

MACROECONOMIC DETERMINANTS OF THE DYNAMICS OF INVESTMENT IN AGRICULTURE (CASE OF POLAND)

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Abstract

In an era of increasing competition and the need to meet increasing consumer demand for food quality and safety, as well as the obligatory requirements of sanitary-hygienic and environmental protection, or the need to meet the challenges of climate change and increasing demand from a growing world population, agriculture requires significant investment. Investment activity of farmers depends on many determinants related to both the agricultural farm and its socio-economic environment. The aim of the study is to identify the macroeconomic factors determining the dynamics of investment in agriculture on the example of Poland. It was found that the factors determining the dynamics of investment are mainly factors of demand nature.

Key words: investments, macroeconomic's determinant, agricultural sector

INTRODUCTION

Agricultural production is a function of several inputs, including the current level of capital (buildings, machinery and equipment, land), which depends on past investment decisions. Investments realized in a specific period create conditions for achieving required future outcomes [16]. Because of that, the investment demand of farmers affects their future production capacity, the level of competitiveness and operational efficiency, market power, and the level of modernity and innovation. In addition, investments in agriculture are one of the most effective ways of reducing poverty and enhancing environmental sustainability. Especially now in an era of growing demand for food, the need to eliminate hunger and making agriculture sustainable will require increased investment in agriculture. At the same time, these investments should aim towards technologies favoring the protection of the environment, resources, agro-ecological and social balance, these should not be investments that promote industrial agriculture.

Domestic private investments play dominant role in the investments in agricultural sector

[1], especially in low- and middle-income countries. Farmers are investing to increase or diversify sources of income, and thus build-up their wealth. Identifying the factors that influence investment demand of farmers, their willingness and ability to invest should be determined in the first place. The tendencies of farmers to invest are psychological and economic motives that inspire to development activities, which is the essence of creation of investment funds. The ability to invest is a measure of the actual investment effort and is an expression of the decision facing the future. Farmer propensity to invest is an expression of his willingness to devote part of disposable income obtained to development and investment capacity is manifested in concrete decisions. Primary importance for the realization of the investment in a farm is farmer's tendency to invest, which - if strong - can be materialized in concrete investments, provided owing the ability to invest.

Factors influencing the propensity and ability of farmers to invest can be divided into two groups: exogenous and endogenous factors. The exogenous factors affecting farmers' investment activities may include [3, 10, 12] factors of demand nature, the expected and the current level of prices, supply conditions, and

in particular the level of costs incurred, current and future economic conditions, geographic and socio-demographic conditions, system solutions (financial, economic, institutional), economical policy of the government, especially the agricultural, fiscal, monetary policy, inflation that underlies the cost of capital, the degree of openness of the economy (especially international trade, flows of financial capital and human factor, participation of the country in various international systems), barriers to international trade regulations especially in the field of environmental protection and preservation of animal welfare, demands and other environmental groups. The endogenous factors are factors related to the potential of the agricultural holding, its equipment in the factors of production, the level of consumption of fixed assets, the level of modern manufacturing techniques used, the level of knowledge of managing agricultural holding, their age, economic - financial situation of farms, etc. [4, 8, 9]. Information reaching a farm from the external environment and internal factors permit the evaluation of the risks associated with the proposed investment project. Adopted by the company hierarchy of objectives of the action together with established set of information allows making a decision on the implementation or failure of the investment. In a study on the factors of agricultural development it is difficult to grasp the role of single factor, because they are closely interrelated and impact the development in a synergistic manner. However, it appears that greater role in stimulating investment activity of farmers is played by exogenous factors. It is difficult to imagine a situation that the farmer guided by the needs of agricultural farms makes investments at unfavorable external factors.

The aim of the study is to identify the macroeconomic factors determining the dynamics of investment in agriculture on the example of Poland.

MATERIALS AND METHODS

The empirical material was statistical data

from the Central Statistical Office of Poland for the years 1990 - 2012. Time range of analysis was dictated by the fact that in 1989 the Polish transformation took place that has been associated with the transformation of the political system (implementation of democratic institutions and procedures) and economic transformation (replacing the economy centrally planned by free market economy). Due to the different principles of operation of the Polish economy, statistical data from before 1990 may not be comparable with data from 1990.

According to statistics massive investment are considered financial or in kind, whose goal is to create new fixed assets or the improvement (rebuilding, enlargement, reconstruction or modernization) of existing assets, as well as the so-called investment in first equipment.

The value of investment in agriculture is expressed in constant prices of 2011, making adjustments based on price indices of goods and services purchased by private farms intended for investment.

To identify macroeconomic factors affecting the investment activity of farmers, a multiple regression equation of the general form was used:

$$Y_t = \beta_0 + \sum_{j=1}^k \beta_j x_{tj} + \sum_{j=1}^k \gamma_j x_{t-1j} + \varepsilon_t \quad (1)$$

where: Y_t – endogenous variable in time t ($t = 1, 2, \dots, T$), x_{t1}, \dots, x_{tk} – exogenous variables in time t , $x_{t-1,1}, \dots, x_{t-1,k}$ – lagged exogenous variables in time $t-1$, $\beta_0, \beta_j, \gamma_j$ – structural parameter of the model ($j = 0, 1, \dots, k$). ε_t – error term in time t (residual).

Investment activity of farmers in Poland has been characterized by a variable whose variability is described by the following model (1):

Y_I – DYNAMICS_INV – growth rate of investment in agriculture (constant prices of 2011, previous year=100%),

Set of potential explanatory variables in the set of variables characterizing the macroeconomic factors included:

x_1 – DYNAMICS_GDP – growth of gross domestic product (constant prices of 2011, previous year=100%),

x_2 – PRICE_GAP – index of price relations

(„price gap”) sold agricultural products to purchased goods and services. Index of price relations („price gap”) constitutes the ratio of price index of sold agricultural products to price index of purchased goods and services. Price indices of sold agricultural products reflect changes in average weighted procurement prices and marketplace prices received by farmers. Price indices of purchased goods and services illustrate changes in retail prices of goods and services purchased for consumer, current agricultural production or investment purposes,

x_3 – REDISCOUNT_RATE – rediscount rate (for end of year),

x_4 – UNEMPLOYMENT – registered unemployment rate (for end of year),

x_5 – INFLATION – inflation,

x_6 – AGR_PRICE_CHANGES – price indices of gross agricultural output (previous year=100%). Price indices of gross agricultural output expressed synthetically the changes of prices of the sold products, i.e. average procurement prices and prices received by farmers on marketplaces,

x_7 – AGRI_TRADE_BALANCE – the ratio of the trade balance of foreign trade in agri-food products to the gross domestic product,

x_8 – TRADE_BALANCE – the ratio of the trade balance of foreign trade to gross domestic product,

x_9 – TERMS_TRADE – *“terms of trade”* index presents the relation of price changes of exported commodities to price changes of imported commodities,

x_{10} – REAL_INCOME – index of gross disposable real income of the households sector per capita (previous year=100%),

x_{11} – EXPORTS – exports (previous year = 100%),

x_{12} – IMPORTS – imports (previous year = 100%),

x_{13} – TOTAL_CONSUMPTION – total consumption (previous year = 100%),

x_{14} – FOOD_CONSUMPTION – consumption of food and non-alcoholic beverages (previous year = 100%),

x_{15} – ALCOHOL_CONSUMPTION – consumption of alcoholic beverages and tobacco (previous year = 100%).

All the variables used in the analysis are in

fact the first difference of variables time series¹. This approach was applied to avoid the danger of spurious regression, as the time series of all the variables (both endogenous and exogenous) are non-stationary².

Set of explanatory variables does not cover all macroeconomic factors determining the investment activity in agriculture. The selection of explanatory variables in the model resulted from the substantive and the availability of data. The a priori selection method was used to remove insignificant variables.

RESULTS AND DISCUSSIONS

During that research period, the rate of investment was characterized by cyclical changes. During this period, one can identify six distinctive phases of investment in agriculture in Poland:

- phase I – years 1991 – 1993,
- phase II – years 1994 – 1996,
- phase III – years 1997 – 2004,
- phase IV – years 2005 – 2008,
- phase V – years 2009 – 2010,
- phase VI – from the year 2011.

The first phase was characterized by a negative rate of changes in the level of investment. Negative rate of investment during this period in Poland was due to the deep recession transformation during the transition of the economy from a centrally planned system to a free market system. Mainly it was a period of managing existing capacity in economic entities which was supported by capital barrier, as well as the high cost of capital. In this period, high barrier to effective demand and high interest rates continued, which raised negative expectations for economic development, and

¹ The problem of spurious regression (or nonsense correlation) was identified for the first time by Granger and Newbold [6] They concluded that even if non-stationary time series are randomly generated, “(...) it will be the rule rather than the exception” [6, p. 117] that econometric models estimated on the basis of this time series will make the appearance of a statistically significant relationship.

² The stationarity of variables time series were tested with ADF and KPSS tests.

resulted in an increase in risk associated with the investment. In agriculture the collapse of investment during this period was also compounded by the significant deterioration in the financial situation of farms in conjunction with the radical reduction of public support for agriculture.

The second phase is a period of very rapid growth in investment. The causes of intensification of investment activities by farmers in this period can be seen in making available since 1994, a relatively large number of new preferential credits (low interest) for the agri-food sector, financed with public funds. Furthermore, in this period of time the profitability of agricultural production has improved as assessed using the ratio of the price relations („price gap”) (Figure 2). In the first phase of the investment in 1992 and 1994, the rate was beneficial to farmers, more than 100, which could result in optimistic perception of the economic situation of farmers in the future and, combined with the ability to benefit from preferential investment loans resulted in increased investment activity.

The third phase of investment in agriculture, covering the period of 1997 to 2004 was characterized by a negative rate of investment (except for 2002). It may be noted that throughout the third phase of investment in agriculture, the "price gap" indicator (Figure 2) remained at a negative level (year 2000 was the only exception), which indicates the relationship of investment activity farmers felt and the expected level of prosperity. The fourth phase of the investment is associated with the Polish accession to the European Union. In agriculture, the fact that the integration affected the intensification of investment activity and maintaining a positive rate of investment. Increase in investment activity of farmers after the integration of Poland with the structures of the European Union on the one hand was associated with the need to adapt agriculture to EU legislation, but on the other hand, it was due to changes in agricultural policy. Polish integration with the European Union allowed Polish farmers to access to funds for the development of agriculture and rural

development that were several times larger than before integration with the EU. In addition, an extensive system of support for agriculture in the European Union, and in particular the agricultural income support made it possible to reduce the risk of current operations and investment activities.

While for agriculture, the positive effect of integration with the EU came a year after the Polish accession to the European Union. In this period it also was possible to observe favorable economic trends in agriculture assessed using the "price gap" indicator which also contributed to the increased level of investments. The importance of agricultural policy in stimulating investment demand of farmers in the countries of Central and Eastern Europe after the accession to the European Union was highlighted by the following authors: Gospodarowicz M. *et al.* [5], Grzelak A. and Kiełbasa B. [7], Sasu G. [11], Wigier M. [13], Wigier M. *et al.* [14], Zawadzka D. *et al.* [15]. Public aid in the form of direct payments and investment grants may affect the investment decisions of farmers, because they are a source of additional resources, which increases the possibility of creation of own funds, and increases the investment capacity of farmers. Farmers whose capability is limited by the lack of capital, when receiving direct payments increase their credit score.

The fifth investment phase, which is characterized by a negative rate of investment, is related to the global financial crisis. However, in agriculture negative capital expenditure rate remained relatively short, only for two years. After this period, there was a sixth agricultural investment phase that is characterized by a positive rate of investment (Figure 1), which also could be related to the economic recovery.

With the help of multiple regression model (1) the macroeconomic factors affecting the rate of growth of investment in agriculture in Poland have been identified.

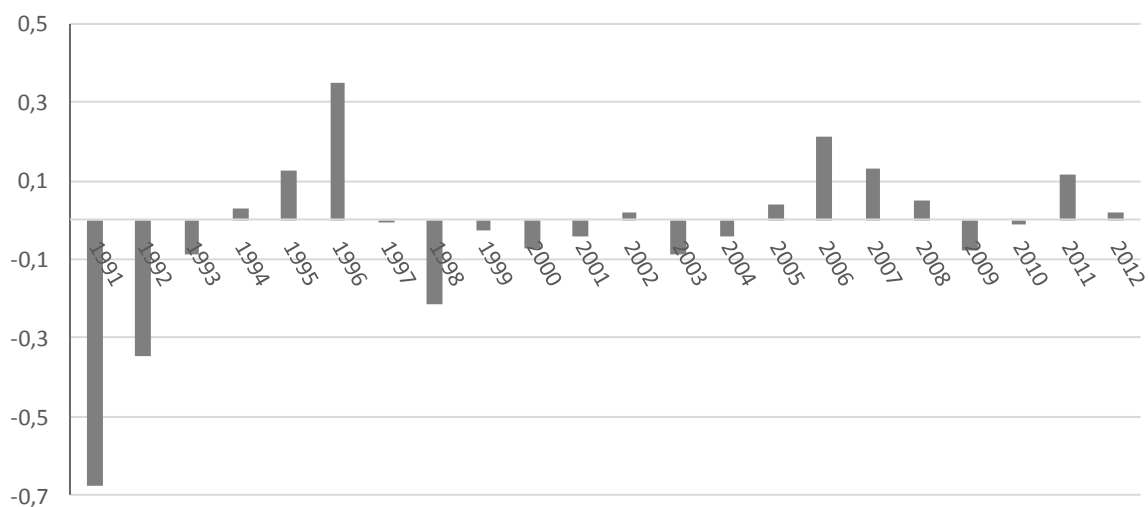


Fig. 1. The rate of investment in agriculture in the years 1991 - 2012 (previous year = 1, constant prices of 2011)
 Source: own calculations based on statistical data of the Central Statistical Office

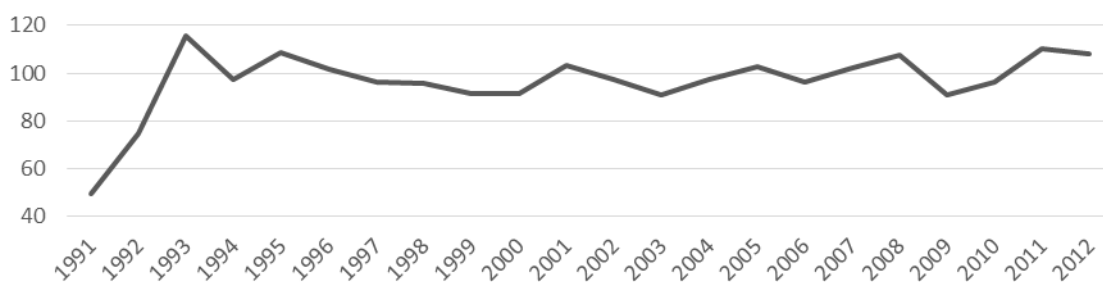


Fig. 2. Index of price relations („price gap”) sold agricultural products to purchased goods and services in years 1990 - 2012
 Source: Central Statistical Office

The level of investment activity of farmers in the analyzed period was explained with the help of six variables (Tab. 1). With the increase of x_7 - relations trade deficit in foreign trade in agri-food products to the gross domestic product, x_{14} - consumption of food and non-alcoholic beverages, x_{4t-1} - the rate of registered unemployment in the previous year, x_{10t-1} - index of gross disposable income real of the households sector per capita in previous year, x_{2t-1} - index of price relations („price gap”) the level of investment made in agriculture increased. The negative correlation was observed between the growth of investment, and x_9 - „terms of trade”. The resulting model shows the positive significance of demand factors, such as increased food intake and growth of real gross disposable income of the households sector per capita in stimulating pro-investment

behavior of farmers. Both of these factors are interrelated, the increase in disposable income and increase food consumption stimulates farmers to take the trouble of investment. Despite the impact of the Engel's law, growth of real gross disposable income of the households sector affects the growth of food consumption, but also has a positive effect on the level of savings, which determine the level of ongoing investment in the economy. It also seems not insignificant that Poland is a country with a lower level of household income and because of that the demand for food has a lower income elasticity than in countries with much higher disposable income per capita. Yet, indices of gross disposable income of the real sector households per capita have impact on the dynamics of investment in agriculture with annual delay. Similarly, the growing importance of exports

of agri-food products in relation to GDP, as a factor of demand factors, has a positive effect on investment activity of farmers. Since the Polish accession to the European Union the importance of foreign trade in agri-food products has been increased. Poland is among the few countries that are net exporters of food [2]. Easier access to EU agricultural markets after the Polish accession to the EU, was very well spent by Polish farmers. However, increasing foreign trade (especially food exports) has placed high demands on the Polish agricultural sector and the agri-food industry, related to adaptation to EU standards of quality, and this required to incur significant capital expenditures. Another statically important macroeconomic factor that influences the dynamics of investment in agriculture was the *terms of trade* index that specifies the relation of changes in prices of exported commodities to changes in the prices of imported goods. However, in this case, the deterioration in the *terms of trade* have a positive impact on farmers' investment activity. This means that a faster decline in the prices of goods exported compared to the prices of imported goods had a positive effect on the level of the investments. This may result from the fact that the Polish agribusiness is based on a price competitive advantage. If price conditions worsen in foreign trade it tends to allow farmers to invest to reduce production costs and improve competitiveness through increased productivity and quality. The specified model also points to the importance of trends in agriculture characterized by the index of price

relations ("price gap"). Along with the improvement of economic situation in agriculture, profitability of agricultural production improves, the risk of management reduces and, consequently, farmers are likely to increase the involvement of investment. Yet, the impact of this indicator appears only after one year. The level of unemployment stimulate increase of investments in agriculture. With the increase in the number of unemployed the level of the investments rises. This may be related to the characteristic features of agriculture in Poland: a high level of employment in agriculture and high dispersion of the agrarian structure. In the case of social upheaval caused by economic change, a household, even a small-area, can be a source of secure income for people who have lost their jobs in non-agricultural sectors. Job loss (in nonfarm sector) by the farmer or members of his family, tends to make investments in production workshop to increase the production capacity of farms and to sustain agricultural income. Matching of designated empirical data model is 91.53%. The inspection of residuals is an important check on the appropriateness of an econometric model. The results of the residuals examining are shown in Table 5. The test listed in Table 2 checks the main properties of residuals that describe the quality of an econometric model. In all the tests used for the inspection of residuals listed in Table 2 the null hypothesis says the model has desired property.

Table 1. Regression summary of depend variables: Y_t - DYNAMICS_INV - growth rate of investment in agriculture

Variable	bj	S(bj)	t	p value	Significance
x_0 - Constant	-4.09772	1.11939	-3.661	0.0023	***
$x_{4,t-1}$ - UNEMPLOYMENT	0.028737	0.00516252	5.566	5.39e-05	***
x_7 - AGRI_TRADE_BALANCE	2.78698	0.543387	5.129	0.0001	***
$x_{10,t-1}$ - REAL_INCOME	0.0462607	0.00662505	6.983	4.41e-06	***
x_9 - TERMS_TRADE	-0.0255722	0.0033519	-7.629	1.54e-06	***
$x_{2,t-1}$ - PRICE_GAP	0.00704656	0.000828816	8.502	4.04e-07	***
x_{14} - FOOD_CONSUMPTION	0.0194998	0.00527857	3.694	0.0022	***

$R^2 = 0.915302$; corrected $R^2 = 0.881423$

Source: own calculations based on statistical data of the Central Statistical Office

Table 2. Summary of equation residuals

Test	Test statistics	p
Breusch-Pagan heteroscedastity test	LM = 4.53377	0.8060
ARCH test	TR ² = 3.41494	0.4909
RESET test	F(1, 12) = 0.188726	0.6717
LM autocorrelation test	LMF = 0.495979	0.4947
Jarque-Bera normality test	$\chi^2 = 1.2691$	0.5302
Quand likelihood test for structural brakes	QLR = 3.19	more than 0.1

Source: own study

The null hypothesis cannot be rejected in all the test. It can be assumed that the mode used for analysis properly described the changes in the agricultural investments in Polish agriculture in the period 1990-2012.

CONCLUSIONS

Investments are necessary to support the growth and development of agriculture and the need to adapt agricultural production to the major challenges of global agriculture, notably meeting increasing demand from a growing world population, contributing to eradicating hunger and malnutrition, and preserving the natural resources upon which agriculture and we all depend. If agriculture is to meet these challenges, it requires increased investment spending.

The agricultural sector is globally exposed to strong changes in its economic environment. Farmers' investment decisions are dependent on the investment climate, which is seen through the prism of changes in the economic environment. If the economic environment, including the macroeconomic environment is conducive, farmers invest more, and the resulting benefits to both private and public are much more likely.

Based on study, it was found that among the analyzed macroeconomic factors positive effect was attributable to the demand factors such as increased food consumption, increase in the importance of exports of agri-food products in the shaping of the GDP or increase of gross real disposable income of the households sector per capita. In addition, the increase of profitability of agricultural production (assessed by the index of price relations "price gap") had a stimulating effect

on the level of investments carried out by farmers, improving their profitability compared to other investment alternatives. The developed model had no variables related to the cost of capital, such as inflation and the rediscount rate. This only confirms that the main significance is related to factors associated with consumer demand, not the factors determining the cost of capital.

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