Explaining the determinants of on-farm diversification: The case Study of Tuscany Region.

Bartolini Fabio[1], Andreoli Maria[1], Brunori Gianluca[1]

1 University of Pisa – Department of Agriculture Food and Agri-environmental (DISAAA-a)
Via del Borghetto 80 - 56124 (Pisa-Italy)

fbartolini@agr.unipi.it

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Summary

The on-farm diversification toward multifunctional activities is perceived as central in the CAP policy reform and in Horizon 2020 strategies, because it strengthen territorial and social cohesion of the rural areas.
While relations between farm-household diversification and rural economies are central into the process of multifunctionality and provision of public goods through agricultural activities, on-farm diversification activities could represent a relevant share of farm income. Agricultural Economics and Rural Sociology literatures have developed models to explain the determinants of on-farm diversification. In this paper the determinants and the motivations to on-farm diversification toward activities different from crops and animal production are investigated The paper applies a count model to explain the amount of on-farm diversification alternatives that are applied in Tuscany farms. Results confirm that location to main touristic areas and closeness to urban markets are strong determinants of on-farm diversification. Results highlight also, a positive contribution of agricultural policies (both first pillar and second pillar policies) in determining diffusion of on-farm diversification activities.

Keywords: on-farm diversification; multifunctionality; determinants; Tuscany

JEL: Q18 – Agricultural Policy; Food Policy; Q10 General

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1. Introduction

The on-farm diversification toward new activities are perceived central in the CAP policy reform and in horizon 2020 strategies, in strength territorial and social cohesion of the rural areas (European Commission, 2011). In developed economies there are different available strategies to differentiate agricultural income, and to provide additional services and functions..

While relations between farm-household diversification and rural economies are central into the process of multifunctionality and provision of public goods through agricultural activities (Johnson et al., 2008), on-farm diversification activities could represent a relevant share of farm income. Vogel (2012), using 2007 ARMS (Agricultural Resource Management Survey) data, estimates that the contribution of on-farm differentiation activities on total value of US agricultural production is about 40%. Other Authors (see for example Carter, 1999) have identified a positive effect of diffusion of diversification activities on rural economic development. The relevance of diversification strategy is growing in rural economies. DEFRA 2008, estimated that since 2006, the portion of UK farmer’s income is continuously increasing, and Turchetti (2013), shows that the share of farm income derived by diversification activity in Tuscany Region is increased by 20% in the last fifteen years. McElwee and Bosworth (2010) pointed out that diversification is mainly increased due to adoption of food processing, retail and tourism sector. Otherwise, Henke and Povellato (2012) found that in 2010 about 5 % of Italian farmers state to have diversified activities, and such activities count for 10 million of Full Time Equivalent (4% of the total). Henke and Povellato (2012), using Italian CENSUS data, found that in the last 10 years farms with diversified activity are reduced about 50% (from 148.000 in years 2000 to 79.000 in years 2010).

Agricultural economics literatures have highlighted that changes in CAP strongly affects the farm structure and the nature of production as well as farmers’ behaviour towards diversification activities (Ilbery et al., 2006). Both first pillar and second pillar payments affects intention to diversified production. Literature have highlighted that income support payments affect the overall profitability of the entire agricultural sector and then the propensity to invest/innovate within the sectors. Furthermore, first pillar payments strongly reduce exit to agricultural sector and intention to allocate productive factors off-farm. Second pillar payments positively affects on-farm diversification adoption due to co-founding mechanism which reduce investment costs, and contributed to rural viability an provision of services.

In this paper the determinants and the motivations to on-farm diversification toward activities different from crops production and animal rearing are investigated. In this paper only on-farm diversification is considered, and the classification of on-farm diversification activity provided by Italian legislation to identify agricultural income has been considered. The paper applies a count model to explain the amount of on-farm diversification alternatives that are applied in Tuscany farms. In order to take into account over-dispersion and zero excess, a zero inflated negative binomial model has been applied. Zero inflated negative binomial model allows to estimate in two steps the on-farm diversification. Firstly the determinants of non adoption of diversified activities are explained and then the determinants of the intensity of diversification are estimated.

The paper is structured as follows: in chapter 2 a review of literature is presented, then in paragraphs 3,4 methodology and data used are presented, and then follows results and conclusion.

2. DIVERSIFICATION IN AGRICULTURAL ACTIVITIES

The diversification strategy has been longely studied by agricultural economics literature. In this field, works could be grouped in three main areas: a) development of diversification activity definition, b) development of classification of activities c) explanation of motivation and determinants of strategy diversify.

Several papers addresses the definition of diversification activity and to provide new definition are beyond scope of the paper. Define diversification is not a simple issues. Firstly literature has provided a distinction between pluriactivity and diversification. Following the definition provided by Vik and McElwee (2011) pluriactivity can be defined as the presence of activities which determines extra income obtained by allocating household labour to market outside the farm or in off-farm business activities. On the contrary, diversification activities represent other on-farm activity with use of household labour on-farm. Within the areas of diversification, the literature has provided a *plethora* of definition, without a clear consensus, and with some overlapping and without providing a borderline among the definition. For example, Iberly (1992), define as “ the development of non-traditional (alternative) enterprises on the farm”, while McNally (2001) with a more restrict definition, identify diversification activity as: “development of non-food enterprise on the holding”. One operative definition used to classify diversification is provided by DEFRA 2007b and identify diversification as “any activity, excluding mainstream agriculture and external employment by members of the farm family, which makes use of farm assets to generate additional income”.

Another field of literature has provided classification of farm diversification activities. For example McIrneney et al., (1989) have classified diversification into 5 category: services, contracting; miscellaneous, specially products and processing and sales, Otherwise Slee (1987) identified the following categories: Tourism and Recreation; adding value to conventional products; unconventional agriculture enterprises; and use of ancillary buildings and resources. Recently, Mc Elwee and Bossworth (2010) make a distinction about what is being diversified: farmer’s income; farmer’s activity or employment of other farm resources. Then Authors identify the following categories: Reduce the Farm Holding; Property Management, diversified into new business activities; diversify the farm business (which is composed by adding value to conventional farm products and unconventional farm productions); diversification of income (which, following definition of Vik and McElwee (2011) is more linked to pluriactivity rather than diversification). Vik and Mcewee (2011) to explain attitude towards diversification use a classification based on two main dimensions: on-farm versus off-farm diversification in one axis and farm related activities versus farm-diverse activities. Henke and Povellato (2012), using data of Italian Census identified two main categories of diversification based on link with the main agricultural production and they use Van Der Ploeg (2000) definition about deepening and broadening activity.

Agricultural economics and Rural Sociology literatures have developed models to explain the on-farm diversification determinants. Since preliminarily work of Johnson (1967), agricultural economics literature has identified in the increasing in returns of productive factors or in reducing the risk of agricultural activities the main reasons to diversify farm activities. Anderson et al., (2002), applying a dynamic portfolio model, find that a lower return in agriculture could be compensated by risk adverse farmers, when on-farm differentiation are risk-reduction activities. In this sense the differentiation of portfolio activities could reduce the exposure to several sources of uncertainty which affect farms (climatic factors, pests and diseases, price and polices related to agricultural production, marketing and trade uncertainties). Then an increase of farm diversification could be considered as a response to avoid these uncertainties. Vik and Mcewee (2011) analysed the motivation for which farmers adopt diversification strategy . Authors develop a survey to more than 1500 famers among Norwegian Agricultural Registered Producers and they found that main reason to diversify activity is the need of an extra income sources. Through multinomial regression applied to several alternative of diversification category, the Authors finds also, that motivation changes among categories of diversification activities. Mc Elwee and Bossworth (2010) through postal survey explained determinant of diversification considering several diversification categories. Authors found that about 50% of the respondents have differentiated activities, and they found that larger farm (belong to the larger quintile), male, young and high educated are determining factors for diversification. Authors find also that farmers with regular internet use shown high probability to participate and they found that business relation such as networking or support where showed few statistical difference between farmers who have diversify by those who have not diversify. Henke and Povellato (2012) found that there are structural constraint of Italian farmers in developing diversified strategy rather than in other Countries. Furthermore they found that large farms (in term of income and/or in term of land) are more likely to diversify rather than small farms. Lange et al. (2013) through a survey in Brandenburg region analyse the effects of rural-urban relation in relation to farm holders' strategic decision-making behaviour about the strategy to diversify versus farm abandonment. Authors argue that abandonment of agricultural activity could be seen as extreme option for farm household in competition with allocation of more household labour to on-farm (diversified) activity. Authors investigate the spatial effect of rural attractiveness in explain diffusion of diversification activity and the farmer's willingness to give up farm activity in relation to farm's location. They found also that even in the case of completely CAP abolishment farmers with high urbanity are more likely to remain farming even if in these area there are higher off-farm income expectation with respect rural areas..

From another point of view, rural sociology, has described the development of on-farm diversification activities as a consequences of the transition process from productivism to post-productivism (see for example work of Wilson 2001) Then, literature on this field has identified territory endogeneity, subjective motivations, preferences, networking and connections among actors as a determinants of diffusion of on-farm diversification. In this field of analysis the heterogeneity of behaviour has highlighted developing a conceptual framework which is unable to explain different behaviour with respect mainstream (see for example literature about transition theory).

3. METHODOLOGY

The paper aims to investigate determinants and motivations to on-farm diversification toward activities different from crops production and animal rearing, and the intensity of such diversification activities adopted. The intensity of on-farm diversification is obtained counting the on-farm diversification activities adopted by each farms. Data used are obtained by micro-data of 2010 Agricultural Census, using the farmers' answers about adoption among 17 possible diversification activity. Such alternatives belong to the following groups: rural tourism, social agriculture; educational farms, on-farm direct transformation of farm produce, aquaculture, subcontractor services, livestock services or feed for animals, forestry activities, and other category.

The dependent variable is the count of on-farm diversified on activities adopted. Econometric literature has suggested several models to analyse and treat count data, developing specific models which are tailored to analyse these variables. Application of count models is quite common in the agricultural economics literature; for example Isgin et al (2008) through application of count data models (Zero-inflated Poisson and Zero-inflated Negative Binomial) estimate the factors affecting the intensity of technological elements implemented in Ohio Farms. To measure such intensity, Authors use the count of the adoption of various precision farming techniques as dependent variable. Karantininis et al., (2010) investigate the linkage between innovation and market structure in Danish agri-food system applying both a Poisson model and a zero-inflated Poisson model. These Authors use a count model to explain determinants of the different could of new products introduced by Danish agri-food firms. Recently Sharma et al. (2011) apply a count model (Poisson and Negative Binomial Models) to investigate technology adoption determinants in relation to pest management. Uematsu and Mishra (2011), estimate through a Zero inflated negative binomial model the determinants affecting the total number of direct marketing strategies adopted by farmers, in order to investigate the relations between the diversification of farm commercialisation channels and the economic viability of U.S. farms. Bartolini et al., (2011) apply a count model to investigate the CAP impacts on the intensity of innovation adopted on farm in two French Case Studies. Authors find that the abolishment of SFP and RDP payments negatively affects the innovation intensity adoption. Low innovation intensity is observed for those farmers which use few information channels to collect decisive information about innovation and highlights the effect of innovation sequences in explaining the expected strategy of innovations adoption in the coming years.

In this paper we applied a count model to explain the amount of on-farm diversification alternatives that are applied in Tuscany farms. Formally, the count of on-farm diversification activities is a function of a set of independent variables (X_i), such that $\ln(\lambda_i) = \alpha_0 + \beta' X_i$, where λ_i is the number of adopted on-farm differentiation activities, α_0 is the constant term and β' is the coefficient of the set of explanatory variable. To analyse the variables, two distributions are considered: Poisson and Zero-Inflated model (Paxton et al., 2011).

Let be Y_i the observed event of count data, the parameter β' depends on the value of explanatory variables and it is possible to write $E(Y_i \mid X_i) = \lambda_i = \exp(\beta' X_i)$ with $i = 1,...N$, and the probability density function for Poisson model is $P.\Pr(Y_i \mid y) = f(Y_i \mid)_i = \frac{e^{-\lambda_i} \lambda_i^{Y_i}}{Y_i!}$. The Poisson specification assume that the first two moments are equal $E[(Y)] = \lambda$ and $V[(Y)] = \lambda$. To take into account overdispersion a more flexible Negative Binomial Regression model has been applied.

Then the density function for the negative binomial model is the following. $NB.\Pr(Y_i \mid y) = \frac{\Gamma(y+\alpha^{-1})}{y!\Gamma(\alpha^{-1})}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\mu}\right)^{\alpha^{-1}}\left(\frac{\mu}{\alpha^{-1}+\mu}\right)^{y_i}$, where Γ is the gamma distribution function. Is worthwhile to note that with $\alpha = 0$ a Negative Binomial becomes a Poisson model.

In order to take into account zero excess, a zero inflated model has been applied. Zero inflated negative binomial and zero-inflated Poisson models allow to estimate in two steps a count variable (Lambert, 1992; Green, 2003).

As above mentioned the count variables is the diversification intensity. Firstly the determinants of non adoption of diversified activities are explained and then the determinants of the intensity of diversification are estimated. The model allows to combine the categorical data (adoption or not of any diversification activity) with the count data (intensity of diversification adopted).

The mechanism underlying the model is related to how zero is generated, in fact such value could be generated from two regimes: one regime where the outcome is always zero and the other one with the usual Poisson (or Negative Binomial) regime that the outcome could produce any non negative integer value (Green 2003); in fact such models generate two separate models, which then are combined. First model is a logit model that analyses the discrete choice about whether innovate or not (first regime). The second model is a Poisson or Negative Binomial model that generated a prediction of the count of the innovation (second regime). Following Mullahy (1986) and Lambert (1992) it is possible to describe the choice as:

$$Y_i = 0 \text{ with probaility } \omega_{it}$$
$$Y_i \sim Poisson(\alpha_{it}) \text{ with probaility 1- } \omega_{it} \text{ (in case of Poisson model)}$$
$$Y_i \sim NBR(\alpha_{it}) \text{ with probaility 1- } \omega_{it} \text{ (in case of NBR model)}$$

Then the probability of the zero positive outcome can be expressed as:

$$\Pr[Y_i = 0] = \{\omega_i + (1-\omega_i)g(0)$$
$$\Pr[Y_t = k] = (1-\omega_{it}) + (1-\omega_{it})g(k) \quad \text{k} = 1,2,3...$$

Where $g(.)$ depends on the model considered and is respectively a Poisson probability function or the negative binomial probability function, as above mentioned

4. DATA USED

In the paper micro-data collected by agricultural census at year 2010 are used. The database contains both the description of on-farm differentiation activities undertaken and a set of variables related to farms, farmers and households characteristics. The database is integrated with data of location, territorial description of the area, and SFP payments. The dependent variable represents the count of alternative diversification strategies applied at farm level. In the questionnaire the adoption of on-farm diversification activities are asked using a list of alternatives. These alternatives were firstly classified in 17 differentiation activities. Then a grouping of on-farm differentiation strategies based on similarity of activities carried out was identified. These alternatives include agri-tourism, social farming, subcontractor services, energy production (different from energy crops production), handcraft, direct transformation of livestock or crop produce, educational farm activities and public green management. In table 1 the frequency of farm with the considered activities are presented for each rural zoning in Tuscany Region.

Table 1. Frequency of diversification activities implemented on-farm.

	Farm	
Diversifications category	(#)	(%)
Rural tourism	3487	4,80
Social agriculture	244	0,34
Educational farm	204	0,28
Handcraft activity	360	0,50
On farm processing	1314	1,81
Energy production	230	0,32
Aquaculture	25	0,03
Subcontractor services	1375	1,89
Supply services for livestock/animal feed	1004	1,38
Forestry activity	891	1,23
Other activities	388	0,53

Diversification activities are quite heterogeneous in term of work and skills needed, services provided and source of income generated. Among the several groups of on-farm diversification activities, rural tourism has the higher frequency between Tuscany Farmers. Such activity counts more than 3500 farmers and represents almost the 5% of the farmers. Less frequent activities are subcontractor services and on farm direct transformation of farm produce. These last two activities involve more than 1500 farmers in the Region, which account for about 1.80% of total farmers. The supply services for livestock and forestry activity count about 1000 farmers which represent 1 % of the farmers. On the contrary, other activities such as social farm and education activities are less present compared to other, with a frequency less than 0.5% of Tuscany Farmers. Intensity of on-farm diversification activities implemented are measured through the count of activities diversification implemented in each farm. In table 2 the count of diversification activities implemented in Tuscany farms is presented. This variable represents the dependent variable of the econometrics model and measure the diversification intensity at farm level.

Table 2. Count of on-farm differentiation activities implemented.

differentiation intensity (# of activity)	**Farms (#)**	**Percentage**	**Cumulative.**
0	65,747	90.45	90.45
1	5,124	7.05	97.50
2	1,309	1.80	99.30
3	336	0.46	99.77
4	107	0.15	99.91
5	44	0.06	99.97
6	12	0.02	99.99
7	4	0.01	100.00
8	3	0.00	100.00

Data show that the majority of Tuscany farmers stated to not apply any diversification strategy. These farmers are about the 90% of the sample. Data show that with respect to a sample of 70,000 farms, more than

5,000 farms applied at least one diversified activity and more than 1,000 farms applied two diversified activities. The number of farms is progressively reducing, increasing the count of on-farm diversification activities (less than 100 farms applied more than 5 differentiation activities). Data shown a very excess of zero observations, then as mentioned in the methodology section, zero-inflated models are used order to correct the estimation which such amount of zero value.

5. RESULTS

As mentioned in the previous paragraph, the dependent variable is the count of the adopted diversified alternatives on the farms. Explanatory variables belonging to geographical, farmers and households, and farm policy categories are identified. Such explanatory variables are obtained using the information of Census data. Table 3 shows the descriptive statistics of selected explanatory variables.

Table 3 Descriptive statistic of selected explanatory variables.

Category	Variable	Observation	Mean	Standard Deviation	Min	Max
	hill	72686	0.6984	0.4589	0	1
	mount	72686	0.1809	0.3849	0	1
	plain	72686	0.1206	0.3257	0	1
	poli_urb	72686	0.1737	0.3789	0	1
	rur_int	72686	0.1008	0.3011	0	1
	rur_trans	72686	0.3408	0.4740	0	1
	rur_decl	72686	0.2413	0.4279	0	1
geographical	rur_probsv	72686	0.1430	0.3501	0	1
	lav_partime	72686	0.4605	0.4984	0	1
	live_on	72686	0.8402	0.3663	0	1
household	selfcons	72686	0.5026	0.4999	0	1
	lav_FTEall	72686	1.1225	1.6321	0.0045	90.81
	lav_onlyfam	72686	0.9421	0.2334	0	1
	d_bio	72686	0.0325	0.1775	0	1
	totliv	72686	1.1745	15.994	0	1965
	uaa_l	72686	0.2456	0.4304	0	1
	uaa_s	72686	0.2344	0.4236	0	1
	uaa_vl	72686	0.2489	0.4323	0	1
	uaa_vs	72686	0.2711	0.4445	0	1
	uaa_1n	72686	1037.81	3508.67	0	2292.08
	uaarent_d	72686	0.1552	0.3621	0	1
	spec_livestock	72686	0.0554	0.2289	0	1
	spec_arable	72686	0.1738	0.3790	0	1
	spec_permanent	72686	0.5871	0.4923	0	1
	spec_vegetable	72686	0.0447	0.2068	0	1
	cond_coltdir	72686	0.9561	0.2047	0	1
	cond_oth	72686	0.0059	0.0770	0	1
Farm	cond_salecon	72686	0.0378	0.1908	0	1
	d_young	72686	0.1042	0.3056	0	1
	d_old	72686	0.4138	0.4925	0	1
	age2	72686	3851.43	1740.82	256	9801
	inform_d	72686	0.0590	0.2351	0	1
	edu_agr	72686	0.0388	0.1932	0	1
farmer	edu_high	72686	0.3302	0.4703	0	1
	edu_low	72686	0.6697	0.4703	0	1
	rdp_axis1	72686	0.0388	0.1931	0	1
	rdp_axis2	72686	0.0312	0.1739	0	1
	rdp_axis3	72686	0.0026	0.0511	0	1
	rdp_121	72686	0.0152	0.1226	0	1
	rdp_311	72686	0.0021	0.0461	0	1
policy	sfp_ha	72686	324.76	754.81	0	1914,37

Explanatory variables are classified into 5 categories. The first category includes geographical variables such as altitude and RDP zoning. As regards to the first, farms are classified based on the location in plain, hill or mountain areas, while the second classification is determined based on farm location on municipality classified according with the Current RDP zoning. Such zoning is based on inhabitants density per municipality. Tuscany territory has been classified into 5 categories. To the first one, namely that of municipalities with highest density of inhabitants (poli_urb) belong farms located into urban areas. In the second category (rur_int) there are farms located in the rural areas (density less than 150 inhabitants per square km) but with very intensive productions. There are three other zones which correspond to rural areas characterised by increasingly socio-economic concerns, namely: rural areas in transition (rur_trans), declining rural areas (rur_desc) and rural areas with development problems (rur_probsv). Zoning and altitude are expected to be relevant as diversification patterns determinants due to the priority mechanism implemented to be eligible for measure 311 (promoting diversification in rural areas) and as determinants of change in diversification of services demand by the collectively. In the second category, explanatory variables belonging to household characteristics are considered. These variables aim to investigate the effects of the relation between farmers' household characteristics and farm strategies. Farms' household characteristics include: farmers living, or not, in the farm (live_on), the relation between farm production and households consumptions (selfcons) and the relation between household and hired labour (lav_FTEall; lav_onlyfam). Based on the amount of household labour allocated on-farm and off-farm part-time farms are identified (lav_partime). The third category of explanatory variables includes farm characteristics, which could be grouped into legal status of the farm (cond_sale_con; cond_coltdir; cond_oth), farm specialisation distinguishing among specialisation in livestock production, vegetable production, permanent production or arable crops production (spec_livestock, spec_vegetable, spec_permanent, spec_arable), quartile of farm size and use of rented-in land (uaa_vs; uaa_s; uaa_l; uaa_vl; uaa_1n and uaarent_d), production intensity (totliv) and production typology such as organic production (d_bio). The fourth explanatory variables category contains farmers' characteristics. These characteristics include information about education level (edu_high in case of education higher than secondary school, edu_ low when farmers have education lower than secondary school and adu_agr when farmers have an agricultural education), age (dummies variable for older or younger than 40 years old and square function of the age) and use of internet for farming activities (inform_d). Finally, variables belonging to policy category are identified. These variables referred to farmers' participation to RDP measures and the amount of SFP received for each unit of Usable agricultural Areas (sfp_ha). Dummies variables about participation to farm modernisation measure (measure 121 of RDP) and diversification activity adoption measure (measure 311 of RPD) are considered. In addition participation at any measure of first axis (competitiveness) and participation to at least one measure of second axis are considered (environmental).

Results of both Zero-inflated Poisson model and Zero inflated negative binomial model are provided in table 5 and table 4. Table 4 presents only the portion of logit model (differentiation yes/not) , while in Table 5 results of the full model are presented.

Table 4. Results of full ZIP and ZINB models (zero –inflated model)

Variable (Description)	Variable (Code)	ZERO INFLATED OUTCOME (Logit) (Model 1)		ZERO INFLATED OUTCOME (Logit) (Model 2)	
Use of internet for farm activity (dummy)	inform_d	-2,04102	***	-2,4378	***
Organic farming (dummy)	d_bio	-1,4961	***	-1,6438	***
Location in rural areas with developing problems (dummy)	rur_probsv	0,5782	***	0.7019	***
Location in plain area (dummy)	plain	-0,4530	**	-0,5899	**
Fourth UAA percentile (dummy)	sau_vl	-0,8875	***	-0,8422	***
First UAA percentile (dummy)	sau_vs	0,6098	***	0,5741	***
Amount of UAA	sau1_ha	-0,0122	***	-0,0179	***
Farm rent-in land (dummy)	sauaff_d	-0,7602	***	-0,8076	***
Farm specialization in permanent crops (dummy)	spec_permanent	0,3577	***	0,3852	***
Farm specialization in vegetable (dummy)	spec_orticult	1.4336	***	1.3731	***
Farm specialization in livestock (dummy)	spec_lviestock	0,3431	**	0,3234	*
Square of farmers' age	age2	0,0002	**	0,0002	***
Education lower than secondary school (dummy)	edu_low	0,2923	***	0.2737	***
Household and external labour (FTE)	lav_FTEall	-0,5166	***	-0,6365	***
Farm using only household labour (dummy)	lav_onlyfam	0,5777	***	0,5686	***
Direct cultivation (dummy)	cond_coltdir	-1,2384	**	-1,2163	***
Participation at at least one measure of first axis of RPD (dummy)	rdp_axis1	-0,2764	**	-0,3577	*
Participation to RDP measure 121 (dummy)	rdp_121	-0,6851	***	-0,8441	*
SFP payments per ha (€)	sfp_perc	1,9805	***	2,0005	***
Constants	_cons	1,8729	***	1,7132	***

(*** significant at 0.01; ** significant at 0.05; *significant at 0.1; Not significant variables have been omitted)

Table 5. Results of full ZIP and ZINB models (count variable)

Variable (Description)	Variable (Code)	FULL MODEL ZIP (Model 1)		FULL MODEL ZINB (Model 2)	
Location in mountain area (dummy)	mount	-0,3989	***	-0,4592	***
Location in urban areas (dummy)	poli_urb	-0,2575	***	-0,1197	*
Location in rural areas with developing problems (dummy)	rur_probsv	0.6726	***	0.6903	***
Fourth UAA percentile (dummy)	sau_vl	0,0707	*	0,1033	**
First UAA percentile (dummy)	sau_vs			-0.1463	*
Amount of UAA	sau1_ha	0,0003	*	0,0003	*
Farm rent-in land (dummy)	sauaff_d	-0,0547	*		
Farm specialization in permanent crops (dummy)	spec_perm	-0,0614	*		
Farmers older than 40 years old (dummy)	d_old	-0,1024	***	-0.1431	***
Education lower than secondary school (dummy)	edu_low	-0,19169	***	-0,21756	***
Family live on the farm (dummy)	live_on	0,1773	***	0,1843	***
Household and external labour (FTE)	lav_FTEall	0,0173	***	0,0201	***
Household labour (FTE)	lav_FTEfam	0,0284	**	0,0365	**
Part-time farm (dummy)	lav_partime	-0,3793	***	-0,3970	***
Direct cultivation (dummy)	cond_coltdir	-0,4934	***	-0,4323	***
Participation at at least one measure of second axis of RPD (dummy)	rdp_axis2	0,3420	***	0,3537	***
Participation to RDP measure 311 (dummy)	rdp_311	0,6137	***	0,6664	***
SFP payments per ha (€)	sfp_ha	-0.0001	**	-0,5032	***
	_cons			-0,2970	*
	lnalpha	-	-	-1.6530	***
Constants	alpha	-	-	0.1914	***

(*** significant at 0.01; ** significant at 0.05; *significant at 0.1; Not significant variables are omitted variables)

Tables 4 and 5 contain results of ZIP and ZINB models respectively in the left and in right columns. In table 4, logit models outcome are presented (as binary variables), while the count models outcome are presented (only for observation without zero value) in table 5.

The coefficients of the logit model could be interpreted as probability to observing a zero value of the count variable, thus the positive coefficient of the significant variables means that farmers are more likely to expect value of zero count (that means no diversification activity). Otherwise negative sign means a reduction in probability to observe value zero (which means at least one diversification activity observed). Count model coefficients of (table 4) represent changes in the expected count for the farmers who have adopted on-farm differentiation activities. The two tables show a comparison between ZIP (model 1) and ZINB (model 2) models. Following literature, a zero-inflated outcome (table 4) is not affected by the model selected (ZIP or ZINB) and in fact significant variables remain constant among models. Vice versa, changes between results of ZIP and ZINB are observed in the outcome of count model (table 5), due to difference in probability distribution function. Both model (ZIP and ZINB) have positively passed the Vuong test about the comparison between ZIP versus Standard Poisson model and between ZINB versus Negative Binomial model. Results suggest that due to excess of zero ZIP and ZINB provide a better fit compared to standard count models[1].

The logit model results are presented firstly and then the count model results follow. The results of logit model show that geographical, farm, farmer, household and policy variables affect the probability to observe farm with no diversification activities implemented on-farm. Geographical variables that negatively affect the probability to observe no diversification adopted on farm are the location in plain areas, while the location in rural area with developing problems affects positively such probability. Results show that farmers characteristics such as age, education and new technology use for farming activity strongly affect the probability to diversify. In fact as expected, young and high educated farmers have lower probability to observe no diversification strategy and farmers which use with regularity internet for farm activity have higher probability to apply any diversification strategy on the farms. Farm elements which significantly affect the probability to observe no diversification activity are farm specialisation, legal status and farm size and the production system. In fact, very small farms (belonging to the first quartile of farm size, which has been identified based on the UAA) and farms specialised in permanent crops, vegetable crops, or livestock have less probability to have applied a diversified activity on farms. Otherwise, large farms and organic farms show higher probability to have applied at least one diversified activities. The allocation of household labour between on-farm or off-farm activities and the amount of labour used on-farm affect the probability to observe adoption of diversification strategy on-farm. An increase of the total labour (both household and hired in term of full time equivalents) positively affects the probability to observe diversification activities, while opposite effect is observed for farms that use only household labour for on-farm Such results highlight the labour consuming features of agricultural diversification activities, which require higher labour availability. Results could be read also as positive effects to the local rural economies in term of job creation. Both I and II CAP pillars affect the probability to observe implementation of at least one diversified activity. Unexpectedly, participation to measure 311 or participation to other measures in third RDP axis does not affect the probability to observe diversification strategy. The main reason is in the design, selection mechanism and competiveness for payments of the measure. In fact the majority of participant to measure

[1] Vuong test for model 1 ZIP versus Standard Poisson has obtained score of 25.25 and significance at 0.01, while Voung Test for model 2 ZINB versus Negative Binomial model has shown a score of 24.08 and significance at 0.01.

311 have adopted diversification activity mainly belonging to two diversification categories (rural tourism and renewable energy production plans) and eligible costs are those mainly for covering investment costs or paid workers. In addition the priority mechanism facilitates the founding of farmers located in rural areas with developing problems or in rural area in transition. As pointed out by the resultes such areas have fewer amounts of farmers with diversified activity compared to other areas.

On the contrary, farm modernisation measure (measure 121) shows a significant negative effect on no diversification strategies. Such results confirm expectations that beside to the participation on modernisation measure farmers renew and rethink the entire production system. First pillar payments (SFP) show opposite effects, in fact increasing the amount of SFP received the probability to observe no diversification strategy on-farm is higher.

The results of Diversification Intensity are presented in table 5. Table 5 shows model results for the portion of farms whose value of the dependent variable is higher than zero (only farm with at least one diversification activity implemented). Positive coefficients mean that variables increase the expected count of dependent variable, while negative coefficients reduce the expected count of diversification intensity. As mentioned in the methodology section, ZIP and ZINB provide different results due to distribution function form used. As explained into the methodology the main difference is due to the inclusion of α -coefficient in the ZINB. Value of α is observed positive and significant, which suggests best fit for ZINB compared to ZIP. Model results show that farmers' location strongly affects the expected count of diversification intensity. Location in areas with lower demand of diversification services such as for example in mountain or in urban areas reduces the expected count of the model, while location in areas with development problems pushes farmers to increase their income diversification sources through on farm activity due to lower off-farm opportunities compared to other rural areas. Results highlight that farm characteristics such as farm size and specialisation affect the diversification intensity. Large farms and farm belonging to the larger quartile show an increase of expected count of diversification intensity, due to the possibility to develop strategies to differentiate production to market and to re-use for diversification activity. Vice versa, specialised farms in permanent crops show a reduction in expected count of diversification intensity due to a lower flexibility of farm productions (such variable is significant only for ZIP model). Age and education are variables that strongly affect expected outcome of diversification intensity. Results show that young and educated farmers have higher expected diversification intensity due to managerial skills and entrepreneurship level required to develop on-farm diversification activities. Significant household characteristics are the connection between the household and the farm activity in term of location of the farmers' house on the farm and the allocation of household labour between on-farm and off-farm activities. Results show that when family lives on the farm there are higher expected count of diversification activity and that with an increase in both household and external labour allocated on farm, there is an increase in the expected value of diversification intensity. Such results are also confirmed by the negative coefficient of part-time variable. In fact when the farm and household income are not generated only by agriculture (in the case of part-time) there is less propensity to differentiate income sources from on-farm diversification activity. Again this is confirmed by the significant and by the positive value of cond_dir (legal status direct cultivation) when the main source of household income is generated by farm activity then there is greater probability to observe high diversification intensity. Policy contexts variables affect expected outcome of diversification intensity. Comparing to the logit model, participation to measure 311 becomes significant, with positive sign. Such result allows to consider participation at this measure as a driver of entire farm production system rethinking, where beside to intervention to cofound agri-tourism or production of renewable energy (the only two diversification activities eligible for measure 311), farmers are developing a new business plan, more focused on integration of farm income through diversification activities. Participation to any measure belonging to RDP second axis (environmental), affects positively the expected count of diversification intensity due to the improvement of provision of environmental quality, or to the growth or manage endangered species.

6. CONCLUSION

In this paper, determinants of diversification activities are analysed, using Italian Census micro-data. The paper develop an econometric model which allows to explain determinants of both discrete choice about adoption of diversification activity and the intensity of diversification, measured as a count of alternative diversification categories. Results show that a relevant portion of Tuscany farmers about 10% have diversity the farm activity applying mainly rural tourism, subcontract services and on farm processing.

Model results show that farm, farmer, household and geographical characteristics strongly influence the attitude in diversifying activity. In particular results show that diversification activity requires skill, competence and a large amount of labour which represent a barrier to the adoption for many farms. In fact results confirm previous literature findings about needs to have availability of enough endowment of farm productive factors (mainly labour and land) to develop diversification strategies. This is observed for example by a lower probability to diversify for small farms and for farm with few household labour allocated on-farms.

Results confirm literature about the effect of diversification in representing a strategy to increase household income using resources on-farm such as labour. Results highlight that relations among household labour, external labour endowment and farming systems are central in determine probability to diversify activity and its intensity. Result shows a pictures where on one hand diversification is one of the tools used by farms that are viable from an economic point of view both for their structural characteristics (farm size, total labour available) and that improve their situation by expanding their size (rented land) and finding new ways for improving farm income, through farm modernization, the research of new markets (organic farming) and the use of tools needed to compete on a larger market (internet). On the contrary, there is a group of farms, mainly located in area with development problems, that suffer for structural problems (small size, high age, low education) where the involvement on agricultural activities is going down. Agricultural activities is highly dependent on SFP and the activities that are carried out are mainly vegetable crops, olives and vineyards, likely using subcontractor services and/or family labour that don't have any other possible use. In this case it seems to exist a low interest in investing, modernising or improving farm capacity to provide an income outside that coming from first pillar subsidies.

Results confirm that location and geographical variables determines changes in observed diversification activity. In particular connection between demand for services provided by diversification (e.g tourism, handcraft, or subcontractor services) and expectation between off-farm income sources activities are determinant to diversification adoption and intensity (Lange et al., 2012). Results show that these components are relevant especially in urban areas (which are mainly in plain areas) and in some marginal areas, such as rural area with development problems. In fact these areas have opposite direction in observing diversification strategy or diversification intensity strategy. Urban and peri/urban area shown a high probability to observe diversification adoption while have opposite effect on intensity of innovation. On the contrary, location on rural areas with developing problem, have opposite effects. In this case the location on developing problems represent a barrier to adopt diversification activities, but at the mean time in many areas represent the main source of income creation, due to less or absence of other opportunity for off-farm labour and a necessity to overcome territorial constraints for the farmers that decide to carry on farming.

Results highlight the role of CAP in promoting adoption and intensity of diversification activity. Both first and second pillar payments affect the adoption to diversify, in two opposite directions. First pillar payments reduce the decision to adopt diversification strategy mainly increasing the income for agricultural and livestock production. On the contrary RDP measures promote diversification activity cofounding investments on diversification (third axis) or in technology used to provide services (such as new machinery or new energy plants) through first axis measure; or incentivate a sustainable production of agricultural (organic production) or maintenance and preserving of landscape elements and biodiversity. The wish to try to make a live from farm activities results also by the high use of labour and the application at II and III axis measures of RDP. This farms are viable and wishing to prosecute their activity and improve their results also taking into account the need for some time before having results from investments. On the contrary, low intensity of diversification is related to agricultural activities in which, again, farmers are no longer interested, due to the fact that farms are not viable (high correlation with farm where less than 0.5 FTE from the family household are employed), farmers are relatively aged, less educated. Again in this case there is a high relation with first pillar payment. In other words, farmers seems more interested in income aids and in keeping the farm more for its “potential” value that for the income that it provides. In this case policies and their motivations have to take in account that those farms do not likely respond to mechanisms aiming to improve firm performances.

The paper has several limitation which are connected to the simplification count of the diversificatioactivity which is based on definition of diversification from Italian legislation, and more accuracy in the category of diversification utilized could provide more useful insight. In addition the set of explanatory variables used, does not allow to analyse networking and social capital effects on diffusion and intensity of diversification as well as of learning effects.

Future works in this direction could be directed to improve the quality of the process of adoption of diversification analysis, adding the above mentioned aspects and investigating determinants between alternative categories of diversifications.

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