The state of other gainful activities in the European Union-27: an empirical analysis of trends and determinants

by Muhammad Abid Shahzad and Christian Fischer

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Abstract: The EU agricultural sector has been experiencing drastic changes, as a result the adoption of pluriactivity by farm households is on the rise in different proportions. Understanding the trends and determinants of pluriactivity is key towards efficient policymaking. This study provides a descriptive analysis of the situation and patterns of pluriactivity in the EU. Then, using the fractional probit model, it identifies the most relevant factors associated with the extent of other gainful activities (OGAs). Results indicate that in general, there is a declining trend in pluriactivity. However, there are member states in which OGA as main and secondary activity have increased such as France and Austria. Also generally, non-farm activities can be explained by economic needs, as OGAs are mostly related to farm size and farm types with the lower net value added (such as grazing livestock and field crops) as well as lower farm productivity. OGA as main activity are mainly related to farmer characteristics such as age and gender. Among all age categories, middle-aged farm managers are positively associated with main OGAs. Secondary OGAs are fully explained by farm characteristics (specialization). In addition, medium-sized farms are firmly associated with secondary OGAs. Further studies should investigate the sustainability implications of OGAs using the most recent data.

Keywords: Pluriactivity; Other gainful activity; EU-27

1. Introduction

In 1989, a report named, *The Future of European Agriculture* by the Economist Intelligence Unit suggested that the economies of rural Europe should lessen their dependence on agriculture which otherwise could result in large food surpluses (Mackinnon et al. 1991). As a result, some farm families left farming, others stayed and tended to diversify their income from non-agricultural sources which led to an increase in off-farm employment in the region (Cox et al. 1989). However, the factors influencing the interest and choice of off-farm activities are not always linked with economic conditions (Edmond and Crabtree 1994). Geographical factors, such as vulnerability and remoteness in the mountain regions also favored setting up other economic activities on the farm (López-i-Gelats et al. 2011). In Addition, such non-farm activities are also classified as 'hobbies' (Schwarzweller 1982).

Whatever the rationale for pluriactivity is, its rate of uptake has increased markedly throughout the world (Moxnes Jervell 1999, Quaranta and Salvia 2000, Harsche 2005, Corsi and Salvioni 2017). As a result, the traditional outlook of the rural population as wholly agricultural, is getting obsolete (Haggblade et al. 2007). As the notion of pluriactivity has become a notion of rural development, these pluriactive farms are transforming the rural livelihood into modern agriculture (Liu et al. 2013). Most of these farms are very small farms (<2ha). Considering smallholder farms' importance – they represent about 84% of all farms and produce about one-third of the world's food (Graeub et al. 2016). Whilst over the past few years, pluriactivity has been on the decline in different forms in Europe, where more than one-third of the sole-holder managers were engaged in 'other gainful activities' (OGAs) during 2005 (Development 2009).

The European Union (EU) agriculture sector has been long recognized as multifunctional and family-farms based (OECD 2001). An important aspect of multifunctionality is to setup diversification activities and have multiple job holdings (Lakner et al. 2018). This manifesto supports agricultural rurality and helps maintain environmental and ecological heritage. EU supports and follows protectionism in its agriculture sector, that is to prevent the abandonment of agricultural activities in rural areas. It is committed to protecting its multifunctionality through the regulations, such as EC/1305/2013 and EC/1307/2013 which ensures the sustainability of social and environmental aspects in its rural development policy (Ragkos and Theodoridis 2016). It further emphasizes the integration of rural development policy with such an agricultural system that constitute young farmers and small farms (Commission 2013). With a possible decrease in direct payments, EU agricultural policy continues to support other

gainful activities (OGAs) at household levels. This has an impact on the share of off-farm income in the total income of farm households.

Until recently the EU agricultural sector has been experiencing drastic changes in the last few decades. It has experienced land abandonment on one in four farms between 2003 and 2013 (Commission 2014). The land consolidation process also affected the farm sizes across member states while the utilized agricultural area has remained steady. Yet, a majority of the farms in the EU are still small farms where sole holders look to supplement their household income. There are some country-specific analyses on pluriactivity in the EU and have investigated the rationale of pluriactivity and its impacts on certain management practices.

However, there is no empirical debate found on how the indicators of agricultural development are linked with different extents of OGAs and the actual patterns of pluriactivity on the changing face of rural Europe. Therefore, this paper seeks to study the patterns and trends of OGAs in EU-27 empirically. The aim is to understand the trends, observe any patterns and study the relationship between aggregated farm group shares (i.e., share of farms by gender, type, size and age of the sole holder manager) and different extent of OGAs (i.e., OGA as main activity and OGA as secondary activity).

2. Literature review

Defining pluriactivity

"The term pluriactivity (adopted from the French *pluriactivité*) describes those farm households which engage in activities in addition to farming" (Fuller 1990). Initially, pluriactivity was either regarded as off-farm labour supply or an incidence of off-farm employment. Later on, the terms such as part-time farming, pluriactivity, multiple job-holding, etc. were used interchangeably to define the phenomenon (Gasson and Ruth 1986, Lund 1991, Latruffe and Mann 2015, Lopez-i-Gelats et al. 2015). Sometimes, the term pluriactivity is used interchangeably with the term part- time farming, although it is also the case that pluriactivity can be thought to encompass both part-time farming and diversification (Evans and Ilbery, 1993).

This definitional problem persisted as Chalamwong et al. (1983) noted that the studies in the past used various criteria to define the instances of off-farm work. This resulted in an unsettled situation. To begin with, either to choose off-farm activities of the landholder or the total household. Then, what should measure the extent of pluriactivity, either time allocated off the

farm or the amount of income incurred from the off-farm activity. For example, Gasson (1988) considered any combination of farm and off-farm work as part-time farming while Kada (1980) defined it as an off-farm activity of 30 or more days in a year by all members of the household. Nonetheless, all such definitions were criticized because of their broader implications.

This study follows the definition illustrated by Fuller (1990) as the term 'pluriactivity' subsumes on-farm and off-farm diversification as well as community activities for which household members receive non-monetary benefits rather than a wage.

When only one part of work time is spent on farm work activities and the other part is devoted to activities other than the traditional agriculture, we call these other forms of gainful activities as "other gainful activities (OGAs)". This includes off-farm work (at the level of sole holder manager) and farm diversification (at the level of farm holding). OGAs are further bisected into different extents (as defined by the Eurostat); OGA as main activity and OGA as secondary activity. This study refers to OGAs at the level of sole holder manager as described by the Farm Structure Survey (FSS) in the Eurostat database. We will use the terms "pluriactivity" and "OGAs" interchangeably.

Past research on pluriactivity: multi-dimensions of studies

The previous literature on pluriactivity exhibits a pattern. Initially, documenting its spread and outlining several factors causing the structural change in different regions of the world. Then, exploring its positive impacts on agricultural production and rural livelihood. Finally, analyzing the disadvantages and concerns associated with its vast spread.

At first, the proponents of part-time farming considered its advantages such as increasing rural income level, facilitation in sustainable farming and raising the standards of lives (Bunce 1976, Robson et al. 1987). During this time, several studies laid stress on the stabilization effects of part-time farming on the agricultural structure especially in developed countries (Prindle 1984, Holland and Carvalho 1985, Klodzinski 1987, Robson et al. 1987, Pires 1988, Pfeffer 1989). After the long-extended advocacy to part-time farming in the 1970s and 1980s, studies started to investigate pluriactive farms for their resource use efficiency and sustainability.

Goodwin and Mishra (2004) hypothesized that greater participation in off-farm work reduces on-farm efficiency. Given that labor is one of the key factors in agricultural production (particularly for small farm households), the decreased labor intensity can lower farm productivity (Alwang and Siegel 1999). A greater share of rural labor force involved in off-

farm activities results in lowering the quality of the laborers engaged in agricultural production (Zhang et al. 2008; Brosig et al. 2009) and may even lead to agricultural land abandonment (Morera and Gladwin 2006; Gellrich and Zimmermann 2007).

Pluriactivity has also been investigated for its impacts on the productivity of farms. One view supports that off-farm employment has a positive impact on farm productivity. Taylor et al. (2003) argued that an additional income helps the farmers avoid financial constraints and facilitate the use of capital resources for increased agricultural production. Pfeiffer et al. (2009) studied the effects of off-farm income on agricultural production. They found that off-farm work leads to lower agricultural productivity, as off-farm activities compete with agricultural production for scarce household labor. They argued that household involvement in OGAs also induces a shift toward an input-intensive production system. Paudel and Wang (2002) found that an increased proportion of pluriactive farms showed no adverse effects on the value of farm products. Yet, the authors acknowledged the fear that increased pluriactivity and decreased concentration of large-scale farms can lead to lower agricultural production. Furthermore, non-farm employment can also be seen as a means of keeping small unproductive farms in business. From this view, off-farm work inhibits the growth of large-scale farms that perhaps are far more productive. Some also see the off-farm activities by farmers as leading to the neglect of the rural areas (Zhang et al. 2008; Brosig et al. 2009; Mc Nally 2002). Some authors subjected the productivity of pluriactive farms to the nature of the motive for off-farm work (as being a choice or a necessity) (Gardner 1981, Holland and Carvalho 1985). Off-farm work, which initially was regarded as an income risk management tool has also been challenged under the assumption that it increases the overall vulnerability of the farm (Kinsella et al. 2000, Andersson et al. 2003, Eder 2011).

Some authors noted a simultaneity in increased off-farm employment and farm abandonment especially in some European rural communities (Kunzmann and Wegener 1991). Only a few studies explicitly emphasized the impacts of off-farm work on farm exits. According to Zabawa (1987), the structural change was effectively the engulfment of the farming economy by the non-farm economy, hence, termed it as a ‘survival strategy’ of farmers. Pietola et al. (2003) argued that the exit decisions are made at farmer level and that individual farmer characteristics and the economic situation of the household determines the decision to exit farming. Using a simple model of structural change, Breustedt and Glauben (2007) found that in Western Europe, farm exits were lower in the regions with more pluriactive farms, however, they received higher subsidies and better farmgate prices. Whereas, Kimhi (2000) used myopic

decision and life-cycle models to investigate the farm-exit decisions and found out that even full-time off-farm work did not lead to total land abandonment. The author implied that off-farm work is viewed as a 'stable long-run combination with farming' rather than a means to permanent farm exit. However, farm families making their way out of agriculture were also considered as permanent migrants, and historically most studies found a relatively lesser presence of 'generational continuity' on pluriactive farms (Gidarakou 1990; Moxnes Jervell 1999; Terres et al. 2015). Hence, the concern stays legitimate that farms operated part-time might be linked to a reduced concentration of agricultural holdings.

It is relatively recent that related issues like farmland abandonment and the rationale of off-farm work are being given attention (Mittenzwei 2017, Kuntz et al. 2018). More knowledge on what affects pluriactivity in the EU and how trends are emerging and affecting the overall agricultural outlook is needed to help policymakers introduce better targeted rural development policies (Rosa et al. 2008, Vik and McElwee 2011, Iqbal et al. 2015). Recently, the EU agricultural policy has linked pluriactivity with small holdings which are responsible for rural maintenance, rural development goals and environmental protection (Casini et al. 2004).

Factors affecting pluriactivity

There has long been an interest in the literature in studying the impact of readily observable farm and farmer characteristics, such as farm size, farmer's age and gender, etc. to the occurrence of pluriactivity (Hansson et al., 2013; Maye et al., 2009; McNamara & Weiss, 2005). Studies also concluded that the household and spouse characteristics affect the coice of off-farm work (Dries et al., 2011; Schmitt, 2009). The educational attainment of the farm manager and household labor force particularly influence the likelihood of participation in OGAs (Brosig et al., 2009). Other elements like farmers' intrinsic and acquired abilities such as skills, knowledge, motivation to innovate and diversify also affect the pursuit of OGAs (Niemelä & Häkkinen, 2014).

In addition, the size of the farm is found to be linked with different types of OGAs. First, larger farms can limit the possibility of pursuing an off-farm job because it demands the greater presence of farmers. Second, it can offer flexibility to setup diversification activities (Salvioni et al., 2020). McNamara and Weiss (2005) found out that larger farms are linked to diversification while larger family sizes and younger farmers are linked to off-farm work.

Several external factors are also associated with OGAs. Whether the farm is located near an urban center or is situated in a remote area, also affect the likelihood of farm manager's

participation in off-farm opportunities (Paudel & Wang, 2002). Further, the cost of commuting also influence the decision to leave the farm and become pluriactive (Guttman & Haruvi, 1986). Similarly, the ease of access and distance to nearby markets is also found to be a factor affecting farmers' choice to diversify. The nearer the market, the easier to sale their product, thus favoring on-farm sales of processed farm products (Ilbery & Bowler, 1993; Meert et al., 2005; Vandermeulen et al., 2006). Another element related to the location of the farm is the natural beauty and landscape value. Where a farm's nearness to a touristic area can enhance its potential for diversification and off-farm work, some geographical features like altitude and topography of the farm can also pose constraints (Dries et al., 2011; Liu et al., 2013). Studies indicate that in less-favored areas there is less opportunity for conventional diversification (e.g., processing of farm products) but more "service-related diversification" (e.g. farm accommodation, agritourism, etc.) at places near touristic spots or naturally attractive areas (Sharpley & Vass, 2006). Other external factors like institutional influence, such as government policies and subsidies also affect the direction of agricultural migration. Studies found that government payments decreased operators' involvement in off-farm employment, essentially slowing down the rate of farm exit (Mishra et al., 2014; Serra et al., 2005).

The structural development in agriculture is typically described as a change in the number and size of farms, however, this may not be sufficient to demonstrate the transformation in EU agriculture during the last decades in terms of structural change, production, level of integration in the food supply chain, etc. Nevertheless, dynamics in terms of farm numbers, types and sizes can serve as a starting point to analyze the direction of EU agriculture since the 1970s along this process of structural change. The knowledge on how the indicators of agricultural development affect the phenomenon needs to be updated.

In the view of the literature regarding OGAs and its determinants, the following research hypothesis is formulated, taking into consideration the context of the study area and the data availability:

H_1: Farm and farmer characteristics, such as gender, farm productivity, farm size, type and age of the sole-holder manager, which represent the agricultural development in EU, are particularly associated with the extent of OGAs (i.e., OGA as main activity as well as secondary activity). However, the importance of individual variables may differ for each type of OGA.

3. Materials and methods

Data sources

The analysis is largely based on Eurostat Farm Structure Survey (FSS) data while partly utilizing farm accountancy data network (FADN) database. The FSS is carried out regularly among all member states which allows for comparison and provides representative statistics. The data for OGAs is at the sole-holder manager's level and the geographical coverage is EU-27. The panel covers the period 2005, 2007, 2010, 2013 and 2016. The missing data for the country case Croatia for the year 2007 are interpolated by applying the average of the nearest two years. Due to data reliability issues, the country case Malta is excluded from the analysis.

Interpretational limitations are needed to consider as the methodological changes in survey coverage affected the data for the period 2016. Our unit of measure for all of the variables except "output-input ratio" is the number of holdings. Nevertheless, the modifications undertaken by countries in the survey methods had only a minor impact on the variables selected.

Description of used variables

The statistics are extracted using the measure "number of holdings" for farm and farmer characteristics to ensure comparability and consistency across all variables extracted from Eurostat database. The analysis uses the data for the share of total number of holdings with pluriactivity (including the two sub-categories: OGA as main activity and OGA as secondary activity) and share of the total number of holdings; by gender, farm size, farm type and age of the sole-holder managers. A proxy variable for farm productivity, extracted from farm accountancy data network (FADN), is also included, i.e., output-input ratio. A brief description of variables is given in table 1.

[Table 1 here]

Choice of variables

The choice of explanatory variables is driven by the relevant literature and the availability of data in the dataset.

The size of the farm limits both the capability and opportunity to involve in OGAs. It increases farm income and reduces income risk. Therefore, farm size is expected to be negatively related to pluriactivity (Salvioni et al. 2014). However, the results from empirical studies are not unanimous. Under favorable climatic conditions, there is an inverse relationship between farm

size and pluriactivity (Benjamin and Kimhi 2006; Alasia et al. 2009). Whereas, for areas with a less favorable climate, there is no conclusive evidence (Kimhi and Rapaport 2004; Brosig et al. 2009).

There is no unanimously accepted definition of farm size (Davidova and Thomson, 2014). The most traditional way to measure farm size is by area. However, it has the distinct disadvantage of not accounting for the economic output of the farm. Since the distribution of farm sizes is not homogenous across the EU, it can also be misleading, as it fails to consider vast differences between countries and production types (Lowder et al., 2016). For example, farms of 5 hectares in Germany might not be considered small while the same could be considered large in Spain and Romania. Additionally, specialized "small farms" can also be substantial businesses in terms of their economic value, such as high-value horticultural farms in the Netherlands (Davidova et al., 2012). Clearly, the opposite can also be true, i.e., physically large farms with smaller economic sizes. This latter type of farms is perhaps more prevalent because of less-intensive farming systems in the EU (Temme and Verburg 2011; Estel et al., 2016; Guiomar et al., 2018). Hence, economic farm size is considered appropriate to study the impact of farm size on pluriactivity. First, because of the better comparability it offers throughout the European region which is why the EU institutions and member states choose this measure in their development policies. Secondly, it can be used as a two-way variable, i.e., acting as the proxy for farm income and an indication of farm size.

Farm specialization and type of farm have also been identified as a factor affecting the decisions to work off-farm, as more time-intensive activities leave little time for other economic ventures (Alasia et al. 2009).

Farmer age and other characteristics of the farmer can also affect the decision and are also found to be important with regard to multiple job holdings (Ilbery and Bowler 1993). The literature has mainly concluded a negative effect of age on pluriactivity (Kimhi and Rapaport 2004; Brosig et al. 2009; Martinez et al. 2014). However, age can also act as a proxy for the 'experience' component and may alter the probable inverse relationship between age and pluriactivity.

Data analysis

The analysis is divided into two steps. First, an in-depth descriptive analysis is provided which outlines the trends in OGAs between 2005 to 2016. Then, using fractional probit model, the impact of change in independent variables is estimated on dependent variable. The dependent

variable is in fractional form, i.e., the proportion of farms with OGAs, where *y* satisfies $0 \leq y \leq 1$. In a seminal paper, Papke and Wooldridge (1996) suggested modeling proportions using non-linear, parametric, fractional response models, known since as fractional logit, fractional probit and the like. They proposed quasi-maximum likelihood (QLM) method based on the log-likelihood function which is in the form of

$$\ln L = \sum_{i=1}^{N} y_i \ln\{G(x_i\beta)\} + (1 - y_i) \ln\{1 - G(x_i\beta)\} \quad (1)$$

where N is the sample size, y_i is the dependent variable, x_i represents covariates, β is the coefficient estimate, and $\ln L$ is maximized. They assumed that for all i,

$$E(y_i|x_i) = G(x_i\beta) \quad (2)$$

where $y_i \in [0, 1]$ and typically, $G(\cdot)$ is (most often) the logistic or normal cumulative distribution function. Namely, the logistic function as the fractional logit and the normal distribution function as the fractional probit. The QLM method is proposed to estimate β in equation (2), given by

$$\max\beta \sum_{i=1}^{N} L_i\beta \quad (3)$$

Papke and Wooldridge (2008) developed the panel data extension of this model, given by

$$E(y_{it}\,|x_{it}, \alpha_i) = \Phi(x_{it}\beta + \alpha_i), t = 1, \ldots, T, \quad (4)$$

This non-linear approach allows the estimation of equation (2). Applying this idea to our problem, which is to estimate the extent of OGAs (i.e., OGA as main activity and OGA as secondary activity) which is y_{it} by explanatory variables (such as, gender, output-input ratio, different categories of farm size, type and age of the sole-holder manager) denoted by x_{it} and Φ is the normal distribution function as the fractional probit, we may approximate equation (2) with

$$E[(y_i\,|x_i \in (0,1)] = M(x_i\beta_i) \quad (5)$$

Where M is the distribution function estimated by the fractional probit. Furthermore, we are interested in average marginal effects rather than parameters, as the average marginal effects (MEs) measure the average change in the dependent variable due to a one-unit change in the independent variables. However, for interpretation we will utilize average MEs in terms of the effect size. In the fractional probit model of Papke and Wooldridge (2008), the average MEs for continuous X_i are given by

$$ME_{X_k} = \frac{\delta E(y_i \mid x_i, \alpha_i)}{\delta X_k} \quad (5)$$

As the data is in fractional form, one of the variables from each category is omitted due to collinearity in the regression model. The empirical analysis is conducted using STATA/SE 16.0.

4. Results and discussion

As the agricultural sector in the EU is experiencing changes, farmers look to supplement their household income through OGAs. This section provides a statistical description and illustrates the trends in OGAs. A brief summary of statistics for the variables used in the model estimation is given in table 2.

[Table 2 here]

Pluriactivity: Trends in Austria, Italy and Germany

The number of farms with OGA as secondary activity have particularly experienced progression in Italy, Austria and Germany except for the 5% decline in Germany between 2013 and 2016. Whilst the proportion of farms with OGA as main activity is generally falling in all countries.

Concerning farm type, in 2016, in Austria and Germany, most pluriactive farms are specialized in grazing livestock (25% and 16% respectively) and field crops (13% and 15% respectively) while the majority of pluriactive farms in Italy are specialized in permanent crops (13%) and field crops (8%). Concerning the change in pluriactivity by farm type for Austria and Germany, the net change between 2005 and 2016 for specialized grazing livestock is marked as +7% and -2% respectively, and the share of field crop specialists roughly remained stable. Whereas the change in the share of pluriactivity for Italy by specialized permanent crops marked as -4% with the stable share of specialized field crops.

Concerning farm size, smaller farms are comparatively more pluriactive than medium and large farms. However, between 2005 and 2016, OGA as secondary activity has increased on large farms in all three countries. For example, in Germany, the net change in OGA as secondary activity on large farms has been +7% whereas the net change in OGA as main activity on small farms is noted as -15%. During the same period, the overall pluriactivity on medium sized farms in Austria and Italy has roughly doubled.

Regarding age, Austria and Germany, being relatively younger farming populations, share a greater number of pluriactive farms. From 2005 to 2013, the proportion of younger pluriactive farmers has remained somewhat steady while the proportion of pluriactive middle-aged farm managers has increased substantially in Austria (12% to 22%) and Germany (16% to 24%). In Italy, on the other hand, the distribution of pluriactivity by age groups changed slightly where the older farm managers comprised 3% lesser share compared to 2005.

Pluriactivity as a dominant feature of EU agriculture

Pluriactivity in EU-27 has remained an important part of the agricultural sector. In 2005, 32% of all sole-holder managers were involved in OGAs as main activity while in 2016 the proportion is decreased to 20%. On the contrary, the proportion for OGAs as secondary activity has increased from 5% to 8% during the same period. In 2005, OGA as main activity ranged from 10% in Belgium to 66% in Slovenia while in 2016 from 7% in Luxembourg to 51% in Norway. Similarly, in 2005, OGA as secondary activity ranged from 0.5% in Cyprus to 15% in Ireland while in 2016 it ranged from 1% in Cyprus to 36% in Norway. There is a steady drop in OGA as main activity from 2005 to 2016 while the share of OGA as secondary activity is increasing but at a slower rate.

At the member state level, within different extent of OGAs, some noteworthy differences are observed (see Figure 1). For example, from 2005 to 2016, in Slovenia and Cyprus, the share of OGA as main activity has reduced by 43% and 26%, respectively. Between 2005 and 2016, some member states observed a considerable increase in the share of OGAs as secondary activity, such as Netherlands (14%), Luxembourg (14%), Denmark (13%) and Germany (12%).

[Figure 1 here]

In 2016, farmers' overall pluriactivity is more developed and widespread in Sweden (57%), Finland (50%), Denmark (53%) and Austria (47%) while it is quite little developed in Belgium (17%), Greece (18%) and Czechia (20%). Overall OGAs are more liked in the Northern member states. Next section illustrates the trends in OGAs by different farm and farmer characteristics. A summary of trends between 2005 and 2016 is given Table 3.

[Table 3]

Farm size and extent of pluriactivity

The effect of farm size on pluriactivity seems to differ by the extent of OGAs. The extent of OGA as main activity decreases with the increasing economic farm size while it is contrary for OGA as secondary activity. The extent of OGA as secondary activity has increased everywhere between 2005 and 2016, but more substantially in the higher economic farm size classes. The progression is particularly significant in the large economic size class where the share has increased from 7% in 2005 to 17% in 2016 while in the same period, the share of OGA as main activity has slightly increased from 3% to 4%.

The extent of pluriactivity, in general, seems to decrease with increasing economic farm size. Notably, at the EU-27 level in 2005, around 75% of the economic potential of farms (in terms of standard output) is linked with large economic farms where 88% of the farms operated full-time. In 2016, the share is decreased to 78%.

Economic farm size influences the need for an off-farm income whereas physical farm size affects the ability to engage in OGAs by limiting the amount of time available. Although pluriactivity is influenced by both economic and physical farm size in quite a similar fashion, yet it remains important to briefly outline the trends in pluriactivity by physical farm size.

Traditionally, the sole-holder managers of smallholdings are considered relatively more available to pluriactivity. In 2005, at the EU-27 level, 42% of farmers with the farm of less than 5 hectares have OGAs, and this share decreases when the size of the farm increases. While in 2016, the share for the same farm size class is reduced to 26%. On the contrary, in 2016, the progression is particularly noticed on large-sized farms. The proportion of pluriactive farm managers has increased from 17% in 2005 to 24% in 2016 on farms of more than 50 hectares – which is why there is an increased pluriactivity in Denmark, Germany, France, Italy and Finland. In some countries, pluriactivity tends to spread more uniformly across all farm sizes.

Despite the significant differences in the total number of farms in almost all farm size categories over time, Across the member states, the losses are up to 4.2 million farms, of which, most farms (85%) were sized under 5 hectares. However, the total number of pluriactive farm managers is still considerably higher on smaller farms than on larger farms.

Indeed, at least two alternatives must be true for the possibility of pluriactivity: the availability of off-farm activities on the one hand and the availability of time on the other hand. Time availability is also linked with the size of the farm. In 2016, around 76% of the farm managers are devoting their full time to farming activities which is 12% more than that of the figures in 2005. This increase in full-time farming can be credited to an increase in the number of larger

farms. Most farmers spending less than 50% of an equivalent of the full-time farmer are in the smaller farm size classes (sized less than 10 ha).

Type of farm and pluriactivity

Pluriactivity is also affected by the nature of the main farming activity which is not wholly reflected in physical or economic farm size. Naturally, some activities are more labour intensive than others and may require a constant presence of the manager while some are seasonal in nature and may allow for OGAs. Over the last decade, the specialization of farms has increased. The change is particularly notable in field cropping and mixed farms. Moreover, the proportions of OGAs as secondary activity are on the rise on almost all farm types.

In 2005, about 30% of all pluriactive farm managers are specialized in field crops, around 16% in permanent crops and slightly above 11% in grazing livestock. In 2016, the shares varied moderately with; 29% specialized in field crop, 18% in permanent crops and 19% in grazing livestock.

In many of the Mediterranean countries with field cropping as a major farming activity (Slovenia, Spain, Cyprus, Greece) and also in Poland and Romania, the share of pluriactive farms specialized in field crops has reduced. Yet, in Sweden (58%), Denmark (55%), and Finland (52%) more than half of the total farms specialized in field crops are pluriactive.

Between 2005 and 2016, in the north-western member states where livestock farming is the dominant farming activity such as Luxembourg (17%), the Netherlands (15%), Austria (11%) and Ireland (3%), livestock specialized farms have seen a steady increase in OGAs as a secondary activity. The share has risen by 24% and 14% for Finland and Germany, respectively.

Another one-fifth (20%) of pluriactive farms are categorized as mixed farms in 2016. Regarding the decline in the total number of holdings across the EU, mixed farms share a significant part. However, among the member states with the most mixed farms, some (such as Bulgaria, Hungary, Romania, Portugal, etc.) have somehow maintained pluriactivity between 2005 and 2016.

Between 2005 and 2016, specialization seems to be expanding throughout the EU and tends to influence the choice of OGAs. Specializations, where farmers were more pluriactive, are tending to become lesser pluriactive (and adopting OGAs as a secondary activity).

Age of the sole-holder manager and pluriactivity

The trends in pluriactivity by age of the farm operator are particularly interesting. Between 2005 and 2013, the share of young and middle-aged farm managers decreased from 7% to 6%, 38% to 37%, respectively, while it increased from 55% to 57% for old farm managers. Within these age categories, 'middle-aged' shares the highest number of pluriactive farm managers. Although, overall, the young farm managers constitute a very small share, nonetheless, around 40% of them are engaged in OGAs. Furthermore, between 2005 to 2013, the share of old farm managers with OGAs has reduced from 14% to 12% while for middle-aged farm managers, it remained steady.

Generally, in the EU most small farms are managed by older farmers who are less inclined towards off-farm work or jobs outside agriculture, perhaps due to physical inability or merely out of disinterest and unwillingness. Many of these farms are managed by farmers near retirement or over the age of retirement and are managed as a hobby, also termed as "non-commercial farms" (Sutherland et al. 2019). These farmers mostly continue to work after their retirement age for which motives are generally non-monetary (Sutherland 2012). Consequently, the share of farm managers without OGAs grew in the 'old' farm manager category.

Factors influencing the extent of OGAs

The estimated fractional probit models show the results for the factors affecting different extents of OGAs (i.e., OGA as main activity and OGA as secondary activity). Each estimated model omits at least one sub-category from the main farm category. The results shows that the different extent of OGAs is influenced by different set of variables. A plausible share of estimated coefficients is statistically significant as given in Table 4. Our study also provides the marginal effects of each independent variable to quantify the effect sizes on the dependent variables.

[Table 4 here]

Gender: Gender is found to be one of the relevant factors. The results show that the share of male farm managers is highly significant (at 1% level of significance) and positively related to "OGA as main activity". The marginal effects show a large effect size of 0.44. Farming, in general, in the EU is dominated by male farm managers. Given that 42% of women working

in agriculture are over 65 (by contrast to just 29% for men) explains males' share into OGAs. Similar tendencies are found by Lagerkvist Carl et al. (2007).

Productivity: The ratio of output to input is used as a proxy for farm productivity. Increased productivity is significantly (1% level of significance) and negatively linked with the proportions of farms with OGAs as their main activity, whilst it is not relevant in case of OGAs as secondary activity. Table 4 shows that a 1% increase in farm productivity (output to input ratio) is linked with a likelihood of 0.21 points reduction in the proportion of OGAs as main activity. The effect size suggests that the adoption of OGAs as main activity is linked with economic needs and lower on-farm production. Results from the study by Serra et al. (2004) also indicate that off-farm income is more important to the households experiencing greater volatility in farm income.

Farm type: The only types of farms that are significantly linked with OGAs are specialist field crop and specialist grazing livestock. Farms specialized in field crops are positively linked with both OGAs as main activity and secondary activity and are significant at 5% and 1% level of significance, respectively. However, the effect size is larger in case of OGAs as secondary activity (0.23***). Specialization in grazing livestock is significantly associated (at 1% level of significance) with OGAs as secondary activity. The average marginal effects show an effect size of 0.18. According to the EU farm economics report 2016, farms specialized in field crops and grazing livestock indicated lower farm economic viability and reported lower solvency score than most of the other farm specializations. Furthermore, from 2010 to 2016, at EU-27 level, the farms specialized in field crops shared 5% lower average farm net value added (FNVA) while the share has slightly increased (by 1%) for grazing livestock farms. Additionally, from 2014 to 2015, the average income per unit labour dropped considerably for dairy farms (-16.6%). Put succinctly, the lower net value added and decreased farm productivity on both types of farms (i.e., grazing livestock and field crops) influenced farmers' involvement in OGAs.

However, farms specialized in grazing livestock leave lesser time and opportunity for off-farm income than those of farms with field cropping. Which is why, field cropping is linked with both types of OGAs while grazing livestock is only associated with OGAs as secondary activity.

These findings are consistent with the Italian study by Dries et al. (2011) and contrast with the findings of Salvioni et al. (2020). The literature has also linked the direct relationship between

increased specialization and pluriactivity with the phenomenon of labor outflow (Wang et al. 2017; D'Antoni et al. 2014). Under labor scarcity, smaller farm households tend to use their labor resources efficiently and specialize in one type of farming. This also indicates that farmers on specialized farms are responding to economic pressures and looking towards off-farm income as a strategy to support their livelihood while preventing their way to exit farming.

Farm size: The results from farm size variables suggest that the impact of farm size also differs with the extent of OGAs. The coefficient of "small" farm size is positive and significant at 1%. The average marginal effects yielded an effect size of 0.35. The coefficient for size category "large" is also significant (at a 10% level of significance) for both OGA as main and secondary activity. However, it is negatively related to OGA as main activity (-0.78*) and positively related to OGA as secondary activity (0.45*). In Addition, farm size "medium" is positively related to OGA as secondary activity and is significant at 5% level of significance. A likely explanation would be that small farm businesses are more likely to become pluriactive because they are necessitated to do so. On the contrary, farmers with medium and large farms may not be able to engage in OGAs as their main activity, perhaps constrained by the availability of time. Yet, they show their willingness to diversify income sources and opt for a secondary non-farm activity which could be a consequence of the financial need for a supplemental income and lower on-farm productivity. This is consistent with the findings of Boncinelli et al. (2018) and McNamara and Weis (2005).

Age: The coefficient estimates for young and middle-aged farm managers are significantly related to OGA as main activity at 5% level of significance. However, the sign of relationship differs. The young farm managers are negatively linked with OGA as main activity. The effect size is considerably large (-1.31**) pointing towards an elastic relationship between the proportions of young farmers and that of OGAs. These results could be explained by the relatively lower overall share of young farmers (6%) in the EU as compared to middle-aged (37%) and old farm managers (57%). Additionally, most young farmers manage larger farms with greater economic efficiency and generate higher monetary value of their agricultural outputs (Zagata and Sutherland, 2015) where the extent of OGAs is lower. The middle-aged farm managers are positively related to OGA as main activity, yielding a large effect size of 0.53.

There is a mixed evidence on relationship between age and the occurrence of off-farm activity. One view supports that 'age' is negatively related to pluriactivity, as Alasia et al. (2009) and

Hansson et al. (2013) reported that with increasing age, the extent of off-farm work decreases, which is true for many contexts. The other view is that off-farm work first increases and then decreases with age (Ahituv and Kimhi, 2006; Serra et al. 2005). Pluriactivity provides more income than would be earned otherwise, thus it seems that farmers in their middle years engage in OGAs far more enthusiastically to expand their incomes (Lien et al. 2010). The latter view is in line with our results. 'Age' also represents the experience component of human capital (Bouchakour and Saad 2020) which also explains how middle-aged farmers are better off with their involvement in OGAs. Whilst older farm managers are limited by lesser off-farm opportunities and physical constraints.

Year 2016: The dummy for the year 2016 is to control for the effects of the data break that is not already in the model. The coefficient sign and significance confirmed that the OGA as main activity is influenced by the effect of the change. However, the other model does not seem to get affected significantly. Therefore, we report our results as merely indicative of the trends in OGAs on the face of changing European agricultural sector.

Hence, overall, our results confirm that farmer and farm-specific variables such as gender, farm productivity, farm type, size and age of the farm manager significantly influence the extent of OGAs. Variables, such as male share, output-input ratio, small farm size and young farm managers are particularly associated with OGA as main activity. While farms specialized in grazing livestock and middle-aged farm managers are linked with OGA as secondary activity.

Conclusion

The EU agricultural sector is experiencing significant changes in its structure. The most evident structural developments are reflected in terms of declining number of farms, growing farm size and a trend towards specialization. There is an evident simultaneity in terms of the trends in pluriactivity and these changes.

Based on our analysis of the state of OGAs in the EU-27, it is found that the trends follow a declining pattern. However, within different extent of OGAs, the trends differ. In the EU-27, overall, OGA as main activity has decreased between 2005 and 2016 whereas the proportion of sole-holder managers with OGA as secondary activity has increased. There are some exceptions at the individual member state level in which OGA as main and secondary activity has increased, such as France and Austria. Nevertheless, our results indicated a trend towards the adoption of lesser extensive type of OGAs.

Furthermore, non-farm activities can be explained by economic needs, as OGAs are mostly related to farm size and farm types with the lower net value added (such as grazing livestock and field crops) as well as lower farm productivity. The variable related to farm productivity further explains the association between economic need and the choice of OGAs.

In terms of main farming type, the trends show that OGA as main activity is declining on all farm types. The share of OGA as secondary activity is on the rise on almost all farm types. Our results indicate that OGAs are particularly associated with farm types with the lower farm productivity. The most remarkable differences, between 2005 and 2016, are observed in mixed farms where the share of farms in terms of absolute numbers reduced to almost half. Although the share of farms specialized in field crops with OGA as main activity has dropped drastically, yet, their share in absolute terms is significantly greater than the other farm types. The share of OGAs as secondary activity has particularly increased on farms specialized in grazing livestock. Put succinctly, OGAs as secondary activity are especially linked with farm type.

Regarding OGAs by age of the farm manager, it is apparent that middle-aged farm managers constitute the largest share. Young farm managers, to a greater extent, are negatively associated with OGAs. It reflects that the holdings managed by young farmers appear far more productive and economically stable than holdings managed by middle-aged and older farmers, and that they are, to a lesser extent, pushed towards the need to adopt OGAs. These conclusions are supported by the statistics as well.

Farm size has remained an important determinant of OGAs, where smaller farms are highly associated with it. It appears that pluriactivity will continue to decline, at least as the main activity, as the rate of decline in the total number of farms seems to persist. Our regression analysis suggests that a decline in the total number of farms combined with a stable total utilized agricultural area gave rise to bigger farms which contributed negatively to overall pluriactivity.

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Figure 1: Trends in pluriactivity in EU-27

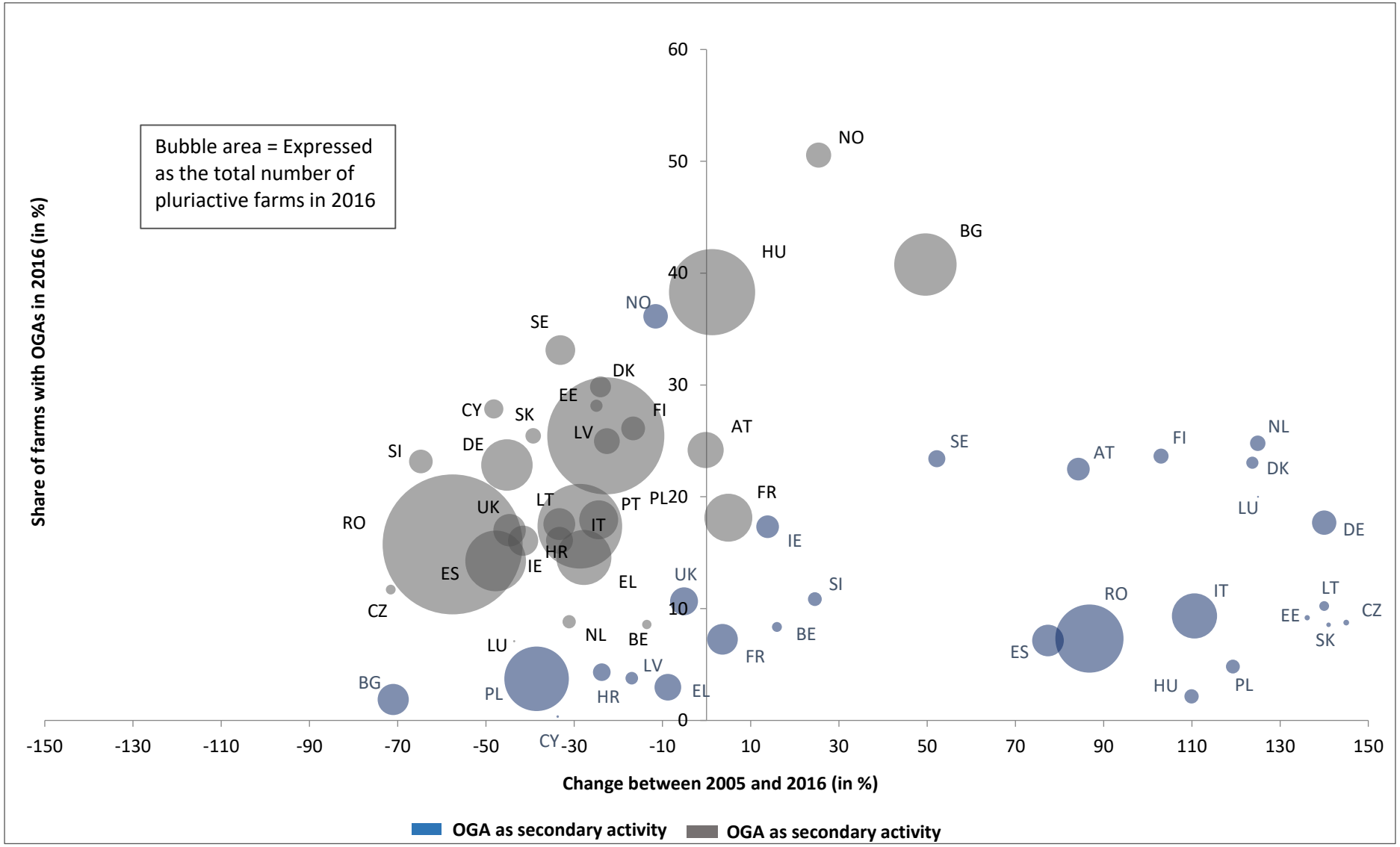

Table 1: Description of the variables used in the model

Variables	Definition (unit)
Dependent variables	
Extent of pluriactivity	
OGA as main activity	Share of holdings with OGAs where farm manager spends more or equal time than the farm work done on the holding
OGA as secondary activity	Share of holdings with OGAs where farm manager spends less time than the farm work done on the holding
Independent variables	
Gender	
Male share	Share of holdings with a male farm manager
Female share	Share of holdings with a female farm manager
Productivity	
Output-input ratio	Ratio of total output in euros of crops and crop products, livestock and livestock products and of other output to inputs including the costs linked to the agricultural activity in euros
Farm type	
Specialist field crops	Share of holdings specialized in field crops
Specialist horticulture	Share of holdings specialized in horticulture
Specialist permanent crops	Share of holdings specialized in permanent crops
Specialist grazing livestock	Share of holdings specialized in grazing livestock
Specialist granivores	Share of holdings specialized in granivores
Mixed cropping	Share of holdings with mixed crops, mixed livestock and mixed crop and livestock.
Farm size	
Small	Share of holdings with small economic farm size (i.e., Standard output of Zero to 24999 Euros)
Medium	Share of holdings with medium economic farm size (i.e., Standard output of 25000 to 99999 Euros)
Large	Share of holdings with large economic farm size (i.e., Standard output of 100000 Euros and above)
Age of the farm manager	
Young	Share of holdings managed by young farm manager (i.e., aged less than 35)
Middle-aged	Share of holdings managed by middle-aged farm manager (i.e., aged 35 to 54)
Old	Share of holdings managed by old farm manager (i.e., aged 55 and above)

Table 2: Summary statistics of variables used in the model

Variables	Mean	Standard deviation	Minimum	Maximum
Dependent variables				
Extent of pluriactivity				
OGA as main activity	0.29	0.13	0.04	0.74
OGA as secondary activity	0.10	0.08	0.01	0.42
Independent variables				
Gender				
Male share	0.78	0.11	0.52	0.95
Female share	0.22	0.11	0.05	0.48
Productivity				
Output-input ratio	1.08	0.20	0.65	1.69
Farm type				
Specialist field crops	0.26	0.14	0.04	0.71
Specialist horticulture	0.02	0.02	0.00	0.14
Specialist permanent crops	0.15	0.19	0.00	0.73
Specialist grazing livestock	0.32	0.21	0.03	0.95
Specialist granivores	0.32	0.21	0.03	0.92
Mixed cropping	0.20	0.14	0.02	0.62
Farm size				
Small	0.73	0.25	0.17	0.93
Medium	0.15	0.10	0.00	0.34
Large	0.12	0.16	0.00	0.63
Age of the farm manager				
Young	0.06	0.03	0.01	0.15
Middle-aged	0.41	0.10	0.22	0.63
Old	0.51	0.13	0.21	0.83

Table 3: Distribution of farms by different farm categories given by number of holdings and their respective share

Variables	2005			2016		
	OGA as main activity	OGA as secondary activity	No OGA	OGA as main activity	OGA as secondary activity	No OGA
Farm type						
Specialist field crops	1340 (40)	161 (5)	1801 (55)	631 (16)	239 (6)	3010 (78)
Specialist horticulture	54 (20)	14 (6)	192 (74)	27 (13)	17 (8)	166 (79)
Specialist permanent crops	761 (33)	84 (4)	1424 (63)	461 (20)	138 (6)	1731 (74)
Specialist grazing livestock	448 (21)	156 (7)	1525 (72)	334 (16)	245 (11)	1576 (73)
Specialist granivores	602 (42)	49 (4)	776 (54)	256 (22)	70 (6)	861 (72)
Mixed farms	1036 (25)	201 (5)	2964 (70)	410 (15)	196 (7)	2103 (78)
Farm size						
Small	4225 (34)	549 (4)	7623 (62)	1971 (18)	639 (6)	8101 (76)
Medium	126 (12)	92 (9)	806 (79)	144 (12)	158 (13)	943 (75)
Large	19 (4)	33 (8)	400 (88)	35 (5)	113 (17)	527 (78)
Age of farm manager						
Young	384 (41)	66 (7)	479 (52)	131 (27)	33 (7)	315 (66)
Middle-aged	2291 (43)	338 (7)	2667 (50)	1093 (31)	257 (8)	2137 (61)
Old	1695 (22)	270 (4)	5683 (74)	850 (15)	346 (6)	4533 (79)

Note: Numbers denotes the total number of holdings (in 000s). The percentage of farms involved in respective OGA is given in parenthesis.

Table 4: Results of the fractional probit model

Variables	OGA as main activity	dy/dx	OGA as main activity	dy/dx	OGA as secondary activity	dy/dx	OGA as secondary activity	dy/dx
Male	1.38***	0.46***	1.32***	0.44***	0.60	0.10		
	(0.28)	(0.09)	(0.25)	(0.08)	(0.40)	(0.06)		
Output input ratio	–0.66***	–0.22***	–0.62***	–0.21***	0.09	0.02		
	(0.15)	(0.05)	(0.13)	(0.04)	(0.18)	(0.03)		
Field crop	0.76***	0.25***	0.40**	0.13**	1.43***	0.24***	1.40***	0.23***
	(0.26)	(0.08)	(0.19)	(0.06)	(0.41)	(0.07)	(0.26)	(0.04)
Horticulture	–0.16	–0.05			–1.43	–0.24		
	(1.64)	(0.54)			(1.52)	(0.25)		
Permanent crops	0.39	0.13			–0.01	–0.00		
	(0.26)	(0.09)			(0.37)	(0.07)		
Grazing livestock	0.30	0.10			1.02***	0.17***	1.08***	0.18***
	(0.29)	(0.09)			(0.35)	(0.06)	(0.14)	(0.02)
Mixed farms	0.47	0.16			–0.0951	–0.02		
	(0.34)	(0.11)			(0.411)	(0.07)		
Small	1.17***	0.39***	1.05***	0.35***				
	(0.45)	(0.15)	(0.32)	(0.11)				
Medium					0.51	0.08	1.05**	0.17**
					(0.55)	(0.09)	(0.43)	(0.07)
Large	–0.53	–0.18	–0.78*	–0.26*	0.54	0.09	0.45*	0.07*
	(0.63)	(0.21)	(0.47)	(0.16)	(0.34)	(0.06)	(0.24)	(0.04)
Young	–3.68*	–1.22*	–3.96**	–1.31**				
	(1.90)	(0.63)	(1.91)	(0.63)				
Middle–aged	1.59**	0.53**	1.60**	0.53**	–0.26	–0.04		
	(0.67)	(0.22)	(0.68)	(0.23)	(0.91)	(0.15)		
Old					0.03	0.01	0.50	0.08
					(0.65)	(0.11)	(0.31)	
2016	–0.22***	–0.073***	–0.19***	–0.06***	–0.10	–0.02		
	(0.08)	(0.03)	(0.07)	(0.02)	(0.13)			
		0.46***		0.44***				
Constant	–2.53***	(0.10)	–2.07***	(0.08)	–2.59***		–2.53***	
	(0.68)	–0.22***	(0.55)	–0.21***	(0.95)		(0.23)	
Observations	130		130		130		132	
Prob > *Chi*^{2}	0.00		0.00		0.00		0.00	
Wald: *Chi*^{2}	215.62		179.83		278.91		230.93	
Pseudo R^2	0.04		0.04		0.06		0.06	