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Factors of cash flow in farms

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The study presents the determinants of the balance of cash flow from operating activities in the farms participating in the PL FADN. The effects of multiple independent variables on the balance of cash flow from operating activities were measured using the robust linear regression model. Statistically significant impact on the balance of cash flow from operating activities was from the family farm income. The agricultural type and the year of measurement had a significant impact on the development of the balance of cash flow from operating activities.

JEL Classifications: D24

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Introduction

Financial liquidity monitoring is of vital importance for proper operation of any business. According to Eljasiak and Parteka (1996) companies do not go bankrupt owing to the lack of profit. They go bankrupt because they do not have money to pay current liabilities even though in many cases they have high accounts receivable. Based on the experience of market economies, Śnieżek and Wiatr (2011) found out that the main reason for bankruptcy of small and medium-sized enterprises is the loss of financial liquidity, not the lack of profit. In the USA in the 1950s, more and more importance started to be attached to the level of actual cash flow, which apart from the profit recognized on the accrual basis enables assessment of the efficiency of the operation of economic entities. The reason for such a change was the fact that cash flow is characterized by a greater objectivity in comparison with the profit. The latter, when recognized on the accrual basis in a short period of time does not necessarily amount to the cash actually possessed by an entity (Dudycz, 2001). Gos (2011) emphasised that the information on cash flow is used as one of the factors in assessing the economic value added (EVA), market value added (MVA) and cash flow return on investment (CFROI). Also, he stated that cash flow is a hard and objective measure. He explained that a hard measure may not be questioned or changed according to the assumptions (e.g. an accounting policy), while an objective measure will stay the same irrespective of the researcher him- or herself.

Śnieżek (2008) quotes the results of many researches into cash flow. She distinguishes three types:

- Empirical research into the relationship between financial flow (cash flow) and the changes in a company's share prices,
- Empirical research into the accuracy of financial flow and cash flow forecasts,
- Empirical research into the relationship between cash flow, financial flow and profits.

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Having analysed the researches, Śnieżek (2008) concluded that financial flow constitutes a separate measure of company performance and is a crucial element of models used by investors or debtors.

Aim and methodology of the research

The aim of the study is to define the determinants of the balance of cash flow from operating activities of the farms participating in the PL FADN[1] system in the Podlaskie voivodeship. The following initial independent variables were applied in order to examine factors that influence the balance of cash flow from operating activities: production value (PLN), the value of assets (PLN), fixed assets (PLN), the value of inventory (PLN), equity capital (PLN), short-term liabilities (PLN), long-term liabilities (PLN), direct costs (PLN), debt ratio (%), debt to equity ratio (%), debt coverage ratio (%), current ratio (multiplicity), quick ratio (multiplicity), cash ratio (multiplicity), return on equity (%), return on assets (%), asset productivity ratio (%), total asset turnover (in days), inventory turnover (in days), receivable turnover (in days), liability turnover (in days), agricultural land (ha), European Size Unit (ESU), stock density (head/ha of agricultural land), basic four cereal yield (dt/ha), working capital (PLN), family farm income (PLN), family farm income + depreciation (PLN), sales revenue (PLN), financial costs (interest on loan) (PLN), depreciation (PLN) and investment expenses (PLN).

A nonparametric correlation analysis was applied to continuous independent variables, while for categorical independent variables (measurement year: 2005, 2006, 2007, 2008, 2009; farm type: field crops, milk cows, grazing animals, granivorous animals, mixed ration animals) a nonparametric analysis of variance or the Kruskal-Wallis test using R, version 3.0.2. was performed.

Continuous independent variables analyzed were not distributed normally so they did not meet the assumptions of the Pearson correlation analysis. Therefore the Spearman rank correlation was used to examine the relationship between variables, which makes no assumptions about distribution of variables and measures the monotonic relationship between them. In order to examine the significance of the Spearman rank correlation coefficient, the p-value was calculated for a relevant statistical test (test 1), which checked the value of this coefficient for 0 (no relationship):

H_0: RS=0, there is no correlation between variables (no relationship),

H_1: RS 0, there is a correlation between variables.

As the research involved multiple testing, the Bonferroni correction was used, which divides the cutoff significance level by the number of tests conducted (Stanisz, 2007). The initial significance level was set at 0.05. After the Bonferroni correction, the significance stayed at 0.000667 (0.05/75). In view if a great number of observations (N=4589), most of the correlation coefficients obtained, even the small ones, were significantly statistically different from 0. Therefore, only those independent variables were presented for which the absolute value of the Spearman rank correlation coefficient exceeded 0.60. Therefore, we presented the relationship between single continuous independent variables and dependent variables which were the most significant.

Simultaneous influence of many independent variables on the balance of cash flow from operational activities was estimated with the use of the robust linear regression model. Independent variables were selected on the basis of literature (Wędzki 2003; Bieniasz, Gołaś 2007; Maślanka 2008). We deleted all independent variables which are a linear combination of other independent variables. Moreover, in the model the explanatory variables[2] were used whose absolute value of Spearman correlation coefficient with the

[1] Polish Farm Accountancy Data Network.

[2] One of the assumptions of the multiple regression model is the lack of colinearity. It means that no variable provides the model with the information which is contained in other variables (Stanisz, 2007).

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explained variable was higher than 0.44. Due to the heteroscedasticity and distribution of residuals being significantly far from normal, an ordinary model of a linear regression could not be applied (Figure 3). As the assumptions of a standard linear regression were violated, the robust regression was used to estimate the coefficients in linear regression models, which allowed for lenient assumptions about the normality of residuals, trying to adjust the linear correlation despite outlying values.

Research results

Table 1 presents the Spearman correlation coefficients and p-values in the test (Test 1) for a dependent variable the balance of cash flow from operational activities. In view of a high number of independent variables, the interpretation is based on those whose absolute value of the Spearman rank correlation coefficient was equal to or exceeded 0.60.

TABLE 1. SPEARMAN CORRELATION COEFFICIENT AND THE P-VALUE FROM THE TEST (TEST 1) FOR A DEPENDENT VARIABLE *the balance of cash flow from operational activities*

INDEPENDENT VARIABLE	R_S	p	INDEPENDENT VARIABLE	R_S	p
Value of production (PLN)	0.87	$<10^{-300}$	Long-term liabilities (PLN)	0.51	3.80×10^{-308}
Family farm income (PLN)	0.88	$<10^{-300}$	Value of inventory (PLN)	0.57	$<10^{-300}$
Balance of current subsidies and taxes (PLN)	0.61	$<10^{-300}$	Non-breeding livestock/herd (PLN)	0.51	5.25×10^{-299}
Subsidies to operational activities (PLN)	0.48	2.23×10^{-263}	Short-term liabilities (PLN)	0.54	$<10^{-300}$
Gross value added (PLN)	0.94	$<10^{-300}$	Money transferred to the farmer's family or from the farmer's family (PLN)	0.70	$<10^{-300}$
Payouts from operational activities (PLN)	0.75	$<10^{-300}$	Agricultural land (ha)	0.69	$<10^{-300}$
Payouts from investment (PLN)	0.54	$<10^{-300}$	Sales revenue (PLN)	0.89	$<10^{-300}$
Intermediate consumption (PLN) *(direct costs + overheads)*	0.76	$<10^{-300}$	Return on assets (%) *(family farm income/ total average state of assets)*	0.51	6.20×10^{-299}
Single area payment awarded (PLN)	0.50	2.62×10^{-292}	Return on equity (%) *(family farm income /equity capital)*	0.56	$<10^{-300}$
Single area payment received (PLN)	0.51	2.49×10^{-297}	Inventory turnover (days) (*Average inventory without a turnover herd *365/ sales revenue*	-0.56	$<10^{-300}$
Total subsidies awarded (PLN)	0.49	1.58×10^{-276}			
Total subsidies received (PLN)	0.50	5.50×10^{-287}	Balance of total cash flow from farm (PLN)	0.71	$<10^{-300}$
Direct costs (PLN)	0.74	$<10^{-300}$	Balance of cash flow from investment (PLN)	-0.50	1.25×10^{-292}
Payouts from financial activities (PLN)	0.55	$<10^{-300}$	Balance of cash flow from operational activities (PLN)	1.00	$<10^{-300}$
Depreciation (PLN)	0.72	$<10^{-300}$	European Size Unit	0.80	$<10^{-300}$
External factors cost (PLN) *(labour cost + rent + interest)*	0.58	$<10^{-300}$	Debt to equity ratio (%) *(total liabilities/equity capital)*	0.44	2.66×10^{-215}
Total assets (PLN)	0.80	$<10^{-300}$	Working capital (PLN)	0.62	$<10^{-300}$
Fixed assets (PLN)	0.79	$<10^{-300}$	Total debt ratio (%) *(total liabilities/total assets)*	0.44	3.74×10^{-216}
Equity capital (PLN)	0.76	$<10^{-300}$	Asset productivity ratio (%) *(total production/total average assets)*	0.61	$<10^{-300}$

Source: Own work based on PL-FADN data.

The analysis of the Spearman rank correlation shows the existence of a statistically significant positive correlation between the balance of cash flow from operational activities and the following independent variables: gross value added (0.94), sales revenue (0.89), family farm income (0.88), value of production (0.87), total assets (0.80), European Size Unit (0.80), fixed assets (0.79), intermediate consumption (0,76), equity capital (0.76), payouts from operational activities (0.75), direct costs (0.74), depreciation (0.72), money transferred to the farmer's family or from the farmer's family (0.70), agricultural land (0.69), working capital (0.62), the balance of current subsidies and taxes (0.61) and asset productivity ratio (0.61).

It has been proved, in apparent contradiction to expert knowledge, that there is a positive correlation between the balance of cash flow from operational activities and the following independent variables: payouts from operational activities, direct costs and intermediate consumption. Farms which generated high balance of cash flow from operational activities had also relatively high direct costs. Greater outlays are connected with higher production costs, which contribute to a rise in sales revenue - payment from sales. Correct conclusions concerning the type and strength of correlation can be drawn only in the context of a higher number of potentially significant factors. This justifies the use of a linear model.

The strongest impact on the balance of cash flow from operational activities was from the gross value added (the Spearman rank correlation coefficient was 0.94). It was connected with the computational formula of this P&L category, which is a difference between the production value and intermediate consumption increased by the balance of current subsidies and taxes. All the components of gross value added significantly influenced cash generated from operational activities. Family farm income, whose computational formula is also connected with gross value added[1], had a strong impact on the balance of cash flow from operational activities (0.88). What needs to be emphasized is a crucial impact from sales revenue and fixed assets on the surplus from basic operations. It can be supposed that thanks to a greater machinery stock, farms gained higher revenue from sales of animal and crop production, which resulted in an increase in cash from operational activities.

The Kruskal-Wallis test was used in order to find the differences in the median of the balance of cash flow from operational activities in groups generated by the 'type of farm' category. The test statistic was equal to 674.004 with the distribution of typical of H_0 ($p<2.2x10^{-16}$)[2]. The p-value of the test was lower than the assumed significance level of 0.05. The null hypothesis was rejected (H_0) in favour of alternative hypothesis (H_1). In at least one pair of groups, the medians are significantly different in terms of statistics. The agricultural type of farm has a significant impact on the median of the balance of cash flow from operational activities.

The posthoc analysis did not reveal statistically significant differences between the medians of the dependent variable in farms of the agricultural type: 'grazing animals' and 'granivorous animals' ($p = 0.5325$). The differences between the medians in other pairs of farm types were statistically significant. The pair of agricultural types: 'milk cows' and 'granivorous animals' had a p-value of 0.0109, while for the pair of agricultural types 'field crop' and 'mixed' p-value was 0.0037, and for other pairs of agricultural types it was below 10^{-7}. These correlations are presented in the box-and-whiskers plot (Figure 1).

The Kruskal-Wallis test was used in order to find the differences in the median of the balance of cash flow from operational activities in specific years. The test statistic was equal to 42.207 with the distribution of typical of H_0 ($p = 1.511x10^{-8}$)[3]. The p-value of the test was smaller than the significance level set at 0.05. The null hypothesis was rejected

[1] Family farm income = gross value added - depreciation - external factors cost + balance of investment-related subsidies and taxes.

[2] $\chi^2(4) = 674.004; p < 2.2x10^{-16}$

[3] $\chi^2(4) = 42.207; p = 1.511x10^{-8}$

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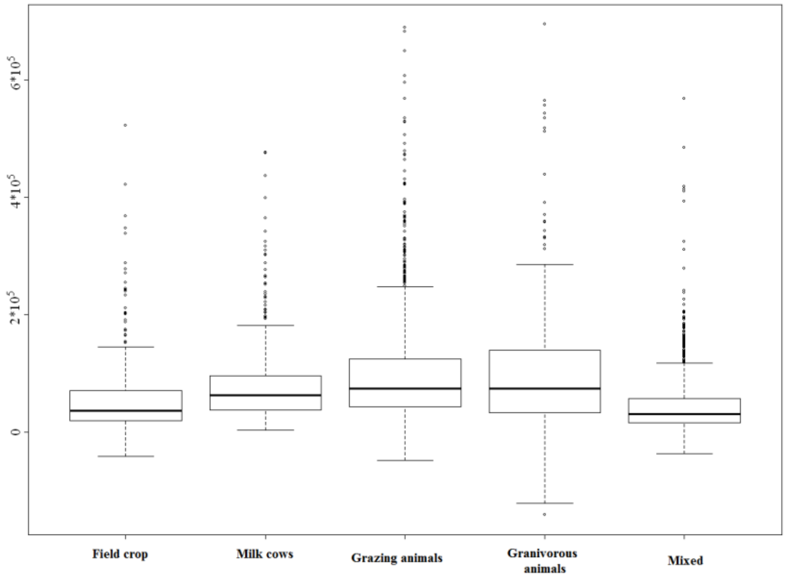
(H_0) in favour of the alternative hypothesis (H_1). In at least one pair of groups, the medians are significantly statistically different. The year of measurement had an impact on the median of the balance of cash flow from operating activities.

The posthoc analysis revealed statistically significant differences between the medians of the dependent variable - the balance of cash flow from operating activities in the following years: 2005 and 2009 ($p = 10^{-8}$); 2005 and 2008, 2007 and 2009 ($p = 0.00018$); 2005 and 2006, 2006 and 2009.

FIGURE 1. THE BOX-AND-WHISKERS PLOT FOR THE BALANCE OF CASH FLOW FROM OPERATING ACTIVITIES AND THE AGRICULTURAL TYPE



Source: Own work.

The difference between the medians in the years 2005 and 2007 is at the threshold of statistical significance ($p = 0.048$). No statistically significant differences were observed between the medians for the remaining pairs of years. The median of the balance of cash flow from operating activities in the years 2005 and 2009 was statistically significantly different from the medians in the other years. The median of the balance of cash flow from operating activities was the lowest in 2005 and the highest in 2009. These correlations are presented in the box-and-whiskers plot (Figure 2).

Figure 3 shows the following diagnostic plots of using the linear regression model for dependent variables:

- residual vs fitted plot,
- normal Q-Q plot,
- scale-location plot,
- Cook's distance plot,
- residuals vs leverage plot[1].

[1] The leverage shows how each point influences estimated regression parameters. High leverage points should have low values of standarized residuals.

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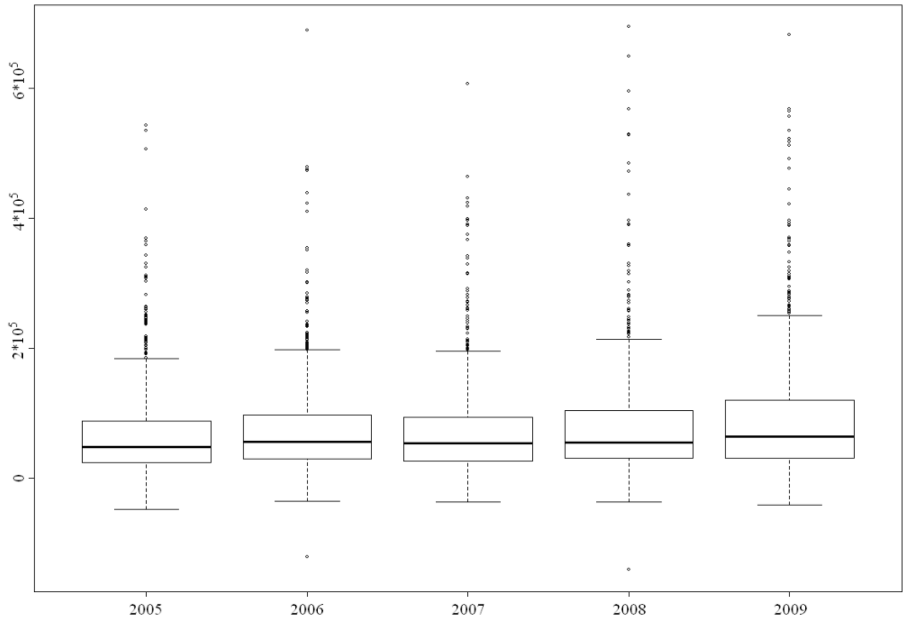
FIGURE 2. THE BOX-AND-WHISKERS PLOT FOR THE BALANCE OF CASH FLOW FROM OPERATING ACTIVITIES AND THE YEAR OF MEASUREMENT



Source: Own work.

The residual vs fitted plot proves that residuals were symmetrically distributed around zero. This means that regression correctly estimates the expected value of each of the dependent variables, which in turn allows for the usage of special algorithm of the robust linear regression. The normal Q-Q plot is used to test whether residuals are normally distributed. Ideal consistency between residuals and normal distribution means that the residuals are situated on a dashed line. It was concluded that the residuals are not consistent with the normal distribution (Figure 3).

The standard linear regression assumption has not been met. The scale-location plot indicates heteroscedasticity of the residuals, where the fitted line is not parallel to the axis of dependent fitted values. The Cook's distance estimates a consolidated influence of the i-sh case (a farm) on the regression coefficient. All observations (farms in a given year) should have small Cook's distances. Then such observations significantly influence the values of regression coefficients and are not very far from the regression line. A large Cook's distance (more than 1) indicates the points which significantly deviate from the regression model, and which simultaneously have a great impact on estimating the regression parameters. Standardized residuals vs leverage plot shows the influence of each point on estimated regression parameters. High leverage points should have low values of standardized residuals.

As the assumptions of standardized linear regression were not met, the robust regression was used to estimate the coefficients of the linear models. The errors of standardized coefficients, the test statistic and the p-value were estimated with a relevant estimator of the variance-covariance matrix, coherent as to the heteroscedasticity and the (potential) auto-correlation of residuals. The results of the analysis are presented in Table 2.

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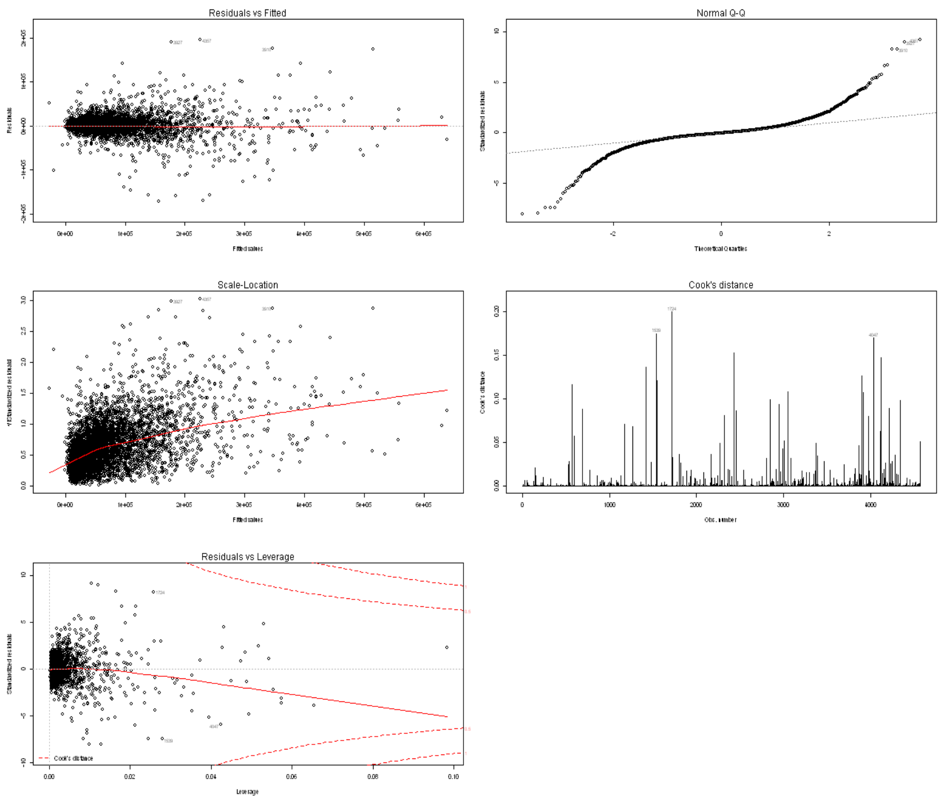
FIGURE 3. DIAGNOSTIC PLOTS OF USING THE LINEAR REGRESSION FOR THE DEPENDENT VARIABLE THE BALANCE OF CASH FLOW FROM OPERATIONAL ACTIVITIES



Source: Own work.

The z test statistic and the p-value are taken from the following test (Test 2):

H_0: regression coefficient when the independent variable is equal to 0,

H_1: regression coefficient when the independent variable is different from 0.

Figure 4 presents the diagnostic plots for the robust linear regression, which describe:

- residual vs fitted plot,
- normal Q-Q graph plot,
- scale-location plot,
- Cook's distance plot,
- standardized residuals vs leverage plot,
- plot of the weights for observations obtained from the algorithm of the robust linear regression.

For all computed models, residuals were symmetrically distributed around 0. Their deviation from the normal distribution is seen on the Q-Q plot. The scale-location plot indicates heteroscedasticity of the residuals and the necessity to apply methods which take this fact into consideration. The Cook's distances did not exceed 0.2 for each

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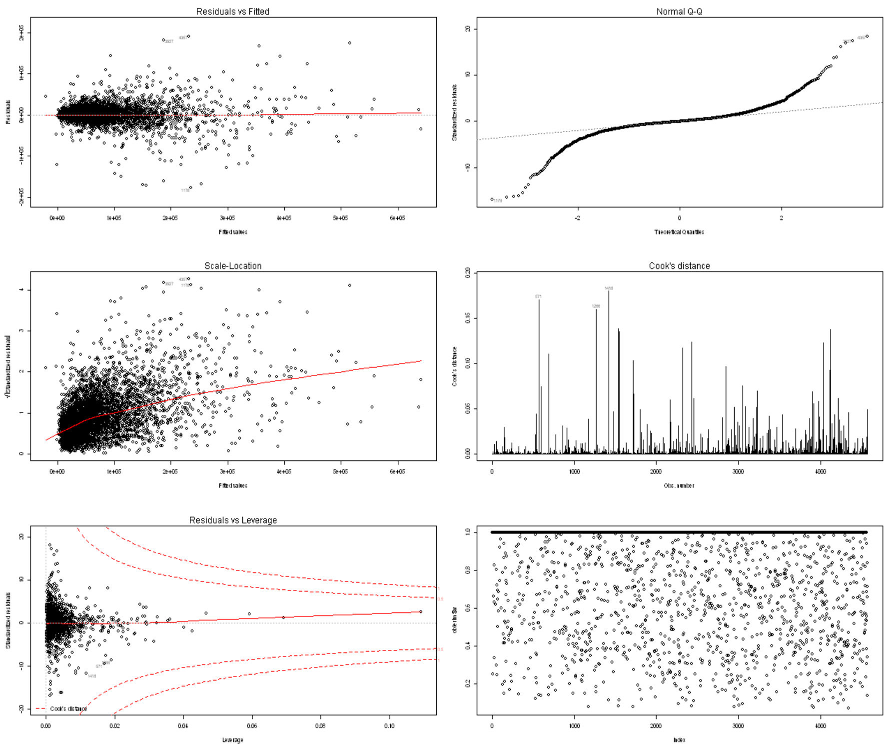
model. Moreover, few points had a leverage exceeding 0.02. Therefore, few point had exceptional values with reference to the models built. In all the models, more than 75% of observations had weights in excess of 0.9, which enabled their positive verification.

FIGURE 4. THE DIAGNOSTIC PLOTS OF USING THE MODEL FOR THE ROBUST LINEAR REGRESSION FOR A DEPENDENT VARIABLE THE BALANCE OF CASH FLOW FROM OPERATIONAL ACTIVATES



Source: Own work.

Table 2 presents the results of estimation of the parameters of the robust linear regression model describing the influence of selected explanatory variables on the balance of cash flow from operational activities. At the significance level of 0.05, there is no reason to reject the null hypothesis (test 2) that the expected value of an absolute term, the coefficient at the equity capital and the European Size Unit is equal to zero.

The impact from single variables on a dependent variable is presented with the use of correlation, while regression informs of the influence of single variables in the context of all variables qualified for the model. The results of estimation of the model parameters show that the following independent variables had a statistically significant influence on the balance of cash flow from operational activities: income from family farms (PLN), direct costs (PLN), depreciation (PLN), fixed assets (PLN), agricultural land (ha), sales revenue (PLN). The factor defining the level of cash flow from operational activities in farms is the production scale[1], estimated by the sales revenue, direct costs and income.

[1] The production scale is the production size (Begg, Fisher, Dornbusch 2007; Manteuffel, 1984).

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TABLE 2. THE RESULTS OF ESTIMATION OF THE PARAMETERS OF THE ROBUST LINEAR REGRESSION MODEL DESCRIBING THE INFLUENCE OF SELECTED EXPLANATORY VARIABLES ON THE BALANCE OF CASH FLOW FROM OPERATIONAL ACTIVITIES

Explanatory variables	Expected value of the regression coefficient	Standard error	Z statistic	p-value of the relevant test	Significance code
Absolute term	-6.1689×10^{2}	5.5595×10^{2}	-1.1096	0.2671643	
Family farm income (PLN)	5.3465×10^{-1}	2.1844×10^{2}	24.4761	$< 2.2 \times 10^{-16}$	***
Direct costs (PLN)	-3.3579×10^{-1}	2.5437×10^{-2}	-13.2011	$< 2.2 \times 10^{-16}$	***
Depreciation (PLN)	4.9629×10^{-1}	5.9985×10^{-2}	8.2736	$< 2.2 \times 10^{-16}$	***
Fixed assets (PLN)	1.9837×10^{-2}	5.2220×10^{-3}	3.7987	0.0001454	***
Equity capital (PLN)	-7.7888×10^{-3}	4.9710×10^{-3}	-1.5668	0.1171499	
Agricultural land (ha)	2.1038×10^{2}	3.6285×10	5.7981	6.706×10^{-9}	***
Sales revenue (PLN)	3.4285×10^{-1}	2.0735×10^{-2}	16.5348	$< 2.2 \times 10^{-16}$	***
European Size Unit	3.9671×10^{1}	8.7502×10	0.4534	0.6502832	

Source: Own work.

Note: Significance codes: '***' 0.001

If the income from family farm grows by one unit, the balance of cash flow from operational activities will rise by 0.53 of the unit in the model applied. If direct costs go up by one unit, the balance of cash flow from operational activities will fall by 0.34 of the unit in the model applied. Therefore, the relationship between the balance of cash flow from operational activities and direct costs is consistent with expert knowledge (intuition), although the relationship between the variables was positive. In farms, the balance of cash flow from operational activities was influenced by the area of agricultural land (ha). Fixed assets also played a crucial role in deciding about the amount of cash generated from the basic area of a farm. It can be supposed that the farms with a greater machinery stock gained higher revenue from sales. In connection with the fact that the changeable balance of cash flow and sales revenue were highly interdependent, only P&L categories, i.e. cash flow from operational activities, should be significant in describing the cash position of a farm. Wędzki said that one of the ways to forecast operational flow is the sum of net profit and depreciation (Wędzki, 2003). In the robust linear regression model both income from family farm (as the equivalent of the net profit) and depreciation occurred. These are the factors that influence the balance of cash flow from operational activities.

Conclusion

The study presents the determinants of the balance of cash flow from operating activities in the farms participating in the PL FADN. Based on the research conducted, the following conclusions can be made:

1. The factor which had a statistically significant impact on the balance of cash flow from operational activities was income from family farm. Other factors influencing the cash flow from operational activities in farm are sales revenue, direct costs and income from family farm. A basic factor influencing cash in farms is the production scale estimated by sales revenue, costs and income from farm.
2. The agricultural type of a farm and the year of measurement have a significant impact on the balance of cash flow from operational activities. The type of agricultural business differentiates the balance of cash flow from operational activities.

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