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Research Article

The role of diversification in the revenue composition of Italian farms

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Abstract. The main aim of this paper is to analyse the evolution, patterns and models of revenue diversification in Italian agriculture in different contexts and for different typologies of farms. The analysis is based on the calculation of the inverse of Herfindahl index, by using different variables available in the Italian FADN database (years 2008, 2013 and 2018), followed by a multiple regression model to analyse the relationship between the diversification index and other variables, in order to highlight both the internal and external factors affecting on-farm diversification processes. The article shows that Italian farms have increasingly adopted non-agricultural revenue diversification strategies to reduce risk and maximize factors' productivity. Among these, agritourism is by far the most relevant; however, in the last few years the production of renewable energy has been growing relatively rapidly. Overall, the study shows that on-farm diversification activities can be either an opportunity for a new entrepreneurship in agriculture or a survival strategy for small and marginal farms that are not sufficiently integrated in the national agri-food system.

Keywords: farm revenues, on-farm diversification, FADN, Herfindahl index.
JEL codes: Q12.

1. INTRODUCTION

The literature on entrepreneurship generally agrees on the economic and social value of a certain degree of revenue diversification (Frumkin and Keating, 2011). Scholars consider multiple sources of business funds, and even a sound combination of earned income and public support, as a rational way to reduce the risk of financial exposure, heavy dependence on one specific activity and income decline. This is particularly relevant in agriculture, where farms are small in both economic and physical terms and revenues depend on many natural and external factors, reducing the possibility of control by farmers (Bowler *at al.*, 1996; Mishra *et al.*, 2004; Salvioni *et al.*, 2020). The Agenda 2000 reform of the Common Agricultural Policy (CAP) was the first EU document to set the bar for the recognition of multifunctional agriculture and the policy tools aimed at enhancing the co-joint production of public and private goods (Commission of the EC, 2000). As a consequence of the abandonment of the productivism paradigm in agriculture and the boost to the multifunctional potential of farms, diversification has become a key strategy adopted by an increasing number of farmers in both developed and developing countries to strengthen farm resilience (Darnhofer, 2010; Wan *et al.*, 2016), increase income and improve market access (Barnes *et al.*, 2015; Barret *et al.*, 2001; Fischer *et al.*, 2012; Markelova *et al.*, 2009). Within the large body of literature on the topic, different definitions of diversification can be identified. Processes leading to diversification are investigated as new challenges and opportunities for farmers, and a diversified enterprise has included, amongst others, the introduction of innovative farming practices, but also non-agricultural activities such as direct marketing, recreational activities and tourism, subcontracting and machinery rental, and so on (Barbieri, Mahoney, 2009).

In this study, the concept of diversification is investigated in a two-step process. The first step looks generically at the diversification of the revenue sources (as opposed to farm and income specialisation). The concepts of specialisation and diversification of revenue sources - which include livestock revenue, crop revenue, insurance revenue, public support and other gainful activities - is a key aspect to increase the understanding of farm business and related risk management strategies, also for its policy implications (Hadrich, 2013). This concept should not be confused with pluriactivity, which includes off-farm work as "diversified sources of income"; on the contrary, the concept of diversification of revenues focuses on multiple income generated within a single business (Hansson *et al.*, 2010).

The second step, in line with the majority of recent studies, limits the concept of diversification to gainful activities outside the range of conventional crop and livestock production. On-Farm Diversification (OFD) in non-agricultural activities has been increasingly recognised as a successful business strategy in which a farmer produces non-agricultural goods and services by employing farm resources (capital, labour and land), with the aim of selling them on the market (Dries *et al.*, 2012; Ilbery, 1991; Boncinelli *et al.*, 2017).

The main objective of this paper is to analyse the evolution, patterns and models of diversification in Italian agriculture in different contexts and for different typologies of farms, building on the two different diversification steps described above (e.g., diversification of revenues and OFD activities). The two steps of analysis are reflected in two different methodological tools: calculation of the inverse of Herfindahl index, followed by an Ordinary Least Squares (OLS) regression model.

In particular, the paper proposes an innovative use of the inverse of Herfindahl index, which was used to identify the different sources of farm revenues in Italy over a decade (2008, 2013 and 2018). To our knowledge this is the first attempt to use this index to calculate revenue diversification at farm level. In a subsequent step, the regression model allowed farm revenues to be decomposed into their individual components (product sales, policy support, self-consumption, agritourism, machinery hire, contract labour, active rent, renewable energies), in order to better understand the role played by the single OFD activities in the revenue composition.

Results show that Italian farms have increasingly adopted revenue diversification strategies to reduce risk and maximize factors' productivity. OFD activities have become an important component of revenues and could also be one of the main reasons why small farms resist dismantling and abandonment of activities, thanks especially to the public financial support targeted to OFD. These farms found a new *reason d'être* in the multifunctional paradigm and the realization of goals that pursue different dimensions of sustainability: economic (income generation), social (labour allocation) and environmental (resource management).

The rest of the paper is organised as follows. The next section provides the background of the study, including relevant definitions and a short review of the literature highlighting the scientific and policy relevance of income diversification patterns in EU agriculture. The third section describes the data and the two-step method used for the analysis of farm revenues and OFD activities, followed by a section showing the main results. The final section discusses conclusions and policy implications.

2. BACKGROUND

Farm diversification can be defined as the generation of an income portfolio from activities with different degrees of risk, expected returns, liquidity and seasonality, thanks to which farmers accordingly adjust their input allocation and output mix (Delgado, Siamwalla, 1997). The main effect of diversification would be the allocation of household productive assets among different gainful activities. The attention and development of farm diversification is a consequence of the crisis of the main productivist paradigm dominating up to the 1980s. That crisis related to an unsustainable model of standardised and overspecialised production that led to a structural crisis of the whole agri-food system, including the mechanisms of EU support and dominant models of consumption (Ortiz-Miranda *et al.*, 2013; Wilson, 2007). The constant decline of agricultural process and revenues pushed towards new internal strategies to differentiate products and collocation of the available inputs in the productive processes of farms. Building on the traditional multi-product family farm model, farm diversification became the new goal of agricultural entrepreneurs and the model explicitly supported by the EU with the reformed CAP. The underlying idea is that there are relevant benefits from the distribution of risk among different processes and products, exactly like in small and medium non-agricultural businesses, based on scope economies (Lin, 1974; Chavas, 2001; Pilati, Boatto, 1999; Fernandez-Cornejo *et al.*, 1992; Henke, Salvioni, 2011).

Building from this body of literature, in the following years the concept of diversification has been extended to other activities developed alongside agricultural products or the allocation of inputs in other gainful non-agricultural activities. On this issue, a systematic classification work had been carried on by van der Ploeg and Roep (2003), which became a key reference in future analysis of on-farm diversification in non-agricultural activities (OFD). Following them, OFD may be grouped in *deepening* and *broadening*: while *deepening* includes activities related to vertical integration of processing and marketing along the food chain, *broadening* covers diversification activities not directly connected to physical agricultural production but to agricultural resources, such as subcontracting, renewable energy production, tourism, educational and recreational activities.

Both *deepening* and *broadening* activities can be adopted for different reasons: while in many cases diversification is the consequence of a new skilled generation of entrepreneurs who look at on-farm business opportunities (Weltin *et al.*, 2017; Forleo *et al.*, 2021), in other cases OFD can be considered a survival strategy for small farms that are seeking to escape from stagnation and decline (Meert *et al.*, 2005; Balázs *et al.*, 2009; Khanal, Mishra, 2014).

Looking at the role of policies, in the European Union the 1992 MacSharry reform of the CAP constituted a major step in shifting the support of farm incomes from products (through prices) towards producers (through direct payments). However, it was especially with Agenda 2000 that reforms increasingly coupled support to specific objectives and functions, opening the way to the multidimensional concept of sustainability, which deals contemporarily with economic, social and environmental issues connected to the process of development and growth (Giovannoni, Fabietti, 2013). In this regard, it may be argued that OFD is also the result of policies that support patterns of new on-farm development, enhancing both internal and external factors that drive, directly and indirectly, the diversification process (Boncinelli *et al.*, 2017; Morris *et al.,* 2017; De Rosa *et al.*, 2019). Indeed, diversification is one of the expected outcomes of public policies that are adopted to foster structural change, as well as to improve the contribution of the farming sector to the growth of the entire economic system (Syrquin, 1988; Timmer, 1997).

Since diversification processes are highly dependent on the effective implementation of public support and, above all, on investments in innovative technologies, the result of the diversification process is heavily affected by a country's specific macroeconomic and institutional conditions. Consequently, analysing diversification is also a way to test the effectiveness of a good part of the policy tools of the most recent CAP programming periods.

In Europe, OFD is also becoming a central point in the body of literature on agricultural and rural economics, for many reasons. Firstly, it helps to explain the heterogeneity of farm structures and the persistence of small farms that were supposed to disappear with the ongoing development process (Meert *et al.,* 2005). Secondly, OFD has been one of the key elements that has contributed to the shift from a sectoral to a regional and rural development perspective on farming (Marsden, Sonnino, 2008). Thirdly, there has recently been increasing attention on the entrepreneurial skills required by diversified farming, which in many cases could be different from those required in conventional farming (De Rosa *et al.*, 2019; Dias *et al.,* 2019), and this may also result in tensions between maintaining a focus towards on-farm activity or pursuing entrepreneurial diversification (Morris *et al.*, 2017). All these factors, together with the development of policies targeted to OFD, have contributed to the theory of transition in terms of multifunctional agriculture and the shift towards a post-productivism paradigm, in which diversification is opposed to specialisation and "monofunctionality" (Wilson, 2007).

As mentioned above, OFD can be considered the result of a switch in the main paradigm driving change in agriculture and rural areas, with the rising post-productivist paradigm focusing on the concept of multifunctionality of agriculture and being based on a spectrum of activities in which farmers get involved to different extents. Indeed, OFD becomes the most evident realization of the multifunctional model of agriculture within a post-productivist paradigm, generating a new role for the primary sector in society and new productive functions that support and stabilise farmers' income (Henke, 2004; Bianchin, Galletto, 2009; Salvioni *et al.*, 2020).

However, what we referred to as the entrepreneurial model as well as the survival model do not compete but rather coexist in European contexts, as well as in other developed environments (Wilson, 2007). These are not alternative and opposing diversification models but rather coexist and make the phenomenon of diversification even more complex.

Italy is a particularly suitable case to represent the coexistence of these different models, since its farming sector is characterized by very different agricultural structures, often associated to different economic, social and environmental functions (Henke, Salvioni, 2008). According to the official statistics and recent analyses, in Italy OFD activities represent a still small but rapidly growing share of total farm income, and often offer job opportunities to the family members of the entrepreneur and also to other skilled non-agricultural workers. Over the period 2010-2019, diversification activities represented about a fifth of the total economic value of agriculture in Italy, playing an important role in stabilising the relative weight of the agricultural sector on the national economic system (CREA, 2020). Among the large body of literature on diversification in Italy, only a few studies have investigated the economic and financial effects of diversification at the national scale (Salvioni *et al.*, 2013 and 2020).

3. DATA AND METHODS

The analysis of revenue diversification of Italian farms is based on set of variables from the Italian Farm Accountancy Data Network (FADN), concerning the 2008, 2013 and 2018 accounting years. The selected years allow the evolution of the different factors to be explored over a decade and cover different socio-economic and policy conditions (e.g., the decade 2008-2018 involved two EU Common Agricultural Policy (CAP) programming periods, 2007-2014 and 2014-2020).

The FADN is a European system of sample surveys that take place each year to collect structural and accountancy data of farms. Its main role is to provide monitoring of farm income and commercial activities and assess the impacts of the CAP, through farm-level analyses based on harmonized microeconomic data. The field of observation of FADN are commercial farms, namely those that are large enough to provide a main activity for the farmers and a level of income sufficient to support their families. In practical terms, in order to be classified as commercial, a farm must exceed a minimum economic size, that for Italy corresponds to 8.000 euros of Standard Production. In accordance with EU guidelines, the stratification adopted in the sample design is carried out according to three main dimensions: geographical region, economic size and type of farming.

The final dataset includes 32,960 farms (11,293 in 2008, 11,379 in 2013 and 10,288 in 2018). We selected all FADN farms located in the Italian national territory. Although panel analyses work particularly well with multiple-topic, multiple-year data, since the FADN farms sample has an annual rotation of around 20-25%, in this study it was not possible to use a panel for the examined time and we opted for a multiple linear regression on cross-section data.

With regards to the geographical distribution of the sample, farms are mainly located in the north of Italy (45%), followed by the south (35.9%) and the centre of the country (19.1%). The average farm size is 34 hectares of Utilised Agricultural Area (UAA), and average farm economic outputs are: 149,582 euros of total outputs and 57,750 euros of net income. As regards the socio-economic profile of farmers, the average age is 55 years, and they are mostly male (81.7%).

The evolution, patterns and models of diversification were analysed through a two-step method: calculation of the inverse of Herfindahl index (D_{ft}), followed by an Ordinary Least Squares (OLS) regression model.

In the first step, the inverse of the Herfindahl index (HI) was used to measure the diversification of farm revenues, in order to evaluate the contribution of each activity to total farm revenues (Dimova and Sen, 2010). This can be considered as a rather innovative use of the HI, since in agricultural studies HI (or its inverse) has traditionally been used to analyse products concentration in the market (Garcìa-Cornejo *et al.*, 2020; Yoshida *et al.*, 2019) or for the diversification of crops and activities at the farm level (Pope and Prescott, 1980; Li *et al.*, 2016).

HI is calculated for each farm as an index of revenue specialisation:

$$R_{it} = \frac{A_{it}}{\sum A_{it}} \tag{1}$$

$$H_{ft} = \sum R_{it}^2 \tag{2}$$

In equation (1) A_i is the revenue of activity I and $\sum A_i$ is the sum of farm revenues. Thus, R_{it} is the share of revenue i in total farm revenues in time t. In equation (2), H_{ft} is the Herfindahl index for farm f in time t, calculated as the sum of farm revenues share squared. The types of farm revenues included in the index are product sales, policy incentives, subcontracting, agritourism, energy production, other *broadening* and *deepening* activities. Because this study examines revenue diversification, the Herfindahl concentration/specialisation index is inverted to formulate a diversification index:

$$D_{ft} = 1 - H_{ft} \tag{3}$$

Where D_{ft} is the level of revenue diversification of farm *f* in time *t* and ranges from 0 to 1: larger values denote higher degree of revenue diversification; lower values indicate greater concentration of revenues.

As for the second step, we aimed at detecting and measuring in a more sound and detailed way the structural and economic factors that have pushed farms towards the diversification of revenues, in order to better capture the role played by the single OFD activities in the revenue composition. For this objective, an ordinary least squares regression model was implemented by carrying out a multiple correlation for the calculation of the parameters.

The regression model utilised may be appropriately represented mathematically using the straight-line equation, in order to obtain the operational formulas for estimating the parameters. The relationship between the explanatory variables and the dependent variable can be written as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \varepsilon_i$$

in which the parameters β_i will have to be estimated. For this purpose, it is necessary to observe the explanatory variables and dependent variable on a sample of *n* observations.

The coefficient for each independent variable reflects both the strength and type of relationship with the dependent variable, including the concordance of signs.

In our study the multiple regression model was used to analyse the relationship between the inverse of the Herfindahl index and the other variables, with the overall objective of identifying and measuring the key factors affecting the farm diversification of revenues over time.

For this purpose, the level of revenue diversification (D_{ft}, i.e. the inverse of the Herfindahl Index) was used as dependent variable (assessed at farm level for all types of farms), while covariates (independent variables[1]) include variables related to the socio-economic profile of farmers (education, age and sex), structural features of farms (type of farming, economic and physical size, location, labour use, etc.), and policy support (direct payments, RDP payments). To fully understand the role of OFD activities, as well as the role of both internal and external drivers on the dependent variable, in the regression model farm revenue was decomposed into its individual components, used as covariates: product sales, policy support (direct payments), self-consumption, agritourism, machinery hire (contract services), active rents, renewable energies'.

To address the potential for heteroskedasticity, multicollinearity and endogeneity of the estimated regression models, the results were subjected to validation and verification tests. In particular, the White and Breuch-Pagan tests were used for heteroskedasticity. To consider multicollinearity, the variance inflation factor (VIF) was calculated for each of the independent variables. Finally, to address potential endogeneity, we used the RESET-Ramsey test, which is a general specification test for the linear regression model. With regard to distribution of the residues, the appropriate tests were performed (Testuhat–- residual normality). The results of the multi-collinearity assumption test (VIF value of the coefficients) on the model show that there is no correlation between the coefficients in the different estimated regression models (multi-collinearity does not occur). Furthermore, the assumption tests on heteroskedasticity (White test and Breuch-Pagan test) show that the models are free from heteroskedasticity. The results of the assumption test on the residual model (Testuhat– residual normality) shows that the residuals are not normally distributed[2].

4. RESULTS

The descriptive analysis of the trend of the diversification index (D_{ft}) over the study period provides interesting insights into the level of revenue diversification on Italian farms. First of all, at national level the average value of the index shows a slight increase from 2008 (0.21) to 2013 (0.22) and a more consistent one in 2018 (0.25). This trend shows that Italian farms have increasingly adopted revenue diversification strategies to reduce risk and maximize factors' productivity.

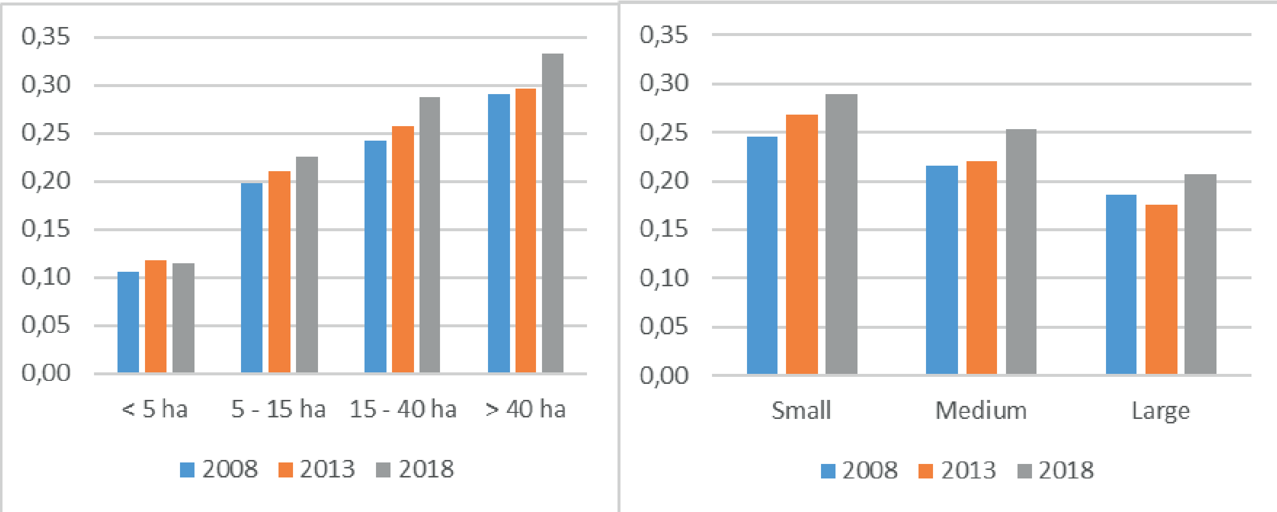
Secondly, a more careful analysis of the index according to the different structural features of farms and their location provides an interesting overview of both the internal and external drivers that may have affected revenues diversification processes.

Regarding internal drivers, a relevant result is related to the observed values and trends of the diversification index according to both the physical and economic size of farms (Fig. 1). When looking at the relations with agricul-

[1] See the Annex (Tab. A.1.) for a full description of the variables used in the regression models.

[2] In particular, the results of this test indicate that the errors tend to be distributed according to a frequency curve with a flattened distribution (or a little pointed - platykurtic distribution) where the kurtosis is very low (negative means that we have light-tails) while the asymmetry takes on a positive value. However, this is acceptable given that the FADN data are representative (the farms are randomly selected from the field of observation), they do not include the micro farms (below 8 ESU) and the sample design is carried out with the rotating panel technique which, however, could lead to a certain discontinuity in the observations.

Fig. 1. Diversification index according to physical and economic size* of farms.



*Small: Standard Output (SO) < € 25K; Medium € 25-100K; Large > € 100K .

tural area, D_{ft} is consistently higher for larger farms compared to smaller ones, while an opposite trend is observed in relation to the economic size, indicating that the diversification of revenues characterises mainly farms with larger agricultural area and with smaller economic size.

To some extent this evidence can be better explained when looking at the diversification index in relation to farm specialisation (Fig. 2): lower values of the index are observed for farm specialised in horticulture, permanent crops and granivores. Traditionally these sectors are characterised by rather specialised practices with smaller areas but larger economic size and, compared to other sectors, direct payments play only a limited role in sustaining their income (EC, 2021). The lower support from direct payments may have affected the diversification index, which includes policy support. On the contrary, Italian farms with mixed production systems and arable crops are traditionally characterised by lower income and higher policy support (CREA, 2021): both factors may have played a role in determining a higher diversification index for these sectors, which are also characterised by farms with larger agricultural areas.

With regards to other farm features observed in the analysis, it is worth mentioning that the diversification index does not show relevant differences according to the age groups of farmers. On the contrary, significant differences are observed between conventional farms (0.20 in 2008; 0.21 in 2013 and 0.23 in 2018), and organic farms (0.32 in 2008; 0.28 in 2013 and 0.30 in 2018), confirming that households with organic production are most likely to diversify activities and revenues (Weltin *et al.*, 2017; Weltin *et al.*, 2021).

When looking at the external drivers potentially affecting the diversification of revenues, it may be observed that the average values of the index vary to a large extent according to the Italian macro-regions and to area typologies (Fig. 3). The higher values observed in central and southern regions of Italy, as well as for intermediate and less favoured areas, confirm that revenue diversification strategies are adopted more in extensive and less specialised farming systems. The significant increase of D_{ft} experienced by farms located in such areas in 2018 is also worth observing. This highlights that revenue diversification could be increasingly adopted as a resilience strategy against income stagnation, especially for farms that are not sufficiently integrated in the national agri-food system and/or located in the most marginal and remote areas.

As shown in section 3, a multiple regression model was adopted in order to better identify the key factors that, to a varying degree and in different ways, manifest their influence on the formation of the diversification index.

The coefficients estimated for the three regression models show a slight difference over time and also that the models obtained are satisfying (see the Annex for additional details on the results and validation and verification tests of the regression models).

The key results of the models are included in Table 1, which shows only the variables that have a maximum level of statistical significance equal to 5%. Other covariates, however, were statistically significant but at a level higher than 5% (e.g., type of farming, presence of machinery, presence of livestock) and were excluded from the analysis.

Fig. 2. Diversification index and farm specialisation.

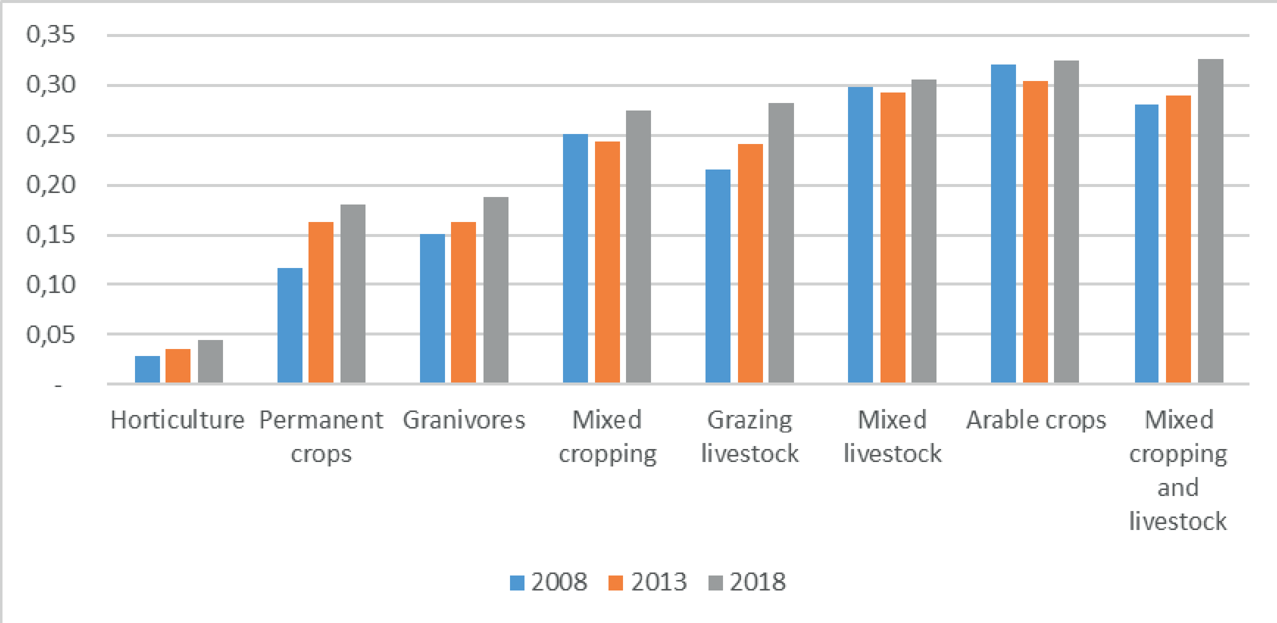
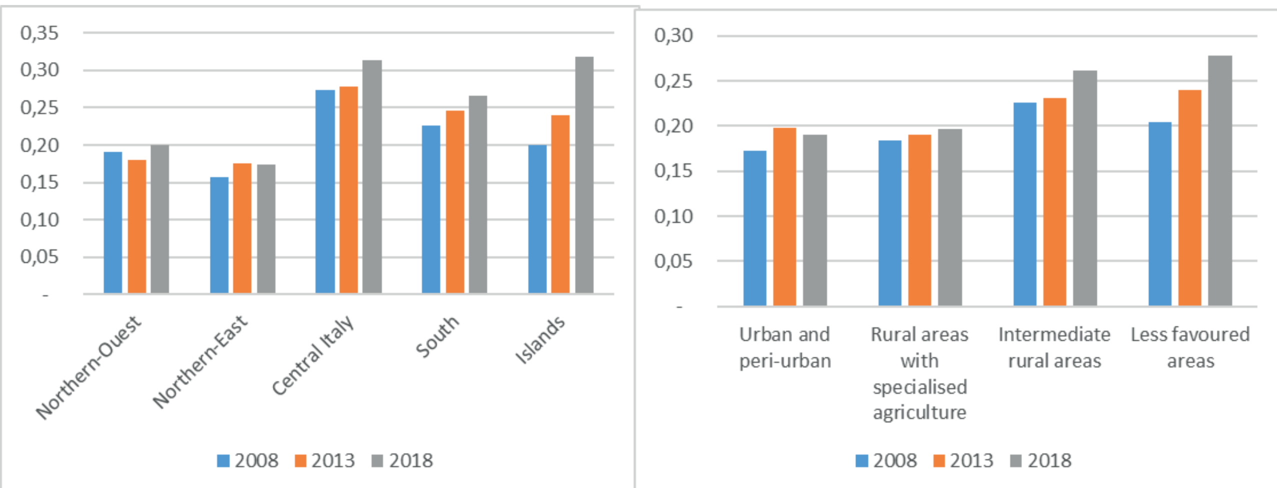


Fig. 3. Diversification index according to Italian macro-regions and area typologies.



Looking at the significant covariates, all the signs of the estimated coefficients are highly significant and consistent with expected results. The only exception is the labour employed, which shows a negative sign in relation to the diversification index. This could be explained by the higher availability of labour for large farms that, as highlighted in the descriptive analysis above, generally diversify their revenues less. To some extent, this value is also in line with the results of Giaccio *et al.* (2018a), who analysed the income sources of Italian agritourism and showed that related income decreases significantly as the number of family members employed on the farm increases.

The regression model confirmed that the structural and economic features of farms played an important role in the farmer's revenue diversification process. Among these variables, the UAA and economic size are significant, even if with an opposite sign, confirming that the diversification of farm revenues increases with the availability of agricultural areas, but decreases as

Tab. 1. The OLS regression results[1].

Coefficients	2008	2013	2018
Const	0,240	0,173	0,206
Geographical area	0,0145	0,017	0,0259
Altimetry	-	0,016	0,0062
Utilised Agricultural Area	0,0006	0,00062	0,00083
Economic size group	- 0,0262	- 0,031	- 0,031
Farm management	- 0,0267	- 0,0183	- 0,0202
Legal Form	-	-	- 0,0047
Type of farming (TOF)	- 0,0030	-	-
Farmer's age	0,00037	0,00054	0,00035
Farmer's gender	0,007*	-	-
Farmer's education level	0,0043	0,0057	0,0035
Level of farmer's engagement	0,0032**	-	-
Farmer's professional conditions	-	-	0,00262
Family work units	- 0,0167	- 0,0062	- 0,0144
Products sales	-	- 1,0936	- 6,2657
Policy support (Direct payments)	1,0381	1,2443	1,1976
Self-consumption	1,2366	2,2012	2,7338
Agritourism	9,0035	1,9581	8,9519
Hire of machinery (contract labour)	2,6674	5,2147	2,4155
Active rent	4,7220	4,9022	-
Renewable energies	-	-	1,0828
Obs.	11.293	11.379	10.288
R^2	0,182698	0,279362	0,276064
F stat	168,056	314,6681	244,7947

Significance: * = 10%; ** = 1-5%; Others = 1%.

[1] A detailed description of variables and additional details on the regression models results are included in the Annex.

the economic size of farms grows. Among the economic variables, the study shows the positive influence of policy support (direct payments), which is one of the key determinants of revenue diversification in all three years under study.

Regarding the single OFD activities, results show that their influence on farms' revenues is significant and relevant, especially for the traditional diversification activities such as agritourism, hiring of machinery (contract labour) and active rent. Particularly high values were observed for agritourism (especially in 2008 and 2018), confirming that it is one of the most important OFD strategies in Italy. Indeed, agritourism plays a central role for the economic development and wellbeing of rural areas in Italy (Lupi *et al.*, 2017; Santucci, 2013), also as the result of a generous policy support (second pillar of the CAP) that has mainly been provided to small and medium-sized farms with tourism activities and located in disadvantaged areas (Giaccio *et al.*, 2018b).

Amongst the other OFD activities, it is worth mentioning that in the last year under review (2018) renewable energy also become statistically significant. Unlike agritourism, the focus on renewable energy as a form of farm diversification has seen little research: additional evidence would be necessary to explore its role in sustaining farming incomes, as well as on the role of policy support in the adoption of income diversification strategies based on renewable energy production (Morris and Bowen, 2020). Results also reveal that some farmer characteristics (i.e., age, gender, education level, major occupation, engagement level, professional conditions) had positive coefficient and were statistically significant but with a very low margin value, suggesting that they are almost completely negligible in influencing the farmer's revenue diversification process.

Overall, the main results of this study showed that both internal and external factors are driving the level and intensity of revenue diversification in Italy, and that their importance and predominance depend on structural features of farms as well as on their geographical location. Supporting policies were identified as a factor that always appeared important, regardless of the size, specialisation, and location of farms, highlighting the key role played by the CAP in supporting farming diversification processes over the last decade.

5. CONCLUSIONS

In this study we adopted a two-step method to describe the evolution, patterns and models of revenue diversification in Italy and to analyse, amongst others, the role played by OFD activities. To accomplish the above objective, we used a nation-wide sample of agricultural holdings based on FADN data.

Overall, the key results confirm the trend identified by official statistics on agriculture (CREA, 2020): OFD activities have become an important component of revenue sources for Italian farms, which have increasingly adopted revenue diversification strategies to reduce risk and maximize factors' productivity.

The analysis of revenue diversification through the Inverse of Herfindal Index showed a widespread and growing share of revenues generated by non-agricultural activities on Italian farms. Such activities are relevant in all farm typologies, probably fulfilling different needs and goals, although higher and increasing values are mainly observed in the most extensive farming systems (mixed farming) located in the central and southern regions of the country and in less favoured areas, confirming that diversification could also be a relevant strategy to avoid dismantling and abandonment of farming.

The descriptive analysis based on the Inverse of Herfindal Index was complemented with a regression model that enabled us to provide additional evidence on the drivers that may affect revenue diversification – and in particular OFD activities – including *internal drivers* (structural aspects and key features of the entrepreneurs such as farm size, economic outputs, age and gender of farmers) and *external drivers* (socio-economic and territorial aspects such as regions, typologies of rural area, altimetry). Results confirm that OFD represent a significant (and growing) share of farm revenues, although with consistent differences amongst farms with different structural features. Data show that diversification strategies are mainly adopted by farms with large agricultural areas and small economic size and that amongst the different OFD activities agritourism – and more recently the production of renewable energy – are giving a substantial contribution to the revenue diversification strategies of Italian farmers.

To some extent the study also confirms the increasing heterogeneity and complexity of different farm structures, which should be better analysed through methods and tools for measuring income but also for evaluating policies (Finger, El Benni, 2021). In relation to the diversification patterns, it is increasingly evident that the coexistence of different agricultural models, with different functions, priorities and organisational structures, call for more effective and targeted policies: a new generation of tools able to address the specific issues and guide the sustained growth of OFD. The call for more targeted and selective policies has been more evident from Agenda 2000 onwards, with the two pillars and institutionalisation of the multifunctional role of agriculture. More recently, both the renewed role of Member States in the CAP implementation and the "new delivery model" have largely opened the way to specific tools in the policy box that enhance OFD activities and set new priorities in the overall support for agriculture and rural areas (Erjavec, Erjavec, 2021; Rac *et al.*, 2020).

The process of OFD could also play a significant role in helping the small-scale agricultural sector to meet the ambitious goals set in the Farm to Fork strategy and, to some extent, the new Green Deal. There is, in fact, a *fil rouge* connecting the diversification of activities in agriculture and rural areas with the overall sustainability of the primary sector, including an enhanced provision of public goods and a reduced and more efficient consumption of natural resources. On this matter, Italy is a very relevant example of differentiated agricultural activity where different models coexist and where farms provide a large set of services, both private and public, meeting the growing demand from citizens for a new role of agriculture and rural areas in contemporary society (Gargano *et al.*, 2021; Mazzocchi *et al.*, 2020).

Further studies could provide additional evidence and more details on trends and patterns of farms revenue diversification in Italy and in other countries, also by addressing some limitations of this study, including the lack of continuity of data over time, and the use of a single database for the analysis. Indeed, while the use of FADN data allowed the internal drivers affecting diversification processes to be explored in detail, an integration with external datasets would be very useful to better capture the external drivers, such as the socio-geographical environment as well as the role played by national and regional institutions and policies in influencing the composition and evolution of farms' revenues. In this regard, the current initiative of converting the FADN into FSDN (Farm Sustainability Data Network) represents a very good opportunity not only to expand the scope of the current network with additional data on the environmental and social practices, but also to improve our understanding on features and development of diversification processes. This new data collection process could also improve the comparability of sustainability performance of different farming systems (including economic performance and income-related issues), as well as better support evidence-based policy making and monitoring, in line with the Farm to Fork strategy objective as well as for future revisions of the CAP.

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APPENDIX

Tab. A.1. Description of the variables used in the regression models.

Variable	Description
Diversification	Inverse of Herfindahl index. Degree of diversification of farms
Geographical area	Localization of farms: North-east, North-west, Centre, South, Islands
Altimetry	Breakdown of farms according to altitude: mountains, hills, plains
Utilised Agricultural Area	Area used for farming in hectares
Economic size group	Economic size of farms, measured in terms of Standard Output
Management	Type of farm management
Legal Form	Type of legal form of the farms (e.g. individual, cooperative)
Type of farming (TOF)	Production specialization of farms
Age	Farmer's age, in years
Gender	Farmer's gender (male, female)
Education level	Farmer's education level
Engagement	Level of farmer's engagement in the farm activity
Professional conditions	Farmer's professional conditions
Family work units	Family workers employed on the farms
Products sales	Gross saleable crop/livestock production
Policy support (Direct payments)	Public support received by farms, in euros
Self-consumption	Value strictly related to the production self-consumption (euros)
Agritourism	Revenues strictly related to the agritourism activity (euros)
Hire of machinery (contract labour)	Revenues strictly related to machinery hire activity (euros)
Active Rent	Revenues strictly related to the active rent activity (euros)
Renewable energies	Revenues strictly related to the renewable energies activity (euros)

Source: Own definitions based on FADN data.

Tab. A.2. Descriptive statistics for dependent variable.

	Diversification		
	2008	2013	2018
Mean	0.21	0.22	0.25
Maximum	0.77	0.76	0.78
Minimum	0.00	0.00	0.00
Std. Dev.	0.18	0.18	0.18
N. Obs.	11,388	11,379	10,288

Source: Own calculation based on FADN data

Tab. A.3. The OLS regression results; year 2008.

	Coefficient	Std. Error	t-statistic	p-value	
const	0.239675	0.012	19.34	<0.0001	***
Geographical area	0.0145160	0.001	11.36	<0.0001	***
Economic size group	−0.0262408	0.002	−17.07	<0.0001	***
Management	−0.0266357	0.002	−14.11	<0.0001	***
Age	0.000370704	0.000	3.00	0.0027	***
Gender	0.00695094	0.004	1.65	0.0986	*
Education level	0.00431206	0.001	3.46	0.0005	***
Engagement	0.00316507	0.001	2.19	0.0284	**
Utilised Agricultural Area	0.000591496	0.000	19.67	<0.0001	***
Family work units	−0.0166712	0.002	−7.83	<0.0001	***
Policy support (Direct payments)	1.03805e-06	0.000	20.97	<0.0001	***
Self-consumption	1.23661e-05	0.000	15.64	<0.0001	***
Agritourism	9.00353e-07	0.000	10.86	<0.0001	***
Hire of machinery (contract labour)	2.66740e-06	0.000	9.62	<0.0001	***
Active Rent	4.72203e-06	0.000	6.71	<0.0001	***
Type of farming	−0.00303143	0.001	−3.71	0.0002	***
Dependent variable mean	0.21		Std. dev. dep. var.	0.18	
Square sum residues	294.77		Std. error regression	0.16	
R^2	0,18		R^2 adjusted	0.18	
F(15, 11277)	168.06		P-value(F)	0.00	
Log-likelihood	4561.68		N. Obs.	11,293	

*, **, ***: significant at 10%, 5%, 1%, respectively.
Source: Own calculation based on FADN data.

Tab. A.4. The OLS regression results; year 2013.

	Coefficient	Std. Error	t-statistic	p-value	
const	0.173163	0.011	15.80	<0.0001	***
Geographical area	0.0169781	0.001	15.32	<0.0001	***
Altimetry	0.0159210	0.002	7.88	<0.0001	***
Economic size group	−0.0308529	0.001	−22.12	<0.0001	***
Management	−0.0182764	0.002	−10.66	<0.0001	***
Age	0.000542593	0.000	4.74	<0.0001	***
Education level	0.00567173	0.001	4.83	<0.0001	***
Utilised Agricultural Area	0.000619377	0.000	20.78	<0.0001	***
Family work units	−0.00617733	0.002	−2.98	0.0029	***
Products sales	−1.09364e-07	0.000	−25.99	<0.0001	***
Policy support (Direct payments)	1.24428e-06	0.000	25.05	<0.0001	***
Self-consumption	2.20123e-05	0.000	18.10	<0.0001	***
Agritourism	1.95806e-06	0.000	15.50	<0.0001	***
Hire of machinery (contract labour)	5.21466e-06	0.000	17.66	<0.0001	***
Active Rent	4.90219e-06	0.000	7.53	<0.0001	***
Dependent variable mean	0,22		Std. dev. dep. var.	0,18	
Square sum residues	256,80		Std. error regression	0,15	
R^2	0,28		R^2 adjusted	0,28	
F(14, 11364)	314,67		P-value(F)	0,00	
Log-likelihood	5424,03		N. Obs.	11,379	

*, **, ***: significant at 10%, 5%, 1%, respectively.
Source: Own calculation based on FADN data.

Tab. A.5. The OLS regression results; year 2018.

	Coefficient	Std. Error	t-statistic	p-value	
const	0.206356	0.013	16.26	<0.0001	***
Geographical area	0.0259509	0.001	20.66	<0.0001	***
Altimetry	0.00621388	0.002	2.81	0.0050	***
Economic size group	−0.0312589	0.002	−20.06	<0.0001	***
Management	−0.0202367	0.002	−11.13	<0.0001	***
Legal Form	−0.00470425	0.002	−2.81	0.0049	***
Age	0.000350416	0.000	2.79	0.0053	***
Education level	0.00371287	0.001	2.93	0.0034	***
Professional conditions	0.00261575	0.001	4.50	<0.0001	***
Utilised Agricultural Area	0.000827093	0.000	19.00	<0.0001	***
Family work units	−0.0144318	0.002	−5.88	<0.0001	***
Products sales	−6.26566e-08	0.000	−17.44	<0.0001	***
Policy support (Direct payments)	1.19760e-06	0.000	12.28	<0.0001	***
Self-consumption	2.73387e-05	0.000	20.40	<0.0001	***
Agritourism	8.95187e-07	0.000	13.31	<0.0001	***
Hire of machinery (contract labour)	2.41550e-06	0.000	11.97	<0.0001	***
Renewable energies	1.08287e-07	0.000	3.83	0.0001	***
Dependent variable mean	0.25		Std. dev. dep. var.	0.18	
Square sum residues	245.53		Std. error regression	0.15	
R^2	0.28		R^2 adjusted	0.27	
F(16, 10271)	244.79		P-value(F)	0.00	
Log-likelihood	4616.37		N. Obs.	10,288	

*, **, ***: significant at 10%, 5%, 1%, respectively.
Source: Own calculation based on FADN data.