The effects of changing regional Agricultural Knowledge and Innovation System on Italian farmers' strategies

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ABSTRACT

The aim of this paper is to identify and assess the role played by innovative extension services in affecting farmers' strategy. More specifically we implement a multivariate probit model to evaluate the effects of different types of extension services introduced by a reform in the domain of Agricultural Knowledge and Innovation System (AKIS) in Italy. The results show that both generalist and specialized services could play a major role in farmers' value creation strategies. They also confirm that different strategies for creating value are jointly implemented. Finally, they show that a further improvement in the quality of public provision of extension services within regional AKIS and a greater (systemic) interaction between farmers, rural actors and local networks should be supported.

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1. Introduction

Over the past decades the Agricultural Knowledge and Innovation System (AKIS) has been mainly organized by public agencies. More recently, several policy interventions have sought to reform AKIS, introducing elements of privatization and decentralization (Rivera, 2008). This has been particularly evident in the European context (Laurent et al., 2006; Labarthe, 2009), where interest in AKIS reform and its impact on farmers' strategies has been rekindled by the debate surrounding EC Regulation 1698/2005 on rural development. Accordingly, each regional AKIS is supposed to stimulate European farmers to achieve more complex and broader objectives, such as more sustainable management of their businesses (Council of the European Union, 2005). Moreover, all member states have to reform their regional AKIS to align them with Europe's overall rural development strategy.

In the literature on AKIS reform the emphasis has recently been laid mainly on the tendency to privatize and/or de-centralize public extension services in different agricultural systems (Qamar, 2005; Knickel et al., 2009; Swanson and Rajalahti, 2010). In contrast, the way farmers re-act to AKIS reform and how this reform impacts their overall strategies still remains puzzling and not completely addressed in this research domain. Indeed some studies analyzed the

impact of AKIS reforms for example on farmers adoption of innovations (Wadsworth, 1994; Leeuwis and Van Den Ban, 2004), agri-environmental outcomes (Morriss et al., 2002), sustainable use of natural resources (Fujisaka, 1994), market performances (Dinar et al., 2007) and risk management (Pennings et al., 2005; Isengildina et al., 2006). Their main results indicate that the potential effect of AKIS reform on farmers decision-making lies in its organization, for example in the way extension services are provided to farmers (Kidd et al., 2000; Morriss et al., 2006). However, only a minority of them analyzed in more details the links between the use of different types of extension services and farmers' strategies (Kidd et al., 2000; Klerkx and Leeuwis, 2008; Knickel et al., 2009).

The objective of this paper is to cover this gap and therefore to better understand the effects of AKIS reform in promoting innovation and impacting on farmers' strategies. Methodologically speaking we decided to evaluate these effects via a case study approach and implementing a discrete choice modeling such as the multivariate probit model. In this way we directly analyzed the effects of an AKIS reform on the strategies made by a selected group of farmers (443) in a region of central Italy (Marche). Despites other papers our approach allowed to control for combination of different strategies and to analyze potential synergies or trade-offs between them.

The paper starts by reviewing the relevant literature on the role of the AKIS in setting farmers' strategies (Section 2). In Section 3 we discuss our conceptual model on AKIS reform. In Section 4 we present the content of the Marche Regional Administration (MRA) reform and evaluate the effects on farmers' decision making

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processes. In Section 5, using data from the case study, we implement a multivariate probit model to represent the farmer's choice. The main results of the model are presented in Section 6 and further discussed in Section 7. In the final section some concluding remarks are provided.

2. Literature review

2.1. Traditional models of organizing AKIS

In a traditional perspective AKIS is considered as a tool for enhancing productivity and competitiveness of the agricultural sector by accelerating the rate of innovation adoption (Holt and Schoorl, 1985). This system has often been defined as the "linear process" of innovation transfer (Godin, 2006; Knickel et al., 2009). The linear model is limited to a mechanism where new products and processes are conceived within the research and/or education systems and transferred to *farmers* and *other rural actors*. In this model, AKIS is mainly organized by public agencies or by other support systems, such as farmers' organizations and input suppliers (Rivera et al., 2005; Knickel et al., 2009).

The linear model is closely linked to the (material) goals given by society to agriculture (Holt and Schoorl, 1985). These goals are mainly related to what have been defined by rural sociologists as the "modernization" paradigm of agriculture[2] (Van der Ploeg et al., 2000, 2002). In this paradigm the role of AKIS is to provide a service to facilitate technological changes (Holt and Schoorl, 1985). This mechanism is based on the idea that, regardless of the socio-economic, institutional, environmental and organizational characteristics of the farming system, a transfer of knowledge would produce a profit-enhancing technological change for farmers (Stephenson, 2003). The cost of this model is completely or largely externalized on society (taxpayers). AKIS is mainly organized as a system of hierarchical organizations, regardless of the specific needs of the single farmers, and mainly responds to power signals (i.e. from policy-makers and/or bureaucrats) rather than price (market) signals. Thus the rate and direction of innovation and technological change in the agricultural sector and in rural areas are hugely conditioned by public-funded hierarchies (bureaucracies) which were lacking in terms of bottom-up feedback (Kidd et al., 2000). Within this model innovations are mainly incremental (what rural sociologists call first-order innovations) rather than radical (second-order innovations) (Brunori et al., 2008).

2.2. From linear to systemic models of innovation transfer

When industrialized societies, such as Western Europe, started to re-conceptualize the role of agriculture, a new paradigm gained consideration. In this paradigm the sustainable use of natural resources, creation of public goods, equity and food quality are considered increasingly as providing value for society (Brunori et al., 2008). Local traditions and cultural values, for example, have started to be a new potential sink of resources for generating value if properly used by farmers. According to this model, AKIS has also become a more complex concept which implies systemic rather than linear relationships between the stakeholders involved

(Knickel et al., 2009; Labarthe, 2009). In this sense farmers have become increasingly sensitive to innovation opportunities not only related to technology changes, but also related to strategy, marketing, organization and management (Labarthe, 2009). Many new actors now have a role within the innovation adoption mechanisms (Labarthe, 2009). In this new paradigm the AKIS centralized model provided by the linear adoption system is substituted by a more de-centralized, privatized and demand-led model (Qamar, 2005; Rivera, 2008).

3. Conceptualizing the effects of AKIS on farmers' strategies

In this new AKIS model the effects that information and knowledge provision have on farmers' strategies have been greatly amplified (Brunori et al., 2008; Knickel et al., 2009). We propose a conceptual framework which takes this mechanism into account by adopting what rural sociologists have termed the "multifunctional model of European agriculture" (Van der Ploeg et al., 2000, 2002). This model is based on the idea that, starting from conventional activities, such as the production of food and fibers, farmers can move towards different paths for creating value, such as diversifying their activities[3] (Van der Ploeg et al., 2002). In this model the role of AKIS is much more complex than in the "traditional" one (Godin, 2006; Knickel et al., 2009). With the adoption of the multifunctional perspective, value creation is not only due to the capacity of improving the production efficiency of standardized foods and fibers, but also aims to extract value from a larger number of activities and transactions. In this model, differentiation rather than specialization is a key element (Brunori et al., 2008). Following this perspective we analyze the most common type of AKIS described in the literature and referred to the European context. In this way we try to formulate hypotheses on the influence they have on farmers' strategies (Table 1).

We classify different types of extension services first according to the content and/or type of activities they should promote (*content-wise dimension*). Then we consider the level of decision making they mainly work at (*decision-making dimension*). Finally, we indicate the type of participation they require from the involved stakeholders, namely whether they are based on single-farm participation, group or collective action, or mixed (*participatory-dimension*).

Content-wise, we distinguish between three types of services pointed out in the literature with different names but that we can generally define as (i) *assistance and consultancy services* (ACS), (ii) *dissemination, information and animation services* (DIAS) and (iii) *specialized services* (SAS) (Rivera, 2008; Swanson and Rajalahti, 2010). ACS play a major role in different steps of the value creation mechanism by mainly affecting the farmer's decision-making process at the level of strategy adoption and development. A typical ACS is a service oriented towards (a) process innovation (e.g. quality management, collective and/or private labeling, technological innovation transfer, sustainable practices management, animal welfare management), (b) supply planning and management (marketing, food chain networking, non-farm activities networking, legal assistance), (c) multifunctional activities

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[2] The paradigm of modernization has been defined also as the "productivistic" model since it has two types of goals: (a) from a society perspective agriculture provides foods and fibers according to a set of public standards based on the reduction of negative externalities, trade-distorting support and the increasing of food security and safety commitments; (b) from a private point of view (e.g. farmers) the goals are mainly related to the (continuous) increase in productivity and efficiency of factors (namely land, labor and capital) used in the production process, subject to two types of constraints namely compliance with public standards and the fulfillment of customer requirements. For a further discussion the reader can also refer to Brunori et al. (2008) or Knickel et al. (2009).

[3] Van der Ploeg et al. (2002) identified three main "directions" in defining farmers' strategies: (i) they refer to *deepening* strategies when agricultural activities are transformed, expanded or re-linked to other actors and agencies in order to deliver products entailing more value added per unit (Van der Ploeg et al., 2002 , p. 12). Organic farming, high-quality and regional products, and short-supply chains are typical examples. (ii) When the "rural side of farm enterprise might be reorganized and amplified" they talk about a process of *broadening*. Examples are agri-tourism, new on-farm activities, diversification, and nature and landscape management. (iii) Finally a process of "mobilization of resources" defines a strategy of *re-grounding* of farmers' activities, such as seeking off-farm income and introducing low input agriculture.

Table 1
Description of the main types of ES services active in the European context.

Contents and activities of extension services[a]	Decision making level[a]	Participation[a]	Potential effects on farmers strategies[b]	
Assistance and consultancy services (ACS)				
Process innovation (quality management, collective and or private labeling, technological innovation transfer, sustainable practices management, animal welfare management)	Mid and long term actions	Mainly single farm based	Increase the capacity of value creation from food productions	Deepening
Supply planning and management (marketing, food chain networking, non-farm activities networking, legal assistantship)	Long and mid term actions	Mainly single farm based	Increase profitability of farming activities (animal and crop productions) and compatibility with environmental cross-compliance rules	Deepening and broadening
Re-orientation towards multifunctional activities and multiple tasks	Long term actions	Mainly single farm based	Enlarging farmers interests and capacities to non-agricultural based activities	Broadening
Management of public support schemes (rural development measures, national/regional supports, etc.)	Mid and long term actions	Mixed	Enhancing financial capacities of the business, introducing non-agricultural activities and promote local linkages between farmers and rural communities	Deepening and broadening
Dissemination, information and animation services (DIAS)				
Information and knowledge dissemination (best-practices, field examples, courses)	Short, mid and long term actions	Mainly collective	Increase the capacity of farmers to replicate best practices, share information and knowledge, build-up informal ties and networks	Heterogeneous
Rural animation (meetings, exhibitions, happenings, farmers–nonfarmers associations)	Short, mid and long term actions	Mainly collective	Enhancing the relationship between farmers and non-farmers, rural community interactions, urban–rural relations (i.e. via touristic activities)	Heterogeneous
Specialized services (SAS)				
Veterinary services (animal breeding improvement, genealogy)	Short term actions	Mainly single farm based	Contribute to enhance ongoing agricultural oriented activities	Traditional
Agro-meteorology and crop-management (genetic improvement, pest-management)				
Accountancy (business management)				

[a] *Source*: our elaboration based on Laurent et al. (2006), Rivera (2008) and Labarthe (2009).
[b] *Source*: our hypotheses based on Van der Ploeg et al. (2002).

and multiple tasking and (d) increasing the management of public support opportunities (e.g. rural development measures, national/regional supports). In our perspective ACS refer to a type of extension service which is mainly provided to each farm singularly, and focuses on specific user needs and goals (problem-solving and on demand). Therefore our hypothesis is that *ACS mainly influence the adoption of a larger set of activities within the farm* (*i.e.* deepening or broadening strategies), *while they are less likely to influence re-grounding and traditional activities* (H1).

By contrast, DIAS describe a second type of service mainly organized as collective action, providing general information, aiming to coordinate farmers in their activities without specific focus on each user's features. This type of extension service corresponds to the more traditional state-run ones. Examples comprise information and knowledge dissemination (i.e. best-practice sharing, field examples, courses, etc.) and rural animation (i.e. meetings, exhibitions, happenings, farmers' and non-farmers' associations). DIAS are usually seen to impact certain farmers' activities and attitudes. For example, they increase their capacity to replicate best practices, share information and knowledge, and build-up informal ties and networks. They may also enhance the relationship between farmers and non-farmers, promoting rural community interactions and urban–rural relations (i.e. via tourist activities). We consider such extension services to have the capacity to affect overall farmers' strategies not only by changing their attitudes and preferences (and perceptions), but also by providing more general information in the decision-making process. In this sense our hypothesis is that *DIAS can affect all the different types of strategy because of their heterogeneous and horizontal nature; they provide an opportunity for the farm to further specialize or broaden the portfolio of farmers' interests* (H2).

Finally, the third service type that we termed *specialized services* (SAS) is considered highly related to the specific fields of knowledge

transfer and/or technology adoption with special focus on limited and specialized competencies that are mainly agriculture-oriented. Typical SAS are (i) veterinary services (i.e. livestock breeding, genealogy), (ii) agro-meteorology and crop management (i.e. genetic improvement, pest management) and (iii) accountancy (business management). Like ACS, this type of ES is mainly single-farm based and is *more likely to affect and strengthen traditional* (*agriculture-based*) *activities* (H3).

A second block of research hypotheses relates to the other components of what we defined as an innovative AKIS, namely (i) the presence of systemic interactions (i.e. the presence of multiple and continuous sources of information and knowledge) and (ii) private rather than public providers. In this perspective our hypotheses are that *public providers of ES are more likely to influence traditional strategies of value creation* (H4) while *the presence of multiple and continuous interactions at the sector and/or Community level would positively affect the attitude of farmers to explore other than traditional strategies for value creation* (H5).

4. The case study

4.1. Re-organization of AKIS in the Marche region (Italy)

We have the opportunity to empirically test the conceptual model (and relative research hypotheses) in a regional case study analysis in central Italy (Marche). In 1999 the Marche Regional Administration (MRA) introduced a far-reaching institutional change in the field of AKIS by approving Regional Law 37/99 (Marche Regional Administration, 1999). After four years the reform was finally transposed and implemented with the introduction of the Operative Program for the period 2003–2005 (Marche Regional Administration, 2003). The main changes concerned the intention to align AKIS with the regional strategy on rural

development. The reform also re-defined the general aims of AKIS and the relative lines of intervention. The MRA approach to the reform took account of the presence of a systemic rather than linear mechanism of innovation adoption. Therefore a strategic pillar of the reform was to change the decision-making mechanism for regulating the organization of AKIS. Extension services within the reformed system were locally re-organized (i.e. at province level) with respect to two main lines of intervention: (1) de-centralizing specialized services such as ACS and SAS and (2) improving generalist services such as DIAS. The role of local farmers' associations was thus consolidated to obtain a more bottom-up approach; for example, farmers' associations could deliver a larger number of ES types and integrate the activities of public servants. Professionals and private organizations (e.g. agronomists and consultancy agencies) could play an enhanced role in providing ES to farmers.

The information and education system were placed outside the AKIS system and fully funded by the Rural Development and Regional Development Programs. The reform was completed and supported by the introduction of a three-year Financial Program. According to our distinction of the ES types, ACS were funded with a yearly support of 1.485 million euro, while the DIAS received about 1.7 million euro per year and the SAS 0.515 million. Total regional public expenditure was set at 11.1 million euro for the period 2003–2005 (Marche Regional Administration, 2003).

4.2. Data from the field survey

In 2006 the MRA assigned to a consortium of consultancy agencies[4] the assessment of the first (short-run) outcomes of the reform. The assessment procedure was organized in order to analyze the farmers' perception of the reform by using a field survey with a sample of beneficiaries and focus groups to discuss and interpret the results. The field survey was carried out via a telephone interview to collect data from a selected sample of beneficiaries of the new AKIS. The interviewees were selected from the list of beneficiaries of 2004 as provided directly by the MRA. More specifically, the interviews involved the beneficiaries of the service in 2004 (the second year of the reform's implementation), because 2003 was considered by the MRA as a start-up period with a huge transitional bias. The sample was stratified in order to respect representativeness criteria among beneficiaries such as size, farm specialization and location (province). A semi-structured questionnaire was submitted to a restricted sample of beneficiaries for pre-testing and it passed two major rounds of revisions by the task-force of experts enrolled by the consortium and the MRA. One of the two authors was direct enrolled as an expert in the evaluation process. He also acted as moderator in all of the focus groups and expert interviews the consortium and MRA carried out. The questionnaire was organized to detect the main factors related to farm and farmer characteristics considered relevant to the decision to adopt different strategies for creating value and to detect the specific role of AKIS and extension services. According to the related literature, we took into consideration farm(er) characteristics (Godin, 2006; Knickel et al., 2009; Labarthe, 2009), specific service characteristics (Pennings et al., 2005; Isengildina et al., 2006), and location features (Brunori et al., 2008) to set the final version of the questionnaire. A team of interviewers were used to perform the telephone interviews. In 2004, 5867 farmers benefited from ES, using 10,022 services. In all, 443 interviews were conducted successfully (85% response rate), covering 7.5% of the universe of total ES users. In this type of survey design the non-response rate is assumed as physiological (Curtin et al., 2005). Non-respondents were mainly farmers who stated they were not available for this type of interview because they had been recently interviewed for other research or statistical purposes. The standard procedure was to have a first call to the potential interviewee to

explain to him/her the purpose of the survey and to arrange an appointment for a second interview to fill in the questionnaire. When necessary, a copy of the questionnaire was sent by fax or e-mail and extra calls were made as well to explain its content and the meaning of the key questions. In this paper we use the data from the field survey and the information reported by the consortium in the assessment report.[5] The main sample characteristics as regards farmers in the regional contexts are presented in Table 2.

The sample of beneficiaries shows a relatively high presence of farms specialized in livestock breeding with respect to the regional context and less mixed farming. Also farm size and farmers' level of education is slightly higher than the regional context. The average farm size in terms of utilized agricultural land is about 41 hectares while in terms of labor units it is 2.38 AWU, compared with the regional average size of 8 ha (ISTAT, 2000) and 0.54 AWU (INEA, 2003). The average number of animals per farm is about two livestock units (LU) which is well below the regional average (20.08 LU) (INEA, 2003). The presence of other gainful activities, a variable that includes all sources of income other than agriculture) is also similar.

A second set of variables refers more to ES characteristics, the way they were provided and/or organized, and the other sources of information and knowledge used by farmers. In terms of service use, 72% of the farmers in the sample used ACS, about 53% DIAS and 19% specialized services SAS.[6] About 73.6% of the ES used by the farmers were provided by public organizations (directly funded and/or organized by the MRA). Local networks were used by 64% of the farmers as a source of information and technology transfer, 48.1% participated in periodical (at least one per month) meetings with other rural actors and experts, 49.2% consulted specialized newspapers and periodicals, while 42% of the interviewees formally belonged to a network or association providing them with relevant information.

Table 3 shows in greater detail the main effects we detected in the sample using the four categories of value creation strategies we identified in the conceptual model. About 58% of the farmers experienced effects which could be classified as what we defined as traditional value creation activities. Another 48% experienced effects more related to broadening, such as the introduction of multifunctional and non-agricultural activities (agriturismo, camping, social activities, etc.), low-impact and animal-friendly techniques and practices (environmental services). About 50% of the farmers introduced so-called deepening activities, such as enhancing product and/or process quality, but also connected to agro-food supply chain management. Finally, 31% of the interviewees revealed effects related to re-grounding.

5. Empirical model

The empirical model was built to analyze the probability of farmers using different types of ES to experience different value creation strategies. Table 4 presents the activities we considered and the linkages with the strategies as indicated by the "multifunctional model approach" (Van der Ploeg et al., 2002) More specifically, we refer to traditional activities if farmers showed any effects related to agricultural productivity-enhancing issues, to broadening, if farmers introduced and/or boosted non-agricultural value creation activities (agriturismo, nature and landscape management, etc.); deepening, if value creation was linked to enhancing the quality of production (local labeling, organic farm-

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[4] The A.T.I. Resco – Ecoter – Unicab.

[5] For a copy of the assessment report, refer to the MRA or the authors.
[6] As pointed out by one referee it is also interesting to look at the joint use of different types of extension services among the beneficiaries: about 31% used only ACS, 14% only DIAS and 2% only SAS. Joint usage of ACS and DIAS was found in 33% of the sample, DIAS and SAS in 5%, ACS and SAS in 8% while about 7% of the beneficiaries interviewed used all three.

Table 2
Description of the main features of the sample.

Variable	Sample		Marche (regional context)	
	N.	%	N.	%
Location: province[a,b]				
Ancona (AN)	131	29.6	15,354	23.07
Ascoli Piceno (AP)	97	21.9	20,452	30.73
Macerata (MC)	114	25.7	15,439	23.19
Pesaro Urbino (PU)	101	22.8	15,318	23.01
Total	443	100	66,563	100
Location: type of area[a,b]				
Mountain area	137	30.9	18,569	27.9
Less favorite area	70	15.8	10,867	16.32
Normal area	236	53.3	37,127	55.78
Total	443	100	66,563	100
Farmer education[a,b]				
No education (<5 years)	15	3.5	5207	8.1
Primary school (5 years)	183	42.7	34,136	53.3
Secondary school (8 years)	134	31.2	11,856	18.5
High school (13 years)	76	17.7	10,326	16.1
Graduate (master equivalent) (18 years)	14	3.3	2575	4
Other professional education (11–12 years)	7	1.6	0	0
Total	429	1000	64,100	100%
Size distribution (UAA)[a,b]				
<1 ha	2	0.5	16,916	25.9
1–2 ha	8	1.8	10,753	16.5
2–5 ha	50	11.3	16,848	25.8
5–10 ha	98	22.2	9897	15.2
10–20 ha	97	22	5919	9.1
20–50 ha	125	28.3	3452	5.3
50–100 ha	38	8.6	934	1.4
>100 ha	23	5.2	474	0.7
Total	441	100	65,193	100
Size distribution (AWU)[a,c]				
1 UL	158	35.9	418	52.8
1–3 UL	219	49.8	336	42.5
>3 UL	63	14.3	37	4.7
Total	440	100	791	100
Agricultural specialization[a,c]				
Arable crop	234	53.4	427	54
Horticulture	10	2.3	6	0.8
Vineyard	23	5.3	28	3.5
Olives tree cultivation	4	0.9	18	2.3
Other permanent crops	1	0.2	6	0.8
Cattle breeding	157	35.8	31	4.0
Other breeding activities	0	0.0	66	8.3
Mix	9	2.1	209	26.4
Total	438	100	791	100
Nonagricultural activities[a,d]				
Farmers with non-agricultural activities (i.e. agro-tourism, on farm processing, etc.)	120	27.1	14.507	26.1

Source:
[a] Field survey 2004.
[b] ISTAT, Census Data 2000.
[c] INEA, 2003.
[d] ISTAT, 2003.

ing, etc.) and/or if food processing was introduced; *re-grounding*, if off-farm activities were pursued[7] (Van der Ploeg et al., 2002).

[7] In accordance with the original approach of Van der Ploeg and colleagues (2002) we did not consider activities related to farming economically as re-grounding strategies. As indicated by the authors, farming economically refers to "low external input" agriculture to describe the process of adopting techniques and practices that increase the usage of internal resources such as manure, savings and grassland (Pretty 1998; Van der Ploeg, 2000). The information collected did not allow us to investigate this issue. For example, although we detected the information related to the contribution of extension services to reduce production costs, we did not consider it as belonging to a re-grounding strategy because it entailed no change in the type of technology used by farmers. While this lack of information might be seen as a limitation of our analysis we can still consider pluri-activity (namely off-farm labor) as a satisfying item to describe re-grounding strategies, as also pointed out in the approach by Van der Ploeg and colleagues (2002).

At the farm level, decisions on the adoption of different strategies are often not unidirectional and can affect simultaneously more than one activity (Oude Lansink et al., 2003). For instance, farmers who decide to enhance the quality of their production (e.g. techniques and procedures for producing and selling local labeled cheese) could also be interested in enhancing productivity (e.g. milk yields). This also shows that many farmers are in a situation where they have to decide between using different types of extension services according to their strategies. The capacity of the chosen services to contribute to this strategy would also depend on the other driving factors involved. Furthermore, the effects of extension services in different strategies may be inter-related. The multivariate probit model is the natural solution to test this inter-relation (Lesaffre and Kaufmann, 1992). It takes the form for strategy *i*:

$$Y_i^* = \beta_i' X_i + \varepsilon_i \quad \text{with } i = 1, \ldots, 4 \qquad (1)$$

In Eq. (1), Y_i^* is a variable reflecting the utility (profit) difference due to the decision of a farmer to adopt a change that requires a strategy, with *i* denoting the type of strategy ($i = 1, \ldots, 4$). It is assumed that a farmer experiences a particular strategy ($Y = 1$) if $Y_i^* > 0$, and s/he does not ($Y = 0$) if $Y_i^* \leqslant 0$. β_i is the set of parameters that reflect the impact of changes in the vector of explanatory variables X_i on the farmer's attitude towards strategy *i*. ε_i denotes random errors of the $i = 1, \ldots, 4$ equations that have a multivariate normal distribution (Oude Lansink et al., 2003).

The multivariate probit model estimates parameters β_i and the variance covariance matrix of the multivariate normal distribution of the error terms (Greene, 1995). Use of such an econometric model to investigate decisions of farmers between potentially joint alternatives is a consolidated technique within the agricultural and rural economic literature in the field of risk management (Velandia et al., 2009), in/off farm labor allocation (Kimhi, 1996), market strategies (Lowell Hill and Kau, 1973; Fletcher and Terza, 1986; Velandia et al., 2009), and investment and planning decisions[8] (Oude Lansink et al., 2003).

6. Results

The multivariate probit model is estimated using the Nlogit Program. Table 5 presents the estimated parameters, their *t*-values and the correlation coefficient between the four equations. Our results show that in the equations on traditional, broadening, deepening and re-grounding, respectively 4, 9, 8 and 7 of the 14 parameters are significant at the 10% critical level. The goodness of fit of the multivariate probit model is assessed using McFadden's R^2 for the system of equations. McFadden's R^2 in the range of 0.2–0.4 is typical for logit models (Oude Lansink et al., 2003). In our case a value of 0.22 is found.

The use of extension services (ACS, DIAS, SAS) is found positively significant to explain the likelihood of farmers choosing all the value creation strategies we consider. However, very specialized services (SAS) show significant correlations only for broadening and deepening strategies.

The group of variables related to farm and farmers' features control for the role of personal and business characteristics on the probability of adopting certain strategies instead of others. What we find is that larger farms with many employees (n_lab) show less probability of pursuing a deepening strategy, and specialized livestock farmers (an_breed) are less likely to implement broadening strategies. By contrast, farmers specialized in vines

[8] Multivariate probit is used to model the presence of endogeneity among dependent variables which describes multiple discrete choices problems. In this case it is used to test whether or not different types of extension services affect, *ceteris paribus*, different farmers' strategies in a model framework where the endogeneity of the different choices on strategies is explicitly taken into account.

Table 3
Description of the variables used in the empirical models.

	Variable name	Description	Unit of measure	Mean	S.D.
Type of effects (Y)					
Y_1	Trad	1 if Farmer experiences effects in terms of traditional strategy	*Dummy*	Yes = 58%	–
Y_2	Broad	1 if Farmer experiences effects in terms of broadening strategy	*Dummy*	Yes = 48%	–
Y_3	Deep	1 if Farmer experiences effects in terms of deepening strategy	*Dummy*	Yes = 50%	–
Y_4	Regr	1 if Farmer experiences effects in terms of re-grounding strategy	*Dummy*	Yes = 31%	–
Type of ES used					
X_1	ACS_use	Use of Assistance and Consultancy Services	*Dummy*	Yes = 72.0%	–
X_2	DIAS_use	Use of Diffusion, Information and Animation Services	*Dummy*	Yes = 52.8%	–
X_3	SAS_use	Use of Specialized Assistance Services	*Dummy*	Yes = 18.7%	–
Farmer features					
X_4	age	Farmer age	*Year*	53.78	13.52
X_2	educ_1	Primary school education	*Dummy*	Yes = 46.2%	–
X_3	educ_2	Lower secondary school education and professional diploma	*Dummy*	Yes = 32.8%	–
X_4	educ_3	Secondary school education	*Dummy*	Yes = 17.7%	–
X_5	educ_4	Graduate (master equivalent) education	*Dummy*	Yes = 3.3%	–
Farm features					
X_6	UAA	Utilized Agricultural Area	*Ha*	40.70	47.39
X_7	N_lab	Total employees	*Number*	2.38	2.71
X_8	UAA_vine	UAA devoted to vineyards	*Ha*	1.28	4.97
X_9	An_breed	Number of adult bovine (importance of livestock)	*Adult Bovine Units (ABU)*	2.07	11.63
X_{10}	RDP_ben	1 if "Farmer participates in at least one regional rural development measure"	*Dummy*	Yes = 39.1%	–
Service features and other sources of information and knowledge					
X_{11}	Pub_AES	1 if the service was provided by public agencies or authorities	*Dummy*	Yes = 73.6%	–
X_{12}	Info_net	1 if "Farmer uses local (rural) networks providing information and knowledge"	*Dummy*	Yes = 64.3%	–
X_{13}	Info_meet	1 if "Farmer participates in periodic meetings with other rural actors for sharing information"	*Dummy*	Yes = 48.1%	–
X_{14}	Info_doc	1 if "Farmer receives information through specialized newspapers and periodicals"	*Dummy*	Yes = 49.2%	–
X_{15}	Assoc	1 if "Farmer belongs to a local (rural) network providing information and knowledge"	*Dummy*	Yes = 42.0%	–
Location					
X_{16}	LFA	1 if "Location is in a Less Favorite Area"	*Dummy*	Yes = 30.9%	–
X_{17}	Mount	1 if "Location is in a mountain area"	*Dummy*	Yes = 15.8%	–
X_{18}	prov_AP	1 if "Location is in Ascoli Piceno province"	*Dummy*	Yes = 29.6%	–
X_{19}	prov_AN	1 if "Location is in Ancona province"	*Dummy*	Yes = 21.9%	–
X_{18}	prov_MC	1 if "Location is in Macerata province"	*Dummy*	Yes = 25.7%	–
X_{19}	prov_PU	1 if "Location is in Pesaro Urbino province"	*Dummy*	Yes = 22.8%	–

Source: our elaboration on field survey data.

Table 4
Effects experienced by farmers in their value creation strategies.

Type of strategy involved		Specific effects experienced by farmers
Y_1	Traditional	Production costs reduced
		Efficiency increased
		Farm investments increased
Y_2	Broadening	Introduction of multifunctional activities
		Introduction of low-impact techniques and animal welfare requirements
		Lower average farm employee's age (due to new on-farm activities)
		Farmer and/or employees' rural settlement stimulated (due to new on-farm activities)
Y_3	Deepening	Introduction of process and/or product certification and traceability
		Quality of production increased
		Farm joined a collective labeling scheme
		Production was re-organized on the basis of buyers' demands
		The capacity of farm to re-organize the supply of agricultural products increased
		Contracts signed with other actors in the food chains
		Marketing strategies introduced
		Product and/or process innovation introduced
Y_4	Re-grounding	Farmers and their workers more informed about off-farm activities
		Farmers and their workers increased their skills in off-farm activities
		Organizational innovation was introduced facilitating off-farm employment

Source: field survey.

(*UAA_vine*) are more inclined to adopt deepening and broadening strategies. Farmers who are beneficiaries of rural development measures (*RDP_ben*) are more likely to implement traditional strategies while those using ES provided by public agencies (*pub_ES*) are less likely to choose broadening and deepening strategies.

Local networks and alternative sources of information and knowledge show that only a farmer's membership of a professional association (*Assoc*) works to increase the likelihood of choosing off-farm activities while farmers participating in periodical meetings with local actors (*Info_meet*) are less likely to

Table 5
Estimates of the multivariate probit model.

Coefficients	Traditional (Y_1 = Trad) Estimates	t-Ratio	Broadening (Y_2 = Broad) Estimates	t-Ratio	Deepening (Y_3 = Deep) Estimates	t-Ratio	Re-grounding (Y_4 = Regr) Estimates	t-Ratio
Intercept	−1.491	0.334[***]	−1.885	0.339[***]	−1.218	0.323[***]	−2.467	0.431[***]
Type of ES used								
ACS_use	0.917	0.179[***]	1.511	0.1826[***]	1.029	0.174[***]	0.82	0.199[***]
DIAS_use	0.757	0.157[***]	0.984	0.1607[***]	0.828	0.149[***]	1.435	0.214[***]
SAS_use			0.408	0.1875[**]	0.493	0.167[***]		
Farm features								
N_lab					−0.07	0.03[**]		
UAA_veny			0.073	0.041[*]	0.064	0.028[**]		
An_breed			−0.016	0.008[*]			0.012	0.006[*]
RDP_ben	0.982	0.159[***]						
Service features and other sources of information and knowledge								
Pub_AES			−0.411	0.174[**]	−0.84	0.162[***]		
Info_meet			−0.498	0.207[**]			−0.605	0.227[***]
Assoc							0.55	0.265[**]
Location								
LFA							−0.517	0.255[**]
prov_AP			0.406	0.202[**]				
prov_AN					−0.543	0.23[**]		
N = 443			McFadden R^2 = 0.22					
μ_{12}	0.296	0.080[***]						
μ_{13}	0.746	0.053[***]	Likelihood ratio test of					
			$\mu_{12} = \mu_{13} = \mu_{14} = \mu_{23} = \mu_{24} = \mu_{34} = 0$:					
μ_{14}	0.663	0.065[***]	chi2(6) = 279.874, Prob > chi2 = 0.0000					
μ_{23}	0.525	0.645[***]						
μ_{24}	0.718	0.079[***]						
μ_{34}	0.842	0.038[***]						

Source: our elaboration on field survey data.
[*] Statistical significance at the 10% significance levels.
[**] Statistical significance at the 5% significance levels.
[***] Statistical significance at the 1% significance levels.

choose broadening and re-grounding strategies. The former indicates the capacity of membership of formal professional networks to increase opportunities also outside the agricultural sector (i.e. part-time job opportunities) while the latter is a clear signal of the traditional focus of this type of meeting in which farmers are accustomed to participating. Local meetings mainly center on agricultural issues more than on rural issues, such as discussing the Common Agricultural Policy problems and its implementation at local level, spreading information about new regulations or standards, to support farmers with administrative and bureaucratic difficulties and raise farmers' awareness of production trends.

The last set of variables controls for the relevance of location to explain the likelihood of farmers choosing strategies. Location in Less Favorite Areas (*LFA*) decreases the probability of farmers choosing an off-farm strategy (*re-grounding*), while being in a mainly rural context (*prov_AP*) increases the likelihood of broadening value creation activities. By contrast, a farmer in a more urban context (*prov_AN*) is less likely to look for deepening strategies.

The last information provided by the empirical model is the correlation between the different strategies. The results clearly explain a positive correlation between all of them. In other words, it proves the presence of strong complementarities between the different value creation strategies but also a low capacity of farmers to pursue a specific one (to be selective).

7. Discussion

We base our research hypotheses on two lines of reasoning: on the one hand we evaluate the effects of a reformed AKIS by consid-

ering the contents and type of participation related to different types of extension services as key variables to explain the likelihood of farmers' decision-making (H1, H2 and H3). On the other, we include variables related to the overall process of acquisition of information and knowledge to evaluate the role of interactions and public/private providers of extension services (H4 and H5). We also control for key variables relevant to the farmers' decision-making process such as farm size, specialization, location and farmers' attitudes and features.

The first set of hypotheses predicts a higher involvement of ACS in stimulating adoption of broadening and deepening strategies while DIAS are considered as more "transversal" with a non-unidirectional impact and SAS as highly linked to traditional agricultural-based strategies.

The results indicate that these research hypotheses are substantially not confirmed: they show the (positive) impact of using ACS and DIAS in all the different strategies of value creation. Specialized services (SAS) are important only in the effects related to broadening and deepening strategies. Hence, while the general hypothesis that, *ceteris paribus*, different types of extension services have a prominent role in stimulating farmers' diversification is supported by empirical evidence, the specificity and direction of their effects are not. Basically, because ACS are more complex and based on farm and/or farmer specificities while DIAS are a very general type of service we would expect a more differentiated impact of the two.

This result is in line with what Laurent and colleagues (2006) found in comparing other AKIS reforms in similar European Union regions. When the regional agricultural system is very heterogeneous, such as in Spain and Greece, then AKIS is afflicted by the tension between "multifunctional" and specialized agriculture (Laurent et al., 2006). This type of tension is recognized also in

contexts outside the European Union (see for example Qamar, 2005; Rivera, 2008; Swanson and Rajalahti, 2010).

The second group of hypotheses concerns the role of participation and the characteristics of the sources of information around the farm (H4 and H5). We test them by using a certain number of related variables on the public/private nature of the extension services provider and the types of sources of information used by farmers (Brunori et al., 2008; Knickel et al., 2009). The empirical results show no impact of public providers on decisions in traditional directions. On the contrary, the likelihood of farmers choosing deepening and broadening strategies decreases when extension services are provided by public agencies. While this confirms shortcomings in the capacity of public interventions to stimulate innovative value creation paths, it also indicates the inadequacy of public extension services to support non-agricultural activities at the farm level. This can also be reconnected to the incapacity of AKIS reform to really address more multifunctional types of farmers' strategies (Laurent et al., 2006). In addition, also multiple and continuous interactions with other rural and professional actors fail to influence or complement the search for alternative strategies of value creation other than traditional ones. Only membership of professional associations and networks appears to increase the inclination of farmers to re-ground their activities.

The presence of different tendencies and tensions within the MRA reform is also confirmed by the results of a more qualitative analysis conducted during the assessment process by implementing focus groups with farmers and service providers. The focus group results show that on the one hand farmers would prefer more specialized and targeted extension services (SAS) in the AKIS reform (demand-led). Such services should concern the transfer of new procedures and/or routines among farmers (productivistic orientation). The participants clearly show a preference for more continuous extension services (more similar to tutoring than advising farmers), with an overall perspective on farm strategies. They also claim less influence of farmers' associations on the way AKIS is organized (de-centralization and demand-led services). They indicate the necessity for a more integrated and "problem-solving" approach with an AKIS more open-to-competition to increase the quality and competencies of service providers (privatization).

On the other hand, the participants indicate that the reform objective to enhance a multifunctional use of local resources has substantially failed because it requires much more time to achieve. Farmers consider multifunctionality a long term strategy that has to be addressed via specialized services and not untargeted ones. The re-organization of a farm from a traditional value creation strategy (mainly based on agricultural products) to a multifunctional one and the capacity to manage contractual relationships with other actors in the food chains require complex skills and a longer time horizon. The participants underline the difficulties of new service providers, such as farmer associations and cooperatives, in organizing specialized services more targeted to the specific needs and characteristics of the final users.

Finally, we think it is also worth reflecting on the role shown by the control variables. The first refers to the role of RD measures. This could be considered a direct effect of the type of RD measures of which farmers are beneficiaries. RD measures are mainly oriented toward measures for supporting farm investments and old/young farmer turnover (57.2% of the sample). The other types of measures are related to financial support for farmers located in less favored areas (16.2%) and agro-environmental schemes (26.6%). As a consequence, about 3/4 of the sample is involved in financial support measures which are not stimulating any shift from traditional activities but actually reinforce them. We would expect a higher contribution of rural development measures in both broadening and deepening strategies. Within the group of variables related to farm features, only specialization in grape production has a

positive impact in the likelihood of farmers of looking at non-traditional strategies such as deepening and broadening. These results are hardly surprising since the production of grapes in Italy as a whole and Marche in particular is often associated with on-farm processing (wine production) and attention and gearing to high-quality production. Large farms and livestock farmers are less likely to diversify their sources of value creation with non-agricultural activities but more likely to look for specialization and cost-reduction and/or productivity-enhancing strategies. Location in a more rural area seems to stimulate the search for broadening activities while a more urban context reduces the capacity of farmers to look at strategies in which quality and processing is a key element.

8. Conclusions and policy implications

The empirical results and theoretical discussion of this paper make a substantial contribution to the debate on the introduction of the rural development measures for supporting farmers in their use of advisory and extension services (Council of the European Union, 2005). In terms of policy implications, the results chiefly show that, to enhance the effectiveness of AKIS in stimulating farmers to improve their businesses and adopt non-traditional strategies, more attention to local dynamics and rural interaction is required. It also emerges that more than one policy strategy could be implemented at regional level. More traditional-sounding services, such as rural animation, information and knowledge dissemination, could also help farmers introduce novelties, restructure their businesses and explore new opportunities in their areas and the food production chains concerned. Such services could remain the chief public domain for service provision, conditional upon the capacity of public agencies to enhance the quality of their services and their overall competencies which currently appear to adversely affect the farmer's probability of seeking new forms of value creation.

In addition, the potential role of more interactive and systemic services has to be addressed in a different way, for example by considering not only the synergic but also the contrasting dynamics that rural and professional-based interactions could have. This is particular relevant in rural and professional communities lacking in trust and reciprocity between the different players and where cooperation and coordination are still weak elements (as in many southern European contexts). In this case more hierarchical organized services could help innovative AKIS in the start-up period while more flexible and self-organized types of extension services can be introduced in a second phase, perhaps when trust and norms of reciprocity have been accepted and strengthened by all the various players in the system. Our results in terms of both quantity and quality indicate that AKIS reform does not impact farmers' strategies in favor of more multifunctional activities but only serves to reinforce on-going trends.

References

Brunori, G., Rand, S., Proost, J., 2008. Towards a Conceptual Framework for Agricultural and Rural Innovation Policies. IN-SIGHT-Project. <http://www.insightproject.net/files/Rapportinsight_WP1_final.pdf>.

Council of the European Union, 2005. Council Regulation (EC) No. 1698/2005 of 20th September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD).

Curtin, R., Presser, S., Singer, E., 2005. Changes in telephone survey nonresponse over the past quarter century. Public Opin. Quarterly 69 (1), 87–98.

Dinar, A., Karagiannis, G., Tzouvelekas, V., 2007. Evaluating the impact of agricultural extension on farms' performance in Crete: a non-neutral stochastic frontier approach. Agric. Econ. 36, 135–146.

Fletcher, S.M., Terza, J.V., 1986. Analyzing farmers selection of available marketing alternatives using the multivariate probit model. Can. J. Agric. Econ. 34 (2), 243–252.

Fujisaka, S., 1994. Learning from six reasons why farmers do not adopt innovations intended to improve sustainability of upland agriculture. Agric. Syst. 46, 409–425.

Godin, B., 2006. The linear model of innovation: the historical construction of an analytical framework. Sci. Technol. Hum. Values 31 (6), 639–667.

Greene, W.H., 1995. Limdep Version 7.0 User's Manual. Econometric Software. Bellpart, New York.

Holt, J.E., Schoorl, D., 1985. The role of innovation, servicing and obsolescence in agricultural extension. Agric. Syst. 18, 239–250.

INEA, 2003. Banca Dati RICA. INEA, Rome.

Isengildina, O., Pennings, J.M.E., Irwin, S.H., Good, D.L., 2006. US crop farmers' use of market advisory services. J. Int. Food Agrib. Mark. 18 (3/4), 67–86.

ISTAT, 2000. Censimento Generale dell'Agricoltura. ISTAT, Rome.

ISTAT, 2003. Indagine sulla struttura e le produzioni delle aziende agricole (SPA). ISTAT, Rome.

Kidd, A., Lamers, J., Ficarelli, P., Hoffmann, V., 2000. Privatising agricultural extension: caveat emptor. J. Rural Stud. 16, 95–102.

Kimhi, A., 1996. Demographic composition of farm households and its effect on time allocation. J. Popul. Econ. 9, 429–439.

Klerkx, L., Leeuwis, C., 2008. Matching demand and supply in the agricultural knowledge infrastructure: experiences with innovation intermediaries. Food Policy 33, 260–276.

Knickel, K., Brunori, G., Rand, S., Proost, J., 2009. Towards a better conceptual framework for innovation processes in agriculture and rural development: from linear models to systemic approaches. J. Agric. Educ. Ext. 15 (2), 131–146.

Labarthe, P., 2009. Extension services and multifunctional agriculture. Lessons learnt from the French and Dutch contexts and approaches. J. Environ. Manage. 90, 193–202.

Laurent, C., Cerf, M., Labarthe, P., 2006. Agricultural extension services and market regulation: learning from a comparison of six EU countries. J. Agric. Educ. Ext. 12 (1), 5–16.

Leeuwis, C., Van Den Ban, A., 2004. Communication for Rural Innovation: Rethinking Agricultural Extension, third ed. Blackwell Science, Oxford.

Lesaffre, E., Kaufmann, H., 1992. Existence and uniqueness of the Maximum Likelihood Estimator for a Mulitvariate Probit Model. J. Am. Stat. Assoc. 87, 805–811.

Lowell Hill, L., Kau, P., 1973. Application of multivariate probit to a threshold model of grain dryer purchasing decisions. Am. J. Agric. Econ. 55 (1), 19–27.

Marche Regional Administration, 1999. Regional Law 23 December 1999, no.37, Disciplina dei servizi per lo sviluppo del sistema agroalimentare regionale. Ancona.

Marche Regional Administration, 2003. Programma Obiettivo Triennale dei Servizi allo Sviluppo Agroalimentare 2003 – 2005 (All. B1 alla DGR 1353/03). Ancona.

Morriss, S.D., Parminter, T., Paine, M., Sheath, G., Wilkinson, R., 2002. Achieving agri-environmental outcomes using models of institutional change. J. Agric. Educ. Ext. 8 (3), 127–138.

Morriss, S.D., Massey, C., Flett, R., Alpass, F., Sligo, F., 2006. Mediating technological learning in agricultural innovation systems. Agric. Syst. 89, 26–46.

Oude Lansink, A., van den Berg, M., Huirne, R., 2003. Analysis of strategic planning of Dutch pig farmers using a multivariate probit model. Agric. Syst. 78, 73–84.

Pennings, J.M.E., Irwin, S., Good, D., Isengildina, O., 2005. Heterogeneity in the likelihood of market advisory service use by US crop producers. Agrib. Int. 21 (January), 109–128.

Pretty, J., 1998. The Living Land: Agriculture, Food and Community Regeneration in Rural Europe. Earthscan, London.

Qamar, M.K., 2005. Modernizing National Agricultural Extension Systems. A Practical Guide for Policy-Makers of Developing Countries. FAO, Rome.

Rivera, W.M., 2008. Pathways and tensions in the family of reform. J. Agric. Educ. Ext. 14 (2), 101–109.

Rivera, W.M., Qamar, M.K., Mwandemere, H.K., 2005. Enhancing Coordination Among AKIS/RD Actors: An Analytical and Comparative Review of Country Studies on Agricultural Knowledge and Information Systems for Rural Development (AKIS/RD). FAO, Rome.

Stephenson, G., 2003. The somewhat flawed theoretical foundation of the extension service. J. Ext. 4 (41).

Swanson, B.E., Rajalahti, R., 2010. Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems. World Bank, Washington.

Van der Ploeg, J.D., 2000. Revitalizing agriculture: farming economically as starting ground for rural development. Sociol. Ruralis 40 (4), 497–511.

Van der Ploeg, J.D., Renting, H., Brunori, G., Karlheinz, K., Mannion, J., Marsden, T., De Roest, K., Sevilla Guzman, E., Ventura, F., 2000. Rural development: from practices and policies towards theory. Sociol. Ruralis 40 (4), 391–408.

Van der Ploeg, J.D., Long, A., Banks, J., 2002. Living Countrysides. Rural Development Processes in Europe: The State of the Art. Elsevier, Doetinchem.

Velandia, M., Rejesus, R.M., Knight, T.O., Sherrick, B.J., 2009. Factors affecting farmers' utilization of agricultural risk management tools: the case of crop insurance, forward contracting, and spreading sales. J. Agric. Appl. Econ. 41 (1), 107–123.

Wadsworth, J., 1994. Adoption of innovations by costa rican livestock producers under different levels of extension intensity: predicted versus observed behaviour. Agric. Syst. 49, 69–100.