Explaining structural policy use by farmers with discrete choice models: an evaluation of structural policies supported by the EAGGF

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Abstract

A farmer's choice to part-take into an on farm investment programme can be modelled as a discrete choice. The idea of this paper is to test the possibility of using discrete choice models in the field of the evaluation of structural policies.

Farmers choose to take part into agricultural programmes according to their preferences, their structural type and their economic environment. Adhesion to a voluntary scheme or policy can be cast as a discrete choice problem. Hence, discrete choice models are adequate to describe probability of choice, especially against a framework of utility maximization.

First, we want to explore if the choice of investing in schemes supported by EAGGF depends on farms' characteristics, such as Used Agricultural Area, Standard Gross Margin, Farm type, Possession of lands, Form of Farm Management, Standard Work Unit, class of European Size Unit, Fixed costs, etc.. We use is the binomial logit model to explain the probability of making an on-farm investment with regard to Italian Central and Northern Regions. The estimation of such a model allows us to identify the determinants of such a decision.

We also use discrete choice analysis to identify the significant determinants of the probability of selection of on-farm investment across 12 investment categories within the Regulation (EC) No 950/97. These include – amongst others – land purchase, system for refusal treatment, land improvement, agricultural machinery, agricultural and non-agricultural farm buildings, land improvements, permanent cultivations etc. We find such an approach to be insightful on the basis of data from the Italian RICA business farm survey, and hence propose to develop it further.

Since 2001, within the RICA, INEA has collected information about the outcomes of Council Regulation (EC) No 1257/1999 regarding the support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF) for rural development plans and operational programmes. The analysis of these data allows us to obtain a number of goals, amongst the most interesting we list:

1. to ascertain that the intended policy goals were achieved in practice by the policies under examination. In particular, one wants to verify if the agricultural firms beneficiary of Structural Funds identify the target of agricultural holding established in programmes, which can be different among Regions. At this point in time, however, this issue can only be superficially addressed due to the lack of regional plans for the pursuance of the Regulation No 950/97 in the Italian Central and Northern Regions;
2. the exploration of a wider set of policy measures of rural development plans and opertional programmes.

Keywords: investment measures, discrete choice models.

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1 Introduction

This paper aims at presenting two sets of discrete choice estimates and some policy simulations on two samples of Italian farmers. The first model is explorative in nature and is estimated on a large sample of over 9,500 farmers. The aim is that of investigating the determinants of farmers investment choice in the year 1999. The second model is more complex in nature and is the one underlying the policy simulations. It aims to explore the determinants of selection of on-farm investment (OFIs) categories in a smaller sample of farms that have received public co-funding under the framework of EC Regulation 950/1997.

The paper is organised as follows. Section 2 provides some background on the policy instrument. Section 3 describes the sets of data utilised for the estimation of discrete choice models, coming from two different sources of data:

1) the Farm Accountancy Data Network (FADN);
2) an evaluation study on the effects of the application of the Regulation (EC) No. 950/97 in the Italian Central and Northen Regions (INEA and Agricolsulting, 2001).

Moreover, some results about the structural and economic characteristics of farms that invest compared with those of farms do not invest are shown.

Section 4 concerns the results coming from the estimation of binomial logit model and that of multinomial logit model and some policy simulations.

We conclude in Section 5 summarising the obtained results and showing future developments on evaluation of structural policies on farm investments implemented through rural development plans in Italian Central and Northern Regions and operational programmes in Objective 1 Italian Regions by using discrete choice models.

2 Some background

2.1 The evolution of the Common Agricultural Policy for the on farm investments

The Common Agricultural Policy for on-farms investments has been part of the general socio-structural policies. In the last decades these policies have suffered a significant evolution and a progressive change of their objectives and instruments.

In the 70's, investments n the rural sector had been already stimulated by socio-structural Directives. These policy instruments had the main objective to compensate the imbalance generated by the Common Agricultural Policy (CAP). With the Structural Funds reform (1988-98), support for on-farm investments (OFIs) were made part of Objective 5a) finalized to speeding up the adjustment of agricultural structures. That reform introduced some general principles, such as multi-year programming and the focus of assistance on priority objectives (Mantino, 2002; Vieri, 2001). Since then Regulation 2328/91 and 950/97 have been the main policy instruments to promote OFIs.

Regulation 950/97 made some provision in order to aid farms to improve their production efficiency. The aims of this instrument were (EC, 1997):

> "to help restore the balance between production and market capacity; to help improve the efficiency of farms by developing and reorganizing their structures and by promoting supplementary activities; to maintain a viable agricultural community; to contribute to the preservation of the environment and the countryside."

The main measures were:

- investments in agricultural holdings,
- measures to encourage the setting-up of young farmers,
- measures to assist agricultural holdings, involving the introduction of accounts and the launching of groups,
- measures to support farm incomes and to maintain viable agricultural communities in less-favoured areas, vocational training projects.

The aims of OFIs have been the improvement of agricultural incomes and hence of farmers' standards of living, working and producing. The typologies of investments were: the qualitative improvements and redeployments of production; the diversification of activities on the holding (tourist and craft activities, direct sale of farm produce); reducing production cost and saving energy; the improvement of living and working conditions; the improvement of the hygiene conditions of livestock and compliance with Community animal welfare standard; the protection and improvement of the environment.

The reform brought about by the agenda 2000 confirmed the financial support to the OFIs by including them between the measures of EC Regulation 1257/99. This regulation gathers, in a unique regulatory framework, all the different instruments of the structural policies for the rural sector (INEA, 2002).

In comparison to the previous programming period, in order to be eligible farms must demonstrate economic viability, to respect minimum standards for environment, hygiene and animal welfare. Furthermore, farmers must possess adequate occupational skill and competence.

3 OFIs under Regulation 950/97 in Italy in non-Objective 1 Regions

A recent study has appraised the effect of the Regulation 950/97 in Italy in non-Objective 1 regions during the 1994-99 programming period (ITA INEA – Agriconsulting, 2001). The three main measures included in the regulation were subject to the appraisal. These included: OFIs, measures to encourage the setting-up of young farmers, measures to support farm incomes and to maintain viable agricultural communities in less-favoured areas. In particular this study has appraised: financial implementation of measures and measures impact on farms.

The analysis of the investment measures evaluated their impact on: efficiency of productive resources; incomes of farmers; conversion and diversification of productive activity; quality of the productions and stabilization of markets; environmental. In this paper, the data of the study are used to first describe the main structural and economic characteristics of the agricultural farms that have realized investments using such funds, then to estimate the determinants of two sets of discrete choices. The first model explains the farm characteristics significantly linked with OFIs in general, while with the second model we try and explain the determinants of selection across the 12 categories of OFIs.

3.1 Data and methodology

The policy evaluation involved two distinct phases (ITA INEA – Agriconsulting, 2001). In the first was employed the sample from The Farm Accountancy Data Network (FADN). This sample satisfies the general methodological requirements for the valutation of a policy impact (counterfactual comparison, uniform methodology of survey and compatibily with communitarian standards). Moreover the FADN:

- is the only economic data archive about farms in the European Union;

- it provides time series on farm income, productivity, costs of production, structural and economic indicators. This data are available on a local scale and sector level;
- this data collection system collects data systematically across regions and time.

Given that OFIs concern different form categories of capital of farm (land investments, farm buildings, agricultural machinery, etc.), the analysis is based upon:

- periodical reapeted observations on a panel of representative farms (constant sample) over the 1990-1998 period. Each farm remained in the panel for at least three accounting years.
- the comparison between the socio-economic status of a farm at the time of absence of OFIs (*initial year*) and the farm situation at the time in which the OFIs can be consided to be completed (*final year*).

The sample is made up of three sub-samples of farms:

- *study group (SG)*, farms that made significant investments under either the EC Regulation 950/97 or the preceding (EEC) Regulation 2328/91;
- *comparison group "with investments" (CGI),* farms with significant investments that did not benefit from (EC) Regulation 950/97;
- *comparison group "without investments" (CGWI)*, farms that did not make significant investments.

For the analysis an OFI is *significant* when at least one of the following conditions is verified:

- the yearly value of new investments (land capital and agricultural machinery) is equal or greater than €12,900.00. Here the purchase of land is excluded from the computation of land capital;
- the ratio between the yearly value of new investments (land included) and the value of the owner-provided capital (debts included) is larger than 5%;
- the initial value of farmlands, or farm buildings, or agricultural machinery, is at least 10% higher than the final value of the previous year.

Farms that made significant OFIs only in the last year of presence in the panel sample are excluded from the groups with investments (SG, CGI) because in such cases the impact consequent to the investment cannot be observed.

To allocate a farm in the SG or CGI sub-sample the farm had to have supplied a Improvement Material Plan (IMP). In order to have access to funds from the (EC) Regulation 950/97 such plan was in fact necessary. Farms that made OFIs without an IMP were allocated to the CGI sub-sample.

The remainder of farms were included in the sub-sample "without investments" which were used as baselines to compare the structural and economic characteristics of farms and the main indicators of farm performance. All value are expressed in real terms, 1990 price values.

The constant sample is made up of 17,030 farms (table 1***). The study group includes 2,227 cases; the comparison group "with investments" includes 4,338 farms, while the comparison group "without investments" includes 10,465 cases.

The sample was also stratified on the basis of a three parameters.

- The economic size of farm (European Size Unit, ESU). For every group three categories have been individualized: "small" farm (ESU < 16), "medium" farm (40 < ESU < 16) and "large" farm (ESU > 40);
- Farm Type (FT); classification of farm into types is based on the financial potential of the various agricultural activities of the farm and the combination of these activities.

- Altimetry of farm, classified in three classes: “lowland”, “hill areas” and “mountain areas”.

The structural and economic situation of farm, before and after investments, has been analyzed observing the following variables:

- Used Agricultural Area (UAA);
- total Annual Work Unit (AWU) and Family Workers Unit (FWU);
- Value of Final Output (VFO);
- Net farm Income (NI).

Moreover we have calculated the following indicators:

- Net farm Income per family workers (NI/FWU);
- Value of Final Output per hectare (VFO/UAA);
- Used Agricultural Area per Annual Work Unit (UAA/AWU);
- Productivity of labour (VFO/AWU);
- ratio between family workers and total labour force (FWU/AWU);
- Return of sales* (NI/VFO).

In the second phase, the study has analyzed the regional case studies (ITA INEA – Agriconsulting, 2001). Case studies have concerned a sample of farms that made investments under the (EC) Regulation 950/97. Sample is made up of 403 farms subdivided in three classes of economic dimension (table 2***).

A questionnaire has analyzed the socio-structural characteristic of farms, the annual balance before and after investment (in particular value of final output, variable costs, fixed costs and net farm income before and after the improvement material plan), the financial aids received on 1994-99 period, the motivations farmer’s choice of investment, and socio-economic and environmental effects.

3.2 Structural characteristic of FADN sample

Following, we have analyzed the main characteristics of farms that have realized investments under (EC) Regulation 950/97. Moreover we have examined the differences between study group and the two comparison groups (CGI and CGWI) (ITA INEA - Agriconsulting, 2001).

Used agricultural area average is 21.5 hectares. This UAA is lower than the GCI group (29,6 hectares) but it is largest than comparison group without investments (14,2 hectares). Moreover, the farms are concentrated in the medium size bracket of agricultural area (5 e 20 hectares) (table 3***). SG group is distributed in uniform way to altimetric level; while CGI and CGSI are concentrate on “lowland” and “hill areas”.

On final year, UAA increases of 17% in the study group, while only 7% in the comparison groups (table 7***).

Analyzing the sample per economic size of farm (ESU), we can be observed that the "small" and "medium" farms prevail in the study group (table 4***), while the "small" farm prevail in the comparison groups without investments. On comparison groups with investments the distribution of farm is instead more uniform. Moreover the UAA in the GCI group is largest than SG group in the "large" farms.

The distribution of groups per farm type (FT) evidences remarkable differences:

- the specialist grazing livestock farms (39%), the specialist vineyards farms (11%) and the specialist fruit and citrus fruit farms (14%) prevails in the SG group;

- the specialist grazing livestock farms (27%), the specialist field crops farms (16%) and the mixed farms (15%) predominant in the CGI group;

- the specialist field crops farms (24%) prevail in the CGWI group.

In the groups with investments (SG and CGI) there is a great use of manpower: in fact, this production factor is equal to 2.2-2.4 AWU. In general, manpower increases in the higher economic size of farm (ESU) (table 5***). In the study group, livestock farms, vegetable-growing farms and floricultural enterprise require a great employment of manpower. The farmer manages the farm directly with the family workers. Ratio between family workers and total labour force is greater than 90%. This indicator decreases in the lower economic size of farm (table 6***). On comparison group with investments there is a large use of hired labour and the family workers are 88% of total AWU.

In the final year the AWU decrease in the whole sample. However, the reduction is greater in the comparison groups: -5% in the group with investments and –6% in the group without investments. In the SG group the reduction is lower than 1%.

In the SG group, value of final output and net income are intermediary in comparison to the others two groups (initial year). However, this economic indicators increase in the final year. VFO increases about of 15% in the study group and of 3% in the CGI group. A similar trend has been observed for the NI: this indicator is equal to 20.300,00 euro in the study group and increases about of 13% in the final year (table 7***).

In the study group, the productivity and profitability indicators are always intermediary in comparison to the others two groups (table 8***).

The value of final output per hectare is equal about to 2,400.00 euro in the initial years and shows modest diminution in the final year (-1%). In particular VFO and UAA increase contextually.

In the SG farms, the productivity of labour is equal to 23,800.00 euro and it is lower than comparison groups with investments. However VFO/AWU and NI/FWU increase clearly in the SG group in the final year. This situation results from an increase of production and from the maintenance of the level of employment (-0,6%).

The land capital and working capital is equal to about 323.900,00 euro in the SG group. Total capital of farms are lower than comparison groups with investments (table 9***). However the SG farms effect significant investment and the total capital increases about of 24% in the final year. Particularly the investments concern the farm buildings improvement and construction (livestock houses, wine cellars, warehouse and store, etc.). The CGI farms invest in farm machinery and agricultural equipment. For this groups total capital increases only to 2% in the final year.

The total costs is equal to 39.100,00 euro in the SG group and it is lower than comparison groups with investments (table 9***). The fixed costs increase meaningfully in the final year.

In the SG group the return of sales is largest than CGI groups; however, this indicator shows a modest decrease in the final year because the fixed costs increase (28%).

In synthesis, the structures of study group are lower than the comparison group with investments in term of:

- economic size of farm (ESU);

- used agricultural area;

- level of employment.

Also the productivity and profitability indicators are lower than comparison group with investments. The SG farms need investments to increase the income and improve farm structures. Then the Common Agricultural Policy for on-farms investments are a significant incentive to modernize agricultural holdings. In the CGI group the farms use the self-financing for realize the investments. In the CGWI group the main problem is the lack of financial resources for realize the profitable investments.

4 Econometric analysis and results

The main objective of this paper is to investigate determinants of farmers choice of investing in farm and those one affecting the selection of one or more investments categories provided by the Regulation (EC) No 950/97 using discrete choice models. The latter model the farmers choices as a distribution of probability conditional to structural and economic characteristics, in the first stage of this analysis, and also to the investment categories attributes, in the second stage of the same.

4.1 *Binomial choice models: explaining which farmers invest*

In order to explore the determinants of farm investment we estimate a dichotomous choice logit model over the 1999 whole sample of farms sited in the Italian Central and Northern Regions from the Italian section of the Farm Accountancy Data Network that counts 9,649 observations. So, we assume that the probability of observing the implementation of at least one investment in one year is dependent on a vector **x** of farms' structural and economic characteristics and this probability is distributed logistically according to the law:

$$Pr(\text{at least one investment on farm}|\mathbf{x}) = \Lambda(\beta'\mathbf{x})$$

where $\Lambda(\cdot)$ is the logit c.d.f..

Investments are defined in abroad sense and include also investments not funded under regulation 950/97. A total of 44.36 percent of these farms were found to have invested in the year 1999.

The determinants of investment are broadly aggregated in groups, which include indicators of economic and financial performance and farm structure.

Amongst the economic performance indicators with negative effect on the likelihood of investment we find the following variables to be significant. Net farm income (RN), value of final output in absolute (PLV) and relative terms (PLVSAU), area by unit of labour (SAUULT), net revenue on value of final output (RNPLV), total rural capital (KFONTOT) and the value of final output from transformation of raw produce into wine and olive oil.

Amongst the economic performance indicators with POSITIVE effect on the likelihood of investment we find the following variables to be significant. Fixed costs (COSTFISS), value of final output per unit of labour (PLVULT), KESTOT (??), REDDOPER (??).

Most farm structure indicators have a positive effect: total unit of labour (ULTOT), used agricultural area (SAU), level of altitude from sea level (LIVALT), dummy for mountainous areas (ZONAMONT), number of separate land units in the farm (CORPFOND), cattle unit equivalent (UBA), grazing area per cattle unit equivalent (ESTALLEV), total income from on-farm tourism (AGRITUR), livestock payments (PREMIALL). Amongst the farm structure indicators with a negative effect we list: age of farm manager in the year 1999 (AGE99), and the usable farming area with slope larger than 15 percent (SAUMACCL).

Overall we find that the magnitude and significance of indicators are consistent with the notion that farms with low economic performance, located in mountainous areas and generally low structural potential and young management tend to invest with higher likelihood.

4.2 Multinomial choice models: explaining which category is funded

In the second stage of the analysis we estimate the probability of investment category selection by farmers that chose to invest from 1990 to 1998, using a sub-sample of 403 beneficiary farms of public funding from Regulation 2328/91 and, in the latter two years, from Regulation 950/97. Anyway, the total number of observations increase to 792 as some farms have implemented more than one investment typology. So, in this case, we treat these different choices as independent among them. The probability of selecting a particular investment category conditional to farm structural characteristics and investment category attributes is modelled by a multinomial logit fuction.

Particularly, for each farm choice, the selection across 12 investments categories considered in the study is assumed to be driven by a random utility process. Consider the following linearly additive indirect utility specification for a choice of a given category j chosen from a set of alternative investment options:

$$v_{ij} = \boldsymbol{\alpha}' \mathbf{s}_{ij} + u_{ij} .$$

The unobserved component u_{ij} includes idiosyncratic preferences known to the single farmer but not observable by the researcher. The deterministic component $\alpha'\mathbf{s}_{ij}$, is observable in the dimensions of the row vector $\mathbf{s}_{ij}$, and the column vector α may be estimated given a quite restrictive set of assumptions on the distribution of $u|\mathbf{s}$ across the population of farms.

Prediction of probability choices on the support of **s** is carried out as if the utility of a given choice were a probabilistic event, even if it does not, and assuming that $u|\mathbf{s}$ is distributed i.i.d. Extreme Value Type I with scale parameter k, which has the distribution function

$$F(u_{ij}) = \exp(-k \exp(-u_{ij})).$$

This assumption is consistent with an underlying population of random utilities (McFadden, 1974). The probability of choosing investment category k for farm i is therefore:

$$\pi_{ik} = \frac{\exp(\boldsymbol{\alpha}'\mathbf{s}_{ik})}{\sum_j \exp(\boldsymbol{\alpha}'\mathbf{s}_{ij})} \qquad j = 1,2,\ldots J \text{ , } i = 1,2,\ldots N$$

The obtained results are presented in table ***. The variable “TEMPDIR” indicates the length of time it takes from the moment of application for funding the investment to the final payment from the granting authority. The estimated value is positive, indicating that the longer this time, the more likely is the probability of funding the associated investment type.

The co-funding established with regulation (EC) 950/97 for each category of investment also displays a positive effect on the probability of funding, as one might expect. The average lack of cash reported by grant recipients in the class of investment shows a negative effect on the probability of funding, suggesting that categories of investments subscribed by farms that are likely to be insolvent have low probability of grants being successful.

The variable IMPDOM is the average total cost of the investment and it shows a positive effect, suggesting that categories with high value investment have higher likelihood of being granted.

CONTDO is the average size of public grant per application in a given farm investment category, and it shows a negative effect on the likelihood of selection for granting. This is probably due to the intention to fund a higher number of applications with the available budget.

INVEST is a variable which indicates the value of the investment for each chosen alternative, while for the competing alternatives (non chosen investment categories) it is represented by the expected sample value, as a plausible measure of the expectation. Such estimate has a positive sign, suggesting, perhaps, that more valuable investments to farmers are funded more frequently than less valuable ones.

A similar variable is FIN_PU, which indicates the amount of public funding of each chosen alternative, while for the other alternatives it is the category average. The negative coefficient suggests that applications with higher demand of public funds are relatively less likely to be funded.

Public funding is enhanced for farms located in disadvantaged areas (DAs). To capture the effect of public funds in such areas we used an interaction variable (CONT_IND) between a dummy variable indicating that the farm is sited in a DA, and CONTDO. Such estimate is positive and indicates that farms in Das are more likely to be funded than elsewhere, irrespective of category of investment.

Finally, the model includes four alternative-specific constants, which capture the effect of unobserved variables linked to single categories of investment (Stable, machinery, improved permanent crops, and "other categories").

The diagnostics of the basic MNL model indicate a relatively low fit. Table*** shows the predicted versus observed choices. In the specification of the model we explored a number of mixed logit specifications, where parameters where assumed to be random and normally distributed. Such models failed to converge and we hence focused on latent class models. We refer to the relevant literature for a detailed explanation of how these two categories of models explain heterogeneity (Hensher and Greene 2002). Briefly, while mixed logit models assume that coefficients are randomly distributed according to continuous parametric distributions (normal, log-normal, uniform and triangular are the most frequently employed) (Train, 2003), latent class models assume the existence of a finite number of classes in the sample, each with a different set of parameters. We tried and estimated a series of models with 2, 3 and 4 classes. Only two latent class specifications achieved convergence in this sample and the estimated parameters are reported in table ***. As can be seen by the diagnostics and the predicted versus the observed choices in table *** this model shows a much superior fit to the previous basic MNL model, increasing from 13.8 to 92.1 percent the number of correctly predicted choices.

The two latent classes show a remarkable difference in the pattern of signs in the estimates. Neither class shows significance of CONT_IND, while class 2 has also parameters OTHERS and FIN_PU which are not significantly different from zero. The only variable whose estimate shows a concordant sign in the two latent classes is FINPU950, which has a positive effect. All other variables show discordant signs in the estimates of the two classes. We suggest that this pattern indicates the presence of two regimes of behaviour, one for low public funding projects (class 1) and one for high public funding projects (class2). Class 1 is associated with an average amount of public funding per realised investment of €8,227 (LIT15,931,000), while class 2 is a much higher public fund class with an average endowment of €27,770 (LIT 53,771,000). We proceed to explore further the determinants of posterior probabilities on the basis of some farm-specific variables. The results of the binary logit model explaining the posterior probabilities of belonging to class 1 is reported in table ***.

Such estimates show that a higher probability of belonging to the low-funding group is found for farms that:

- were managed by women;
- with a low number of family members working on-farm (RISUMAZ);
- that would have proceeded with the investment regardless of public funding (SENFPNO);
- with low income from farming (RAtAgrP);
- with low income from on-farm produce transformation (RAtTraP);
- low family income (RNucleoP);
- low public funding level from public policies (RAiutiP)

In the next subsection we assess the latent class model by examining its sample predictions under various hypothetical policy changes.

4.3 Policy simulation

The first policy change postulates a 10 percent increase in the rate of public co-funding, while the second postulates a reduction of 20 percent in the number of applicants lamenting a lack of cash-flow in the financial plan during the realisation of the investment. While the first is a direct provision reachable by simply increasing the budget or reducing the number of beneficiaries, the second is an indirect provision that can be reached either by implementing more flexible measures of financial engineering for farmers, or by improving the financial flow of public funding to beneficiaries, so that farmers need not bear the cost of financial exposure.

Each policy is simulated in turn at a different scale. First across all categories of investment, second only for investments in farm buildings, then it is limited to a given category of buildings: those for extra-agricultural activities to enhance farms' multi-functionality.

The implied sample simulations from both MNL and two-class LCM models are reported in tables ***.

We note that both models predict an increase of the likelihood of investment in building categories when the *first policy* is applied across categories, although with some differences in the shares due to the fact that the LCM accounts for the presence of two different regimes. As a consequence, when the policy is restricted to farm buildings categories these effects are amplified.

On the other hand, when the simulation is restricted to non-agricultural farm buildings only, the two models produce predictions of similar magnitude in terms of own-effects, but somewhat different cross-effects.

Quite a different picture is predicted by the simulation of the second policy: While the MNL model predicts a shift to building categories, the LCM predicts a higher share to non-building related categories of investment. The difference in predictions between the two models is emphasized in the other two scales of the policy simulation, in terms of both the magnitudes and signs of own-effects and cross-effects.

The prediction of the changes in shares for the combined policy scenario, are – of course – hybrids between the two. Overall the MNL seems to indicate that both policies, separately and jointly, would promote the likelihood of funding investments of building categories. On the other hand, the LCM predictions are characterized by a more heterogeneous outcome, with markedly smaller magnitudes, especially when policies are limited to investment in farm buildings.

5 Conclusions

The empirical analyses of determinants of on-farm investment decisions and selection have shown to produce insightful results. In particular, the binomial decision of investing on-farm was found to be significantly linked to various relevant indicators of farm economic performance and farm structure. In general, it was shown that low economic performance and marginal farm structure increase the likelihood of investment.

The multinomial (conditional logit) analysis of determinants of selection amongst categories of on-farm investment uncovered the existence of two different regimes of decision behaviour for public funding decisions under regulation 950/97. These were highlighted by making use of latent class modelling, and would not have become apparent in a conventional multinomial logit approach. The two class model employed showed a much better fit, correctly predicting over 92 percent of observed choices, versus a poor 13 percent of the conventional multinomial logit approach.

The implications for policy simulations of the two models were also supportive of the 2-class approach, and indicated that the main response to an increase of public co-funding would result in an increase of the probability of selecting categories of investment related to farm buildings.

In the light of these results we suspect that discrete choice analysis may be a fruitful avenue of investigation of such policy programs. Evaluation agencies perhaps should organise their data collection accordingly, and privilege the collation of data suitable for such form of analysis.

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Tables

Tab. 1*: Number of cases: FADN data bank

	No farms	Share
Study group	2.227	13
Comparison group with investments	4.338	25
Comparison group without investments	10.465	61
Total	17.030	100

Source: ITA INEA – Agriconsulting, 2002

Tab. 2*: Number of cases: regional case studies

	ESU			Total
	< 16	16-40	>40	
Number of farms	100	153	150	403
Share	25	38	37	100

Source: ITA INEA – Agriconsulting, 2002

Tab. 3*: Number of farms and UAA per size bracket of agricultural area (initial year)

Size bracket of agricultural Area	Study group		Comparison groups			
			with investments		without investments	
	farms %	UAA average (ha)	farms %	UAA average (ha)	farms %	UAA average (ha)
da 0 a 4,99	16	3,2	13	2,8	26	2,5
da 5 a 19,99	57	10,5	48	11,5	56	10,4
>20	27	55,9	40	52,7	19	42
Totale	100	21,5	100	26,9	100	14,2

Source: ITA INEA – Agriconsulting, 2002

Tab. 4*: Number of farms per ESU (initial year) (share)

ESU	Group of study	Comparison groups	
		with investments	without investments
< 16	41	31	53
16 – 40	39	37	33
> 40	21	33	15
Total	100	100	100

Source: ITA INEA – Agriconsulting, 2002

Tab. 5*: Annual Work Unit (AWU) per ESU (initial year)

ESU	Study group	Comparison groups	
		with investments	without investments
< 16	1,8	1,7	1,5
16 – 40	2,1	2,1	1,9
> 40	3,2	3,3	2,7
Total	2,2	2,4	1,8

Source: ITA INEA – Agriconsulting, 2002

Tab. 6*: Ratio between family workers and total labour force per ESU (initial year)

ESU	Study group	Comparison groups	
		with investments	without investments
< 16	0,98	0,98	0,99
16 – 40	0,94	0,95	0,96
> 40	0,84	0,78	0,84
Total	0,92	0,88	0,95

Source: ITA INEA – Agriconsulting, 2002

Tab. 7*: Used Agricultural Area, Annual Work Unit, Value of Final Output and Net farm Income (initial and final year)

		UAA ha	VFO .000 euro	AWU	FWU	NI .000 euro
Study group	initial	21,5	52,3	2,2	2,0	20,3
	final	25,2	60,3	2,2	2,0	23,0
	var.%	17	15	-1	-3	13
Comparison groups with investments	initial	26,9	71,1	2,4	2,1	27,3
	final	29,3	73,5	2,3	2,0	28,2
	var.%	9	3	-5	-5	4
Comparison groups without investments	initial	14,2	32,3	1,8	1,7	14,0
	final	14,7	31,6	1,7	1,6	13,8
	var.%	3	-2	-6	-6	-1
Total	initial	18,4	44,8	2,0	1,8	18,2
	final	19,8	46,0	1,9	1,7	18,7
	var.%	7	3	-5	-5	3

Source: ITA INEA – Agriconsulting, 2002

Tab. 8*: Productivity and profitability indicators (initial and final year)

		VFO/ UAA .000 euro	UAA/ AWU ha	VFO/ AWU .000 euro	NI/ VFO %	AWU/ FWU %	NI/ FWU .000 euro
Study group	Initial	2,4	9,8	23,8	38,8	0,92	10,0
	final	2,4	11,5	27,6	38,1	0,90	11,7
	var.%	-1	18	16	-2	2	17
Comparison groups with investments	initial	2,6	11,3	30,0	38,3	0,88	13,1
	final	2,5	13,0	32,5	38,4	0,88	14,2
	var.%	-5	14	8	0	0	9
Comparison groups without investments	initial	2,3	8,0	18,1	43,2	0,94	8,2
	final	2,2	8,7	18,7	43,6	0,94	8,6
	var.%	-5	9	4	1	0	5
Total	initial	2,4	9,2	22,5	40,5	0,93	9,9
	final	2,3	10,4	24,2	40,5	0,92	10,7
	var.%	-4	13	8	0	1	8

Source: ITA INEA – Agriconsulting, 2002

Tab. 9*: Costs and capital (.000 euro) (initial and final year)

		Variable costs	Fixed costs	Total costs	Land capital	Working capital	Total capital
Study group	initial	27,0	12,1	39,1	253,5	70,4	323,9
	final	29,0	15,5	44,4	325,6	74,6	400,3
	var.%	7	28	14	29	6	24
Comparison groups with investments	initial	36,7	16,9	53,6	326,0	89,3	415,3
	final	35,5	18,6	54,1	337,6	87,7	425,3
	var.%	-3	10	1	4	-2	2
Comparison groups without investments	initial	13,8	7,7	21,6	177,3	38,2	215,5
	final	12,7	7,9	20,6	172,6	32,2	204,8
	var.%	-8	2	-5	-3	-16	-5
Total	initial	21,4	10,6	32,0	225,1	55,4	280,6
	final	20,6	11,6	32,2	234,6	51,9	286,5
	var.%	-4	9	1	4	-6	2

Source: ITA INEA – Agriconsulting, 2002

Table 10. Logit estimates for OFIs.

	Log-lik -5456,782				
		coeff	st. err.	asymp. Z-value	p-value
	Constant	-7,15E-01	1,32E-01	-5,40	0,000
1	RN	-3,29E-05	7,93E-06	-4,15	0,000
2	RN_SQ	3,21E-13	5,88E-14	5,46	0,000
3	ULTOT	4,99E-01	3,94E-02	12,65	0,000
4	SAU	5,87E-03	1,30E-03	4,51	0,000
5	PLV	-5,87E-06	5,81E-07	-10,11	0,000
6	PLVSAU	-4,79E-07	6,85E-08	-6,98	0,000
7	SAUULT	-1,48E-02	2,50E-03	-5,94	0,000
8	PLVULT	8,45E-06	8,20E-07	10,31	0,000
9	PLVULTSQ	-1,22E-12	3,51E-13	-3,48	0,001
10	RNPLV	-1,56E-02	1,26E-03	-12,37	0,000
11	COSTFISS	3,85E-06	1,35E-06	2,85	0,004
12	KFONTOT	-1,01E-07	3,08E-08	-3,28	0,001
13	KESTOT	3,28E-06	2,62E-07	12,49	0,000
14	LIVALT	1,57E-03	2,21E-04	7,10	0,000
15	ALT_SQ	-5,32E-07	1,68E-07	-3,17	0,002
16	ETA99	-1,84E-02	1,83E-03	-10,08	0,000
17	ZONAMONT	1,34E-01	6,36E-02	2,11	0,035
18	CORPFOND	2,31E-02	3,26E-03	7,10	0,000
19	SAUMACCL	-4,97E-05	2,30E-05	-2,16	0,031
20	UBA	2,08E-03	6,67E-04	3,11	0,002
21	ESTALLEV	3,36E-02	1,95E-02	1,73	0,084
22	REDDOPER	3,50E-05	7,89E-06	4,44	0,000
23	AGRITUR	6,11E-06	2,51E-06	2,43	0,015
24	PREMIALL	2,25E-05	6,31E-06	3,57	0,000
25	PLTRVIOL	-1,21E-06	4,83E-07	-2,50	0,013
26	MALE	-3,68E-02	6,77E-02	-0,54	0,587
		Efron	McFadden	Ben./Lerman	
		0,23075	0,17653	0,61774	
		Cramer	Veall/Zim.	Rsqrd_ML	
		0,22561	0,33724	0,21532	
			Predicted		
		Actual	0	1	Total
		0	4442	927	5369
		1	1892	2388	4280
	Total	6334	3315	9649	

Table 11 Multinomial logit model estimations: the investment category selection

Number of observations			783
Log likelihood function			-1705.534
R2=1-LogL/LogL*	Log-L fncn	R-sqrd	RsqAdj
No coefficients	-1945.6819	.12343	.12087
Constants only	-1713.7317	.00478	.00189

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
TEMPIR|1	.57069248	.21016906	2.715	.0066
FINPU9|1	3.83271027	2.00658333	1.910	.0561
CARELI|1	-.06686941	.01604709	-4.167	.0000
IMPDOM|1	.542872D-04	.217930D-04	2.491	.0127
CONTDO|1	-.00012485	.518698D-04	-2.407	.0161
INVEST|1	.270425D-05	.145836D-05	1.854	.0637
FIN_PU|1	-.137383D-04	.597676D-05	-2.299	.0215
STA|1	.73999079	.16931462	4.371	.0000
MAC|1	2.12722627	.15594243	13.641	.0000
IMP|1	1.47630883	.26570487	5.556	.0000
ALTR|1	1.26045782	.19566619	6.442	.0000
CONT_I|1	.100230D-04	.283792D-05	3.532	.0004

Table 12 Latent Class Logit Model estimations: the investment category selection

| Number of latent classes = 2 |
| Number of obs.= 792, +--+

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
Utility parameters in latent class -->> 1				
TEMPIR|1	-5.95386584	1.49443320	-3.984	.0001
FINPU9|1	43.7945839	10.5452761	4.153	.0000
CARELI|1	1.12813934	.18904643	5.968	.0000
IMPDOM|1	-.00322588	.00045838	-7.038	.0000
CONTDO|1	.00790024	.00112025	7.052	.0000
INVEST|1	-.00055457	.762044D-04	-7.277	.0000
FIN_PU|1	.00020570	.586013D-04	3.510	.0004
STA|1	30.4571915	4.42096940	6.889	.0000
MAC|1	19.9039316	2.69426078	7.388	.0000
IMP|1	-9.44926695	2.06400827	-4.578	.0000
ALTR|1	27.7523009	3.91832501	7.083	.0000
CONT_I|1	.123094D-04	.132371D-04	.930	.3524
Utility parameters in latent class -->> 2				
TEMPIR|2	9.16248689	.75670860	12.108	.0000
FINPU9|2	45.2250871	6.56191201	6.892	.0000
CARELI|2	-.59260108	.05567453	-10.644	.0000
IMPDOM|2	.00329669	.00018869	17.471	.0000
CONTDO|2	-.00791714	.00045350	-17.458	.0000
INVEST|2	.00029423	.180635D-04	16.289	.0000
FIN_PU|2	-.815792D-05	.207065D-04	-.394	.6936
STA|2	-19.7169725	1.31910568	-14.947	.0000
MAC|2	3.61183413	.42721392	8.454	.0000
IMP|2	22.7322095	1.47660665	15.395	.0000
ALTR|2	-.63493895	.62063384	-1.023	.3063
CONT_I|2	-.485667D-06	.940561D-05	-.052	.9588
Estimated latent class probabilities				
PrbCls_1	.62706840	.01751180	35.808	.0000
PrbCls_2	.37293160	.01751180	21.296	.0000

Table 13 Characteristics farms on latent Class

Multinomial Logit Model	
Number of observations	792
Iterations completed	5
Log likelihood function	-504.7722
Hosmer-Lemeshow chi-squared =	5.58127
P-value= .69402 with deg.fr. =	8

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Characteristics in numerator of Prob[Y = 1]					
Constant	2.55472550	.37357628	6.839	.0000	
SENFPNO	-.45119847	.19938696	-2.263	.0236	.18560606
MALE	-.70487836	.24162313	-2.917	.0035	.84595960
RISUMAZ	-.15299853	.05013446	-3.052	.0023	3.26136364
RATAGRP	-.00531216	.00278723	-1.906	.0567	67.3988636
RATTRAP	-.00991901	.00442330	-2.242	.0249	5.43308081
RAIUTIP	-.01427439	.00478927	-2.980	.0029	7.07714646
RNUCLEOP	-.09770697	.06158046	-1.587	.1126	3.50883838

Table 15 Policy predictions

	10%	FINPU950										
	per tutti				FABBRICA,CAPANNON,stalla,eedifici,altri				solo edifici			
	Discrete	Choice	Latent	Class	Discrete	Choice	Latent	Class	Discrete	Choice	Latent	Class
	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb
Stables	0,47%	4	0,23%	1	**1,10%**	**9**	**0,51%**	**4**	-0,06%	0	-0,03%	-1
Sheds	0,35%	2	0,66%	5	**0,82%**	**6**	**1,49%**	**12**	-0,04%	-1	-0,06%	0
Silos	-0,09%	0	-0,16%	-1	-0,21%	-1	-0,38%	-3	-0,01%	0	-0,05%	0
Other stori	0,27%	3	0,54%	4	**0,63%**	**5**	**1,27%**	**10**	-0,03%	0	-0,09%	-1
Agric. Mac	-0,64%	-5	-0,77%	-6	-1,48%	-12	-1,84%	-14	-0,07%	-1	-0,09%	0
Waste dis	-0,04%	-1	-0,14%	-1	-0,09%	-1	-0,31%	-3	0,00%	0	-0,01%	0
Buildings	0,26%	2	0,40%	3	**0,61%**	**5**	**0,98%**	**8**	-0,03%	0	-0,01%	0
Land purcl	-0,07%	-1	-0,19%	-2	-0,16%	-2	-0,41%	-3	-0,01%	0	-0,01%	0
Land impr	-0,07%	0	-0,14%	-1	-0,16%	-1	-0,33%	-2	-0,01%	0	-0,05%	0
Permanen	-0,16%	-1	-0,17%	-1	-0,36%	-3	-0,39%	-3	-0,02%	0	-0,03%	0
Non-agric	0,07%	1	0,06%	1	**0,16%**	**1**	**0,16%**	**1**	**0,32%**	**3**	**0,46%**	**4**
Others	-0,37%	-3	-0,32%	-3	-0,85%	-7	-0,75%	-6	-0,04%	0	-0,04%	0
Total	0,00%	1	0,00%	-1	0,00%	-1	0,00%	1	0,00%	1	0,00%	2

					carenza liq							
				-20%	FABBRICA,CAPANNON,stalla,eedifici,altridep							
	Discrete	Choice	Latent	Class	Discrete	Choice	Latent	Class	Discrete	Choice	Latent	Class
	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb
Stables	0,61%	5	-0,23%	-2	**4,09%**	**32**	**0,33%**	**2**	-0,28%	-2	0,00%	0
Sheds	-0,60%	-5	-0,21%	-1	**1,78%**	**13**	**0,17%**	**1**	-0,22%	-2	-0,01%	0
Silos	0,26%	2	-0,51%	-4	-0,62%	-5	0,26%	2	-0,05%	0	0,02%	0
Other stori	-0,40%	-3	0,30%	2	**1,43%**	**12**	**-1,08%**	**-8**	-0,16%	-1	0,02%	0
Agric. Mac	-0,15%	-1	-0,70%	-5	-4,48%	-35	-1,22%	-9	-0,38%	-3	0,04%	1
Waste dis	0,45%	3	1,77%	14	-0,27%	-3	-0,29%	-3	-0,02%	-1	0,00%	0
Buildings	-0,04%	0	-0,38%	-3	**1,81%**	**14**	**2,77%**	**22**	-0,15%	-1	-0,02%	0
Land purcl	0,00%	0	-0,21%	-2	-0,48%	-4	-0,58%	-5	-0,04%	-1	-0,01%	0
Land impr	-0,13%	-1	0,45%	4	-0,50%	-3	0,47%	4	-0,04%	0	0,02%	1
Permanen	0,60%	5	-0,31%	-2	-1,10%	-9	-0,09%	0	-0,09%	-1	0,01%	0
Non-agric	0,36%	3	-0,10%	-1	**0,91%**	**7**	**-0,17%**	**-1**	**1,66%**	**13**	**-0,06%**	**0**
Others	-0,96%	-8	0,12%	1	-2,58%	-20	-0,56%	-5	-0,22%	-2	0,01%	0
Total	0,00%	0	0,00%	1	0,00%	-1	0,00%	0	0,00%	-1	0,00%	2

				Combinato carenza liquidita` e finanziamento pubblico 950								
	Discrete	Choice	Latent	Class	Discrete	Choice	Latent	Class	Discrete	Choice	Latent	Class
	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb	ChgShare	ChgNumb
Stables	1,10%	9	-0,03%	-1	**5,17%**	**40**	**0,56%**	**4**	-0,38%	-3	0,00%	0
Sheds	-0,27%	-3	0,50%	4	**2,53%**	**19**	**0,80%**	**6**	-0,29%	-3	-0,02%	0
Silos	0,16%	2	-0,57%	-4	-0,82%	-6	0,24%	2	-0,07%	0	0,01%	0
Other stori	-0,14%	-1	0,96%	8	**2,00%**	**16**	**-0,66%**	**-5**	-0,21%	-1	0,01%	0
Agric. Mac	-0,78%	-6	-1,31%	-10	-5,89%	-46	-2,22%	-17	-0,50%	-4	0,03%	1
Waste dis	0,39%	3	1,31%	10	-0,36%	-3	-0,43%	-4	-0,03%	-1	0,00%	0
Buildings	0,23%	2	0,05%	0	**2,39%**	**19**	**3,22%**	**25**	-0,20%	-2	-0,03%	0
Land purcl	-0,07%	-1	-0,31%	-3	-0,62%	-5	-0,69%	-6	-0,05%	-1	-0,02%	0
Land impr	-0,20%	-1	0,17%	2	-0,65%	-5	0,42%	4	-0,06%	0	0,02%	1
Permanen	0,43%	3	-0,45%	-3	-1,44%	-11	-0,19%	-1	-0,12%	-1	0,01%	0
Non-agric	0,44%	4	-0,07%	0	**1,08%**	**9**	**-0,16%**	**-1**	**2,20%**	**17**	**-0,02%**	**0**
Others	-1,30%	-10	-0,26%	-2	-3,39%	-27	-0,89%	-7	-0,29%	-2	0,01%	0
Total	0,00%	1	0,00%	1	0,00%	0	0,00%	0	0,00%	-1	0,00%	2