

Article

# Determinants of Fixed Asset Investment in the Polish Farms

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**Abstract:** The aim of this study was to determine the factors affecting the level of investment activity of agricultural producers in Poland. Detailed studies included 4309 farms that kept accounts within the Farm Accountancy Data Network (FADN) accounting system in the years 2010–2018. The study uses Person's linear correlation method, the multiple correlation method, and regression analysis. For the regression analysis, both static and dynamic models were applied. The level of expenditure on agricultural investment varied in the surveyed households and showed an upward trend during the years 2010–2018. Studies have shown that the investment activity of Polish farms largely depends on the possibility of raising funds from European Union programs dedicated, inter alia, to the development of agricultural holdings. The regression analysis demonstrated that the principal factors affecting the level of agricultural investment include: the amount of long-term liabilities, the family income of the farm, and the amount of investment subsidies. Preferential loans are an important parameter in a dynamic investment model. This study suggests that agricultural policy factors should be taken into account to ensure the appropriate development of Polish farms.

**Keywords:** development; agriculture; holdings; income; investment subsidies; liabilities; static and dynamic models



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## 1. Introduction

In a market economy and in the agricultural sector, the functioning of enterprises is associated with the continuous improvement of competitiveness, as well as the improvement of production efficiency. Meeting the requirements, which is an implication of the ongoing changes, requires taking actions that ensure the development of firms in the long term. These actions are based on investments in fixed assets. Equipping farms with production assets has a significant impact on their economic situation, and the structure of production assets determines their production capacity. It is also important to adapt farm equipment to the current directions of production.

The rationale for enlarging the resources of machinery and equipment is the existence of potentially cost-effective options to increase production and reduce costs by choosing more capital-intensive production methods [1]. Investments form an integral part of the process of both simple and extended reproduction, and they ensure the implementation of the principles of sustainable development in the practice of agricultural holdings.

According to J. Mikolajczyk, investment is needed to reproduce and develop production capacity and improve the profitability and competitiveness of Polish agriculture [2]. Productive investment decides the development opportunities of farms. It indicates the expansion of fixed asset inventory or an increase in its quality, which contribute to the growth of the farm's potential in the future. Improving technical working materials, as well as the introduction of modern machinery and equipment in agricultural production, results in increased productivity in both crop and livestock production. With the spread of the sustainable paradigm in agriculture, the nature of investments will change, from those

aimed strictly at increasing productivity to pro-environmental investments, which at the same time will also translate into an increase in the farm efficiency (e.g., investments in biogas plants or renewable energy).

Investment projects are mainly substitutes for human labor. This is due to changes in the cost factors of production, among which the labor costs are the most dynamic [3]. This has consequences for the economy and organization of farms, consisting of the preference for labor-saving, but also capital-intensive techniques and technologies [4]. The increasing use of capital-intensive technologies contributes to the growth of agricultural production by promoting the substitution of both land and labor inputs with capital. According to K. Zielinski, limited demand for raw materials of agricultural origin should lead to the lower employment of both labor and land resources [5]. This is stressed in the official publications of the EU administration. Investments in buildings, machinery, and equipment, are considered to be the main factors of productivity growth and therefore are effective substitutes for labor [6].

Investments in infrastructure are often seen as a solution to the problems of unemployment and depopulation of rural areas, and are also considered as a way of stimulating the economic situation [7]. In contrast, no investment activities may lead to divestment processes that involve the reduction of production resources or the restriction of the number (or range) of operations [8].

Agricultural investment should be also considered in a broader sense, pertaining to the whole sector. According to A. Kowalski, the objectives of the investment measures that are implemented in agricultural holdings should be in line with the adopted directions of structural changes in agriculture [9]. They involve, among others, the provision of adequate size and structure of food production, the improvement of living and working conditions of rural population, and environmental protection. The last of these issues matters with regard to the growing importance of sustainable agriculture. This concept strongly accentuates the model of agricultural production that is goal-oriented in terms of both production and the implementation of environmental and social objectives.

Management of investment activities on farms is associated with incurring greater or lesser financial expenses. The selection of appropriate sources of financing the investment is the key element influencing the investment cost, and thus its profitability in the long term. The basic source of financing investments in the agricultural sector is self-financing [10]. Nevertheless, the agricultural sector has little capacity to accumulate capital [11], so there is a need for external support for investment activities. Poland's accession to the EU has resulted in increased investment activity in farms. This is mainly due to the necessity to adapt them to EU requirements in the fields of production hygiene, environmental protection, animal welfare, and food safety. For the implementation of investments in this area, agricultural producers have received financial support from EU funds under various programs [12]. Subsidies from the funds allocated to the common agricultural policy of the European Union and the growing demand for Polish agri-food products in the single European market are the main reasons for the change in farmers' approach to investment.

Given the importance of investment in agricultural holdings and agriculture in general, the aim of the study is to determine the factors differentiating the level of investment activity of agricultural producers in Poland. This research investigates the hypothesis that of the many factors affecting the level of farm investment, the most important one is the availability of loans, particularly those granted on preferential terms for farmers.

## 2. Factors Influencing Farmers' Investment Decisions—Literature Review

The reference books describe many models taking into account the investment behavior of business entities, from those preceding neo-classical models (e.g., the accelerator model or the cash flow model) to modern concepts incorporating irreversibility and uncertainty (real options).

In the accelerator model, one of the main factors influencing investment is consumption. The first economist who drew attention to the importance of consumer demand in

the creation of investment demand was T. N. Carver [13]. However, it was mainly J. M. Clark who popularized the model [14] and introduced “the principle of acceleration” to economics. This principle holds that relatively small changes in demand for consumer goods cause major changes in the level of investment. Hence, what matters for the dynamics of investment is the situation in the economy and the real disposable income of households, which determines consumer demand, whereas the measure of changes in consumer demand, which is important for agriculture (including the dynamics of investment in the sector), are changes in the consumption of food and other groceries.

According to the of cash flow theory, the level of investment depends primarily on cash flows, i.e., the possibility of financing investment from the investor’s own resources [15,16]. Enterprises that have high financial constraints are characterized by greater sensitivity of investment to cash flows. The neoclassical theory of investment formulated by Jorgenson assumes that investment decisions depend on the cost of capital [17]. Additional capital units are bought to the point at which the marginal benefit of capital is equal to the marginal cost of capital, which is the price of the rent. In contrast to the accelerator model, the Jorgenson model assumes that investment is a function of the rental price of capital. In line with the information asymmetry theory, J. Stiglitz and A. Weiss found that the price of credit is not necessarily at the market equilibrium level, which is usually determined by the law of supply and demand under perfect information conditions [18]. Financial markets are characterized by imperfect information, which leads to credit rationing (this restricts the availability of credit), and this leads in turn to a reduction in investment activity. B. Greenwald, J. Stiglitz, and A. Weiss found that in the conditions of credit rationing, it is the availability of capital and not its cost that is of major importance for investment decisions [19]. In turn, the ‘real options’ method involves changing the method of assessing the effectiveness of investment. It suggests to look at the investment project not as a string of time-ordered cash flows, but as a set of real options. This approach allows the assessment of tangible investments through the prism of their flexibility and the value that they carry in themselves [20]. Various theories or models of investment behavior generally relate to one or more determinants, and they are therefore most commonly considered as complementing one another.

Basically, the investment decisions made by farmers result from the impact of both exogenous and endogenous factors. The exogenous factors may include factors related to the demand for the given products, the expected and current level of prices for agricultural products, supply conditions and in particular the level of incurred costs, the availability of production factors and their prices, the current economic conditions and those anticipated by farmers, systemic (financial, economic, institutional) solutions; economic, fiscal, monetary, and especially agricultural policy; the inflation rate and interest rates on the capital acquisition cost, the degree of openness of the economy to international connections, regulations, requirements on environmental protection, and others [21–23].

Endogenous factors result from the productive potential of agriculture (land, labor, and capital resources), the degree of fixed asset depreciation, the level of modernity of production techniques, the level of knowledge of farm managers and their age, the economic and financial situation of holdings, and, in particular, the level of generated agricultural income [21,24–26]. Both external and internal factors have an impact on farmers’ decisions to implement or abandon projects.

Among the determinants of farmers’ investment behavior identified in the literature on the subject, the following should be mentioned:

- the phase of the business cycle (boom/bust in agriculture) [22,27];
- factors related to the macroeconomic and political environment [28];
- features of investment projects (including start time, duration, source of financing);
- characteristics of commodity markets as well as factor markets (e.g., credit market);
- features of a family farm [29,30];
- the attitude of the agricultural producer.

The scale of an investment activity thus depends on many determinants related to the undertaking and its socio-economic environment. E. Ostrowska conducted an analysis of these factors in terms of macroeconomics and microeconomics [31]. The first group included: economic situation and state policy, technological development, and geographic and socio-demographic conditions. The mesoeconomic factors included the situation in the sector and the competitive environment of the undertaking. The microeconomic determinants involved the type of manufacturing and marketing factors, as well as capital (financial) resources and human resources.

According to A. Woś, the driving force behind investment is the projected income earned from the realized investments [32]. It is the farm's income that determines the level of investment, which is turned into new technologies, thereby providing multiplication of income, and this in turn gives rise to new investments. The importance of agricultural income as a driving force for the development and expansion of agricultural holdings was also indicated in the studies of D. Kusz, S. Gędek, and M. Ruda [33]. In turn, G. Thijssen pointed out that agricultural investments are very sensitive to changes in prices, costs of capital, and production technology [23]. The pricing policy is therefore a useful tool for influencing the investment behavior of farmers. This is due to the fact that changes in these factors affect the level of agricultural income. Due to various theories regarding the factors that determine investments in farms, this research was conducted in this area.

### 3. Materials and Methods

The study was based on both secondary research using previous literature, and on the data collected in the framework of the Polish Farm Accountancy Data Network. This system includes representative samples of farms producing 93.03% of the standard output (SO) of all classified holdings in Poland. The minimum threshold for the Farm Accountancy Data Network field of observation is an SO of 4000 euros, which means that there are developmental units that will affect the shape of Polish agriculture in the future. Hence, the resulting conclusions can be generalized.

Detailed datasets included 4308 holdings that consistently kept accounts within the Farm Accountancy Data Network in the years 2010–2018. Due to changes in the value of investment goods over time, the level of investment in the surveyed households was discounted by the price deflator of investment goods in individual holdings published by the Central Statistical Office in Poland.

To identify the determinants of the level of investment, this study uses Person's linear correlation method, the multiple correlation method, and a regression analysis. The Pearson's linear correlation coefficient is a symmetric measure, i.e., it measures the strength of dependency of the characteristic  $y$  on the characteristic  $x$  and vice versa, of the characteristic  $x$  on  $y$  (hence  $r_{XY} = r_{YX}$ ) [34]. It is expressed by Formula (1).

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x}) \sum_{i=1}^n (y_i - \bar{y})}{S_X S_Y}, \quad (1)$$

where:  $S_X$ ,  $S_Y$  are population standard deviations  $x$  and  $y$ ;  $\bar{x}$  and  $\bar{y}$  are average values of the features  $x$ ,  $y$ .

The values of Pearson's linear correlation coefficient are in the range  $[-1, 1]$ ; the closer they are to the extremities of the range, the greater the strength of linear correlation between the variables.

The multiple correlation coefficient refers mainly to a multidimensional correlation. It is a measure of the strength of correlation between the characteristic  $y$  and the other characteristics  $x_1, x_2, \dots, x_n$ , and its values are in the range  $[0, 1]$ . The multiple correlation coefficient does not show the correlation's direction and it only measures its strength. This measure is equal to the root of the determination coefficient (the study gives its value as multiple  $R$ ), as it informs what variation part of the  $Y$  characteristic is explained by

the regression relative to the characteristics  $x_1, x_2, \dots, x_n$  [35]. The multiple correlation coefficient is calculated according to the Formula (2).

$$R_{y|x_1, x_2, \dots, x_n} = \sqrt{1 - \frac{\det(R)}{\det(R_{yy})}}, \quad (2)$$

where:

- $\det(R)$ —determinant of the matrix of Pearson's linear correlation coefficients;
- $\det(R_{yy})$ —determinant of sub matrixes resulting from plotting the  $y$ -th row and  $y$ -th column from matrix  $R$ .

The study also used multiple regression analysis. Two regression models were applied that use investments at two different levels:

- static, in order to determine the factors that differentiate the level of investment outlays in agricultural holdings,
- dynamic, in order to determine the impact of given factors that impacted changes in the amount of investment outlays in farms over the analyzed period.

To estimate the models, a backward stepwise regression approach was used. Firstly, the study evaluated the significance of individual parameters of the model and its goodness of fit. In static and dynamic terms, the value of investment outlays in a farm ( $y$ ), which includes the value of purchased and manufactured fixed assets, was adopted as the variable explained for the models. As a response variable in the static and dynamic models, the study adopted the value of investment in a farm, which includes the value of purchased and manufactured fixed assets. Then, based on the previous literature review, a set of factors was distinguished that could significantly affect the value of investment outlay. Out of many variables, the study took into account only those variables that have a substantial impact on the investment outlays. The endogenous factors that were considered in the analysis, most often included:

- the potential of a business entity, expressed in land [3], labor, and capital resources [36,37] or in its economic strength, and also other production factors such as, for example, technical equipment of holdings [38].
- the financial situation and the level of income [39,40], which determine the possibilities for internal and external financing [15,16].

Investment decisions of farmers are also affected by a number of exogenous factors. These include, among others, the accessibility of funds from the Common Agricultural Policy after Polish accession to the European Union [41,42], the supply of preferential loans, and commercial interest rates [43]. The variables used in this study are measured at the farm level and are taken from the Farm Accountancy Data Network.

To implement the model and identify the factors differentiating the level of investment in the surveyed holdings, the authors adopted the following set of variables:

- $x_1$ —economic size of the farm;
- $x_2$ —labor inputs per 1 ha utilized agricultural area [AWU/ha];
- $x_3$ —technical utilities of the land [value of fixed assets without land/ha];
- $x_4$ —technical equipment for work [value of fixed assets without land/AWU];
- $x_5$ —total debt ratio [total liabilities/assets];
- $x_6$ —share of costs in production value;
- $x_7$ —profitability ratio [income/production value];
- $x_8$ —value of investment subsidies;
- $x_9$ —long-term liabilities;
- $x_{10}$ —income from a family farm;
- $x_{11}$ —return on fixed assets (income/value of fixed assets);  $x_{12}$ —utilized agricultural area;
- $x_{13}$ —value of farm assets (fixed assets).



In order to find which factors determined the variability of investment outlays (dependent variable) in dynamic terms in the analyzed period, the following explanatory variables were identified:

- $z_1$ —income from a family farm without operating subsidies;
- $z_2$ —operating subsidies;
- $z_3$ —income from a family farm in the previous year [ $n - 1$ ];
- $z_4$ —value of preferential loans;
- $z_5$ —value of other long-term liabilities;
- $z_6$ —value of investment subsidies;
- $z_7$ —value of short-term liabilities.

This research selected only those variables whose impact on the level of investment outlays can be substantively justified. The selected variables were also characterized by a sufficiently large range of variability. Then Pearson's correlation coefficients were calculated between the explanatory variables to eliminate variables that were correlated with each other.

For the construction of regression models, the “backward” stepwise elimination method was used, which means that variables for which the F-Snedecor test value is lower than the threshold value were removed from the model in subsequent steps. The procedure was repeated until the best model describing the dependent variable was obtained. Student's t-statistics were used to evaluate the significance of the model parameters. The econometric models were estimated using both MS Excel and Statistica software.

#### 4. Results

The research covered 4308 farms that throughout the period of the study (2010–2018) kept accounting under the FADN. As a result of structural changes, macroeconomic factors, and investments made, the characteristics of farms were being transformed. The general characteristics of the surveyed entities in the base year, i.e., 2010, are presented in Table 1. The farms were divided into three quartile groups.

- ... Q1—25% of farms, with the lowest level of investment outlays;
- ... Q2–Q3—50% of farms, with an average level of capital expenditure;
- ... Q4—25% of farms, with the highest level of investment outlays.

The average economic size of the researched farms was 46.4 thousand euros SO (Standard Output). The share of plant and animal production in the total production value was similar and amounted on average to 43.7%. The average farm in the research generated income at the level of PLN 49.3 thousand, while the share of subsidies to operating activities in income was 37% (Table 1).

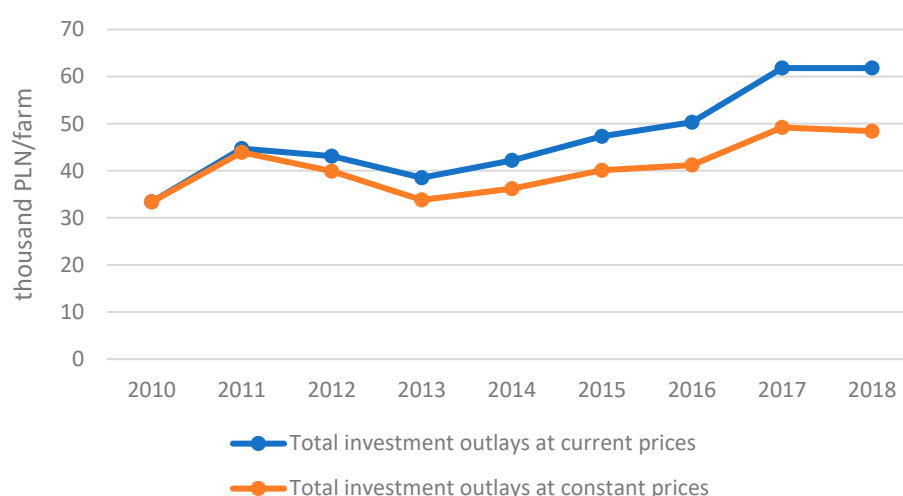
**Table 1.** General characteristics of farms for 2010.

Specifications	Q1	Q2–Q3	Q4	Total
Number of farms	1102	2104	1102	4308
Economic size (EUR SO)	20.9	35.4	83.0	46.4
Utilized agricultural Area (ha)	14.0	25.4	58.1	32.5
Total labor inputs (AWU)	1.7	2.0	2.6	2.1
Total production value (thous. PLN)	63.8	120.3	307.0	163.7
In it: plant production (%)	44	42	45	43.7
Total costs (thous. PLN)	52.0	92.9	231.5	125.5
In it: direct costs (%)	52	54	58	54.7
Agriculture income (thous. PLN)	17.4	37.3	93.1	49.3
Share of subsidies in income	45	34	32	37

Source: own study based on Farm Accountancy Data Network data.

The global level of investment in the sector of Polish agriculture consists of individual investment decisions of each farm. The decisions are influenced by numerous exogenous and endogenous factors. Larger changes in the level of expenditures relate to farms with

higher investment outlays, which are due to their financial capabilities. In the surveyed households, the average level of investment in the years 2010–2018, calculated in constant prices for 2010 amounted to PLN 40.7 thousand per household. The level of expenditure on agricultural investment was characterized by an upward trend, although the dynamics of changes in individual years were quite varied due to the evolving economic situation in agriculture and the changes in the access to external financing, including promotional loans and funds from the Rural Development Program. In 2010, the average level of investment amounted to PLN 33.4 thousand per farm; in 2017, it peaked and was 85% higher (Figure 1). In 2018, there was a slowdown in the growth of capital expenditures. The increase in capital expenditures in 2017 and their high level in 2018 was caused by the increase of funds allocated for the purchase of land. This was related, among others, to the sale of land from the Treasury Agricultural Property Stock.



**Figure 1.** The amount of capital expenditures in the examined holdings at current and constant prices. Source: own study based on Farm Accountancy Data Network data.

The most significant item in the structure of agricultural investment after 2010 was machinery and equipment, which accounted for 25–35% (depending on the year) of the total value of investment outlays (Table 2).

**Table 2.** The structure of capital expenditures in the examined holdings in %.

Specification	2010	2011	2012	2013	2014	2015	2016	2017	2018
Land	11.7	10.7	15.1	17.9	18.0	18.8	21.5	26.7	32.8
Buildings and structures	25.4	35.1	30.9	21.3	13.3	16.5	14.5	13.6	16.5
Means of transport	19.2	21.9	21.8	24.4	31.0	26.6	25.7	25.9	20.4
Machines, tools, and technical facilities	26.6	25.5	25.5	30.4	33.2	34.7	34.5	30.1	26.9
Intangible fixed assets	2.7	2.2	2.3	1.3	1.2	1.1	1.2	1.3	1.5
Others	14.4	4.5	4.4	4.7	3.3	2.3	2.6	2.3	1.9

Source: own study based on Farm Accountancy Data Network data.

These investments related mainly to fixed assets used the crop production. Such investments are characterized by greater flexibility, and a high degree of reversibility in relation to investment in buildings and structures. Hence, there is a lower risk of loss due to bad investment decisions. Their value is strongly correlated with the value of purchased tractors, which forced the adjustment of the rest of the machine park equipment in terms of increasing tractive force. Purchases of agricultural machines were facilitated by aid programs implemented in the framework of the European Union funding. Within the framework of Rural Development Program measures “Modernization of agricultural hold-

ings" in years 2007–2013, Poland drew the highest amount for investments in machinery and equipment of all the countries in the European Union.

In order to determine what household features are related to the value of investment, the authors carried out a statistical analysis, which consisted of examining the significance of individual parameters with respect to the response variable that is the value of the investment outlays ( $y$ ). Pearson's linear correlation coefficients and multiple regression analysis were used to assess the relationship between the variables. The analysis of factors affecting the investment variation in holdings revealed what parameters affect agricultural investments and with what force. It also allowed the determination of which holdings invest more than others and what parameters they have. The correlation coefficients between the explanatory variables and the investment outlays ( $y$ ), and between each of the variables, are presented in Table 3.

**Table 3.** The coefficients of correlation between the explanatory variables and the response variable (value of investment outlays).

	y	x <sub>1</sub>	x <sub>2</sub>	x <sub>3</sub>	x <sub>4</sub>	x <sub>5</sub>	x <sub>6</sub>	x <sub>7</sub>	x <sub>8</sub>	x <sub>9</sub>	x <sub>10</sub>	x <sub>11</sub>	x <sub>12</sub>	x <sub>13</sub>
y	1.00													
x <sub>1</sub>	0.61	1.00												
x <sub>2</sub>	−0.01	0.01	1.00											
x <sub>3</sub>	0.06	0.08	0.68	1.00										
x <sub>4</sub>	0.63	0.49	−0.03	0.16	1.00									
x <sub>5</sub>	0.50	0.33	0.03	0.09	0.35	1.00								
x <sub>6</sub>	−0.05	−0.06	−0.02	0.01	0.01	−0.02	1.00							
x <sub>7</sub>	−0.01	−0.05	−0.08	−0.10	−0.11	−0.02	−0.62	1.00						
x <sub>8</sub>	0.55	0.36	−0.04	0.00	0.52	0.21	0.00	−0.01	1.00					
x <sub>9</sub>	0.80	0.58	0.05	0.18	0.54	0.70	−0.02	−0.06	0.33	1.00				
x <sub>10</sub>	0.69	0.82	0.00	0.03	0.49	0.33	−0.19	0.12	0.40	0.58	1.00			
x <sub>11</sub>	0.01	0.13	0.04	−0.03	−0.15	0.08	−0.26	0.31	−0.05	−0.01	0.29	1.00		
x <sub>12</sub>	0.65	0.64	−0.11	−0.07	0.44	0.36	0.00	0.07	0.36	0.55	0.72	0.12	1.00	
x <sub>13</sub>	0.80	0.74	0.04	0.23	0.76	0.38	−0.05	−0.09	0.53	0.73	0.76	−0.08	0.64	1.00

Source: own study based on Farm Accountancy Data Network data.

The highest level of correlation with the response variable (investment outlays) was given by: long-term liabilities (80%), the value of fixed assets (80%), and the income from the family farm (69%). The analysis also showed fairly significant levels of correlation of income (76%) and the long-term liabilities (73%) with the value of household assets. These results indicate a relatively high level of interdependence between these factors.

On the basis of the assessment of the significance levels of each of the parameters, using both a multiple regression analysis and a backward stepwise regression method, and having removed the interdependent (multicollinear) variables from the analysis, the following model was estimated:

$$y = 35.5 \times x_8 + 2.56 \times x_9 + 1.96 \times x_{10} - 11,499$$

$$(t = 34.5, p = 0.00) (t = 66.5, p = 0.00) (t = 30.6, p = 0.00)$$

$$R^2 = 77.7\%, \text{ multiple } R = 88.1\%, \text{ standard error} = 330,379, p = 0.00$$

The regression model shows that the factors that significantly influenced the level of investment in the surveyed holdings were: the long-term liabilities, the income from the family farm and the obtained subsidies for investment. The estimated model explained about 78% of the sample variation. The resulting parameters were found to be statistically significant, as indicated by the value of the Student's  $t$  statistics, because the  $p$  value was lower than the adopted significance level ( $\alpha = 0.05$ ). A high value of the multiple correlation coefficient (88%) confirms a significant effect of all these factors on the volume of investment.



The interpretation of the resulting econometric model suggests that an increase in the level of long-term liabilities on the farm by an average of PLN 1 helps increase investment by PLN 2.56, assuming the other factors are unchanged. The increase in the income level of the family farm by about PLN 1 results in an increase in investment outlays by PLN 1.96, assuming the other factors remain unchanged. An increase in investment subsidies by PLN 1 results in an increase in investment outlays by PLN 35.5, with the given level of other factors.

Taking into account the fact that investing in agricultural holdings is a complex process that is distributed over time, another econometric model was built for the years 2010–2018. The response variable and the explanatory parameters were measured as the arithmetic means in the considered time period.

The level of investment in global terms was, however, as the research indicates, quite varied in different years. The dynamics of these changes may have been largely affected by macro scale determinants, which are dependent on the farmer to a lesser extent. The first group may include, e.g., the amount of financial assistance for investment or the economic situation of the agricultural markets.

To determine the effect of individual factors on the level of investment during the studied period by using the dynamic approach, the authors used multiple regression analysis. As in the earlier statistical model, the model was estimated with the use of backward stepwise regression. Beside the model construction, the authors also assessed the significance of individual parameters and the model fitting (Table 4).

**Table 4.** Value of selected statistical variables adopted in the assessment of volatility of investment outlays in the years 2010–2018 (thousand PLN per farm).

Years	Investment Outlays	Additional Payments for Operating Activities	Income from a Family Farm without Subsidies	Income from a Family Farm in the Previous Year ( $n - 1$ )	Preferential Loans	Other Long-Term Liabilities	Investment Subsidies	Short-Term Liabilities
2010	33.4	15.9	30.6	42.0	11.4	2.5	4.1	5.2
2011	44.7	24.7	35.8	46.5	17.8	4.5	24.6	6.6
2012	43.1	20.5	53.0	60.6	17.3	2.9	9.7	4.6
2013	38.5	31.2	30.6	73.5	15.7	3.6	3.6	5.6
2014	42.2	35.0	24.8	61.7	14.4	6.2	15.5	5.5
2015	47.3	36.3	50.6	59.8	16.2	6.9	16.3	4.4
2016	50.3	41.7	63.4	86.9	18.0	6.1	12.1	4.5
2017	61.8	37.6	68.7	105.1	22.3	10.9	15.3	4.6
2018	61.8	43.6	56.7	106.3	24.1	8.8	8.3	3.9

Source: own study based on Farm Accountancy Data Network data.

The set of variables which might have affected the changes in the investment outlays in the years 2010–2018, the correlation coefficients between the explanatory variables, and the response variable ( $y$ ), measured by the value of investment outlays, are shown in Table 5.

**Table 5.** Correlation coefficients of explanatory variables in the dynamic model.

	$y$	$z_1$	$z_2$	$z_3$	$z_4$	$z_5$	$z_6$	$z_7$
$y$	1.00							
$z_1$	0.76	1.00						
$z_2$	0.80	0.52	1.00					
$z_3$	0.87	0.80	0.72	1.00				
$z_4$	0.95	0.66	0.75	0.85	1.00			
$z_5$	0.91	0.80	0.64	0.80	0.77	1.00		
$z_6$	0.27	0.15	0.10	−0.14	0.21	0.31	1.00	
$z_7$	−0.57	−0.51	−0.72	−0.63	−0.47	−0.49	0.37	1.00

Source: own study based on Farm Accountancy Data Network data.

The estimation resulted in a model where the response variable was the value of investment outlays and the explanatory variable was the value of preferential loans:

$$y = 2.4 \times z_4 + 5233.8$$

$$(t = 8.1, p = 0.00)$$

$$R^2 = 90.4\%, \text{ multiple } R = 95.1\%, \text{ standard error} = 3207.13, p = 0.00$$

Based on the values specified in dynamic terms, the constructed model explains 90% of the volatility of investment outlays in the examined period. A high value of the multiple correlation coefficient (0.95) points to an important influence of preferential loans on agricultural investment in a given year. The estimated model parameter (preferential loans) was statistically significant, as indicated by Student's *t*-test, because the *p*-value was lower than the accepted level of significance ( $\alpha = 0.05$ ). However, due to a small number of observations (9 years), the presented estimation model should be interpreted with caution, as the volatility of explanatory factors in the following years could significantly affect the shape of the model. The developed model can be interpreted in such a way that an increase in the level of preferential loans in the given year by PLN 1 contributed to an increase in investment outlays in agricultural holdings by PLN 2.4.

On the basis of these results, it can therefore be concluded that increasing lending by means of preferential loans, and supporting investment activities through subsidies of interest were the most appropriate ways to create the conditions for the growth of investment in the agricultural sector. This is all the more significant as the importance of preferential lending is clearly emphasized by agricultural producers. The study conducted by the Food Economy Bank in 2011 on a group of 758 agricultural producers who had benefited from preferential loans shows that the vast majority of them (77%) would not use a commercial loan to finance investments in the absence of a preferential loan. As many as 97% of respondents attributed this to the higher cost of such a loan. Given the scale of negative responses, it can be concluded that a reduction of support in the form of subsidies for agricultural loans would adversely affect the level of investments in agriculture in the country.

The multiple regression analysis showed no statistical relationship between changes in agricultural income and the level of agricultural investment in the years 2010–2018, both in terms of their actual level in the given year and with a back-shift by one year ( $n - 1$ ). The level of preferential loans (important parameter) in the surveyed households was also dependent on the amount of agricultural income, which has a significant impact on the creditworthiness of agricultural producers. The correlation coefficient between the amount of income without subsidies and preferential loans value was 0.76, which indicates a strong correlation between the examined characteristics. On the one hand, the parameter of preferential loans, as opposed to income, takes into account the aspect of farmers' willingness to take risk, which may be caused by non-economic factors, such as, e.g., the age of the farmer and the related problems of succession, education, health, etc. Therefore, it can be stated that not every farmer who is ready to take a credit will receive it for profitability reasons. On the other hand, not every farmer who could receive such a credit will apply for it for the reasons stated above.

## 5. Conclusions

The conducted research does not exhaust the problem of investments in farms, but on its basis, several conclusions can be drawn. In the surveyed households, the level of expenditure on agricultural investment was varied and showed an upward trend in the years 2010–2018. Dynamics of changes in individual years, however, was different due to the developing economic situation in agriculture, and due to changes in access to funds raised for investment. The increase in investment outlays in the years 2017–2018 resulted from the increase of funds allocated for the purchase of agricultural land. Throughout the examined period, the structure of agricultural investment was dominated by machinery

and technical equipment, which accounted for 25–35% of the total value of investment outlays. This related mainly to fixed assets used for crop production.

The investment decisions made by farmers are a function of various factors related to the undertaking and its socio-economic environment. They are related to the anticipated benefits at the microeconomic or macroeconomic scales, which result from non-market functions of agriculture. The investment activity of Polish holdings hugely depends on the possibility of raising funds from European Union programs, dedicated, inter alia, to the development of agricultural holdings.

The regression model demonstrated that the principal factors that affect the level of agricultural investment include: the amount of long-term liabilities, the family farm income, and the amount of investment subsidies. In turn, an important parameter in the dynamic investment model proved to be the amount of preferential loans. On this basis, it can be concluded that the research hypothesis formulated in the paper has been positively verified.

The findings of this research suggest that the loans availability, especially of preferential loans, has the largest impact on the level of farm investment. Although the level of agricultural income is significantly related to the amount of preferential loans received, it did not prove to be a significant factor for the volatility of investment in Poland post-2010. Compared to income, preferential loans take into account a wider range of stimuli that influence the amount of investment outlays. These determine, among others, the agricultural producers' willingness to take risks, and they may be related to non-economic factors such as the age of a farmer and problems of succession, education, or health. Appropriate agricultural policy in respect to these factors will enable further development of investment holdings that will be also in line with sustainable development principles.

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