Is Michał Kalecki's theory of investment applicable today? The case study of agricultural holdings in the EU countries

Aleksander Grzelak[1]*, Piotr Kułyk[2]

[1]*Department of Macroeconomics and Agricultural Economics, Institute of Economics, Poznań University of Economics and Business, Poznań, Poland*
[2]*Department of International Economics and Market Analysis, Faculty of Economics and Management, University of Zielona Góra, Zielona Góra, Poland*
*Corresponding author: agrzelak@interia.pl

Abstract: The purpose of the article is to recognise whether Michał Kalecki's investment theory works in the functioning of farms in the EU countries. We use the data of farms of the EU FADN (Farm Accountancy Data Network) system. The dynamic panel (the 1st difference generalised method of moments – GMM) estimator model was employed for analysis. The assessments were related to the economic size of farms. The results have allowed the partial confirmation of the validity of Kalecki's model to explain agricultural holdings adjustment mechanisms in the investment sphere. It is about medium-large (ES4) and large farms (ES5). In smaller farms (ES1–3) this mechanism was not recorded, and also in the largest agricultural holdings (ES6) where the development mechanism is more complex. Thus the size of farms determines different changes in investments activity in analysed groups of farms. Results suggest that a demand effect of investment expenditures, in the case of the examined group of farms, predominates to supply effect. It can be attributed to the fact that agriculture through the institutional system (the CAP – Common Agricultural Policy) and the peculiarities of this sector have weakened internal competition. We should be aware that the developmental mechanisms of agricultural holdings in the investment sphere are complex, and Kalecki's theory may somewhat better understand these mechanisms.

Keywords: agriculture; assets; capital accumulation income; dynamic panel models; Kalecki's investment theory

The investment theory of the business cycle of Michał Kalecki (1935, 1937) we employed to evaluate the investment in agricultural holdings. This model allows us to look at investment processes both from a demand-side perspective (investments that generate the purchase of additional capital goods) and supply (investments create capital supply) taking into account the dynamics of these phenomena. In our opinion, there is a gap in the literature on the causes of fluctuations in farm investment activity, taking into account considering both supply and demand aspects. Meanwhile, a better understanding of these problems has implications for identifying the developing mechanisms of farms.

The objective of the article is to recognise whether Michał Kalecki's investment theory works in the functioning of farms in the EU countries. We formulated two research hypothesis:
– the relationship between demand and supply effect of investment in agricultural holdings is consistent with Michał Kalecki's investment theory;
– the size of farms determines investment behaviour and thus consistent with Michał Kalecki's investment business cycle theory.

Our study contributes to the literature by examining agricultural holdings in the EU countries and related adjustment mechanisms due to the economic size of agricultural holdings.

THEORETICAL BACKGROUND

Selected elements of the business cycle theory by Michał Kalecki. The investment theory of the business cycle of Michał Kalecki was formulated in the mid-1930s.

This model was formulated as a function of investment (Equation 1):

$$I_{t+1} = aS_t + b\Delta I_t - m\Delta K_t \tag{1}$$

where: I_{t+1} – investments in next year ($t + 1$); S_t – entrepreneurship funds available for accumulation (depreciation, undivided corporate profits, savings); ΔI_t – changes in investment expenditure; ΔK_t – changes in production capacity; a, b, m – coefficients of the linear function.

This theory is based on the contradiction between the demand and the supply aspect of investment. The demand dimension is that investments (I_t) create increased demand for investment products. These investments in the next periods are embodied in capital resources, thereby increasing production capacity (supply aspect). Under conditions of demand barrier (situation of developed countries), this necessitates limiting investment. While the investment and the own funds available for accumulation affect the further investments of business entities positively, the increase of the capital stock – negatively (Equation 1).

In recent decades, the economy has become more open, and the role of the financial sector in the economy has increased, leading to a growth in the volatility of the economic system. These elements can be found in Minsky's theory of financial crises (Minsky 2008). Because of the weaker links between farms and financial markets, the impact of financial markets in agriculture is weaker, although their importance is increasing (Magnan 2015). Moreover, due to the relatively small importance of credit in financing development, agricultural holdings do not go bankrupt. Hence, the market-based selection mechanism, in this case, is limited in scope. Therefore, Minsk's theory seems less useful in the agricultural sector.

Because of the low contribution of agriculture in the GDP, it is difficult to expect that the mechanism of investment activities, according to M. Kalecki's theory will have an autonomous character in agriculture.

Rather, it is to be expected that the economic impulses penetrate agriculture from the economic environment and under their influence adjustments are made on the investment side. However, this does not exclude the existence of at least a part-time (due to time synchronisation) investment mechanism in agricultural holdings, in which current investments (demand effect) weaken the next ones (supply effect). Arguments supporting such reasoning include the existence of a barrier to demand for food products, limitations in agricultural land trade and mobility of production factors. As a consequence, both underinvestment and overinvestment in agricultural holdings take place (Skevas et al. 2017).

There may be doubts about the translation of this macroeconomic theory to microeconomic, or mesoeconomic levels. If we assume that the aggregated data reflects the behaviour of business entities that are the result of individual units or sectors, then this should not be an obstacle. In our considerations, we focus mainly on interactions (a mechanism) between the demand and supply aspect of investment in farms, excluding the analysis of issues related to the morphology of cyclical fluctuations in investment. It should be noted that, at present, changes in private investment in agriculture to a lesser extent than at an early stage of economic development are agricultural output constrained. The main burden of farm development is stimulated by demand determinants which appoint the range of production volume.

LITERATURE REVIEW

The contemporary approach of Kalecki's model refers to the issues related to the capital structure used to finance investments, including the reduction of the role of internal finances in the real sector of the economy, influencing its cyclical fluctuations (Hein and van Treeck 2010). Xiao-Hong et al. (2016) used modified Kalecki's model for macroeconomic analyses of the Chinese economy. The results show that both capital stock and investment lag are certain factors leading to the occurrence of cyclical fluctuations in the macroeconomic system. In turn, Kufel (2016) uses M. Kalecki's theory for research on the mechanism of the countercyclical markups in the food industry in the EU. Thus, it is possible to verify this model analyses at the sectoral level. As Blecker (2002) note, irrespective of the imperfections indicated, the Kalecki's model is thought to be a useful tool for analysis at the country level. There are also examples of the theoretical use of this conception to further improve it (Hattaf et al. 2017).

Many theories explain the investment processes in agriculture: agency theory, q-Tobin theory, adjustment cost theory or Euler's approach (Fertő et al. 2017). In the latter case, it is emphasised that investment was positively associated with public subsidies which can mitigate capital market imperfections in the short-term, but in the long-run, selling produce and securing sufficient cash flow for investment is crucial. In turn, results (Czubak and Pawłowski 2020) indicate that structural funds available under the CAP clearly provided an investment incentive for farms. According to studies (Maart-Noelck and Musshoff 2013), farmers' investment behaviour escape classic economic theories, as we wrote earlier in the context of Minsky's theory. All this makes the question of return on invested capital in the case of investment in agriculture is less fundamental, especially since the rate of return on agriculture is relatively low (Kataria et al. 2012). On the other hand, the experience of French and British farms (Benjamin and Filmister 2002) shows that investments are sensitive to changes in cash flows and because of the functioning of capital markets, including the level of credit collateral. All this makes analysing investment processes in agriculture is complex. Thus employ Kalecki's investment theory after its appropriate adjustment, can give an alternative view including both: demand and supply effect of investment. It seems reasonable to use and be complementary to other research approaches.

METHODOLOGY AND DATA

Panel models were used in the research. The econometric models estimated by the panel data assume that the development of a dependent variable influences, in addition to the explanatory variables, non-measurable, time-fixed and object-specific factors, called group effects (Wooldridge 2002). There are many different estimation methods for modelling panel data. We employed dynamic panel models, the 1st step – the 1st difference generalised method of moments (GMM) of Arellano and Bond (1991). This is a method that allows the estimation of model parameters directly from moment conditions, which can be linear or non-linear with concerning parameters (Windmeijer 2005). So unobserved heterogeneity and endogeneity can be absorbed with the help of forming an instrumental variable matrix consisting of all available lags of dependent and exogenous variables (Salahuddin and Islam 2008). This approach we used because of the endogenous nature of the variables in the models, which could affect the incompatibility

and bias of the estimators. The problem of correlation of a random component with endogenous variables is solved in the GMM method by taking into account the so-called instruments. In this case of estimation, delayed instruments are used in the equation on increments. Dynamic GMM models are also used when variables are fixed in advance to explain, what happens in this article. However, there is a concern that the use of the 1st difference GMM will place a biasing of the estimators. This may result in the fact that delayed variable values may be potentially weak instruments for equations in the form of first differences due to weak correlation with subsequent first variable differences. In practice, this occurs when the value of the autoregressive parameter approaches the value of one for this GMM estimation method (Blundell et al. 2001). Therefore, it was verified whether the value of the autoregressive parameter is close to the value of one. Because this did not happen, we employed an estimation of the 1st difference of GMMs.

The quality of the models was verified by tests: Arellano-Bond (AR), Sargan and Wald. The first test for the first-order correlation of a random component. The Sargan test refers to the over-identifying condition or the correctness of the estimation instruments in the sense of their non-correlation with the random component of the model. Its value should exceed 0.05. While Wald's verified the correctness of the data accepted for the study, test for joint significance. Besides, the VIF (variance inflation factor) test we used to exclude the multicollinearity of variables, assuming that its value should not exceed 5 (Haan 2002).

The stability of the analysed models was verified by taking into account the control variable: the relation of the number of full-time employed persons in the agricultural holding (working 2 120 hours per year) to the area (ha) of agricultural land (L/UAA – number of full-time employed persons/utilisied agricultural area). The choice of this variable was dictated by the fact that the labour factor and the land were not included in the models.

The Kalecki's model, in our case, takes the following form (Equation 2) after modifications:

$$I_{it+1} = \alpha_{0t} + \gamma_1 I_{i,t+1}(-1) + \beta_1 S_{it}^T + \beta_2 \Delta I_{it}^T - \beta_3 \Delta K_{it}^T + \varepsilon_{it} \tag{2}$$

where: I_{it+1} – investments less the purchase value of land; S_{it} – the economic surplus – agricultural holdings income increased by depreciation and reduced by calculated costs of self-employment (family unpaid

labour input); ΔI_{it} – changes in investment level (excluding investment in the land); ΔK_{it} – capital accumulation (excluding land); i – the analysed EU(24) countries, t – analysed years (2004–2017).

The modification of the model takes into account the specificity of agricultural production. It is about the exclusion of land values from investments and value of capital. The point is that the value of land is also linked to the level of subsidies received in this case from the budget of the EU (Common Agriculture Policy – CAP), to the development of other segments of the economy, including rural urbanisation. The value of land was often speculative, as evidenced by the significant increase in its value in some countries (e.g. in France, Belgium, Poland) (Krupowicz et al. 2015). There are also disruptions related to the capitalisation of subsidies in the price of agricultural land (Van Herck and Vranken 2013). In turn, the research (Kirchweger and Kantelhardt 2015) carried out in farms in Austria results that an increase in the agricultural area seems to be fairly decoupled from the investment activity of agricultural holdings. Therefore, in the light of the arguments cited above, this research approach enabled to explore a "cleaner" link between investments and production capacity in agriculture.

The variable S_t is estimated as the difference between the farm's surplus (sum of agricultural income and depreciation) and the payment for farmer's family work. The costs of self-employed were estimated based on the hourly workload and the wage rates persons employed in the agricultural holdings. The variable ΔK_t was determined as a difference in the value of equity of agricultural holdings (accumulation) excluding land.

In our approach, we did not separate subsidies from investment because it depends on the propensity to invest (and this on the business cycle phase) as well as the type of supporting. A separate issue, beyond the study, is the impact of supporting by instruments of the CAP on farmers' investment behaviour (Viaggi et al. 2011) or for the economics of agriculture (Sedláček et al. 2012).

The article uses the data of farms of the EU FADN system (EU FADN 2020). The spatial range of the research concerns the agricultural holdings from the EU countries (25), so those countries that belong to this group since at least 2004. Danish farms were excluded from the survey because of the outlier nature of the data. This may result from the fact that in this country there is a system of inheritance of agricultural holdings, in which the successor (often son) buys a farm from the farmer (often his father), on many cases through the use of credit, and finally, family members are often included in the paid work (in other countries, this is not the case). As a result, the analyses concern the EU countries (24).

We built the models separately for each economic size class of farms (ES6)[1]. This made possible to include the context of the scale of agricultural activity in the research. The time scope in the analysis refers to the period 2004–2017. To reduce the influence of fluctuations of the tested variables on the results of the estimated models, time series were adjusted using three periods moving average.

EMPIRICAL RESULTS

This choice (only for two groups of farm: ES4–ES5) was dictated by sign at ΔK_t. In the case of agricultural holdings from other economic size classes (ES1–3 and ES6), it assumed positive values, which would mean the lack of occurrence of the investment supply effect, and even mutual reinforcement of demand and supply effects of investments, which contradicts the assumptions of the M. Kalecki's model. The surveyed farms with a larger economic size were characterised by a higher level of investment as well as an economic surplus (S_t), which is a consequence of higher agricultural incomes. For changes in investments (ΔI_t), in the capital (ΔK_t) and indicator labour to land (area of ha), the situation was similar. In the case of the last of these variables, this was because of the relatively greater importance of animal output in farms in the ES5 group (Table 1).

Models referring to the modified concept of M. Kalecki's investment business cycle (Tables 2–3) are stable. Adding the control variable: work per 1 ha of UAA did not affect the change of signs at variables, and the values of regression coefficients turned out to be similar. The results of the AR's, Sargan's and Wald's tests show that variables are properly selected and models are correct.

The impact of the explanatory variables on the dependent variable (I_{t+1}, Tables 2–3) was varied according to the size of the farms.

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[1]Economic size class is defined as the sum of the standard value of agricultural output so-called standard output (SO – the average monetary value of the agricultural output at farm-gate price of each agricultural product – crop or livestock in a given region) and is expressed in thousands of EUR. The analyses used the delimitation of 6 classes of economic sizes: very small farms ES1 (2–8 thousand EUR SO), small ES2 (8–25 thousand EUR SO), medium ES3 (25–50 thousand EUR SO), medium-large ES4 (50–100 thousand EUR SO), large ES5 (100 500 thousand EUR SO), very large ES6 (over 500 thousand EUR SO).

Table 1. Descriptive statistics (period 2004–2017) for examined variables in agricultural holdings (FADN system) belonging to the economic size class ES4–ES5 in the EU(24)

Variables	Economic size	Mean	SD	SD within	SD between	75% quartile	25% quartile
I_{t+1} (EUR)	ES4	16 872	14 802	14 924	3 947	9 031	26 577
	ES5	48 795	31 901	31 653	10 215	30 691	67 815
S_t (EUR)	ES4	20 904	14 760	14 568	4 584	10 721	29 072
	ES5	63 192	30 142	29 591	9 839	44 168	76 722
ΔI_t (EUR)	ES4	202	10 625	10 565	3 061	–4 081	3 563
	ES5	880	14 636	13 992	5 760	–6 680	7 033
ΔK_t (EUR)	ES4	13 645	31 871	32 335	6 701	–922	17 380
	ES5	32 171	70 525	71 525	15 083	5 853	46 460
L/UAA	ES4	0.07	0.14	0.14	0.02	0.02	0.06
	ES5	0.08	0.2	0.21	0.03	0.02	0.05

Number of countries = 24; I – investment; S – economic surplus; ΔI – changes in investment level; ΔK – capital accumulation; L/UAA – number of full-time employed persons/utilisied agricultural area (ha)
Source: Own calculations based on EU FADN (EU FADN 2020)

All selected models (Tables 2–3) showed that the assumptions about the direction of the independent variables were correct for two groups of the economic size of farms (ES4–ES5) (medium-large to large farms) (Tables 2–3).

We can observe that change (increase) in investments caused growth of the level of investment in the next period in the groups of surveyed holdings. Finally, this variable (ΔI_t) and also economic surplus (S_t) assumed the highest value of the regression coefficient in all investigated models and was characterised by the highest level of significance. The change in the value of capital

negatively affected the level of investment in the following year in the two distinguished groups (ES4–ES5). However, in all analysed models, this variable was not statistically significant. This means that the supply effect is relatively weak in the shaping of investments in agricultural holdings.

DISCUSSION

The demand effect of investments in the surveyed farms is more clear in comparison with the supply effect. This process can be attributed to the fact that ag-

Table 2. Dynamic panel models (GMM) verifying M. Kalecki's concept in agricultural holdings (FADN system) belonging to the medium-large farms (ES4 class) for the EU(24) countries; the dependent variable Y: I_{t+1}, time scope 2004–2017

Variables	(1)	(2)
Constant	43.740 (263.26)	21.338 (257.65)
I_{t+1} (–1)	0.132** (0.052)	0.147*** (0.043)
S_t	0.471*** (0.055)	0.437*** (0.062)
ΔI_t	0.41*** (0.089)	0.372*** (0.093)
ΔK_t	–0.011 (0.043)	–0.024 (0.043)
L/UAA	–	–15 559.9** (7 847.61)
AR(1) test for error (*P*-value)		–3.102 (0.0019)
Sargan test for over-identifying condition (*P*-value)		97.755 (0.0554)
Wald test (joint) (*P*-value)		123.372 (0.0000)

*, **, ***Statistically significant level at 10, 5 and 1%, respectively; I – investment; S – economic surplus; ΔI – changes in investment level; ΔK – capital accumulation; L/UAA – number of full-time employed persons/utilisied agricultural area (ha); test VIF: S_t = 1.04, ΔI_t = 1.03, ΔK_t = 1.04, L/UAA = 1.06
Source: Own calculations based on EU FADN (EU FADN 2020)

Table 3. Dynamic panel models (GMM) verifying M. Kalecki's concept in agricultural holdings (FADN system) belonging to the large farms (ES5 class) for the EU(24) countries; the dependent variable Y: I_{t+1}, time scope 2004–2017)

Variables	(1)	(2)
Constant	397.194 (458.958)	310.452 (473.797)
I_{t+1} (−1)	0.251*** (0.045)	0.312*** (0.039)
S_t	0.565*** (0.065)	0.495*** (0.064)
ΔI_t	0.524*** (0.159)	0.497*** (0.156)
ΔK_t	−0.013 (0.024)	−0.017 (0.024)
L/UAA	−	−32 023.1***(7 685.68)
AR(1) test for error (*P*-value)	−3.73204 (0.0002)	
Sargan test for over-identifying condition (*P*-value)	92.474 (0.1103)	
Wald test (joint) (*P*-value)	281.75 (0.0000)	

*, **, ***Statistically significant level at 10, 5 and 1%, respectively; I – investment; S – economic surplus; ΔI – changes in investment level; ΔK – capital accumulation; L/UAA – number of full-time employed persons/utilisied agricultural area (ha); test VIF: $S_t = 1.1$, $\Delta I_t = 1.031$, $\Delta K_t = 1.06$, $L/UAA = 1.08$
Source: Own calculations based on EU FADN (EU FADN 2020)

riculture in the EU countries through the institutional system (CAP) and the peculiarities of this sector have weakened internal competition. It is also important that part of the investment does not translate into productive effects and they are linked with the realisation of cross-compliance rules within the CAP instruments. One can expect that in the case of an increase in demand for food on the world market, investments in agricultural holdings may reveal an even greater extent the demand effect in relation to the supply effect, as well as to be more autonomous. This can be indicated by the Chinese experience which shows that growth in agriculture was more resilient during the recent economic slowdown than growth in the manufacturing and service sectors (Chen et al. 2018). The study (Kallas et al. 2012) in the Spanish COP sector (cereal, oilseed, and protein) shows that subsidies (more precisely partially decoupled payments) generate a statistically significant increase in the investment in farm assets. Thus, there are broader possibilities of finding a surplus, especially on a larger farm. This would require further examination, in particular as the subsidies were not subject of research in this article.

The analysed theory, as previously reported, was not confirmed in the group of smaller farms (i.e. with the value of annual standard production below 50 000 EUR) and the largest (with the value of annual standard production above 500 000 EUR). In these farms (ES6) there is probably a slightly different adjustment mechanism in the area of investment activity. This may be because of the effects of scale as well as the broader involvement of external production factors. Similar conclusions were

confirmed in the study of the impact of market factors on the income of farms, divided into area-size classes (UAA6) in Poland (Augustowski 2016). In the largest farms, the capital allocation was different and was conditioned by other factors than in the case of other groups of agricultural holdings, e.g. capitalisation of subsidies in the value of assets. Consequently, the supply effect of investments does not necessarily impede new investments in the next periods. In this group of farms, the supporting with subsidies is high. It mitigates cyclical variability, which can disturb the investment mechanism according to the concept of M. Kalecki. However, in smaller farms (ES1–3), the level of investment in the analysed years (2004–2017) on average in the EU countries did not allow to cover the costs of consumption of assets expressed as the value of depreciation. Thus, these units showed the decapitalisation of assets. Non-agricultural incomes are more important, then investments are not so substantial. In the case of other groups of farms (ES4–5), this theory can be accepted in a moderate scope. It is mainly about the weak impact of the supply effect of investment. This allows confirming the second hypothesis only partially. The above-outlined differences in investment adjustments of agricultural holdings due to economic size may also be associated with changes in the real total factor productivity. This could be indicated by the results of research (Czyżewski and Majchrzak 2017) conducted for family farms in Poland.

The findings provide differences in investment behavior between farm sizes in the EU countries. There may be a question about the differences between

the individual analysed countries? Although this was not the subject of the article's survey, mainly due to the lack of access to the individual results of farms from different countries, it is possible to formulate preliminary observations based on deductions from the conducted research. It can be expected that there are differentiation between countries in terms of farm investment adjustments, due to differences in the resources used, farm market links and factor productivity. To the greatest extent, M. Kalecki's theory can be applied in the EU countries where farms from ES4–5 economic size groups dominate, e.g. Belgium, Germany, France for which the studies have confirmed the most significant adjustments in line with this theory.

CONCLUSION

The considerations carried out in the article show that investment processes in agriculture and especially the relationship between demand and supply effect of investments is very complex. The results of estimated models of investment for particular economic classes of farms for a group of the EU countries (24) have confirmed the validity of the Kalecki's model partially in explaining farm adjustment mechanisms in the sphere of investment. It allows accepting the first hypothesis only to a limited extent. The result related to the statistical significance of the variable ΔK_t, which expresses capital accumulation is less satisfactory. So supply effect of investment create a weak effect (not statistically significant) in the mechanism shaping the cyclicality of investment changes. However the demand effect of investment expenditures, in the case of the examined groups of farms, predominates. It can be attributed to the fact that agriculture through the institutional system (EU CAP) and the peculiarities of this sector have weakened internal competition. Confirmation of the surveyed relationships for medium-large and large (ES4–5) agricultural holdings is because of their larger scale of production and thus the more market-oriented approach to smaller units. As a consequence, the relationship between investments and capital in these farms is consistent with the analysed investment theory. In smaller farms (ES1–3) this mechanism was not recorded. On the other hand, the development mechanism is more complex in the largest agricultural holdings (ES6) because of economies of scale, greater heterogeneity of this group, as well as high supporting that mitigates the cyclicality of investment changes. Thus, the size of farms

determines changes in investments, and in the case of two groups of farms (ES4–5) activates adjustment mechanisms in the investment sphere consistent with Michał Kalecki›s investment theory. However, it is necessary to be aware of the fact that it is only one of the developmental mechanisms of agricultural holdings.

The research results also have an application dimension. It would be desirable to include the support instruments, the existing differences in developmental mechanisms due to the scale of farm production in the development of the next EU CAP framework beyond 2020. In turn in the case of small farms, the function connected with the creation of public goods should be appreciated in the CAP. The supply effect of investment in these units is less strong because of non-agricultural income, decapitalisation of assets, and the need to invest more in environmental aspects of the agricultural activity.

Further studies related to the investment adjustment mechanism of agricultural holdings should develop towards taking into account the environmental context. This is an increasingly important problem also at the level of designing of the changes in the CAP and the challenges of climate change.

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