FARM INVESTMENT BEHAVIOUR IN THE EU: AN EX POST ANALYSIS THROUGH PANEL DATA

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Paper prepared for presentation at the 114th EAAE Seminar 'Structural Change in Agriculture', Berlin, Germany, April 15 - 16, 2010

ABSTRACT

Farm investment behaviour is the result of the complex interplay of several variables and is strictly connected to expectations by farmers. The main objective of this paper is to investigate the determinants of investment behaviour in EU farming systems, based on a panel analysis of 178 farm households in 6 EU countries. The analysis focuses in particular on the changes occurred between 2006 and 2009 in terms of stated intention to invest. The results confirm the role of major structural (location, farm size) and demographic (farmers age) variables in affecting farm investment as already known from the literature. However the panel analysis emphasises the changes in investment attitude occurred in the period 2006-2009, likely as a combined effect of the economic crisis and of the dynamics of agricultural costs and prices.

Keywords: Investment behaviour; Agriculture; European Union; farm household

1. INTRODUCTION

The investment decisions taken by an economic agent is fruit of a large set of very different factors ranging from individual and subjective to straightforward fixed factors. Some can be easily measured (e.g. income) others, given their "immaterial" nature have to be modelled or simulated in order to become tangible (e. g. risk behaviour, knowledge, expectations). Assessing investment behaviour in EU agriculture in the first decade of the XXI century appears particularly difficult, not only due to the continuous process of Policy reforms (Agenda 2000, Fischler reform, Decoupling, Health check) shaping the context of farm investment decisions, but also for the interaction with increasingly volatile markets and continuously changing economic context (globalisation, climate change, new competitors).

In particular, the combination of increased costs of agricultural production causing high volatility of the price of agricultural products and the general economic and financial crisis occurred in the period between 2006 and 2009 are likely to have affected strongly farm investment behaviour. This may have happened through a combination of increased financial constraints, worsening of expectations about future profitability and increase perception of context uncertainty. On the other hand, the contemporary difficulty in non-faming sectors, including unemployment, may have pushed both labour and capitals to move to agriculture.

The main objective of this paper is to investigate the determinants of investment behaviour in EU farming systems, with a focus in particular on the changes occurred between 2006 and 2009 in terms of stated intention to invest. The analysis is based on a panel analysis of 178 farm households in 6 EU countries which were interviewed both in 2006 and 2009.

The paper is divided in five sections in addition to the present one: 2) a brief review of the literature; 3) the description of the survey and the questionnaire; 4) a methodology section describing the statistical tool for the panel analysis; 5) the results; 6) discussion and conclusion.

2. LITERATURE REVIEW

In literature, the theme of investments is widely studied, though the number of paper is lower compared to other fields of agricultural economics. A wide literature review on farm investment behaviour has been carried out in Gallerani et al. (2008). An additional analysis is available in Raggi et al. (2008), which focuses more on investment behaviour as a reaction of to CAP reforms. The analysis of investment at the firm level became an important issue in the general economic literature during the 1950s and 1960s, and burgeoned in the agricultural economic literature during the 1990s. Early approaches, based on the neoclassical theory of the firm, were subsequently discussed, improved and developed into a number of topics such as asset fixity and adjustment costs, uncertainty and information, risk and other objectives, household characteristics, on-farm versus off-farm investment, investment and labour allocation, investment and farm structure, investment and technical change, investment and contracts and investment and credit constraints.

The variables most frequently observed as determining farm investment behaviour can be classified as: a) technical (investment characteristics, farm characteristics, technical change); b) economic (product markets, factor markets, policy); c) household characteristics and farmers' attitudes (Gallerani et al., 2008). These variables may be interpreted either as affecting resource availability (labour) or, most importantly, determining the subjective evaluation of the outcomes of investment in terms of expected flows of utility.

Aramyan et al. (2007) address once again the issue of determinants of investment focusing on the adoption of energy-saving technology in Dutch farming. They use management and Option Value theories to explain investment decisions, and Neo-classical adjustment cost theory of investment to explain levels of investment. Two econometric models (Probit and Cragg's model, also known as the Double Hurdle model) are used for this purpose and applied to FADN data for the period 1990-1998. Capital stock in energy-saving systems and labour are major determinants in the decision to invest. On the contrary, price variations, used to test option value theory, are not significant. Other determinants confirm the general characteristics already well established in the literature, such as the existence of a successor, farm size and farm specialisation.

A large set of the literature focus on specific investment types. The most frequent types of investment considered in the literature are (not in order of relevance): a) tree crops and vineyards (e.g. Jefferson-Moore et al., 2008); b) machinery (e.g. Mooney and Larson, 2009); c) facilities for energy production (e.g. Mallon and Weersink, 2007; Leuer et al., 2008; Zou and Pederson, 2008); d) production rights such as milk quotas (e.g. Hennessy and Shrestha, 2007); and e) dairy farm investments (e.g. Lehtonen, 2008; Rikkonen et al., 2008). Land markets have also gained renewed attention in recent years, both in connection with economic transition (e.g. Biró, 2007) and CAP reform (Swinnen et al., 2008).

The most recent literature examines some of the main issues already addressed. Standard budget accounts or Net Present Value (NPV) approaches remain the most common methodologies when investment profitability is the sole or main focus of empirical studies. Both econometric and programming approaches are used, in more research oriented papers, with increasing attention to dynamics. The Real Option approach seems to be the most relevant developing approach, particularly for the evaluation of single investments (rather than whole farm choices) taking into account the option to delay investments, and hence their timing (e.g. Tzouramani, 2008; Zou and Pederson, 2008; McClintock, 2009).

Time series are often used in econometric analyses of investment behaviour in order to take into account of changes in the economic context, including prices and policy.

3. SURVEY

This paper is based on two surveys carried out in 2006 and 2009 on a sample of 178 farm-households, in 6 EU countries, interviewed in both periods. The number of farm-households in the sample, divided by country and system are shown in Table 1. In Spain, 4 farm households have abandoned farming between the two surveys, so the repeated farm households are 178, instead of 182.

In both cases the survey was conducted through face-to-face interviews. The main focus of the survey was farm household investment behaviour under the CAP reform process. In particular the questions addressed asked about the farm structure: labour, management and organisation, about investments/disinvestments and current assets; then the questionnaires focus the attention on the future expectations and objectives. The section about policy and decoupling was devoted to collecting accurate information about the household's reaction to decoupling. The section about foreseen farm-household and farm developments included detailed information about intended investments in the next 5 years in both consumption good (e.g. house) and productive goods (e.g. farm assets). Agricultural related assets were divided into land, buildings, machinery and those not belonging to these groups.

The content of the questionnaire was the same both in 2006 and 2009, except some additions including questions concerning: the reason for abandonment (if any) and the destination of land in such cases; the role of RDP subsidies in investment; the effects of the financial crisis; the demand for policy changes.

In this paper we focus on stated investment intentions in the two surveys, taking separately into account land, buildings and machinery.

4. METHODOLOGY

Based on the availability of observations for the same set of farms in two time periods, data analysis was carried out using a panel model.. One of the most important advantages of longitudinal analysis compared to cross-sectional, is the possibility to control for individual unobserved heterogeneity improving the accuracy of the estimated effects of the explanatory variables (Greene, 2003).

In general, panel analysis consists in a regression model where the difference between time is the independent variable and the panel data set results are balanced because of the two observations for each statistical unit. In our analysis where t=1,2 and i= 1,2,...178, we use a random effect model (RE), whereby individual effects changing between time periods are included in the constant term. The model is expressed through the following general form:

$$y_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 x_{it} + ... + v_i + \varepsilon_{it}$$

In a regression with a constant term, the RE model assumes that the intercept β_0 is a random outcome variable; x_{it} represents all the variables in the model, β are the coefficients; the random

error v_i, constant over time, represents the random heterogeneity specific for each *i*-th observation and ε_{it} represents the random error and is specific to the individual effects. The random effects model has the advantage of allowing for time-invariant variables to be included among the regressors, and all the estimators are consistent for β with the assumption of absence of correlation between v_i and x_{it}.

We construct four RE models, each with a different dependent variable, considering different typologies of investment: a) for land investment two models were built: the first, a logit model, was applied to investigate the decision to invest in land (yes/no) and the second, a regression model, was used to explain as dependent variable the amount of land (hectares) that the farm intended to buy; b) for buildings investment a logit model was applied to investigate the decision to invest in new buildings or improve existing ones (restructuring), the variable taking again values yes/no; c) for machinery a logit model was applied to investigate the decision to invest in new machinery (yes/no), independently from the number and size of the machinery to be bought (however excluding minor tools).

5. RESULTS

The comparison between 2006 and 2009 (Table 2) denotes a general increase in farm-household labour on-farm, with a reduction in non-household labour used on-farm. Owned land decreases while rented land increases, with an overall small decrease in farm size, though the absolute value of such changes is negligible. For the investment behaviour a large importance is given to the availability and use of credit. Comparing 2009 and 2006, the main effects concern the strong increase in farms that do not use credit, and the dramatic decrease in the use of short-term credit (-50% for orchard/vineyard systems and -48% for farm in mountain areas). This is likely due to the financial and economic crisis diminishing credit availability for farms.

In the Table 3 the percentage of stated intention to invest are reported. As the panel analysis suggests, investments decrease in all the typologies between 2006 and 2009, but the larger reduction is in land investment (from 33% in 2006 to 17% in 2009). Considering only whom have the intention to invest in land, the percentage of those that have already choose the investment decreases from 21% to 6%. An opposite behaviour can be seen in the investment in quantity of land (for those willing to invest), in fact the average quantity stated in land increases from 9 ha in 2006 to 15 ha in 2009. This basically hints at a tendency of those buying land (coinciding with the biggest farms) to increase the amount of land bought.

The model applied for panel data considers, as explanatory variables, demographic, personal, structural, and policy-related data. Table 4 shows the output of the models, starting with the logit

model where the dependent variable is the decision to invest in land, machinery and building. There are several variables significant for investment, in particular the year and country dummies. The negative sign for the covariate year means a negative trend of investment decision over the period, i.e. over the period the probability to invest in land, machinery and building decreases. About the country, all the coefficients, when significant, of the country are negative meaning that the probability to invest is lower compared to the Dutch case study. In fact, the Netherlands are omitted due to the collinearity of the observed variables and could be considered as the reference category.

For land investment, the lack of use of credit by the farm has a negative effect on the probability to invest, which reflects the association between credit use and investment. However, it is not possible to say from this outcome if the willingness to invest encourages the use of credit or the availability of credit encourages the willingness to invest. Considering building investment, a positive effect is shown by farm size (in land surface), which was not significant for the other two investment types.

The constant is always significant and this means that there is heterogeneity between farms so the parameter estimates obtained by RE logit model are appropriate.

The rho coefficient is interpreted as the proportion of the total variance, contributed by the panel-level (i.e. subject level) variance component. When rho is zero the panel-level variance component is unimportant. In our case rho is different from zero.

The right hand side column of Table 4 shows the significant variables of the regression model where the dependent variable is the hectares of land to be invested. The significant coefficients are for the covariates total farm land (land_tot), Poland, Italy, Greece, Spain. France and the arable typology are omitted due to collinearity and could be considered as the reference categories. The positive effect of the covariate total land means that the hectares increase when the farm has a larger area. The positive coefficients of the country Poland, Italy, Greece, Spain could be interpreted as a comparison to the France case study.

Some covariates and their effects are the same in the three different investment typologies. The year covariate captures the negative trend of the investment decision in the period. The country covariates when they are significant, summarize a mix of variables and typical aspects of the case study considered.

6. DISCUSSION

The results of this paper show a major drop of investment intentions in the period 2006-2009, which can be interpreted as a combined effect of economic crises, increased volatility of prices and increased production costs. However, lower prices and economic crisis, in the short term are likely to mostly affect liquidity availability and hence push for a delay in investment but do not change the general investment attitude of the farmers. This is likely confirmed by the relevance of country variables and by the constant, which collect a number of individual and context-related components which remain as the main determinants of investment decisions. Structural factors, in particular farm size, have a more complex effect, as they seem to affect more the quality and the size of investment rather than the attitude to invest. The role of expectations is unclear from these results and could be an issue for further research.

One of the major drawbacks of this study is the small sample size, particularly considering the number of different countries involved. As an effect of this sample, the role of some relevant variables could have been obscured by the country dummy. This hints at the potential interest for wider sample surveys and/or a more focused analysis of the same sample using selected data for the countries with the higher number of observations.

In terms of policy implications, the results calls particularly the attention to two points: a) the need for a more focused credit policy to deal with the contingency brought by the crisis and in general with farm investment; as shown by the lack of significativity of different amounts of SFP, the general agricultural support does not supply to the difficulties of farm types more willing to invest; b) the fact that strong drivers of investment are likely hidden behind individual (farm, farmer and household) characteristics and that these tend to maintain investment attitude in spite of the turbulent economic context, calls for higher attention to entrepreneurship and positive select of farmers/farms on which to base the development of EU agricultural competitiveness.

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Table 1: Number of farm household divided by country and system

Technology	Area	Specialisation	ES	FR	GR	IT	NL	PO	Total
Conventional	Mountain	Arable	-	-	1	4	-	-	5
		Livestock	-	-	-	3	-	11	14
		Trees	2	-	-	10	-	6	18
	Plain	Arable	1	6	6	14	-	5	32
		Livestock	-	-	-	5	5	17	27
		Trees	14	-	-	11	-	8	33
Emerging	Mountain	Arable	-	-	3	6	-	-	9
		Livestock	-	-	-	6	-	5	11
		Trees	-	-	-	2	-	2	4
	Plain	Arable	-	-	2	7	-	1	1-
		Livestock	-	-	-	3	6	4	13
		Trees	-	-	-	6	-	-	6
Total			17	6	12	77	11	59	182

Table 2: Main differences in descriptive between repeated farm-household 2009-2006

	Min	Max	median	Cov	% of farms with positive value
Family farm	-	-		-	-3%
Age of farm head (years)	3	5	2.50	-0.01	0%
Successor (% of yes)	-	-			-7%
Household head labour on farm (hours/year)	0	620	0.00	0.01	-6%
Household head labour off farm (% of yes)	-	-	-	0	-
Household labour on farm (hours/year)	0	11800	284.00	-0.64	-6%
Household labour off farm (hours/year)	-	-	-	-2.73	-
Total external labour purchased (hours/year)	0	-11040	-160.00	-0.21	-11%
Owned land (ha)	0	0	0.18	-0.10	0%
Land rented in (ha)	0	84	0.00	0.09	1%
Land rented in (% of total farm area)	0	0	0.27	-0.53	1%
Land rented out (ha)	0	0	0.00	-13.49	0%
Total land (ha)	-1.3	0	-0.10		0%
Share of organic products (%)	0	0	0.00	0.04	0%

Table 3: Percentage of stated intention to invest in 2006 and in 2009

Stated intention to invest	2006	2009
Land	33%	17%
Already decided in land	21%	6%
Machinery	52%	34%
Building	38%	21%
Land in ha (average)	9	15

Table 4: Random effects logistic regression for investment (land, machinery and building) and random effect GLS regression for investment in quantity of land

	Random-effects logistic regression[1]						**Random effects GLS regression for investments [2]**	
Variables	Land		Machinery		Building		Land (ha)	
	β	s.e.	β	s.e.	β	s.e.	β	s.e.
constant	846.74	276.97	983.44	264.60	995.98	280.19		
land_tot	-	-	-	-	0.01	0.01	0.12	0.01
year	-0.42	0.14	-0.49	0.13	-0.49	0.14		
credit_no	-2.24	0.79	-	-	-	-		
poland	-3.04	1.01	-	-	-	-	26.76	10.76
italy	-4.96	1.15	-4.53	1.26	-3.23	0.98	24.79	10.85
spain	-4.71	1.31	-4.97	1.48	-	-	24.95	11.65
france	-4.09	1.79	-	-	-4.47	1.94		
greece	-5.68	1.46	-5.14	1.46	-4.02	1.31		
Rho coeff	0.33	0.16	0.44	0.13	0.41	0.13		

[1] The Netherland is the reference category

[2]France and arable typology is the reference category