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What determines investment rate of Polish large-sized farms?

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There is a set of various factors affecting farm investment behavior (in result, IR) inter alia economic variables (factor markets and public policy), farmer's attitudes and socio-demographic features. The paper aims to identify determinants of IR of Polish large-sized farms (>100 hectares of arable area). The empirical studies based on a random sample of large-scale farms surveyed annually by IAFE-NRI (the processed research sample consisted of 25 entities annually). The research period covered years 2007-2011 because of data availability. First, we used panel models (both REM and FEM) with explanatory variables (proposed in the literature, including lagged variables) including investment subsidies. Then, we switched form unsatisfactory panel models to a GLS model approach. Our results indicated that a shift toward a strong specialization may weaken the propensity to invest at large-scale farms. The effect of EU investment subsidies was particularly evident after 1 year. The importance of diversification from the standpoint of market-oriented large-sized farms should not be neglected. The accumulated experience and knowledge of farm operators may stimulate the investment activity. The significance of farm operator's characteristics should be a prerequisite for life-long education.

JEL Classifications: G31, H25, Q14

Keywords: Agricultural finance, investment, subsidies, large-sized farms

Introduction

Determinants of investment activity has been identified by macroeconomists (Mankiw, 2009; Barro, 2008; Tucker, 2011; Boyes and Melvin, 2014). From the macroeconomic standpoint investment play a significant role as the factor that may improve the competitiveness of the country (Michaelides, Roboli, Economakis, and Milios, 2005). As Kosma (2008) underlined, investment may lead to an increase in a "country's productive capacity". Furthermore, there is a dependency between investment expenditure shifts in the level of employment and the personal income. The neoclassical economics (represented by Marshall, Fisher, and Pigou) contributed to the theory of investment (Hassett, 2008). Meanwhile, Keynesian macro concepts put an emphasis on the role of the public investments with "Multiplier Effect". The contribution of Jorgensen was a neoclassical synthesis referring to the role of the government and public policies in processes of investment (Hassett, 2008). Morever, the Hall-Jorgenson model of investment and "user cost" model shed light on the role of incentive polices (Elmorchid and Mansouri 2003). Morever, McDonald, and Siegel (1986) explained the optimal investment rule with the formula for the value of option that may be treated as a link between previous macroeconomic models and early concepts of corporate finance. Real-option approach was developed, inter alia, by Dixit (1989), Lambrecht and Perrudin (2003), as well as Miao and Wang (2007). The latter authors investigated into the role of an entrepreneur's attitude to risk. Bolton, Wang and Yang (2014, p.2) contributed to the theory of real options: they found that "financial constraints significantly affect the

standard real options results and a financially constrained enterprise may behave in a risk seeking sense".

While a fairy large body of literature in finance has tried to identify sources of financing for real investment and develop the methodology of real investment projects, less attention has been paid to identify the determinants of investment activity. The literature in corporate finance presents investment process from the standpoint of analysis of single investment projects (Bodie and Merton, 2000; Schwartz and Trigeorgis, 2004; Eckbo, 2007; Smit and Trigeorgis, 2012, Kasiewicz and Rogowski, 2009). A relatively small number of empiral studies is devoted to determinant of investment rate (gross investment divided by depreciation) at the micro level. The empirical studies of Devereux and Schiantarelli (1990) proved that cash flow is strongly linked to investment rate and within the category of size new businesses are characterised by higher investment rate. Furthermore they found that the importance of 'stock of debt' depends on the size of the research sample. Their results referred to the former findings of Jensen and Meckling (1976) who underlined the issue of agency costs of debt. Similarly, Myers (1977) underlined that partial debt financing may lead to restrain investment projects.

The specific nature of the agricultural sector is refered to its connection to the natural factors, including agricultural land. Consequently, the agricultural production is exposed to the impact of various risk factors (Olson, 2011; Dolutschitz, Morath, and Pape, 2011; Mußhoff, Hirschauer, 2011; Juszczyk, 2013). This means that yields, and, as a result, agricultural output and incomes fluctate to even greater degree. Furthermore, most economic entities in the agriculture are owned and managed by families, though, the largest farms as legal entities are similar to non-agricultural companies in terms of difficulties concerning the size. As Kay, Edwards and Duffy (2012, p.17) rightly noted, "farm busineses will continue to became larger, and their operatord will have to acquire specialized skills (…)". Troskie, Mathijs, and Wink (2000, p.586) stated emphatically that "the agricultural sector is not isolated from the rest of the economy". Furthermore, the higher degree of dependence on the technical progress will result in the need for new investment. There is a growing body of literature on investment behaviour of farmers (Hubbard, Kashyap, 1990; Hermann, Musshoff, and Agethen, 2014). This stems from the fact that a significant part of the EU or national subsidies is intended to be increase the level of investment rate. One of interesting research areas is to investigate in farmer's decision on switching to organic (non-conventional) farming. Modernization of farm equipment through real investment processes leads to improvement the quality of agricultural products, as well as better a deeper connection with agricultural markets (Józwiak, Kagan, 2008). Furthermore, real investment resulting in modern machinery and technical equipment may drive new on-farm technologies. As a result, this leads to a significant growth of labor productivity and/or increase in the scale of production (Gołębiewska, 2010).

Kata (2013) stated that the investment activity of family farms depends on the access to investment credits. His empirical studies indicated that behavioral factors affecting farmers' credit decisions include, inter alia, risk attitude, knowledge and skills (e.g. in the field of risk assessment, cost and benefit analysis), experience in using financial instruments, satisfaction with occupational status, openness to change, individual willingness to cooperate (particularly, with the institutional environment). Empirical studies of Ryś-Jurek (2014) were based on on aggregate (country-level) data FADN (research period: years 2004-2011). The results indicated that even high surpluses of farms are allocated for non-investment pursposes. This is due to the fact that the low level of income (in the smallest units) discourages the investment process in the development of the farm. This may seem be an unsoluble problem. Based on a broad literature, Kusz, Gędek, and Kata (2015) identified enumerated exogenic and endogenic factors that may determine the investment activity of family farms. The first of group of factors included, inter alia, individual demand on good and services, consumer preferences, macroeconomic outlook (interest rates, CPI), system solutions, sociodemographic and natural conditions. Endogenic determinants refer to, inter alia, production potential, possibilites of self-

financing of real investment. Financial support (as EU or national subsidies) may affect farmers' investment decisions. Sckokai and Antón (2005) investigated into the problem of delaying farm investment decisions. The regional allocation of EU agricultural funds (both pre- and post-accession) may strenghten competitiveness of agriculture in the central part of Poland (Czubak, 2012).

There is a growing body of literature referring to the impact of socio-demographic characteristics of farm operators on financial decisions, including investment decisions. A part of empirical studies (Wolf, 2003) underlines this problem in the context of farm transfer. Lefebvre et al. (2015, p.7) stated that "younger farmers may not be able to invest because of inexperience or financial constraints". They indicated the important issue of 'non-linearities in the age-investment relationship' that was explored by many European agricultural economists.

There is an obvious limitation of the empirical studies referring to determinants of investment rate of large-sized (large-scale) farms. The measurement of investment activity is analysed from the perspective of macroecomics, but the approach integrating exo- and endogenic factors seems to be interesting. One of new directions of research that addresses that investment rate depends on investment subsidies, as well as selected characteristics of farm operators. We attempt to analyse the significance of selected determinants of investment rates of large-scale agricultural entities in Poland.

On the basis of the theoretical assumptons from the literature and results of previous empirical studies and we state three hypotheses as follows:

H1: There is a positive relationship between investment rate of large-sized farms in Poland and EU subsidies (investment subsidies within Sector Operational Programme 2004-2006 and Rural Development Programme 2007-2013).

Investment subsidies may, in theory, increase investment activity of large-sized farms, and thus their investment rate. However, this effect may be delayed.

H2: There is a positive relationship between investment rate of large-sized farms in Poland and diversification of agricultural production.

This means that a shift towards specialisation (eg. arable crops) reduces the investment activity and thus investment rates.

H3: There is a positive relationship between investment rate of large-sized farms in Poland and selected characteristics of farm operators (mainly, age and educational background).

This hypothesis is derived from the fact that an accumulated experience and knowledge, that increase with age of farm operator/manager, may expand the scope of managerial duties s in large-sized farms. As a result, in contrast to small family farms, older farm operators of the abovementioned entities are able to make real investment decisions.

The remainder of this paper is organised as follows. Sections 2 and 3 highlight the research framework: the description of the macroeconomic/sector background, research sample and the methodological issues. Section 4 presents and discusses results. Finally, we conclude with remarks about key findings, recommendations for policymakers and suggestions for future research.

Macroeconomic/sector background and research sample

Table 1 (Appendix) presents macroeconomic and sector indicators referring to the agricultural sector. Macroeconomic conditions for agricultural production in 2010 and 2011 were significantly improved compared to 2008-2009. It should be noted that 2009 was an extremely unfavorable year, which was depicted by two types of price relations in agriculture (see e.g. Kulawik (ed.), 2012; Seremak-Bulge, 2012).

Poland's membership in the EU has radically changed the overall situation in the agricultural sector (Table 2, Appendix). The Agricultural Census of 2010 indicated 2 277

600 farms in Poland, of which only about 900 entities represented the public sector. Many mid-size farms were consolidated into larger units. The number of medium-sized farms (area: 5-10 hectares) decreased by 76 047 (a drop of 17.8%), whereas the number of farms (area 30-100 hectares) increased by 15 231 from 2002 to 2012. These changes indicate a shift toward a more competitive market-oriented agriculture. In fact, the structural changes in Polish agriculture have accelerated.

The agrarian structure in Poland may be described as "bipolar": on the one hand, a relatively small averaged utilised arable area (UAA) on a European scale, a significant share of family farms representing a negligible economic power, on the other hand, large-sized farms with higher efficiency and productivity than the rest of agricultural holdings. The Table 3 (Appendix) presents some selected characteristics of large-sized farms in Poland and selected EU countries (France and Germany). Morever, the economic importance of larger farms in UE countries will increase in a near future. These entities are able to "mobilise resources to improve efficiency and marketing. These farms also have greater bargaining power vis-à-vis the more concentrated upstream and downstream parts of the industry" (European Commission, 2013, p.12). It should be noted that, amongst Polish farms, those with 100 hectares or more UAA operate on nearly 23% of agricultural area and more than 24% of sown area (GUS, 2011). This underlines the economic significance of segment of large-sized farms. Moreover, Józwiak (2013) indicates that large-sized commodity entities play a crucial role in shaping competitive ability of Polish agriculture.

The source of primary data (a random sample of large-scale farms) was surveys of farmers (operators of large-sized farms conducted annually by the Department of Economics of Farm Holdings at Institute of Agricultural and Food Economics - National Research Institute (IAFE-NRI). The total number of large-sized farms increased from 8 109 (in 2007) to 9 882 (in 2011). It should be clarified that large-sized (large-scale) farms are defined as agricultural entities with min. 100 ha of utilised arable areas (UAA). In Polish agriculture the group of these businesses is very small, but its importance seems to be very high. The results of Agricultural Census (2011) show the share of large-sized farms was only 0.63%, while these entities operated 22.3% of farmland in Poland (GUS, 2012). This indicates that the group of large-scale farms has and will have an increasingly important impact on the competitiveness of the Polish agricultural sector (Józwiak and Kagan, 2008). Furthermore, these entities have to face the mechanism of "capping" and other limitation to the amount of payments. However, large entities may benefit from positive effects of economies of scale (Kulawik (Ed.), 2014). The "raw" research sample consisted of 65 large-sized farms in 1995, whereas the number of large-scale entities in 2010 was 131. We use a balanced panel of large-sized farms: 25 entities per during the year 2007-2011 (125 observations). The initial number of farms in each year varied, and therefore we eliminated outliers by using the interquartile range (IQR). Based on theoretical considerations and previous empirical studies, we identified a set of potential explanatory variables for investment rate. All calculations and model parameters were estimated in GRETL 1.9.13 PL. The variables were summarized with the use of descriptive statistics particularly to show its main features. The basic descriptive measures are depicted in Table 4 (Appendix). This table provides summary statistics for the variables for our balanced panel.

Model approach

We test selected relationship between investment rate (gross investment/depreciation of tangible fixed assets) and selected explanatory variable. To test the three stated hypotheses we have tried to build two types panel data regression models: (1) Fixed Effects Model (FEM); (2); Random Effects Model (REM) with Pooled Pooled Ordinary Least Squares (Pooled OLS) as the estimator (Cottrell and Lucchetti, 2015). In general, the aforesaid panel models may be expressed as follows (Baltagi, 2008; Greene, 2008):

$$y_{it} = m_i + bx_{it} + e_{it},, \quad (1)$$

Where, m_i - intercept, b - structural parameter expressing the impact of explanatory variable x, x_{it} explanatory variable realisation for i-th object in the t-th period, e_{it} - residual value.

The selection between the FEM and REM was based on Hausman's test. The abovementioned econometric procedure was employed "to detect violation of the random effects modeling assumption that the explanatory variables are orthogonal to the unit effects" (Clark and Linzer, 2012). Our model approach included robust standard errors proposed by Arrelano in 1987 (Baltagi, 2008). We presented outcomes of our econometric modelling in Table 5 (Appendix). It should be noted that models 2,4,6,8 include time units as possible explanatory variables. Unfortuntately, a panel model approach seemed to be inadequete, given the insignificant constant. That prompted us to use a different methodological approach. We applied Generalized Least Squares (GLS) model approach with heteroscedoscity correction procedures (Cottrell and Lucchetti, 2015). Using three sets of data for variables (including two subsets of lagged variables) led to building three models (Model 1, Model 2, Model 3).

Results and discussion

Table 6 (Appendix) presents regression estimated for all models. The goodness of fit of models is not too high (as indicated by the value of the coefficient of determination R-squared). It should be underlined that relatively high values of the constants may indicate the extension of the set of variables. Model 2 may be charactersied by the highest practical utility. Its constant is statistically significant. Analyses of the statistical distributions of model residuals, values of coefficients of determination indicate that the regression equation for Model 2 is sufficiently estimated. However, it should be noted that values of constants are much higher than parameters of independent variables. This may indicate a need for adding new independant variables. The impact of investment subsidies on the investment rate of large-scale farms seems to be ambiguous. Our results are consistent with previous empirical studies of Slovakian and/or Czech economists (see e.g., Rizov, Pokrivcak, and Ciaian, 2013; Buchta and Buchta, 2009). It should be underlined that owners of large-scale agricultural entities are able to face various challenges caused by free-market conditions. Consequently, their dependence on subsidies is therefore not as high as in the case of small family farms. The explanatory variables reffering to farm operator seem to be significant (excluding EDUCATION in models 2 and 3). The direction of relationships indicates that the accumulated experience and knowledge of farm operators may stimulate the investment activity (see eg. Aramyan et al, 2007). In addition, some owners of large-sized farms are not strongly engaged in operational management. The opposite situation occurs in family-owned farms. The impact of factors reffering the structure of production (HHI, the share of crop output in total output) seems on investment rate to be complex. The results of the estimation of models 1 and 3 imply that a shift towards a strong specialisation may weaken the propensity to invest at large-scale farms. This is a logic theoretical assumption (but not confirmed at a statistically significant level) because diversification of agricultural production requires implementation modern technologies and diversified structure of tangible fixed assets (inter alia, combine harvesters). There is a limited number of empirical studies concerning the the impact of diversitification of agricultural production (at the micro level) and investment activity. For example, Bartolini et al. (2014) noted that both CAP Pillars (including RDP measures) may potentially enhance diversification strategy. Mishra and

El-Osta (2002) indicated that there is an indirect linkage between diversification (as 'a self-insuring strategy') and investment activity.

Comparison of the models constructed leads to the assumption that the use of lagged variables may significantly improve goodness of fit. The analysis of estimated parameters indicates that using lagged variables (even t-2) does not result an increase in in a statistically significance of variables that may be associated with investment subsidies. However, the impact of the category of investment subsidies (as the element of Rural Development Programme 2007-2013) on the investment activity of market-oriented farms should be assessed as a positive measure. Moreover, Ciaian et al. (2015, p.1) found that "the crowding-out effect of the RDP is close to 100%, implying that firms use public support to substitute for private investments".

The third hypothesis (H3) on the importance of selected farm operator's characteristics could be verified positively (as for farmer's age). This refers to the subsector of large-sized farms (including agricultural holdings as the legal entities). In the case of smaller farms, the relation may be reversed (see: Olsen and Lund, 2009). Generally, if a farm operator is older, the level of informal education may increase. This refers to field cropping farm and is consistent with previous findings enumerated by Lefebvre et al. (2015) who identified some reasons for lower investment activity. Serra, Goodwin and Featherstone (2004) indicated that the effect of age of farm operators depends on the type of investment.

The rest of hypotheses (H1, H2) could not be confirmed. The dependencies between investment rate and investment subsidy or diversificiation of agricultural production (depicted by estimated parameters) seem to ambigous. Furthermore, the limited research sample (a balanced panel with removed outliers) seems to be a significant methodological problem. Nevertheless, the results from econometric models may depict trends in the subsector of large-scale agricultural entities.

Conclusion

We highlighted various approaches to the investment processes, including macro concepts and theory of corporate finance. Furthermore, we focused on some peculiarities referring to real investment in the agricultural sector. Our hypotheses were derived from the previous empirical studies and theoretical assumptions. We confirmed our hypothesis on a positive relationship between investment rate and farm operators' characteristics. The interaction between the dependent variable and, inter alia, investment subsidies, may be partially confirmed. Our results are consistent with previous empirical studies (particularly, referring to intensive and large-scale agriculture in the Czech Republic and Slovakia).

There are some limitions of our methodological approach. First, the research sample was very limited (because of a significant number of outliers) and restricted to average large-scale entities. Furthermore, a GLS model (with heteroscedascity correction procedure) approach has some significant limitations (described in the literature in econometrics). Nevertheless, our empirical studies show some particular trends and may be useful for policymakers. A panel data model approach may be employed in further in-depth research restricted to a large population of family farms. We did not include macro-economic data as potential explanatory variables. Indeed, these data did not lead to an increase in diversity of research objects. Non-econometric approaches (based on Data Mining) may shed light on the complexity of dependecies between investment decision (as a result, investment rate) and various set variables at macro/sector/micro level.

Based on our results, we propose some policy recommendations. First, the significance of farm operator's charateristics should be a prerequisite for life-long education (e.g. traininings, on-line courses). Second, the importance of diversification from the standpoint of market-oriented large-sized farms should not be neglected. We propose a holistic approach to real investment, including some tax preferences and an access to

external financing. However, large-sized entities have learnt how to compete at the free market (even a very limited financial support, e.g. direct payments).

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Appendix

TABLE 1. ANNUAL MACROECONOMIC AND SECTOR INDICATORS FOR POLISH AGRICULTURE

Specification	2007	2008	2009	2010	2011
MACROECONOMIC OUTLOOK					
Gross Domestic Product (GDP) - current prices[A]	1 186 773	1 277 322	1 361 850	1 437 357	1 553 582
Harmonized index of consumer prices (HICP) (previous year=100)[A]	102.6	104.2	104.0	102.7	103.9
Imports of goods and services (% of GDP)[B]	42.1	43.2	38.3	42.3	44.9
Gross capital formation (% of GDP)[B]	24.8	24.3	20.2	21.0	22.2
Cash surplus/deficit (% of GDP)[B]	-1.9	-3.7	-6.1	-6.7	-4.2
Domestic credit provided by financial sector (% of GDP)[B]	45.9	59.9	60.6	62.6	65.0
Long-term interest rate (per cent per annum)[C]	5.48	6.07	6.12	5.78	5.96
SECTOR OUTLOOK					
Agriculture, value added (% of GDP)[B]	3.4	2.9	2.9	3.0	3.3
Gross agricultural output (constant prices)[A]	105.9	103.2	102.4	97.3	102.2
crop output [A]	108.9	108.3	103.0	90.6	105.9
animal output [A]	102.9	97.1	101.7	105.0	97.9
Total yields of cereals (per 1 ha in dt)[B]	32.5	32.2	34.8	35.6	34.3
Price relations ("price gap") of sold agricultural products to purchased goods and services[A]	107.7	91.0	96.0	110.1	108.3
Price relations ("price gap") of sold agricultural products to goods and services purchased for current agricultural production and investment purposes[A]	107.2	90.1	96.1	110.2	107.3

Source: data from GUS (Central Statistical Office), World Bank and OECD
Note: [A] GUS Central Static Office, GUS; [B] World Bank, [C] OECD.

TABLE 2. THE NUMBER OF FARMS WITH AN AREA OF MORE THAN 1 HECTARE OF AGRICULTURAL AREA

AREA GROUPS	2002	2011	2012
1-2 hectares	517 040	391 864	298 718
2-5 hectares	629 850	563 698	481 725
5-10 hectares	426 869	342 060	350 822
10-15 hectares	182 685	158 981	144 457
>15 hectares	199 697	198 665	204 308
- 30-100 hectares	44 072	52 183	59 303
- > 100 hectares	7 422	9 882	9 767

Source: Data from GUS (Central Statistical Office).

TABLE 3. SELECTED FEATURES OF LARGE-SIZED FARMS (>100 HECTARES) IN POLAND AND SELECTED EU COUNTRIES

DESCRIPTION	PL	FR	DE	EU-15	EU-27
The number of large-sized farms/ the total number of farms [%]	0,6	18,5	11,2	5,0	2,6
UAA* covered by large-sized farms/total UAA [%]	21,7	59,1	55,0	48,4	49,8
The number of livestock units (LU) per 100 hectares of UAA	44,5	57,0	68,5	54,5	46,8
Productivity of labour (Standard Output/Aweraged Weighted Unit) [EUR/AWU]	56 305	89 722	110 020	95 266	76 145

Source: data from GUS (based on EUROSTAT data).
Note: UAA - utilized arable area.

TABLE 4. DESCRIPTIVE STATISTICS FOR THE BALANCED PANEL OF LARGE-SIZED FARMS (N=125)

Variables	Mean	Median	Min	Max	St. Dev.	CV	Skew ness	Curtosis
Investment rate (-)	19.8169	9.0038	0.0000	129.1290	27.5406	1.3898	2.0016	4.2581
The share of crop output in total output [CO/TO] (-)	65.4735	72.4961	0.0000	100.0000	32.4314	0.4953	-0.5901	-0.8853
Herfindahl-Hirschman Index (HHI)* (-)	0.6078	0.5122	0.3243	1.0000	0.2183	0.3592	0.7451	-0.8277
Investment subsidies (Rural Development Programme) [IS] (dummy variable: =1 if a farm receives, =0 otherwise)	0.5520	-	0.0000	1.0000	0.4993	-	-	-
Financial surplus/liabilities [FS/L] (-)	0.6440	0.4198	-0.3501	2.8071	0.6241	0.9691	1.5447	2.1629
Livestock units (LU) per hectar [LU/ha]	26.6109	24.1935	0.0000	107.6520	27.4365	1.0310	0.6249	-0.6711
Age of farm operator [AGE]	54.2320	55.0000	38.0000	66.0000	6.8922	0.1271	-0.4613	-0.6423
Education level (0 – secondary education, 1- higher education) [EDUCATION]	0.6800	-	0.0000	1.0000	0.4684	-	-	-

Source: own calculations.
Note: abbreviations of variables in brackets, * a measure of specialization at the farm level as „the sum of the squares of agricultural income shares derived from different production activities" (Qin and Zhang, 2012, p.6);

TABLE 5. SPECIFICATION OF PANEL DATA MODELS

NON-DELAYED EXPLANATORY VARIABLES				DELAYED EXPLANATORY VARIABLES (T-1)			
FEM MODELS		REM MODELS		FEM MODELS		REM MODELS	
Model 1	Model 2 (0-1 time units)	Model 3	Model 4 (0-1 time units)	Model 5	Model 6 (0-1 time units)	Model 7	Model 8 (0-1 time units)

Source: Own studies.

TABLE 6. INVESTMENT RATE: ESTIMATED PARAMETERS UNDER GLS MODELS (HC)

MODEL 1: Estimation - Heteroscedasticity Correction (HC), observations 1-125					
Dependent variable (Y): investment rate					
VARIABLES	COEFFICIENT	STANDARD ERROR	T-STUDENT	P-VALUE	SIGNIFICANCE
const	-25.0934	18.1263	-1.3844	0.16888	
CO/TO	-0.028303	0.0644	-0.4389	0.66152	
HHI	-3.47452	9.80825	-0.3542	0.72379	
IS	10.9819	4.08101	2.6910	0.00817	***
FS/L	-1.85532	3.03396	-0.6115	0.54204	
LU/ha	0.036842	0.0909	0.4051	0.68615	
AGE	0.626567	0.30527	2.0525	0.04235	**
EDUCATION	14.934	4.01988	3.7150	0.00031	***
SSR		496.7784	Standard Error of Residues		2.060575
R-squared		0.180117	Adjusted R-squared		0.131064
F(7,117)		3.671894	p-value for test F		0.001276
Log-likelihood		-263.6067	Crit. inform. Akaike'a		543.2134
Crit. Bayes-Schwartz		565.8399	Crit. Hannan-Quinn		552.4054
MODEL 2: Estimation - Heteroscedasticity Correction (HC), observations 1-100 (explanatory variables t-1)					
Dependent variable (Y): investment rate					
VARIABLES	COEFFICIENT	STANDARD ERROR	T-STUDENT	P-VALUE	SIGNIFICANCE
const	-32.5736	17.7039	-1.8399	0.06901	*
CO/TO	0.07600	0.0633	1.2011	0.23278	
HHI	11.3036	11.8101	0.9571	0.34102	
IS	10.5805	5.1042	2.0729	0.04098	**
FS/L	0.533546	3.6547	0.1460	0.88425	
LU/ha	0.0865243	0.0930	0.9305	0.35456	
AGE	0.533852	0.2956	1.8060	0.07419	*
EDUCATION	5.31134	4.3800	1.2126	0.22837	
SSR		359.0898	Standard Error of Residues		1.975639
R-squared		0.163541	Adjusted R-squared		0.099897
F(7,92)		2.569636	p-value for test F		0.018285
Log-likelihood		-205.8140	Crit. inform. Akaike'a		427.6279
Crit. Bayes-Schwartz		448.4693	Crit. Hannan-Quinn		436.0628
MODEL 3: Estimation - Heteroscedasticity Correction (HC), observations 1-75 (explanatory variables t-2)					
Dependent variable (Y): investment rate					
VARIABLES	COEFFICIENT	STANDARD ERROR	T-STUDENT	P-VALUE	SIGNIFICANCE
const	-2.24644	17.4722	-0.1286	0.89808	
CO/TO	-0.0185948	0.0456	-0.4080	0.68459	
HHI	-17.6413	7.9485	-2.2195	0.02985	**
IS	6.07765	4.85973	1.2506	0.21543	
FS/L	1.07942	4.69843	0.2297	0.81899	
LU/ha	0.0291727	0.0646	0.4514	0.65319	
AGE	0.476698	0.2631	1.8119	0.07449	*
EDUCATION	-1.48701	3.81177	-0.3901	0.69769	
SSR		197.2463	Standard Error of Residues		1.715801
R-squared		0.315350	Adjusted R-squared		0.243819
F(7.67)		4.408594	p-value for test F		0.000447
Log-likelihood		-142.6816	Crit. inform. Akaike'a		301.3632
Crit. Bayes-Schwartz		319.9031	Crit. Hannan-Quinn		308.7659

Source: own calculations (computed by GRETL).

Note: standard errors in brackets; *** 1% significance. **5% significance. *10% significance