European Countryside | volume 14 | No. 2 | p. 363-378 | DOI: 10.2478/euco-2022-0018

ANALYSIS OF SPECIALISATION AND MANAGEMENT IN ITALIAN FARMS THROUGH A PARTIAL LEAST SQUARE-STRUCTURAL EQUATION MODELLING APPROACH

Nicola Galluzzo[1]

[1] Dr. Nicola GALLUZZO PhD., Director of Association of Geographical and Economic Studies of Rural Areas, Rieti, Italy. ORCID: 0000-0003-4674-0621, Email: asgear@libero.it

Received 4 October 2021, Revised 28 December 2021, Accepted 11 January 2022

Abstract: Using Italian data published by the Farm Accountancy Data Network, this study investigates whether certain variables such as labour, assets, crops, cost, and financial subsides allocated through the Common Agricultural Policy are able to act on the management and on the productive specialisation of Italian farms, and focuses on assessing the main relationships that exist between these variables and the items correlated to them in 8 main types of farming for the period 2004–2019. The results have revealed that while the type of farming practiced has had an influence on farm management, the impact of financial subsides allocated through the CAP has differed. This research fills a gap in the literature by investigating the main relationships that exist between farm specialisation and farm management through the PLS-SEM. that enables the identification of which variables have the greatest influence on the management of Italian farms.

Keywords: PLS-SEM, CAP, Second pillar, FADN, crop specialisation

Highlights:

- In Italy there has been a significant increase in the land capital of farms over the last decades.
- Labour, assets, cost, and CAP subsides have also differed in function of the farming specialisation.
- The dimension of farms and the crop specialisation have had an influence on the management of Italian farms.
- The financial subsidies allocated through the CAP have influenced on the management of Italian farms.

1. Introduction

Every ten years, the Italian National Institute of Statistics (ISTAT) usually carries out a Census aimed at assessing the main changes occurring in the primary sector. At the same time, every year, with the Farm Accountancy Data Network (FADN), the European Commission analyses the impact of the financial subsidies allocated through the Common Agricultural Policy (CAP) on a sample of farms in the countries of the European Union. Comparing the Italian Census dataset from 1990 to the most recently published EUROSTAT and ISTAT data, it emerges that there has been a sharp increase in the usable agricultural area of Italian farms, while there has been a significant decrease in the number of farming enterprises as well as of farmers over the same period. The main consequence of this has been an increase in the average land endowment of Italian farms, which is now close to 10 hectares, albeit this figure remains notably lower than the average European value of around 14 hectares, as reported by the EUROSTAT statistics. The reasons for the decrease in the number of Italian farms are manifold. In general, the aging demographic of farmers, the scarcity of new labour-savings technologies, and various exogenous constraints linked to a modest generational turnover of farms to young farmers, have induced many farmers to quit and retire (Galluzzo, 2018a). Since 2007, however, specific financial subsidies allocated through the second pillar of the CAP have had an effect in stimulating a greater generational turnover in farms that has led to notable improvements in technical efficiency (Galluzzo, 2018a; 2020).

2. Theoretical background

In non-European countries such as the United States, there has been an observable decrease in the number of farms in recent years along with an increase in land capital, linked to a higher level of specialisation in farms than in the past due to significant investments in new labour-saving technologies and a consequent low level of demand for human labour in agriculture (Janssen, 2018). Indeed, according to this author, the dimension of farms is one of the main variables able to influence farm management. Through productive diversification and changes in the level of labour capital invested in farming, there

have been improvements in farm management even if, in the literature, some studies have argued that labour capital plays a more central role in stimulating the management of farms than their physical dimension in terms of land endowment (Langemeier & Jones, 2000).

In fact, farm management represents one of the most important pillars in increasing the technical and economic efficiency of farming (Galluzzo, 2018a; 2019; 2020; Latruffe et al., 2017; Forleo et al., 2021). An adequate farm management is able to increase productivity, even if the farming specialisation and the geographical location of farms also have some impact on productivity, as estimated using different quantitative approaches (Liu et al., 2021).

In dairy farms, an intensification of the productive process has resulted in an increase in investment, as well as a more rationale and efficient use of the inputs (Soteriades et al., 2019). These authors have argued that changes in the productive diversification and an intensification in dairy production in farms have resulted in greater inputs and decreases in technical efficiency compared to farms following other types of specialisation, owing to a different utilisation and exploitation of land capital.

For farmers, it is very important to diversify their production and to obtain a positive effect from financial subsidies allocated through the CAP, which have had some impacts on the technical efficiency in farms (Galluzzo, 2020; Forleo et al., 2021; De Roest et al., 2018; De Rosa et al., 2019). In any event, one of the main targets of farmers is to reduce risks in the management of farms, and addressing risk implies a use of financial resources by farmers in function of a different productivity and allocation of the resources available to them (Vigani & Kathage, 2019), even if diversification in farming represents one of the most efficient tools for reducing income variability (Vera & Colmenero, 2017).

In general, an increase in crop specialisation has positively affected agricultural productivity in farms, also increasing the opportunities for the commercialisation of farmer's productions. Using quantitative methods, it has been possible to corroborate this theoretical hypothesis (Sekyi et al., 2021), offering policy makers some insights in regards to the specialisation and improved management of farms.

Other quantitative studies carried out in Sweden aimed at assessing the relationships between farm specialisation and diversification have shown that diversified farms have had a modest impact on the total revenue of farms (Hansson et al., 2010); hence, as these authors argue, the degree of specialisation and diversification have been most influenced by management in terms of the specific characteristics of the farm's business and other intrinsic features of individual farms the farmer's style of management. Therefore, the differences in a farm's management and its specific characteristics such as its land capital, level of investments, and productive specialisation, can all influence different development strategies and determine different outcomes in regards to the farmer's targets and their efforts (Hansson et al., 2010). Bowman argued in 2019 that the farm's specialisation impacts on farm financial performance, and also depends on the magnitude of economies of size and scope. He argues that a productive specialisation is associated with an increase in farm performance, and that productive diversification has some effects on crop and livestock production.

The theoretical framework suggests that farm size, in terms of land capital, is inversely related to specialisation and directly related to decisions regarding diversification (Anosike & Coughenour, 1990). Even if these two authors have also investigated other factors correlated to decisions regarding diversification and specialisation, their studies have in fact shown that land tenure, off-farm work, and educational level determine an increase in land capital and, consequently, farm size, which are linked to a more efficient farm management, and that these are two variables able to reduce the rate of increase in farm specialisation (Anosike & Coughenour, 1990). In fact, farm size is a driving factor in technical efficiency but has no effect on farm specialisation (Mugera & Langemeier, 2011).

In literature, several studies have assessed as the productive specialisation is associated with an increase in farm performances in terms of productivity, technical efficiency and financial performances as well (Bowman, 2019; Galluzzo, 2017; Garrone et al., 2019; Mugera & Langemeier, 2011; Pokharel et al., 2020). Not so common are quantitative approaches aimed at assessing which variables correlated to the productive diversification have had some effects on the management of farms (De Roest et al., 2018).

Tab 1. Main variables and items investigated in the quantitative model. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

Variable	Item	Description	Code
Management	Total output	Total production yield of farms	SE131
	Economic size	Economic size in terms of income	SE005
	Efficiency	Incidence of output on total produced input in farm	SE132
Assets	Land, permanent crops, and quotas	Value of fixed assets in land	SE446
	Buildings	Value of buildings used in farms	SE450
	Machinery and equipment	Assets in agrarian capital	SE455
	Breeding livestock	Agrarian capital made up by animals	SE460
Cost	Fertilisers	Expenses for fertilisers to crops in Euros	SE295
	Crop protection	Expenses for protection to crops in Euros	SE300
	Machinery and buildings current cost	Expenses for agrarian capital in Euros	SE340
	Energy	Annual cost of energy in Euros	SE345
Crops	Other field crops	General field crops	SE041
	Forage crops	Forage crops in hectares	SE071
	Dairy cows	Number of cows for dairy in production	SE085
	Cattle	Number of cows for beef in production	SE085
	Sheep and goats	Number of sheep and goats in production	SE086
	Pigs	Number of pigs in production	SE100
CAP	Total direct payments	Total payments allocated under the first pillar of the CAP in Euros	SE606
	Environmental subsides	Payments made to farmers engaged in environmental protection measures	SE621
	LFA subsides	Payments under the second pillar of the CAP made to farms located in disadvantaged rural areas	SE622
Labour	Paid labour input	Paid labour input expressed in Annual Working Units	SE020
	Arable land	Arable land in hectares	SE026

The theoretical model of production suggests that land capital endowment is a key factor in the management of farms that is inversely related to specialisation and directly related to decisions regarding productive diversification (Anosike & Coughenour, 1990), technical efficiency and on-farm diversification (Forleo et al., 2021). Other studies argued as land capital does not affect predominantly farm specialisation (Mugera & Langemeier, 2011), which has other fundamental links to other variables as financial performances. Furthermore, in the theoretical model of production in farms, other variables have been involved in the productive process as labour, asset, costs correlated to the material input, fixed capital and other investments. In literature, many authors have pointed out a fundamental even if unclear effect of financial subsidies allocated by the Common Agricultural Policy to the productivity and technical efficiency (Galluzzo, 2018b; Rudinskaya et al., 2019; Minviel & Latruffe, 2017; Garrone et al., 2019). In this study it has used a theoretical approach based on the productive process as land capital, assets, fixed capital, costs in order to assess the relationships among these variables and the effect of farm specialization on the farm performances and management.

The main objective of this study was to assess whether productive specialisation has acted on management in a sample of Italian farms included in the FADN dataset, and to identify which variables from 5 different clusters, namely assets, cost, crops and animals, CAP subsidies, and labour, have a relationship, both with farm management and with each other. Each of these variable clusters comprise different items able to generate a formative link, as reported in table 1. Furthermore, each variable is represented through a formative model connecting different items which have had some effects on the variable.

3. Methodology

The source of the data utilised in this study is the Farm Accountancy Data Network (FADN), an annual survey carried out on a sample of farms in different European countries in order to assess the impact of payments allocated under the Common Agricultural Policy, which is published by the European Union Commission (Galluzzo, 2018a). For the purposes of this analysis, a sub-sample has been used made up only of Italian farms, investigated during the period 2004 to 2019.

The principal aim of this study is to assess some cause-effect relationships in respect to the sample of Italian farms included in the FADN dataset, stratified in function of their specialisation according to 8 main typologies of farming, through a quantitative non-parametric approach called Partial Least Square Structural Equation Modelling (PLS-SEM). The FADN dataset is made up of 8 typologies of farming, proposed by the European Union in 2008 by Regulation (EU) 2019/1242, with farms classified in function of the predominant production representing more than two thirds of its total output. These 8 main types of farming proposed by the European Union are: Field crops, Horticulture, Wine, Other permanent crops, Milk, Other grazing livestock, Granivores, and Mixed. However, in the analysis, only 7 type of farming excluding horticultural and vegetables farms have been investigated due to the lack of data with the risk of estimating non-significant the relationships among variables in the PLS-SEM.

The analysis has been carried out using the Smart PLS 3 software in order to estimate the cause-effect relationships between variables in the Partial Least Square Structural Equation Modelling (PLS-SEM) (Ringle et al., 2015).

The PLS-SEM is appropriate for the research objectives since it fits well to the specific features of the analysis and to the observation sample, namely a scarcity of theoretical models in literature able to be applied to other areas of study, and a modest size of the sample investigated, which in this case comprises less than 4,000 farms (Hair et al., 2017a; 2017b; 2016; Tenenhaus et al., 2004; Galluzzo, 2018a; 2019). In fact, a huge advantage of the PLS-SEM non-parametric model is that it needs no restrictive underlying assumptions compared to the Covariance Based Structural Equation Modelling (CB-SEM) (Hair et al., 2017a) that, in contrast, has a well-defined field of application in literature, with lots of studies and a priori assumptions, a theoretical framework, and other constraints (Hair et al., 2016).

In relation to this research, the scarcity of previous studies in the literature concerning the relationship between management and crop specialisation as well as other basic theoretical assumptions have pushed the choice towards using a PLS-SEM approach (Galluzzo, 2018a; 2020). In this study, a formative approach has been used for each variable, underlined by the direction of the single-headed arrow that moves from each indicator or item (yellow rectangle) to the variable. In the formative model, the indicator has a direct link of causality to the latent variable (Wong, 2019).

The Structural Equation Modelling describes the causality between certain latent variables through an iterative approach that is aimed at estimating both the internal and external correlations defining, in respect to each variable and item, the value and the sign of correlation (Hair et al., 2017b; 2016; Tenenhaus et al., 2004, Wong, 2013; Vinzi et al., 2010; Galluzzo, 2018a; 2020).

Briefly stated, the PLS-SEM model can be written considering the differences between exogenous and endogenous variables, according to the formula proposed by Monecke and Leisch in 2012, as:

$$Y = YB + Z$$

where Y is the exogenous or endogenous latent variable matrix and Z is the error, which is assumed to be $E[Z] = 0$. B represents a coefficient in this equation. Further, the main elements in the matrix of coefficients are assumed to be equal to zero when the elements of the adjacency matrix are also zero (Monecke & Leisch, 2012). As such, each latent variable is tightly correlated in a direct expression of the previous latent variable in a system of many interrelated equations (Hair et al., 2017b; 2016; Monecke & Leisch, 2012).

4. Results and discussion

Figure 1 is important in explaining the main cause-effect relationships among all variables in the PLS-SEM approach used in all the Italian farms that are part of the FADN dataset. Analysing the results, it emerges that the variable crops has had the lowest value of R^2 (0.37) able to explain the variance. In contrast, the two variables, labour (0.90) and cost (0.86), have had the highest value of R^2 explaining more than 85% of the variance.

The strength of the cause-effect relationship between variables and between variables and items is indicated by the p-value in the arrows. The p-value has been estimated using the bootstrapping approach in the PLS-SEM with an adequate number of interactions of at least 300 interactions.

The variable management has been strongly influenced by three indicators as total output, economic size in terms of income and efficiency that have been statistically significant with a p-value < 0.001. This has corroborated as proposed in literature according to which the technical efficiency, the dimension of farms, in terms of economic size, and productivity have influenced the management of Italian farms (Galluzzo, 2017; Bowman, 2019; Garrone et al., 2019; Mugera & Langemeier, 2011; Pokharel et al., 2020). Furthermore, the variable management has been strongly influenced by the incidence of output on total produced input in farm by the variables cost, CAP, and crops. In contrast, the variable assets had not had any strong relationships with the variable management; hence, investments in fixed and agrarian capital, machinery and buildings do not impact on the management. The variable financial subsidies allocated through the CAP and the variable labour have both had a significant impact on the variable crops. Addressing the analysis to the total effects, the research findings have revealed that the variables labour, crops, CAP and labour have had the highest effect on the management, while the impact of the variable assets has been very modest. Drawing some conclusions, it emerges as the financial subsidies allocated by the Common Agricultural Policy have had an indirect correlation on the management decreasing the efficiency and productivity as argued by other studies (Garrone et al., 2019), Findings have corroborated the theoretical hypothesis according to which CAP subsidies impact on the management reducing the productivity and the technical efficiency in farms (Garrone et al., 2019; Minviel & Latruffe, 2017; Latruffe et al., 2017; Galluzzo, 2020). At the same time, the variables cultivated areas with specific crops, the cost and the labour, in terms of hours, have had a direct link to the management. Research outcomes have underlined as increasing the land capital there has been a growth of working units with some effects on the variable management.

The estimation of the multicollinearity among all investigated variables has pointed out as there is no collinearity in all typologies of farming specialization and in the base model because the Variance Inflation Factor (VIF) in inner and outer model has been under 3 and in a range between 1 and 2.970. Addressing the attention to the test of reliability of the construct, it has used the index of composite reliability that has been 0.736 for the variable management above the threshold of 0.70. The Average Variance Extruded (AVE) has been for the variable management a good value of convergent variability close to 0.599. The value of the rho_A reliability coefficient for the variables CAP, assets, cost, crops and labour, has been above 0.90 with the exception of the variable management close to 0.882.

The model fit has pointed out a modest fit in this research with an adequate Standardized Root Mean Square Residual (SRMSR) close to 0.14 and a Normative Fit Index equal to 0.6. A literature review in the field of study in farms and agricultural economics do not seem to define an optimal threshold for the model fit. Furthermore, because this research has tried to fill the gap in the literature about the relationships between management and specialization using the PLS-SEM, there is no reference studies able to define an adequate threshold of evaluation of the quality of the model fit and its goodness. A reason of a modest fit model is due to a lot of items and variables involved that can act to the complexity of cause effect relationships.

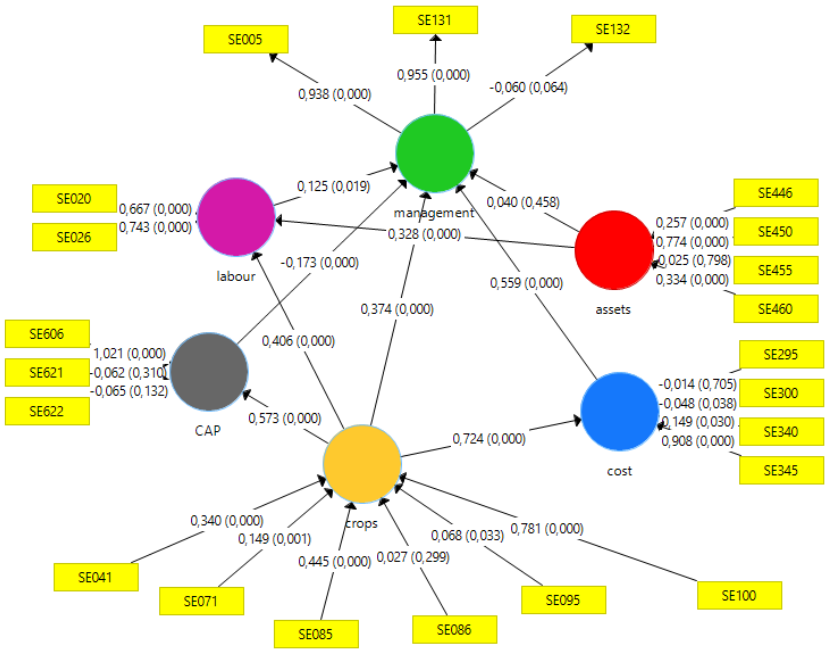

Fig 1. Main results in all Italian farms included in the FADN dataset. The number is the weight of the variable and in brackets its p-value. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

The descriptive statistics of the outer weights in the complete model of all type of farming have pointed out as statistically significant relationships in all investigated variables with the only exception of the link assets-management that has not been statistically significant (Tab. 2). An indirect correlation has been assessed between the variable CAP and management that implied as an increase in financials subsides allocated by the Common Agricultural Policy has been able to reduce the management of farms due to a reduction of productivity and technical efficiency as argued by other studies (Garrone et al., 2019; Forleo et al., 2021; Galluzzo, 2020; Minviel & Latruffe, 2017).

Table 3 shows the main results of the model evaluation in all variables involved in the PLS-SEM in the variable management both in the complete model and also in each type of farming. The variable management has pointed an acceptable value of the rho_A in all type of farming. The other quality criteria in the PLS-SEM have underlined a good value of Composite Reliability in the complete model and in each type of farming above the acceptable threshold of 0.60 (Hair et al., 2016). The Average Variance Extracted has been above the required minimum level of 0.50 (Hair et al., 2016), hence, the variable management has been able to explain very well the variance in the model. The Cronbach's alfa has pointed out some fluctuations in each type of investigated farming due to the heterogeneity in the items and variables correlated to the management.

Tab 2. Outer path coefficient and other main descriptive statistics investigated in all variables in the PLS-SEM complete structural model. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

Variable relationships	Path coefficient	Sample mean	Std. Deviation	t-statistics	p-value
CAP -> management	-0.173	-0.179	0.022	7.749	0.000
assets -> labour	0.328	0.332	0.032	10.225	0.000
assets -> management	0.040	0.035	0.056	0.725	0.477
cost -> management	0.559	0.567	0.038	14.721	0.000
crops -> CAP	0.573	0.577	0.038	14.919	0.000
crops -> cost	0.724	0.722	0.028	26.108	0.000
crops -> labour	0.406	0.404	0.025	16.003	0.000
crops -> management	0.374	0.381	0.053	7.035	0.000
labour -> management	0.125	0.121	0.036	3.431	0.003

Tab 3. Quality criteria valuation of the variable management in the PLS-SEM complete model and in each type of farming. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

Variable	Cronbach alfa	rho_A	Composity reliability	Average variance extraxted (AVE)	Cronbach alfa	rho_A	Composity reliability	Average variance extraxted (AVE)
	Complete model				**Type of farming: field crops**			
management	0.532	0.882	0.736	0.599	0.449	0.661	0.642	0.528
	Type of farming: granivores farm				**Type of farming: milk**			
management	0.480	0.824	0.707	0.570	0.637	0.965	0.805	0.648
	Type of farming: mixed				**Type of farming: other grazing livestock**			
management	0.593	0.953	0.780	0.640	0525	0.950	0.759	0.643
	Type of farming: other permanent crops				**Type of farming: wine**			
management	0.515	0.790	0.719	0.552	0.227	0.732	0.601	0.575

Focusing attention on the Italian farms specialised in field crops (Fig. 2), the cause-effect relationships among variables have highlighted a significant impact of the variable crops on the variable labour, as well as a significant impact of the variables cost, labour, CAP and crops on the management. The statistical significance in the relationships among variables is expressed in terms of p-value in figure 2. It is important to observe that all the items have had a direct and significant impact on the variable CAP. This latter aspect implied as the cluster field crop is made by an heterogenous typology of farms which need different subsidies to implement their production.

Summing up, the management of Italian farms specialized in field crops have been strongly influenced by the variable labour and arable land in terms of cultivated hectares even if the type of specialized crops in hectares, expressed by the variable crops, did not impact the management. The variables subsidies allocated by the CAP and costs correlated to the items energy and the invested agrarian capital (machinery and buildings) have had a direct effect to the management of farms. This explains as an increase in energy costs, correlated to the machinery endowment in field crops Italian farms, is able to influence the management directly and the decisions of the farmer.

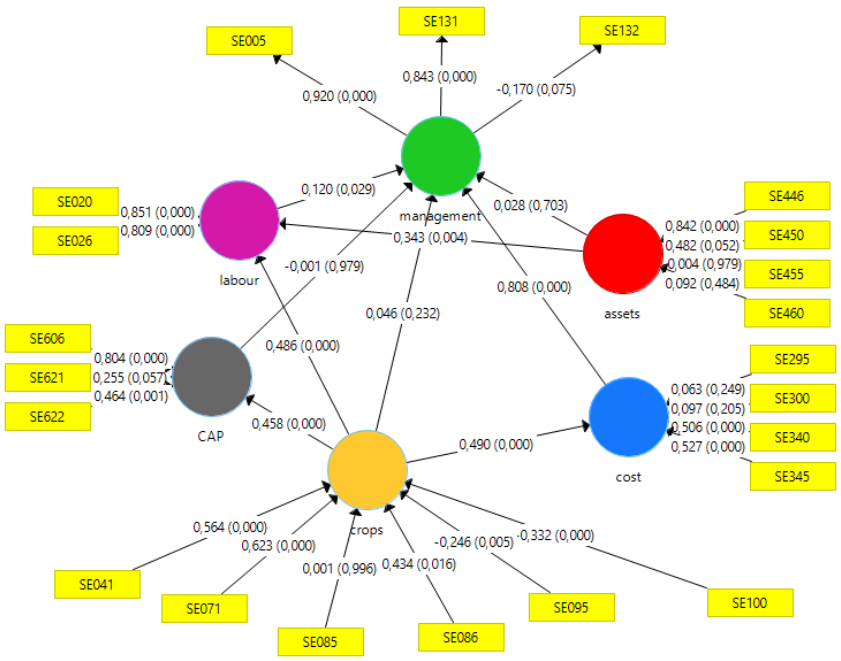

Fig 2. Main results in all Italian farms included in the FADN dataset specialised in field crops. The number is the weight of the variable and in brackets its p-value. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

In the Italian farms specialised in granivores (poultry and pigs), the research outcomes have revealed a drop in the R^2 (0.68) for the variable CAP (Fig. 3). The variable crops have been shown to be directly and statistically significant, in terms of p-value in figure 3, and correlated to different variables such as CAP, labour, and cost. This is the consequence of a significant and direct impact of two items, namely pigs reared in farms and area cultivated with other field crops, on the variable crops. Meanwhile, the management has been strongly influenced by the variables, cost and labour. An increase of labour positively impacts on the management of Italian farms specialised in granivores. From this, a first observation related to Italian farms specialised in granivores emerges, namely that in these farms, there have been significant labour-saving investments and an adequate level of innovation in farming aimed at improving the management performance. Moreover, a null correlation has been found between the variables CAP and management, p-value close to 10%, evidencing any impact of financial subsidies allocated through the CAP on the management of farms specialised in granivores. This reflects the generally modest financial subsidies this type of farm receives from the European Union. In several cases, this financial support has been addressed to biodiversity and to other agri-environment protection actions such as reducing the use of chemicals in farming. In this study, only the item total direct payments allocated through the CAP has been shown to have had a direct and significant impact on the variable CAP. In fact, in this type of farming, many CAP subsidies are not coupled to the production which represent one of the main sources of subsides for farmers.

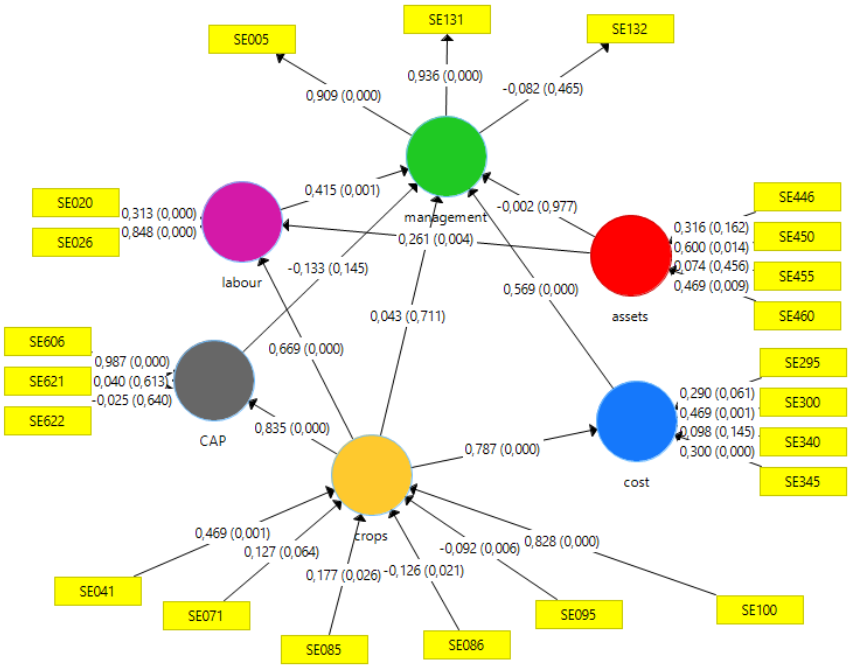

Fig 3. Main results in all Italian farms included in the FADN dataset specialised in granivores. The number is the variable weight and in brackets there is the p-value. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

The sample of farms specialised in dairy production have revealed the highest values of R^2 for all variables in the PLS-SEM, able to explain more than 75% of the variance. With regards to the variable management, a high impact has been found on the variables crops, cost and CAP, with these latter variables having a nexus on the farm management (Fig. 4).

Focusing attention on the variable CAP, the findings have underlined that the items total direct payments allocated through the first pillar of the CAP, and LFA subsidies to disadvantaged rural areas have all had a direct significant cause-effect relationship on this variable, which corroborates the view that Italian farms specialised in dairy production are multiform structures, representing various types of enterprise and located in diverse geographical contexts (mountain, plain, and hill), that are heavily reliant on CAP financial subsidies in order to be economically and technically efficient. Furthermore, Italian dairy farms

seem to have an intense endowment of invested capital (assets), such as buildings, machinery, and breeding animals, that has an impact on management. In contrast, the variable crops have a direct and positive impact on the two variables cost and CAP. Summing up some conclusions, it has emerged in the analysis as the item efficiency has had a direct and positive impact on the management as argued in other studies (Garrone et al., 2019; Galluzzo 2018b; 2020). Furthermore, the capital endowment, in terms of total assets as breeding livestock, machinery and land, has been fundamental to influence the management; hence, the higher the level of invested assets in dairy farms, the more intense is the effect on the management.

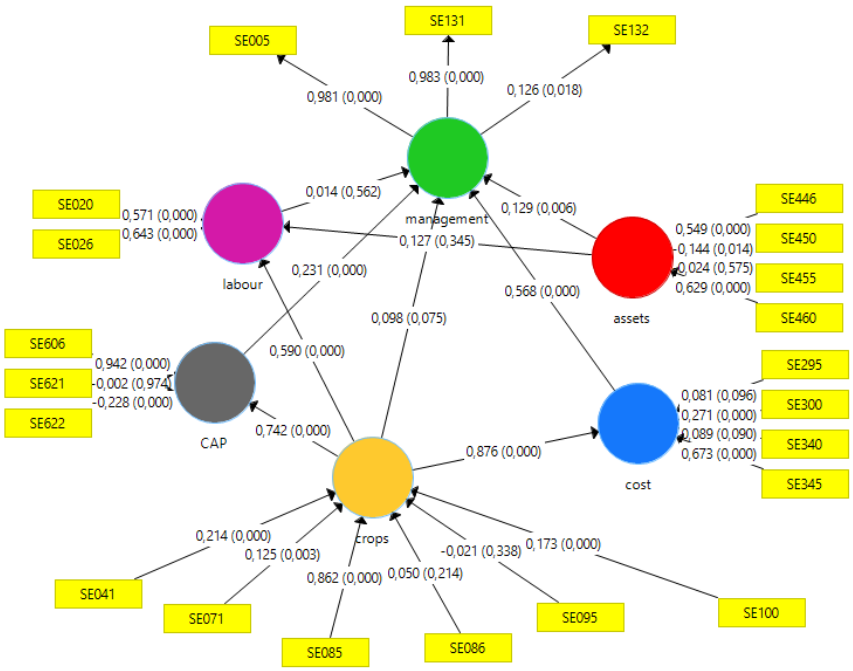

Fig 4. Main results in all Italian farms included in the FADN dataset specialised in dairy productions. The number is the variable weight and in brackets there is the p-value. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

The findings for mixed Italian farms have shown a good level of explained variance in all variables assessed by the PLS-SEM. In regards to this type of farming, it is very interesting to observe that the results of the cause-effect analysis are more or less similar to those assessed for the Italian farms specialised in milk production (Fig. 5). Meanwhile, the variables assets and crops have both shown a direct cause-effect relationship to the management. It is important to note that the variable crops have been strongly influenced by the variables cost, CAP, and, assets but not by the variable labour. In mixed farms, the item efficiency has had a direct and positive effect on the variable management corroborating the hypothesis according to which the crop diversification in terms of cultivated hectares has had a positive impact to the management by generating different source of revenues for farmers. Because of the different crops and reared animals in mixed farms, the fundamental has been the endowment of fixed capital, as land and agrarian capital as well; hence, between the variable assets and management, it has been found a direct and significant correlation corroborating as the higher is the level of assets in mixed Italian farms the higher is the level of management.

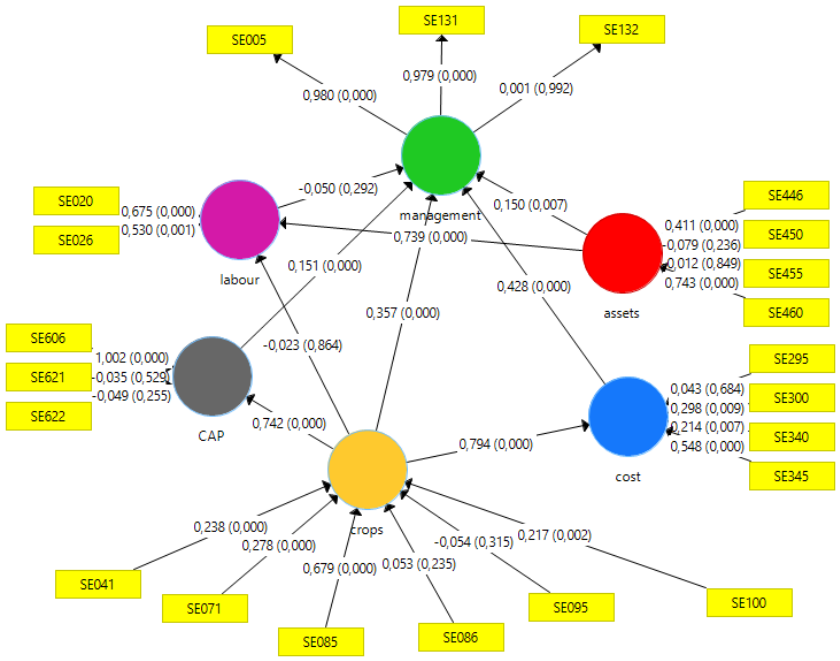

Fig 5. Main results in all mixed Italian farms included in the FADN dataset. The number is the weight of the variable and in brackets there is the p-value. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

Italian farms specialised in other grazing livestock have shown a significant and direct impact of the variables cost, CAP and crops on the management (Fig. 6), and this corroborates the impact some livestock such as sheep and goats and other crops have on the management of farms. It is also notable that the findings reveal certain items such as buildings, machinery, and breeding livestock have had a direct and significant link on the variable assets, corroborating the need that these farms have for specific endowments of capital in order to rear animals.

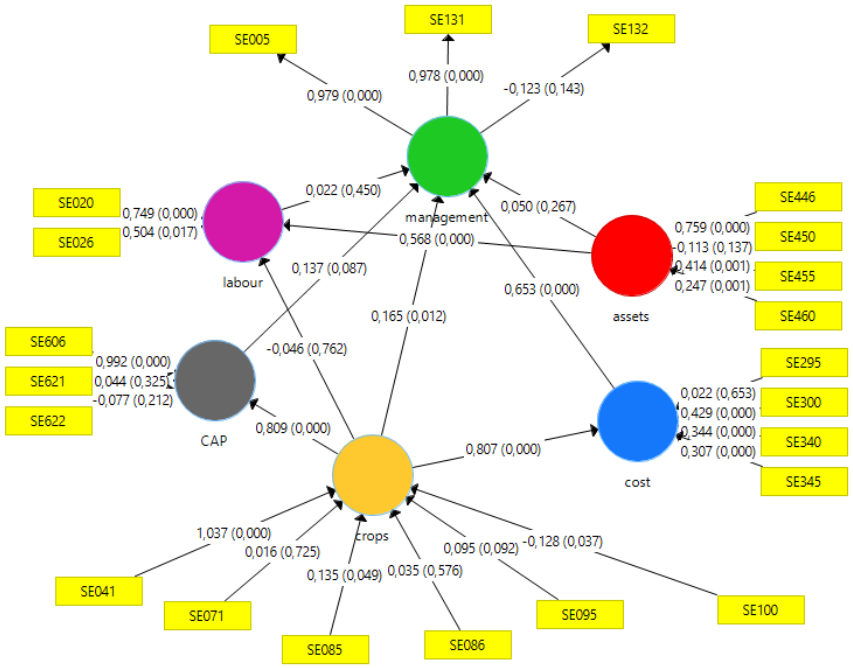

Fig 6. Main results in all Italian farms included in the FADN dataset specialised in other grazing livestock. The number is the weight of the variable and in brackets its p-value. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

In relation to farms specialised in other permanent crops, the variables cost, assets, crops, and labour have all had a direct impact on management; in particular, the research findings have underlined the direct role of two variables, cost and labour, in influencing the management of farms specialised in other permanent crops (Fig. 7). Focusing on the cause-effect relationships assessed by PLS-SEM, the variable crops has had a modest value of R^2 in terms of explained variance, the items other field crops, forage crops, and sheep and goats have all had a direct impact in the formation of this variable, while no significant cause-effect relationship has been found between the two variables crops and animals. Furthermore, the item total direct payments allocated through the first pillar of the CAP has a direct and important impact on the variable CAP.

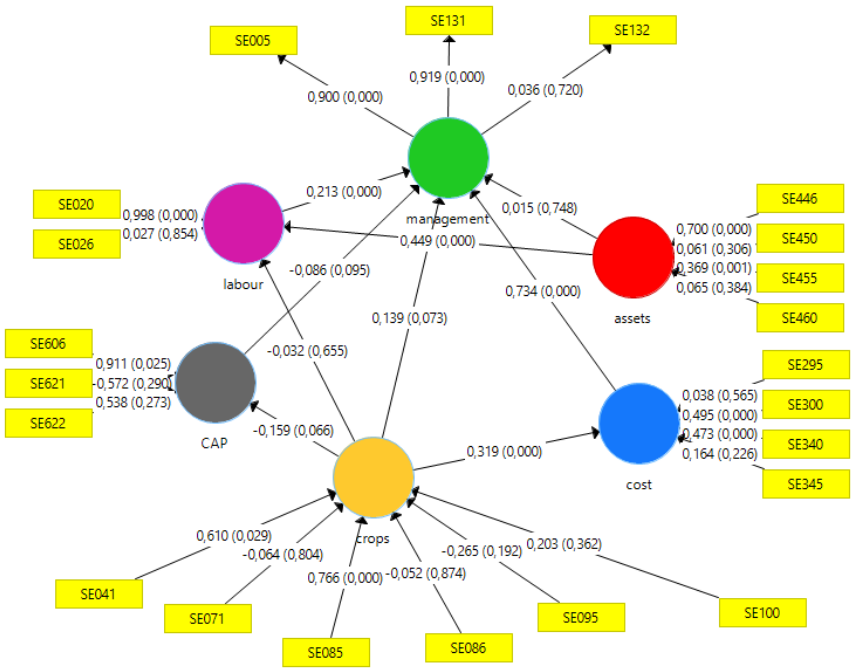

Fig 7. Main results in all Italian farms included in the FADN dataset specialised in other permanent crops. The number is the weight of the variable and in brackets the p-value. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

The Italian farms specialised in wine production have shown the lowest value of explained variance R^2 of the variable CAP, which is lower than 20%. The item financial environmental subsidies allocated through the CAP had a direct relationship on this variable (Fig. 8). In contrast, the variable Less Favoured Areas payments has had an indirect effect on the variable CAP. The management has had a direct cause-effect relationship with the variables cost, assets, and crops. In particular, the variables cost and assets had the highest impact on the variable management, hence, wine farms need of significant level of fixed investments and other capital endowment to improve their level of productivity, efficiency and management in Italian agricultural sector. Focusing the attention to the variable crops, the diversification in wine farms in terms of cultivated field crops areas in hectares and the presence of some animals as well, are two items able to act on the management. Research findings have corroborated in these wine farms the role of diversification as a leverage able to increase the productivity and the technical efficiency improving the management of farms as investigated by other authors (Forleo et al., 2021; Galluzzo, 2020). These latter authors have argued the role of the diversification in the improvement of the technical efficiency in farms and in their management.

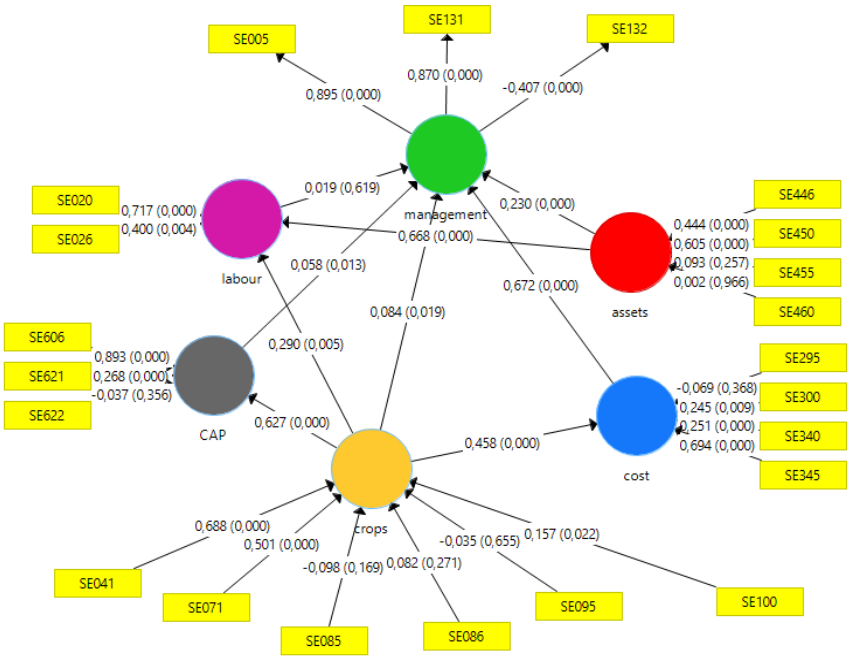

Fig 8. Main results in all Italian farms included in the FADN dataset specialised in wine. The number is the variable weight and in brackets the p-value. Source: author's elaboration on FADN data available at https://ec.europa.eu/agriculture/rica/diffusion_en.cfm

The variable labour and the variable CAP have been in all the different type of farming the most important in acting on the variable management. In particular, the variable CAP by the financial subsidies allocated by the total payments allocated by the first pillar has been able to improve the management of Italian farms.

It is important to underline the role of the variable cost and in minor extent of the variable crops in acting on the management of farms. In particular, these variables have influenced the efficiency of the farms by impacting the yields and the decision process of farmers in doing some specific crops instead of others. In this case, fundamental is the role of financial subsidies allocated by the CAP compensating the growth of cost and consequently impacting on the management of farms by the technical efficiency (Galluzzo, 2020; Bojnec & Ferto, 2019; Latruffe et al., 2017).

This research's outcome has corroborated findings argued by other scholars about the link between CAP subsidies and effect on farms management (Galluzzo, 2020; Garrone et al., 2019). In fact, the CAP payments influencing the technical efficiency in farms have implied a significant change in the farm's management as corroborated by this study. One of the reasons of this relationship between the variables CAP and management can be found in the role of subsidies in stabilizing the farms income as argued by Bojnec and Ferto in 2019, and also in reducing inequalities as investigated in literature (Espinosa et al., 2019). In all type of farming, it emerged a different role of the variable assets towards the management. In general, only in mixed farm and in other high specialized farms as wine and dairy farms assets have been directly correlated to the management due to the highest level of investments able to face with different productions, such as in the case of mixed farms, or high labour intensive farms as wine and dairy, which particularly need endowment of capitals (land and buildings) and investments in technology. The different investments in assets in Italian wine and dairy farms have impacted on the management, which is improved over time. This has had some consequences in reducing their technological gap as assessed in some European countries (Alem et al., 2019) and in some large dairy farms outside the European Union (Gargiulo et al., 2018).

5. Conclusion

The findings of this research have revealed that the kaleidoscopic structure of Italian farms has had some impact on the management of farms, while many items have impacted on the variables correlated to

the management. This implies that the strategy of policy makers, both at a national level and also at the level of the European Union in the framework of the Common Agricultural Policy, must be tailored to take account of differences between territories as well as farming specialisations. Furthermore, this research has filled the gap in the literature regarding the cause-effect relationship between management and other variables correlated to it, using the PLS-SEM to examine the management of farms in function of their specialisation. This study has identified which variables and items have been directly involved in the management of Italian farms. In literature, in fact, it is not so common to find the application of this quantitative methodology in estimating the cause-effect relationships between the variables of CAP payments, assets endowment, and cost and the management of farms in function of their specific type of farming specialisation.

Drawing some conclusions from the research, it is possible to observe that Italian farms specialising in field crops have seen only a benefit from the financial subsidies allocated through the second pillar of the CAP, especially payments allocated to disadvantaged rural areas (LFA payments). The decoupled payments allocated through the first pillar of the CAP have had a very strong impact, which implies that field crop farms are not predominatly located in disadvantaged areas but, rather, in plain areas; hence, the management has been addressed to implementing labour-saving technologies able to improve the technical efficiency of the farms. Meanwhile, the research outcomes have underlined the heterogeneity of dairy farms in different Italian regions that have positively benefited from the different types of financial subsidies allocated through the first and second pillars of the Common Agricultural Policy. In fact, decoupled payments and LFA subsidies have both positively impacted the management of Italian dairy farms.

In contrast, the management of Italian wine farms has not been influenced by the allocation of some financial subsidies disbursed through the CAP such as direct payments and agri-environmental subsidies. Instead, the management of wine farms, that are a highly specialized typology of farms in the framework of Italian agriculture, has been strongly influenced by the level of fixed investments and the endowment of fixed assets as land and buildings.

In general, however, the research broadly confirms that, as well as the specialisation of farms, the financial subsidies allocated through the CAP have a fundamental impact on the management in Italian farms. As such, the local authorities involved in the rural development programme have to focus on defining strategies in line with the farm's specialisation and their particular spatial and geographical context. In fact, the measures of intervention aimed at improving farm management must be better tailored in function of the productive context and other endogenous features. Drawing some conclusions, the Common Agricultural Policy should be addressed to stimulating the generational turn-over of farms, increasing investments in labour-saving technology, and increasing the endowment of land capital. Together, these aspects represent the most serious bottleneck in Italian farm management and technical efficiency with some direct effects to the management of farms.

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