# Diversification in Italian farm systems: Are farmers using interlinked strategies?

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## Abstract

*This paper analyses interlinkages between farm household diversification strategies in rural Italy. The paper contributes to the literature by providing a quantitative analysis of farm household decisions while explicitly taking into account the potential interaction in the choice of diversification strategies. We use data from the 2006 Italian Farm Accountancy Data Network. Diversification is explained based on internal and external characteristics. External determinants include the distance to urban population centers, landscape features and social capital in the local community. Internal determinants include farm size, specialization, tenancy restrictions, labor use and business structure. We apply a multivariate probit model to determine the factors that affect diversification decisions so as to assess the correlation between farmers' strategies. The results highlight the importance of social capital and networks in developing diversification in Italian rural areas. Furthermore, we find the presence of both synergies and trade-offs in different types of diversification. These results should be taken into account more explicitly when tailoring rural development measures.*


**Keywords:** *Interlinked farm strategies, diversification, Italy.*


## Rèsumé

Dans ce travail, nous allons parcourir les interconnections entre les stratégies de diversification des ménages agricoles en Italie. L'objectif est d'apporter une contribution aux connaissances à travers une analyse quantitative des décisions des ménages agricoles, considérant explicitement l'interaction potentielle dans le choix des stratégies de diversification. A cette fin, nous allons utiliser des données relevant du Réseau d'information comptable agricole italien de 2006. La diversification est expliquée sur la base des caractéristiques internes et externes. Les déterminants externes incluent la distance aux centres de population urbains, les traits distinctifs du paysage et le capital social dans la communauté locale. Le déterminants internes comprennent la taille de l'exploitation, la spécialisation, les restrictions en matière de location des terres agricoles, l'utilisation de la main d'œuvre et la structure de l'exploitation. Nous allons appliquer un modèle probit multivarié pour déterminer les facteurs qui influent sur les décisions de diversification afin d'évaluer la corrélation entre les stratégies des exploitants. Les résultats permettront de souligner l'importance du capital social et des réseaux dans la promotion de la diversification dans les espaces ruraux en Italie. En plus, des synergies et des arbitrages dans les différentes formes de diversification seront mis en évidence. Les résultats obtenus devraient être pris en compte plus explicitement lorsqu'on est appelé à élaborer des mesures de développement rural.


**Mots-clés**: stratégies agricoles interconnectées, diversification, Italie.

## 1. Introduction

Structural change in agriculture has been observed and studied for several decades. In recent years, the topic receives renewed attention in the EU as the pressure on existing farming systems is increasing due to the continued reform and liberalization of the Common Agricultural Policy (Blandford, 2006; Happe et al., 2008; Matthews et al., 2006; Onate et al., 2007). Based on existing studies we can distinguish between three broad patterns in structural farm adjustment, namely: farm exits; concentration and intensification; and farm diversification (Barbieri and Mahoney, 2009; Breustedt and Glauben, 2007; Meert et al., 2005; Moreno-Perez et al., 2011; Oude Lansink et al., 2003). The latter category presents an interesting case of interaction between different system components. Interaction occurs because diversification activities compete for the same farm resources (labor, land, human and physical capital). It is therefore surprising that the majority of the existing studies considers diversification strategies as independent choices by farm households. Taking into account the potential complementarity between different activities can improve our understanding of the evolution of farm systems because the interaction between strategies is likely to be a factor in the farmer's decision-making process.

This paper contributes to the literature by providing a quantitative analysis of farm household decisions while explicitly taking into account the potential jointness of diversification strategies. This is important from a methodological perspective because ignoring the correlation between different strategies that compete for the same resources may lead to biased results (Pfeifer et al., 2009). Furthermore, this study has interesting policy implications. The current EU rural development policy is based on three separate axes[1]: (1) improving the competitiveness of the agricultural and forestry sector; (2) improving the environment and the countryside; (3) improving the quality of life in rural areas and encouraging diversification of the rural economy. Each of these axes provides support for specific measures related to different types of farm diversification. However, there is very little room to support combinations of strategies that cross the borders of different axes. The combination of objectives is limited to initiatives in axis 4 (LEADER), which deals with local development strategies at the community level. We argue, however, that such combined strategies are also worthwhile to consider at the individual farm level.

In order to investigate our claim about the interlinkage of farm diversification strategies, we focus on Italian farm

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[1] http://ec.europa.eu/agriculture/rurdev/index_en.htm

households. Studying farm systems in the Italian context is interesting for several reasons. The agricultural sector is still important in Italy[2]. Recently, the sector is confronted with a number of developments that affect its dynamics. Changing consumer preferences, drastic policy revisions (that turn the focus on environmental, animal and food safety issues) and increased urbanization (unlocking rural areas) are just a few factors that had a major influence on the Italian farm sector in recent years[3]. Some of the challenges that this changing environment creates are stronger competition for natural resources – especially land –, increased constraints on resource use, and a rise in regulations that restrict the farm operator's choice set. At the same time, the changing farm business environment also offers new opportunities, e.g. the proximity to large consumer markets and better links to infrastructure and logistics networks. The current institutional and economic environment has created the opportunity, or sometimes even the need, to assign farm resources to diversified activities.

Several studies point to the importance of diversification in Italian rural areas (Aguglia et al., 2009; Esposti and Finocchio, 2008; Salvioni *et al*., 2009). However, an important feature of Italian rural areas is their heterogeneity. The first source of heterogeneity is due to geographical diversity (OECD, 2009). The Italian rural countryside is characterized by the prevalence of hilly and mountainous areas. Out of a total land area of about 30 million hectares, only 23% is categorized as plains (MIPAAF, 2007). Furthermore, the combination of varied climate conditions (from the south to the north and from the coastal to the inner areas) and altitudes have produced a great range of different eco-systems.

A second source of heterogeneity is related to the diversity in socio-economic conditions. Important differences can be observed between the economically wealthier north and the poorer south of the country. South Italy is characterized by poor development conditions. Moreover, southern Italian rural areas have a less developed material and immaterial infrastructure (i.e. roads, irrigation systems, highways, railways and internet connections) than rural areas in the center and north of Italy. This is affecting job opportunities in and outside the agricultural and food sector. This distinction is also translated in the prevailing structure of the agricultural complex. For example, average farm size changes from around 10.1 ha in the north, to 8.3 ha in the center and 5.8 ha in the south of Italy (MIPAAF, 2007). Moreover, the agricultural sector in the center and the north of the country has the main features of more industrialized societies, i.e. a higher productive capacity, good infrastructure, access to water, high factor productivity, better organized supply chains and the presence of strong processors and retailers. On the other hand, hilly and mountainous areas in the center and south are characterized by the presence of small-scale agricultural systems, a great variety of local production and niche markets and strong traditions.

Furthermore, the richness of habitats, biodiversity and agro-natural landscapes in Italy is threatened by urbanization of rural areas and depopulation of rural communities. While northern Italian agricultural systems are experiencing an increase in resource use and demographic pressure (especially in the river Po basin), central and southern Italian rural areas are exposed to economic growth difficulties, depopulation, and land abandonment (MIPAAF, 2007). This heterogeneity in natural and social environment is likely to translate in different farm strategies. It is therefore particularly interesting to analyze farm system change in Italy, taking the prevailing heterogeneity of the rural areas into account.

## 2. Conceptual framework

### 2.1. Diversification defined

Farm diversification is defined as the development of income-earning activities outside the range of conventional crop and livestock enterprises associated with agriculture (McInerney et al., 1989; Ilbery, 1991). It involves a diversion of resources (land, labor and capital) which were previously committed to conventional agricultural activities (Ilbery, 1991). The narrow definition of diversification would exclude off-farm employment as a type of diversification. The argument goes that off-farm employment generally doesn't use diverted resources but rather previously un- (or under)employed household labor (Jervell, 1999). However, off-farm employment makes a significant contribution to farm household incomes across different countries and regions in Europe (Shucksmith and Smith, 1991). As such, we expect it to be correlated with other farm strategies and we include it in our analysis.

Many studies have looked at diversification in terms of a survival or even an exit strategy (Barbieri and Mahoney, 2009; Meert et al., 2005). Others have pointed out that diversification should be seen as a natural development in rural resource use (McInerney et al., 1989). In line with this view, a study on farm diversification in the U.K. states that "as the requirement for agriculture, particularly food production, to have the primary claim on land use has receded, the demands for a range of new products and services that farmers can provide have become more evident" (Centre for Rural Policy Research, 2003, p. 38)[4]. This natural development towards diversification fits within the classification of farm systems by Bowler et al. (1996):

1. Industrial model;
2. Non-conventional agricultural production;

[2] In 2007 there were 1,679 thousand farms in Italy. In total, these farms employed around 1.2 million annual work units (AWU). Italy has the second largest agricultural sector in the EU, behind France. While the average size of Italian farms is below the EU average, output per farm is above average (European Commission, 2009).

[3] For example, in the presentation of the Strategic Plan for Rural Development the Italian Ministry of Agriculture, Food and Forestry reported the presence of 2.8 million hectares of High Value Nature agricultural land and an extension of Natura 2000 sites over 20% of the national territory (MIPAAF, 2007).

[4] This observation has led a number of authors to link diversification to the notion of multifunctionality of agriculture (Meert et al., 2005; Renting et al., 2009).

3. Non-agricultural products and services on-farm;
4. Off-farm employment and other gainful activities;
5. Traditional model of conventional farm production;
6. Hobby / winding down / semi-retirement;
7. Retirement.

Bowler's model includes the three broad farm adjustment strategies and the status quo strategy (the conventional farm system in path five). Path one corresponds with a strategy focused on concentration and intensification. Paths two, three and four are considered as farm diversification. Paths six and seven correspond with an exit strategy. In practice, farm households can follow different strategies simultaneously[5]. The framework by Bowler et al. (1996) will be used as a starting point in this paper.

## 2.2. Determinants of diversification

A wide range of papers exists that investigate the determinants related to farmers' diversification decisions (Barbieri and Mahoney, 2009; Bowler et al., 1996; Ilbery, 1991; Maye et al., 2009; Meert et al., 2005). Diversification has been explained in the literature based on internal – to the farm and farm household – and external characteristics. External determinants are often linked to the location of the farm.

Location includes the degree of rurality and the distance to urban population centers. Nearby urban centers can be important for example to determine the potential for on-farm sales. Furthermore, the proximity of a local job market creates opportunities for off-farm employment (Barbieri and Mahoney 2009; Centre for Rural Policy Research, 2003; Heimlich and Barnard, 1997; Heimlich and Brooks, 1989; Ilbery, 1991; Meert et al., 2005; Vandermeulen et al., 2006). Another element related to location is that of landscape features. Natural beauty of the landscape can enhance opportunities for diversification while specific landscape features – e.g. high altitude – can also pose constraints. Studies have found that there is less diversification in less favored areas but at the same time, more service-related diversification (e.g. agro-tourism) in environmentally attractive locations (McInerney et al., 1989; Bowler et al. 1996; Ilbery, 1991; Sharpley and Vass, 2006).

The quality of social embeddedness or social capital of the communities in which farmers operate differs between regions. Following Ostrom (2000), social capital can be defined as "the shared knowledge, understandings, norms, rules, and expectations about patterns of interactions that groups of individuals bring to a recurrent activity". Trust and social networks are the two main aspects of social capital. Polman and Slangen (2008) find that a low level of social capital decreases the probability of farmers to diversify towards providing environmental services.

Other external factors that can influence the move towards diversification strategies are cultural aspects, regional population dynamics and policy changes (Centre for Rural Policy Research, 2003; Maye et al., 2009). Finally, Maye et al. (2009) point out that the degree of diversification is also affected by macroeconomic conditions, e.g. an economic crisis.

Numerous farm-related internal determinants of diversification have been identified in the literature. There is mixed evidence on the relation between farm size and diversification (Shucksmith and Smith, 1991; Centre for Rural Policy Research, 2003; Ilbery, 1991; Meert et al., 2005). Specialization also plays an important role. Extensive livestock and seasonal production is more suited for a combination with other activities on and off the farm, while intensive livestock and dairy production are less favorable (McInerney et al., 1989; Ilbery, 1991; Bowler et al., 1996; Centre for Rural Policy Research, 2003).

Other farm characteristics that are linked to diversification strategies are: the financial structure; tenancy restrictions; labor use – family versus hired labor – and business structure (Ilbery, 1991; Bowler et al., 1996; Maye et al., 2009).

Farmer and farm household characteristics are a final category of internal determinants. Variables that have been looked at in this category include farming experience, education level and marketing skills of the farmer and spouse; culture, household composition and other family-related characteristics and unearned income (Ilbery, 1991; Woldehanna et al., 2000; Centre for Rural Policy Research, 2003; Meert et al., 2005)

# 3. Farm system diversification in Italian rural areas

## 3.1. The importance of diversification in Italy[6]

The Italian Census Bureau (ISTAT) defines farm diversification as the presence of "non-agricultural activities". These activities include agro-tourism, handicraft work (hand-made wooden articles, embroidery, straw baskets and pottery), on-farm processing of plant and animal products (wine, olive oils and cheese), bio-energy production, aquaculture, leisure activities and contracting of farm equipment. There were about 121 thousand diversified farms in 2007 that represented roughly 7% of the entire Italian farm population. This is an increase by 15% compared to 2005. Diversification in agro-tourism has increased the most (+41%), followed by on-farm processing (+ 12%). On-farm processing of plant products remains the most popular diversification activity and is found in 71 thousand farm businesses.

Diversified farms are spread evenly across the north (39%) and the south of Italy (39%) with an increase of 20% and 10% respectively from 2005 to 2007. The remaining 22% of diversified farms are located in central Italy. Farms that follow a diversification strategy are mainly small- and medium-sized businesses. About 19% of them have less than 1 hectare and perform only one non-agricultural acti-

[5] A common term from small business economics is sometimes also applied here: portfolio entrepreneurship. This means that entrepreneurs / business partners can simultaneously manage different businesses. For example, a farm household can manage a conventional farm unit and at the same time be engaged in agro-tourism, or direct on-farm sales.

[6] This section is based on ISTAT (2000; 2007a; 2007b; 2008; 2009)

vity. Farms with a size of 5 to 10 hectares are more likely to diversify in 2 or more activities simultaneously.

Apart from the growing importance of diversification in Italian rural areas, the types of activities have also changed in recent years. While traditional agro-tourism mainly involved catering and accommodation, Italian farms are increasingly adopting a wide range of tourist activities. For example, accommodation and hosting activities are present in 83% of the Italian agro-tourism farms and catering in 49%; activities like product degustation and leisure activities (sports, horse riding, health-care, etc.) are performed in 56% of these farms.

Diversification is also related to the capacity of farm households to enhance the quality of "traditional" agricultural production and to create more value-added. An indicator of this is the number of farms using quality labels. In Italy, 76 thousand farms delivered products with Protected Designation of Origin (PDO) or Protected Geographical Indication (PGI) in 2008, mainly cheeses (34 thousand), olive oils (18 thousand) and fruits and vegetables (15 thousand). This is an increase of about 40% compared to 2005.

Finally, also off-farm employment is widespread in Italian rural areas. In 2000 one out of four Italian farm managers worked off-farm, mainly in the industrial sector. About 16% of farm spouses are engaged in off-farm activities, while about 2% of other relatives (living in the farm household) have off-farm employment.

## 3.2. Diversification in the Italian Farm Accountancy Data Network (FADN)

The empirical analysis on farm diversification in Italy is based on the information from the 2006 Farm Accountancy Data Network (FADN). This dataset contains detailed information on more than 15,000 farm businesses. The Italian National Institute of Agricultural Economics (INEA) is responsible for collecting and organizing the FADN on a yearly basis. The data is representative for the population of farmers in Italy and it is in line with the formal procedures of the European Commission. Data is counter-checked by I-STAT. The sample is stratified on three key variables, i.e. location (21 NUTS2 regions), economic size (6 classes) and farm types (19 typologies) (INEA, 2006). We use the information related to farm location to attach site-specific variables to each observation.

We typify diversification following the framework used in Meert et al. (2005) and adapted from Bowler et al. (1996) and Ilbery (2001), and identify four farm strategies in our analysis: agricultural diversification, structural diversification, environmental diversification[7] and income diversification. Table 1 shows that a substantial share of Italian farms is actively diversifying. About one third of farm households are diverting farm resources into non-agricultural production activities such as on-farm processing or agro-tourism and more than one third of farms is providing environmental services. Furthermore, about a quarter of surveyed farms gain income from activities unrelated to the farm business. Agricultural diversification is the least likely diversification strategy (chosen by only 6% of the sample).

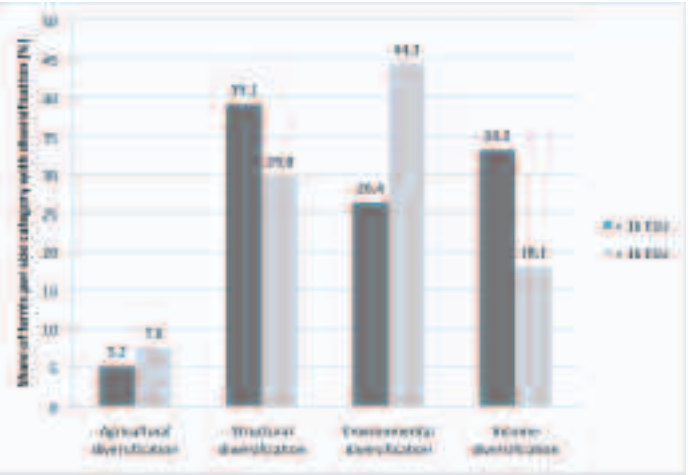
Figure 1 distinguishes diversification strategies followed by large and small farms. A higher share of small farms is actively diversifying. The only exception is agricultural diversification which is a strategy chosen by around 7.6% of large farms but only 5% of small farms. This is in line with the hypothesis that agricultural diversification requires a higher capital-generating potential from the farm, and hence, is less likely to be found in small farms (Ilbery, 1991; Meert

Table 1 - *Diversification in Italian farms, 2006.*

| Type of diversification | Share of farms | | |
|---|---|---|---|
| | *North* | *South* | *Italy* |
| 1. Agricultural diversification | 4.9 | 11.8 | 6.8 |
| *Organic farming* | *4.4* | *11.8* | *6.4* |
| *Energy crops* | *0.5* | *0.0* | *0.4* |
| 2. Structural diversification | 30.2 | 41.1 | 33.2 |
| *Agro-tourism* | *3.4* | *0.5* | *2.6* |
| *Direct sales* | *19.2* | *31.3* | *22.5* |
| *On-farm processing* | *27.7* | *40.7* | *31.2* |
| *Geographic indication and quality certification (i.e. PDO, PGI)* | *1.6* | *0.1* | *1.2* |
| 3. Environmental diversification [a] | 37.7 | 38.2 | 37.8 |
| 4. Income diversification (off-farm employment) | 22.9 | 25.5 | 23.6 |

[a] Environmental diversification includes services such as landscape management and the preservation of biodiversity. These services are included if they result in at least 250 Euro revenue for the farmer on a yearly base.
Source: Own calculations based on FADN (2006)

Fig. 1 - *Share of small and medium-large farms in different diversification categories.*



Source: Own calculations based on FADN (2006).

[7] In the context of this paper we make a distinction between structural diversification and the provision of environmental services. We include the latter in a separate category, which we define as environmental diversification. A basis for this distinction that is often used in the literature is that revenues from environmental services are the result of public policies while with structural diversification revenues are still mainly the result of "private" transactions.

Table 2 - *Description of variables.*

| Variables | | Explanation | Mean | Std. dev. |
|---|---|---|---|---|
| *External factors (farm location)* | | | | |
| South | *south* | 1 if located in south Italy | 0.27 | 0.45 |
| Population density | *pop_den* | Thousand inhabitants per km$^2$ | 0.23 | 0.38 |
| Mountain | *mont* | 1 if located in a mountainous area | 0.20 | 0.40 |
| Social capital (trust) | *criminalit* | % of households with high perception of criminality | 26.0 | 9.91 |
| Networks (1) | *ass_prod* | 1 if member of agri-cooperative | 0.52 | 0.50 |
| Networks (2) | *other_netw* | 1 if member of other rural network | 0.44 | 0.50 |
| *Internal factors (farm / farmer)* | | | | |
| *Farm characteristics* | | | | |
| Farm size | *small* | 1 if farm < 16 ESU | 0.36 | 0.48 |
| Specialization (1) | *arable* | 1 if specialized in arable crops | 0.22 | 0.41 |
| Specialization (2) | *horticult* | 1 if specialized in horticulture | 0.07 | 0.26 |
| Specialization (3) | *perm_crop* | 1 if specialized in permanent crops | 0.30 | 0.46 |
| Specialization (4) | *livestock* | 1 if specialized in livestock | 0.23 | 0.42 |
| Family labor | *fam_labor* | % family AWU[a] in total AWU | 0.85 | 0.26 |
| Land tenancy | *uaa_rent* | % UAA[b] rented | 0.30 | 0.39 |
| *Farmer characteristics* | | | | |
| Manager type | *manager* | 1 if manager provides farm labor | 0.91 | 0.29 |
| Age farmer | *age* | Age in years | 54 | 13.8 |
| Presence of successor | *success* | 1 if successor is present | 0.06 | 0.23 |

[a] Annual Working Unit (AWU)
[b] Utilized Agricultural Area (UAA)
Source: INEA (2006); MIPAAF (2007); ISTAT (2001); ISTAT (2006).

et al., 2005). Also environmental diversification is mainly followed by large farms (44.3%) and less by small farms (26.4%).

Table 2 describes the variables that are used to explain the choice of farm strategy. The nature of the dataset makes that internal factors related to the farm household are underrepresented. However, this should not be problematic to our analysis as Bowler et al. (1996) find that economic factors are most important in discriminating between different business development pathways, more so than farmer and farm family characteristics.

## 4. Drivers of farm diversification strategies

In this section we analyze the likelihood of observing a certain activity associated with a set of factors related to farm location, farm business characteristics and farmers' features. The main novelty of the approach is that we employ a multivariate probit model to study the joint-decision making process of resource allocation between different strategies and to identify their potential substitutability or complementarity (Lesaffre and Kaufman, 1992). Because the decisions to allocate resources to different activities are related – for example spending time in one strategy lowers the amount of time left to dedicate to other strategies – it is important to allow for different combinations of strategies. Bowler et al. (1996) point to other ways in which different strategies followed by farm households can be correlated. For example, earnings from off-farm employment can be used to invest in on-farm diversification (positive correlation). On the other hand, complementing conventional farm income with off-farm income sources can reduce the need for other types of farm diversification (negative correlation).

The multivariate probit model used to investigate farmers' decisions between potentially joint alternatives has been used extensively in the field of information and knowledge transfer (Velandia et al., 2009), on- and off-farm labor allocation (Kimhi, 1996), market strategies (Hill and Kau, 1973; Fletcher and Terza, 1986), investment and planning decisions (Oude Lansink et al., 2003; Pascucci and de-Magistris, 2011) and participation in agri-environmental schemes (Polman and Slangen, 2008). The model is specified as follows:

$$Y_i^* = X_i \beta + \varepsilon_i \quad (1)$$

where $Y_i^*$ denotes a vector of K latent variables of net payoffs in K different activities for observation i, $Y_{i1}^*,...,Y_{ik}^*$, $X_i$ represents the set of explanatory variables related to farmer and farm characteristics, location and context features, and $\varepsilon_i$ are error terms.

For the 4 alternative activities that we identified in section 3.2, the model can be specified as:

$$Y_{i1}^* = X_i\beta_1 + \varepsilon_{i1} \text{ for k = 1 (agricultural diversification)} \quad (2)$$
$$Y_{i2}^* = X_i\beta_2 + \varepsilon_{i2} \text{ for k=2 (structural diversification)} \quad (3)$$
$$Y_{i3}^* = X_i\beta_3 + \varepsilon_{i3} \text{ for k=3 (environmental diversification)} \quad (4)$$
$$Y_{i4}^* = X_i\beta_4 + \varepsilon_{i4} \text{ for k=4 (income diversification)} \quad (5)$$

Furthermore, $Z_i$ denotes a vector of observed binary 0/1 responses (i.e. labour allocation decisions) of the i$^{th}$ observation: $Z_{i1},...,Z_{iK}$. The relationship between the observed response and the latent variable in the multivariate probit model is given by:

$$Z_{ik} = 1 \text{ if } Y_{iK}^* > 0 \text{ and 0 otherwise} \quad (6)$$

Multivariate probit analysis explicitly assumes that the error terms ($\varepsilon_{i1}$, $\varepsilon_{i2}$, $\varepsilon_{i3}$ and $\varepsilon_{i4}$) may be correlated. Therefore, instead of independently estimating equations, they are considered to be a multivariate limited-dependent-variable model, in which the four error terms follow a multivariate normal distribution with mean zero and variance and covariance matrix $\rho$:

$$E[\varepsilon_1] = E[\varepsilon_2] = E[\varepsilon_3] = E[\varepsilon_4] = 0 \quad (7)$$

$$\text{cov}[\mathring{a}] = \begin{bmatrix} 1 & \rho_{12} & \rho_{13} & \rho_{14} \\ \rho_{12} & 1 & \rho_{23} & \rho_{24} \\ \rho_{13} & \rho_{23} & 1 & \rho_{34} \\ \rho_{14} & \rho_{24} & \rho_{34} & 1 \end{bmatrix}$$

The variance-covariance matrix of the cross-equation error terms has values of 1 on the leading diagonal, and the off-diagonal elements are correlations to be estimated. The

model coefficients and correlations are estimated using the *mvprobit* command in STATA software.

Table 3 provides the estimation results of the multivariate probit model. These results indicate the impact of the explanatory variables on the likelihood to observe a certain type of diversification[8]. The goodness of fit of the multivariate probit model is assessed using McFadden's $R^2$ for the system of equations. McFadden's $R^2$ is calculated as: $1-,\frac{Log\ L(\beta)}{Log\ L_0}$ where $Log\ L_0$ is the value of the log-likelihood function subject to the constraint that all regression coefficients except the constant term are zero, and $Log(\beta)$ is the maximum value of the log-likelihood function without constraints (Oude Lansink et al., 2003). While a McFadden $R^2$ in the range of 0.2–0.4 is typical for logit models (Sonka et al., 1989), we find a McFadden $R^2$ of only 0.002. This may be an indication that the farmer and household characteristics that we are unable to include in our model, may nevertheless have important explanatory value.

Table 3 also documents the correlation between different strategies and shows which types of diversification activities are substitutes or complements. Next, we discuss the main results.

Table 3 - *Multivariate probit model: Factors associated with diversificationa.*

| Explanatory variables | | (1) Agricultural diversification | | | (2) Structural diversification | | | (3) Environmental diversification | | | (4) Income diversification | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Coeff.* | *(SE)* | *Sign.* | *Coeff.* | *(SE)* | *Sign.* | *Coeff.* | *(SE)* | *Sign.* | *Coeff.* | *(SE)* | *Sign.* |
| | cons | -0.446 | (0.112) | *** | -0.456 | (0.079) | *** | 0.201 | (0.081) | ** | -2.273 | (0.087) | *** |
| **Location** | south | 0.501 | (0.036) | *** | 0.231 | (0.025) | *** | 0.290 | (0.027) | *** | 0.057 | (0.027) | ** |
| | pop_den | -0.280 | (0.072) | *** | -0.425 | (0.041) | *** | -0.560 | (0.044) | *** | 0.069 | (0.031) | ** |
| | mont | -0.083 | (0.043) | ** | -0.475 | (0.030) | *** | -0.752 | (0.032) | *** | 0.084 | (0.031) | *** |
| | criminalit | -0.015 | (0.002) | *** | -0.011 | (0.001) | *** | -0.005 | (0.001) | *** | -0.005 | (0.001) | *** |
| | ass_prod | -0.001 | (0.033) | | 0.130 | (0.022) | *** | 0.062 | (0.023) | *** | 0.137 | (0.024) | *** |
| | other_netw | 0.254 | (0.033) | *** | 0.166 | (0.022) | *** | 0.050 | (0.023) | ** | 0.042 | (0.024) | * |
| **Farm** | small | -0.161 | (0.038) | *** | 0.261 | (0.024) | *** | -0.616 | (0.027) | *** | 0.348 | (0.025) | *** |
| | arable | -0.017 | (0.044) | | -0.213 | (0.030) | *** | 0.370 | (0.029) | *** | 0.099 | (0.031) | *** |
| | horticult | -0.853 | (0.124) | *** | -0.402 | (0.052) | *** | -1.167 | (0.055) | *** | -0.087 | (0.052) | * |
| | perm_crop | 0.026 | (0.040) | | 0.469 | (0.027) | *** | -1.110 | (0.031) | *** | 0.122 | (0.029) | *** |
| | uaa_rent | 0.000 | (0.000) | | -0.001 | (0.000) | *** | 0.003 | (0.000) | *** | -0.001 | (0.000) | *** |
| | fam_lab | -0.003 | (0.001) | *** | 0.000 | (0.001) | | 0.002 | (0.001) | *** | 0.001 | (0.001) | |
| **Farmer** | manager | -0.111 | (0.058) | * | -0.025 | (0.043) | | -0.141 | (0.044) | *** | 0.082 | (0.047) | * |
| | age | -0.010 | (0.001) | *** | 0.002 | (0.001) | *** | 0.002 | (0.001) | ** | 0.022 | (0.001) | *** |
| | success | -0.116 | (0.073) | | 0.198 | (0.047) | *** | -0.008 | (0.051) | | 0.128 | (0.053) | ** |
| **Correlation between strategies** | | | | | | | | | | | | | |
| Agr. & Env. | | -0.012 | (0.018) | | Env. & Structural | | | -0.039 | (0.014) | *** | | | |
| Agr. & Structural | | 0.175 | (0.017) | *** | Env. & Income | | | -0.036 | (0.015) | ** | | | |
| Agr. & Income | | -0.049 | (0.018) | *** | Structural & Income | | | 0.016 | (0.014) | | | | |
| Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: chi2(6) = 128.162 Prob > chi2 = 0.0000 | | | | | | | | | | | | | |
| Log likelihood = -28232.819 | | | | | Wald chi2(60) = 6574.51 | | | Prob > chi2 = 0.0000 | | | | | N = 15,380 |

[a] SE represents the standard error. The significance level is indicated as follows: *** 1%; ** 5%; * 10%.
Source: Own estimations based on FADN (2006).

## 4.1. Farm location

In our analysis the role of farm location is linked to several socio-geographical factors. The first element refers to the location of the farm in the south of Italy (*south*). In this region the likelihood to observe a certain activity is higher for all four strategies than in the north. As pointed out in the introduction a structural socio-economic differentiation exists between southern and northern regions. The socio-economic environment in the south creates barriers for the development of "traditional" agricultural activities. As a result, non-traditional activities are set-up to complement agricultural incomes. This is in line with Maye et al. (2009) who find that farmers' diversification strategies are to a large extent determined by macroeconomic conditions.

Location in the vicinity of an urban area (*pop_den*) positively affects the likelihood to observe income diversification while it negatively affects agricultural, structural, and environmental diversification. The positive correlation between income diversification and proximity to an urban area is found in a number of studies in both Europe and North-America and indicates that urbanization increases opportunities to find off-farm employment. Less explored are the linkages between urban location and agricultural and structural diversification. Proximity to an urban area means that farmers are close to final consumers, which increases the potential to set-up short supply chains of local products. Moreover, as pointed out by Vandermeulen et al. (2006), location within an urban region increases the likelihood that agricultural areas are the main source of amenities for urban citizens. This creates possibilities for businesses that provide leisure activities such as agro-tourism. However, the negative signs for agricultural and structural diversification do not confirm these hypotheses. The negative sign for environmental diversification is plausible since urbanization can pose constraints to farmers willing to provide environmental services such as landscape protection and agri-environmental schemes.

Another element we consider when addressing farm location refers to location in a mountainous area (*mont*). This negatively affects agricultural, environmental and structural diversification while increases the likelihood to observe an income diversification strategy. This result is in line with Maye et al. (2009) who emphasize the importance of off-farm employment as a survival strategy in marginal areas. A negative correlation between location in less favorite areas and diversification activities such as agro-tourism and direct sales was also found by McInerney et al. (1989) in the British context.

[8] Wald chi2(60) is the Wald Chi-Square test statistic. The number in the parenthesis indicates the degrees of freedom of the Chi-Square distribution and is defined by the number of predictors in the model. Prob > chi2 is the probability of getting a test statistic as extreme as, or higher than that observed under the (null) hypothesis that all of the regression coefficients in the model are equal to zero. The small p-value, <0.00001, leads us to conclude that at least one of the regression coefficients in the model is not equal to zero.

Finally, we use both trust and participation in farmers' networks to analyze the connection between social capital and the likelihood to observe farm diversification. Being located in a region with a low level of trust due to the high perception of criminal activity and social insecurity (*criminalit*) negatively affects the likelihood to observe diversification activities. On the other hand, belonging to a producer association or other rural network (*ass_prod* and *other_netw*) increases the likelihood to observe farm diversification. As pointed out by Polman and Slangen (2008) a lower level of social capital can discourage famers from undertaking business initiatives whose success is highly dependent on collective action. This is particularly relevant for implementing strategies such as environmental and structural diversification.

## 4.2. Farm characteristics

Farm size (*small*) is the first farm characteristic that we analyze. We find that small farm businesses are less likely to develop agricultural diversification and environmental diversification strategies, while they are more likely to implement structural and income diversification. This is in line with findings by Meert et al. (2005) who show that structural and income diversification are survival strategies in response to internal resource constraints. In this perspective, small size can be seen as a proxy for insufficient resource endowment.

Farm specialization is also used as a determinant of diversification. Results show that farms specialized in arable crops (*arable*) are more likely to engage in environmental and income diversification while they are less likely to structurally diversify. Diversification is not common on horticultural farms (*horticult*), while farms specialized in permanent crops (*perm_crop*) are more likely to use structural and income diversification strategies. Seasonality (of both arable and permanent crop production) seems to be a key factor in explaining income diversification. The additional time available for farmers and their family members in certain periods of the year allows them to look for non-agricultural sources of income. Being specialized in arable crops increases the capacity to switch to organic or energy crops. Being specialized in permanent crops, such as vineyards, fruit and olive trees, can be associated with on-farm processing and quality labeling strategies.

Tenancy characteristics such as renting land (*uaa_rent*) are highly relevant to explain Italian farmers' decisions to diversify. Renting provides fewer safeguards about the way the benefits from investments are allocated. Therefore, tenancy restrictions can cause a lower propensity to use assets for non-agricultural purposes such as agro-tourism and direct sales. This can explain the lower likelihood of tenant farmers in following structural diversification. Renting can also be interpreted as a signal of the centrality of agricultural activities for the farmer and his family, which implies a lower propensity to rely on off-farm employment.

Finally, also the importance of family labor (*fam_lab*) is found to affect the likelihood of diversification.

## 4.3. Farmer characteristics

A farm manager who also contributes labor services to the farm business (*manager*) presents a lower probability to observe agricultural and environmental diversification while there is a positive correlation with the presence of income diversification. This form of management is the most widespread in Italy. On the one hand, it is often related to the traditional form of family farm organization. On the other hand, it is also the type of organization most often observed among part-time farmers.

More experienced farmers (*age*) are less likely to follow agricultural diversification strategies while they are more likely to engage in the other types of diversification. Organic and energy crops are rather complex in terms of farm and marketing management.

The presence of a successor (*success*) increases the likelihood to observe structural and income diversification. This indicates that these types of diversification are calling for a more long-term business plan and are motivated by the presence of more continuity in the family business.

## 4.4. Correlation between strategies

The multivariate probit model also allows us to identify the potential correlation between different diversification strategies. The results indicate that a complementarity exists between agricultural and structural diversification strategies. On the other hand, a negative correlation exists between agricultural and income strategies, structural and income strategies and structural and environmental strategies. This finding is not discussed yet in the literature and it deserves reflection. Resource diversion from agricultural to non-agricultural activities is costly and risky. Usually farmers prefer to follow only one alternative. In the case of agricultural and structural diversification more synergies are possible. For example, developing organic farming can also lead to the development of short supply chains at the local level, opening an on-farm shop, or introducing certification and labeling as tools for direct marketing. The positive relationship between agro-tourism and organic farming is also documented by Mansury and Hara (2007).

The negative correlation between agricultural and structural diversification on the one hand and income diversification on the other points to a substitution effect between off-farm employment and on-farm diversification efforts. It also shows the importance of labor as a binding resource constraint. When household labor is employed outside of the farm, the opportunities for farm diversification become scarcer. Finally, we find a negative relationship between structural and environmental diversification. In other words, Italian farms seem to focus their efforts either on environmental / public service provision or on private service provision but shy away from a combination of both.

# 5. Conclusions

This paper analyses interlinkages between farmers' diversification strategies. This is a challenging and often debated issue, especially in the light of structural change in the agricultural sector. Our results indicate the presence of trade-offs and

complementarity between different strategies. An important finding is the strong complementarity and synergy between agricultural and structural diversification. In other cases competition between resources results in a negative correlation or in the absence of an interlinkage between strategies.

More in general we find that diversification can be seen as a response of farmers to adverse socio-economic conditions which tend to reduce the capacity of agriculture to provide sufficient income to the farm household. External stimuli, such as a depressed economy or an insecure socio-cultural context, have been recognized as key-factors to explain farmer strategies. We highlight how social capital is important and how participation in networks can lead to diversification.

Our empirical findings confirm that diversification is more likely to occur when the specificity of the farm's internal resources to agricultural activities is low. Therefore, farm businesses that have developed flexible capacities and multiple skills are more likely to combine agricultural with non-agricultural activities. In other words, agricultural asset specificity matters to explain diversification.

The results imply that the presence of potential synergies and trade-offs in different types of diversification are elements to be considered when tailoring rural development measures. Current EU rural development policy is based on an "axis approach". This approach relies on three alternative development paths for the farm: an increased relevance of agricultural activities (in line with agricultural diversification) is emphasized mainly via the support to improve the competitiveness of the agricultural sector (axis 1); diversification towards the reduction of input use and the implementation of environmental services (in line with environmental diversification) is stimulated through the support for improving the environment and the countryside (axis 2); diversification towards non-agricultural activities on the farm and income diversification for farmers and their family members (in line with structural diversification and to some extent also income diversification) is supported by measures to improve the quality of life in rural areas and the diversification of the rural economy (axis 3).

More specifically, axis 1 (competitiveness) includes measures for upgrading knowledge and human capital of farmers and the modernization of agricultural holdings. Axis 2 (quality of the environment) includes support for less-favored and mountainous areas, as well as agri-environmental payments. Axis 3 (quality of life and diversification) provides support to develop agri-tourism activities and farm-related micro-enterprises, as well as community-level service provision.

In the light of our results we argue that more room for "mixed" strategies should be given in the rural development measures, mainly via the combination of measures belonging to different axes. Our results specifically favor the combination of axis 1 and axis 3 measures as a strongly positive correlation was found between agricultural and structural diversification. In other words, the opportunities provided by activities such as agri-tourism and farm sales are likely to be reinforced by human capital building and farm modernization efforts. This linkage between strategies has already been introduced in the rural development plans for 2007-2013, where packages of different measures have been allowed under special circumstances. Our argument is to consider this approach more systematically in the future for example by introducing an axis fully dedicated to combined measures in order to support diversification strategies.

On the other hand, the negative correlation between agricultural and environmental diversification strategies suggests that there is limited complementarity between axis 1 and axis 2 of the rural development policy. This result is not surprising given the challenges to improve agricultural efficiency in less-favored, mountainous areas. Furthermore, following a strategy that focuses on increased agricultural activities, also makes farms less likely to implement agri-environmental schemes. Again this may not be surprising. However, as the policy objective of axis 2 is to improve the environment, the inclusion of agricultural diversifiers may be desirable. Again this could point to the necessity of linking rural development axes. By incorporating environmental aspects in the measures supported under axis 1, it may be possible to extend the reach of axis 2 and hence substantially contribute to improving the quality of the environment.

It is interesting to note that axis 3 – which is aimed at improving employment opportunities for the rural (farm) population – combines measures that stimulate structural diversification as well as measures that are aimed at improving opportunities for off-farm employment (income diversification). Our results indicate that there is a negative correlation between both types of diversification strategies. This means that farms that benefit from off-farm employment opportunities are unlikely to be engaged in agri-tourism or other structural diversification activities. A better understanding of the types of farms (or regions) that may gain from the distinct measures in this axis may help to target rural development measures better in the future.

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