracted variance	100.00%	100.00%
Total redundancy	24.4714%	19.8137%
Variables: 1	Z 1	Y 1
2	Z 2	Y 2
3	Z 3	Y 3
4	Z 4	Y 4
5	Z 5	Y 5

Source: own study.

The total redundancy parameter is a sum of redundancies for all canonical variables. The extracted efficiency factors explained 19.81% of variance of the variables for the financial situation of agricultural companies. This attested to the moderate canonical relationship between the efficiency indicators of using economic resources and financial variables. However, given the correlation dependencies between the canonical variables and the efficiency factors and variables describing the financial situation (Tables 10 and 12), it can be concluded that the capital involvement efficiency factor was most closely related to the value of investment inputs and fixed assets and the labour efficiency factor with the sales result. The extracted land efficiency factor was closest correlated with the value of sales revenue.

Conclusions

The study determined the efficiency of using inputs and identified their relationships with the financial situation of agricultural companies. The following conclusions were drawn based on the studies conducted:

1. In 2005-2013, the efficiency of using inputs of agricultural companies was at a low level, as evidenced by the insufficient ability to generate profit. In the periods of better profitability, there was an increase in the level of equity capital and investment inputs of agricultural companies, resulting in higher sales revenues per unit of inputs involved.

2. Increased equity capital and fixed assets did not contribute to a significant improvement in the efficiency of using economic resources. The reduced profitability of equity capital in the conditions of increased assets attested to the low growth rate of profit for agricultural companies. The improved efficiency of land and labour use stemmed from a lower growth rate of inputs of those factors, in relation to the equity capital and profit growth.

3. The synthetic factors differentiating analysed companies in terms of the efficiency of using labour, capital and land were extracted by using principal component analysis. The greatest impact on the development of the financial situation in companies was that of labour resources, while capital and land factors were less important in this regard.

4. The efficiency factors to a moderate extent explained the development of the income and asset situation of agricultural companies. The capital involvement efficiency was more closely related to the value of investment inputs and fixed assets, while the efficiency of using labour and land resources differentiated the level of sales revenues and sales result of the analysed companies. This means that in making a decision on material investments, managers of agricultural companies must largely focus on keeping the appropriate level of capital and of the financing structure. On the other hand, the achievement of the expected revenues and operating result may require special caution in shaping inputs related to land and labour resources.

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ZALEŻNOŚCI MIĘDZY EFEKTYWNOŚCIĄ WYKORZYSTANIA ZASOBÓW WYTWÓRCZYCH A SYTUACJĄ FINANSOWĄ PRZEDSIĘBIORSTW ROLNICZYCH

Abstrakt

W opracowaniu określono efektywność wykorzystania zasobów wytwórczych oraz dokonano oceny zależności między czynnikami efektywności a sytuacją finansową przedsiębiorstw rolniczych. W latach 2005-2013 efektywność wykorzystania zasobów wytwórczych w przedsiębiorstwach rolniczych kształtowała się na niskim poziomie, o czym świadczyła niewystarczająca zdolność do generowania zysku. Ponadprzeciętne zwiększenie nakładów inwestycyjnych nie przyczyniło się do znacznej poprawy rentowności kapitału. Stwierdzono, że największy wpływ na kształtowanie się sytuacji finansowej przedsiębiorstw wywierały nakłady zasobów pracy, natomiast czynniki kapitału i ziemi miały mniejsze znaczenie. Efektywność wykorzystania kapitału była w największym stopniu związana z sytuacją majątkową przedsiębiorstw, a zasoby pracy i ziemi wykazywały silniejsze powiązania z przychodami ze sprzedaży i zyskiem z działalności operacyjnej.

Słowa kluczowe: efektywność, zasoby wytwórcze, przedsiębiorstwo rolnicze, analiza składowych głównych, analiza kanoniczna.