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Technical and economic efficiency analysis on Italian smallholder family farms using Farm Accountancy Data Network dataset

More than 90 per cent of Italian farms have a usable agricultural area of less than 9 ha, even if over time there has been a growth of the average agricultural area per farm as a consequence of rural out-migration. This paper compares, using a non-parametric model, the technical efficiency of smallholder family (*diretto coltivatrice*), co-operative and limited company farms during the period 2000-2011. The *diretto coltivatrice* farms and the co-operative farms had higher levels of scale efficiency than the limited company farms, with a scale efficiency value equal to 100 per cent in ten years out of twelve. The average technical efficiency of *diretto coltivatrice* farms was higher than those of co-operative and limited company farms. The second part of the quantitative analysis used the self-organising maps (SOM) proposed by Kohonen. The SOMs indicated that the size of the agricultural area has a direct impact on the technical efficiency of farms and on their level of income.

Keywords: smallholder family farms, co-operative farms, limited company farms, Kohonen's maps, allocative efficiency

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Introduction

The average size of the usable agricultural area per farm in the 27 European Union (EU) Member States was 14.5 ha in 2010 (Eurostat, 2015). Nevertheless, in nine Member States, including Cyprus, Greece, Italy, Malta and Romania, the average usable agricultural area is below the EU mean value. In Italy, numerous farms have an average size of less than 9 ha. More than 95 per cent of Italian farms are family farms owned by only one farmer, a figure that similar to the EU-27 value of 96.9 per cent (Eurostat, 2015). The percentage of limited company farms and co-operative farms in Italy is around 4 per cent (Istat, 2011).

The United Nations recognised 2014 as the International Year of Family Farming, a label that encompasses many types of farms including small semi-subsistence enterprises and large farms, and those that rely on diversified activities such as agritourism and other non-farming activities (FAO, 2014). The EU's rural development policy recognises the role of family farming in promoting multifunctionality and endogenous rural development which are key factors in protecting the rural space against environment threats.

In Italy the property of family farms belongs predominantly to smallholder farmers called in Italian *diretto coltivatori* farmers that run *diretto coltivatrice* farms. Such farms are a tiny unit of agricultural production, mostly fragmented, with an agricultural area of less than 5 ha, managed and owned by one farmer. The family farm has been criticised because of its small size and fragmentation, but the *diretto coltivatrice* farm has been able to mitigate rural out-migration, protecting the rural space against socio-economic marginalisation. Property, functions and gender relations in European family farms are hierarchically well codified even if since the late 1990s there has been a weakening of the prevailing position of male dominance on the farm (Brandth, 2002). As a consequence of rural out-migration, in Italy, Ireland, France and the Netherlands many family farms are in the hands of women with a consequent radical transformation of productive specialisation and the development of other activities such as agritourism being in many cases managed by female entrepreneurs (Di Domenico and Miller, 2012; Galluzzo, 2014a).

The role of family farms

In the early 1990s some studies investigated the role and the effect of the Common Agricultural Policy (CAP) on family farming using a specific analysis on a sample of farms belonging to the Farm Accountancy Data Network (FADN). Between EU Member States the role and the function of family farms are completely different with several and specific contrasting effects. Hill (1993) observed that in the United Kingdom there was a limited incidence of family farms compared to Italy where family farms are deep-rooted in the countryside and in its rural setting. The features of family farms are a low level of income, a shared labour capital and a production of almost 50 per cent of the total European agricultural output, which have implied, in order to allow maintain the economic sustainability of farmers, a diffusion of pluriactivity in family farms and a growth in the incidence of off-farm revenues in the total household income (Hill, 1993; Jervell, 1999; Sofer, 2001).

Together with their small size, one of the main constraints of family farms in Italy, Greece and other central European countries is the excessive land fragmentation which can have ruinous effects on farm efficiency, increasing variable and fixed costs and restricting the technical-economic development of farms (Lund and Hill, 1979; Alvarez and Arias, 2002; van Dijk, 2003; Gorton and Davidova, 2004; Zhu and Lansink, 2010). Some studies have investigated in depth whether big farms owned by limited companies and co-operatives are more efficient than small ones; therefore, between three variables (property of the farm, farm size and economic-technical efficiency) there is a strong nexus (Bravo-Ureta *et al*., 2007). Until now few studies have investigated the connections between typology of property and efficiency (Bravo-Ureta and Pinheiro, 1997; Chavas and Aliber, 1993). Other scholars in contrast have examined predominantly the role of farm size on efficiency (Carter, 1984; Galluzzo, 2013). Using a non-parametric quantitative approach on the FADN dataset in France, Latruffe and Nauges (2014) showed that farm size has a direct impact on technical efficiency and on the decision process of farmers on whether to transform their farming activities via a transition from a conventional cultivation system to an organic model.

Studies in many EU Member States have used the FADN dataset or a sample of farms to investigate the impacts of Pillars I and II of the CAP on farmers' incomes (Gorton and Davidova, 2004) and on the level of technical efficiency (Zhu and Lansink, 2010). Several authors have detected relationships between farm size, farming specialisation and technical-economic efficiency (Bielik and Rajcaniova, 2004; Latruffe *et al*., 2004; Latruffe and Nauges, 2014; Bojnec and Latruffe, 2007). In terms of efficiency defined by constant return to scale, large sized farms are more efficient than small ones (Van Zyl *et al.*, 1996). In particular, small family farms have been considered technically inefficient in terms of productive scale because of their size and their land fragmentation (Morrison Paul *et al.*, 2004). In Italy only few studies have investigated the nexus, using the FADN dataset, between the farm dimension and the technical and economic efficiencies (Galluzzo, 2013). The general view is that the *diretto coltivatrice* farms are not efficient but they maximise the labour factor of production and its organisation (Van Zyl *et al*., 1996), minimising, conversely compared to the large sized farms, entrepreneurial risk by diversification in the agricultural process, using the workforce more efficiently and by reducing socio-economic marginalisation (Galluzzo, 2013) by a reduction in farm unemployment (Latruffe *et al.,* 2004).

Factors influencing efficiency in family farms

The main theoretical neoclassical approach describes economic and technical performances of farms as being influenced by the legal type of management. Family farms are more efficient in terms of costs, productivity and profitability than large farms as a consequence of a different management process (Gorton and Davidova, 2004), which are dependent on acquiring some productive factors from outside the farm.

In general, there is no common and unique assumption about the role of family-owned farms in improving technical and economic efficiency. According to some scholars, the property of the farm rather than farm size is the most fundamental factor affecting efficiency. Small family farms in several EU Member States are more efficient than other types of farms such as co-operative and limited company farms (Schmitt, 1991; Gorton and Davidova, 2004). The good level of efficiency in small farms is tightly linked to the low level of transaction cost (Hagedorn, 1994). Nevertheless for other authors farm size is a major constraint on farm technical efficiency; hence, the traditional family farm is not an efficient productive organisation (Morrison Paul *et al.,* 2004) as it is not able to adapt itself to changing circumstances of production or to amortise its investments, diversifying its own production factors. Several authors have argued that family farms are not as well prepared as co-operative and limited company farms to face market challenges because of a poor level of capital investments (Allen and Lueck, 1998). Cropping specialisation is a key factor that can directly influence the level of efficiency and maximisation of output (Bojnec and Latruffe, 2008; Latruffe, 2010; Latruffe and Nauges, 2014), influencing the productive decision process on small farms.

Aim of the research

The main research question was to investigate, using a quantitative model, whether, because of their small scale structure, Italian *diretto coltivatrice* farms have been more efficient in recent years than limited company and co-operative farms. Another purpose of the research was to assess how much usable agricultural area is sufficient to gain in terms of technical efficiency. This research used and elaborated time series of microeconomic datasets published by the Italian National Institute of Agricultural Economics in the FADN database for the period 2001-2011. The purpose of the FADN is to evaluate farmers' incomes and to assess the impact of the CAP on a representative sample of European farms. In the research the sample was stratified both according to the type of property such as small family-owned farms or *diretto coltivatrice* farms, co-operative farms and limited company farms, and also according to the altimetry of farms as highland, hilly areas and farms on the plain, even though in the research the efficiency was assessed according to the typology of property only.

A second stage of the quantitative analysis used self-organising maps (SOM) or Kohonen's maps to estimate which size of farm is adequate to guarantee a satisfactory level of farmer's income in *diretto coltivatrice* farms. Another purpose of the SOMs was to detect among *diretto coltivatrice*, co-operative and limited company farms which of these was the best type of enterprise for improving the farm's net income.

Methodology

Data Envelopment Analysis

There are two approaches to assessing efficiency: a parametric or deterministic approach, which needs a function of production and other parametric variables, and a non-parametric model or Data Envelopment Analysis (DEA) (Farrell *et al*., 1957; Färe *et al*., 1985; Färe *et al*., 1994). The purpose of DEA is to define a hypothetical function of production or frontier of production and on the basis of the distance from the frontier of this hypothetical function of production to determine an index of technical efficiency (Forsund *et al*., 1980; Bauer, 1990; Bielik and Rajcaniova, 2004).

In a non-parametric model deviations from the frontier of productive functions are caused by inefficiencies and they are not connected to errors (Bojnec and Latruffe, 2007). The technical efficiency is described as the capability of a farm to maximise outputs and minimise inputs or vice versa on the basis of constraints in the business choices either in terms of disposable input or in terms of produced output (Coelli *et al*., 2005; Bojnec and Latruffe, 2007).

According to many authors (e.g. Farrel, 1957; Battese, 1992 and Coelli, 1996) the model of quantitative analysis and estimation of efficiency are not tightly linked to a specific frontier of production but rather to a parametric function. In this paper efficiency has been estimated by a non-parametric model, applied to different specification models

such as constant return to scale (CRS) and variable return to scale (VRS) and in two further orientations as input oriented and output oriented using the software PIM-DEA. As the outcomes of efficiency from using the input oriented model and the output oriented model were the same, in the paper the input approach has been used, aimed at assessing which factors in the productive process have been fundamental in improving technical and economic efficiency.

The DEA approach was used to estimate the economic efficiency in three types of Italian farms or Decision Making Units (DMUs): smallholder family farms (*diretto coltivatrice* farms), limited company farms and co-operative farms. The input variables used in the model were usable agricultural area in hectares, land capital, labour capital, invested agrarian capital and subsides allocated by the CAP in EUR; the output variable was the net farmer's income in EUR.

Self-organising maps

The SOMs are based on a method of unsupervised learning in a restricted space provided that the topological properties of an input space or stimulus come from the outside (Kohonen, 2001). The main benefit of the SOM approach is to obtain a unique pattern able to classify homogenous groups or clusters, preserving their dissimilarities and, as with Principal Component Analysis, reducing the complexity via a map that highlights the relationships among the variables (Mehmood *et al*., 2011).

The SOM is a neural network where the artificial output neurons (or nodes) are arranged in grids based on a lower dimension in connection to all neurons of input which in the analysis are the variables used in the model of efficiency: usable agricultural area in hectares, variable costs, fixed costs, added value and subsides allocated by the CAP. The output variable is the farmer's net income. Each input or stimulus is connected to the other neurons of the output by a weight vector assessed to define the position of the centroid in the space. In general this network in the SOM is characterised by a pattern in two connected layers; one layer is made up by input and the other layer (commonly called the Kohonen layer) is constituted by output (Kohonen, 2001).

Using the free software SPICE-SOM, the training of neurons (training is a method of analysis to find the best neuron in the dataset) used competitive learning. The model used an input training sample towards the network and the Euclidean distance among input and output neurons is calculated from all weight vectors (Kohonen, 2001). The neuron with a weight vector most similar to the input is called the Best Matching Unit (BMU) and the weights of the BMU and neurons close to it in the SOM lattice are the closest to the input vector. The intensity of the approach process decreases over time and is a function of the distance of neurons from the BMU. The formula used for updating the weights of a neuron Wv is (Kohonen, 2001):

$$Wv\,(t+1) = Wv\,(t) + \Theta\,(v, t)\,\alpha\,(t)\,(D\,(t) - Wv\,(t)) \qquad (1)$$

where $\alpha\,(t)$ is the monotonous descending learning coefficient and D (t) is the input vector. The function that defines the neighbourhood $\Theta\,(v, t)$ depends on the distance in the hexagon between the BMU and the neuron v. In this simplified competitive network it is equal to 1 for all the neurons close enough to the BMU and 0 for the other, but the most common choice is the Gaussian function represented by the mathematical function similar to a Mexican hat where values are in a range from 0 to 1.

Results

Over the period of observation there has been a significant drop in the number of family farms in Italy and an increase in the average agricultural area per farm as a consequence of rural out-migration (Figure 1). Rural out-migration in Italy has affected several rural areas, including some upland territories where most *diretto coltivatrice* farms are located. The

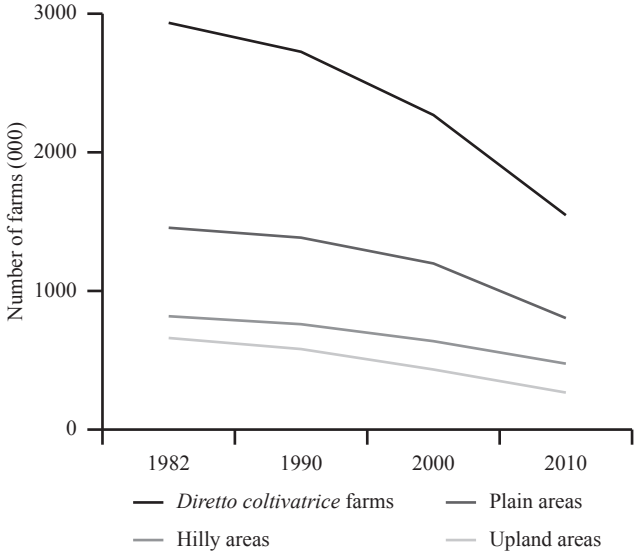

Figure 1: Evolution of family farm numbers in Italy as a function of topography, 1982-2010.
Data source: Italian National Institute of Statistics

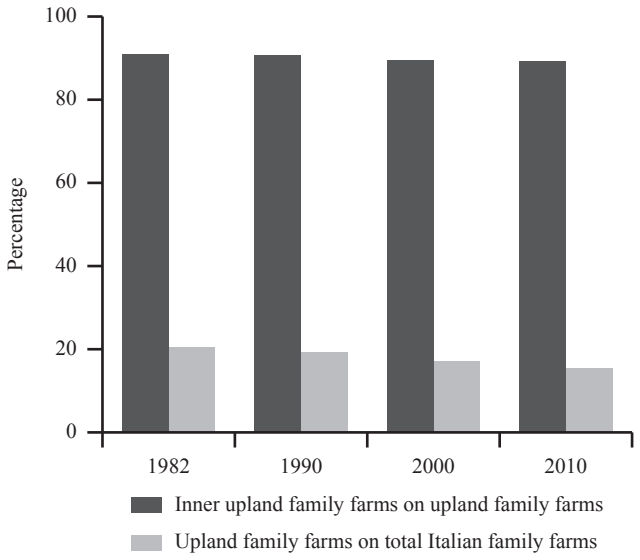

Figure 2: Incidence of family farms located in inner upland rural areas in Italy, 1982-2010.
Data source: Italian National Institute of Statistics

exodus from the countryside has been particularly intense in less favoured rural areas such as mountainous territories (Figure 2), the locations of more than 75 per cent of family farms.

Italian National Agricultural Census data have shown a significant fall in the usable agricultural area of family farms, from 13 million ha in 2000 to 9.7 million ha in 2010. The same trend can be observed with co-operative farms, which declined from 176,187 ha in 2001 to 127,909 ha in 2010. By contrast, the usable agricultural area of agricultural limited companies stabilised at 1.9 million ha as a consequence of some legislative interventions aimed at strengthening these types of farms.

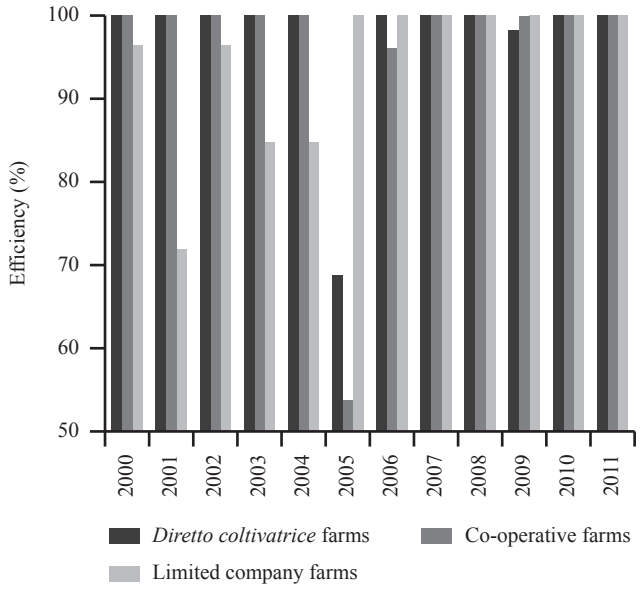

Figure 3: Scale efficiency of family farms, co-operative farms and limited company farms during the period 2000-2011.
Data source: Italian FADN database

Data Envelopment Analysis

The DEA analysis shows the *diretto coltivatrice* farms and the co-operative farms had higher levels of scale efficiency than the limited company farms (Figure 3) with a scale efficiency value equal to 100 per cent in ten years out of twelve. The scale efficiency such as the technical efficiency in family farms was close to the threshold value of 100 per cent, which is the optimal value in terms of use of inputs and produced outputs, and only in two years (2005 and 2009) was it below the maximum value equal to 100 per cent.

The average technical efficiency of Italian *diretto coltivatrice* farms was higher than those of co-operative farms and limited company farms, by 97 per cent and 93 per cent, respectively, even if the VRS efficiency has pointed out a higher value compared to CRS of 97 per cent and 90 per cent (Figure 4). For *diretto coltivatrice* farms the efficiency in CRS was lower than 1 or 100 per cent only in 2002 and in 2006; even if the economic efficiency was lower than the allocative efficiency, in particular in 2002. This suggests that *diretto coltivatrice* farms are able to maximise their output but they need to improve their management and their productive and managerial choices, taking into account (in the input-oriented model) the price of inputs in their production decisions.

Over the time of observation the efficiency in CRS of co-operative farms in Italy was less than 100 per cent in 2003, 2004 and 2006, and both the allocative efficiency and the technical efficiency in average terms were below 100 per cent with an average scale efficiency of less than 100 per cent (Figure 5). These findings show that co-operative farms are not able to maximise their output and at the same time they need to improve their productive process, minimising inputs and also increasing their control over input prices compared to other types of agricultural enterprises.

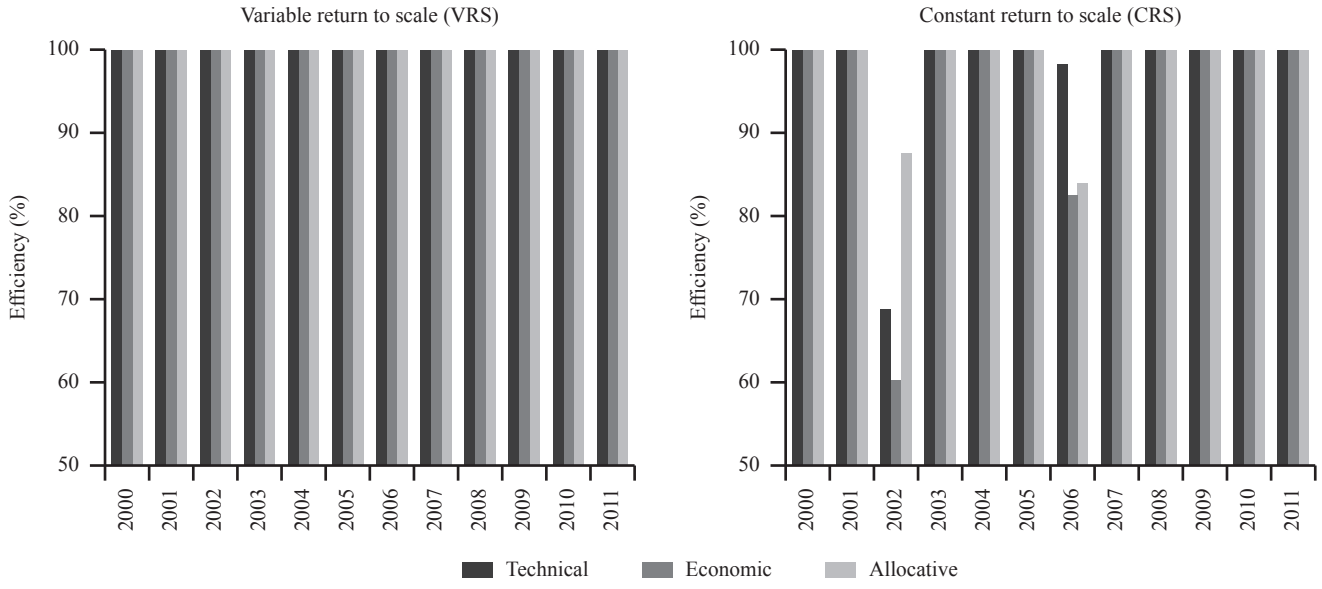

Figure 4: Technical, economic and allocative efficiencies of Italian *diretto coltivatrice* farms comparing variable and constant returns to scale during the period 2000-2011.
Data source: Italian FADN database

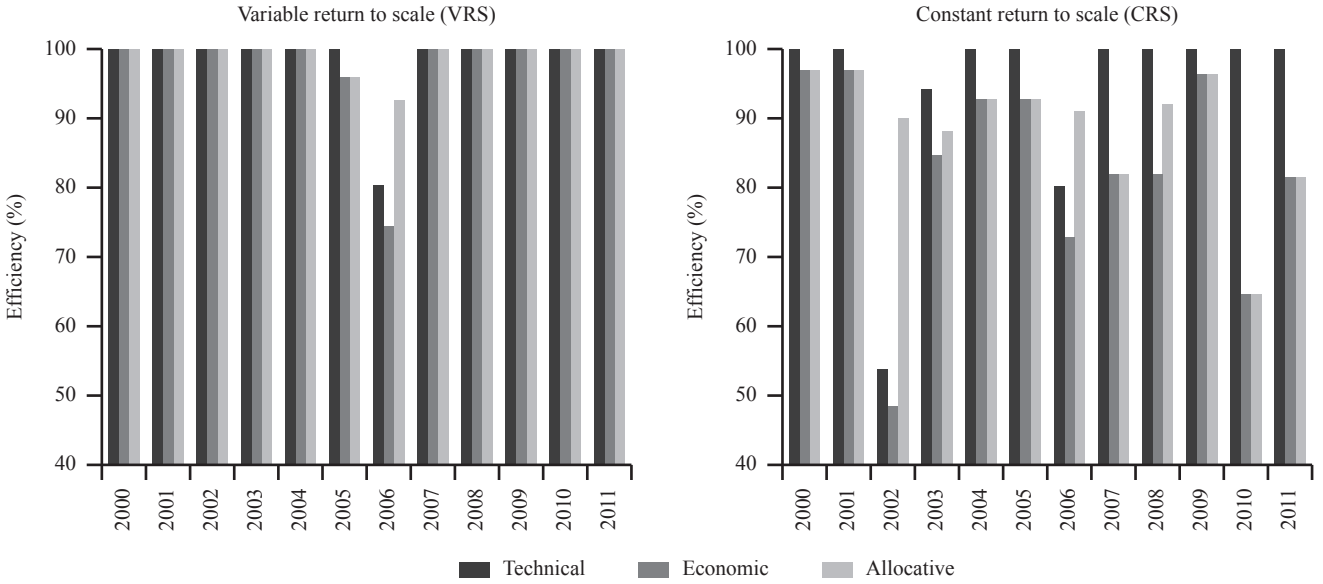

Figure 5: Technical, economic and allocative efficiencies of Italian co-operative farms comparing variable and constant returns scale during the period 2000-2011.

Data source: Italian FADN database

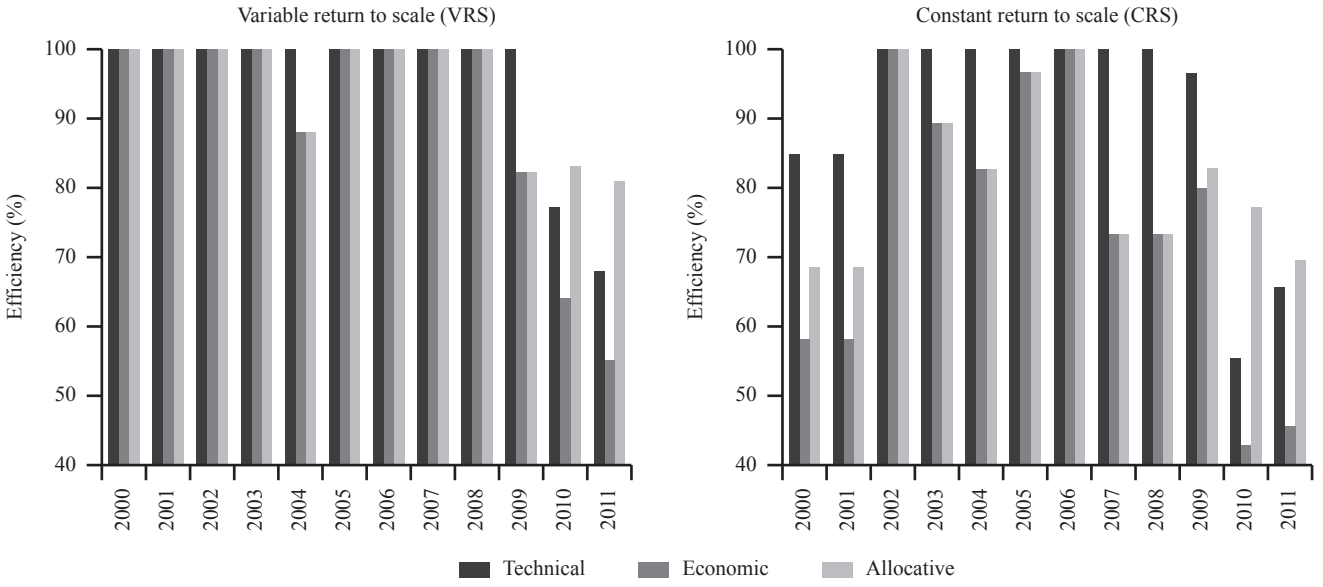

Figure 6: Technical, economic and allocative efficiencies of Italian limited company farms comparing variable and constant returns scale during the period 2000-2011.

Data source: Italian FADN database

The technical efficiency of agricultural limited companies both in CRS and also in VRS was below the optimal threshold of efficiency equal to 100 per cent. The technical efficiency in CRS was above 100 per cent in six years, with some values of allocative and economic efficiency below 100 per cent. This is particularly true in terms of CRS. The value of allocative and technical efficiency was below 100 per cent (Figure 6). This implies that the limited company farms in Italy are not able to maximise their levels of output; thus, they need meaningful actions both to improve management decisions and also to implement the productive choices connected to poor and inefficient control of input prices with financial and technical consequences for their economic sustainability.

Analysing the efficiency over the period 2000-2010 as a function of topography both in VRS and CRS, it was found that the average values were higher in the VRS model than the CRS, even if farms located in plain areas have an efficiency lower than those in upland areas (Table 1) and in particular in terms of cost and allocative efficiency.

The size of farm had an effect on efficiency in terms of CRS and VRS as well; in fact, the average efficiency was higher in farms of less than 5 ha, in some Italian farms with an area of 5-10 ha and in others larger than 50 ha (Table 2). Nevertheless, the small farms in terms of usable agricultural area, ranked as smaller than 5 ha, 5-10 ha and 10-20 ha, have levels of efficiency close to 100 per cent with some significant fluctuations in some years.

Table 1: Technical, economic and allocative efficiencies of Italian farms during the period 2000-2010 as a function of topography.

Year	Upland			Highland			Lowland		
	Technical	Economic	Allocative	Technical	Economic	Allocative	Technical	Economic	Allocative
Variable return to scale									
2000	92.8	80.5	86.7	100.0	100.0	100.0	100.0	100.0	100.0
2001	100.0	100.0	100.0	100.0	88.7	88.7	100.0	100.0	100.0
2002	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2003	100.0	100.0	100.0	100.0	100.0	100.0	33.8	14.7	43.5
2004	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2005	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2006	100.0	96.8	96.7	100.0	100.0	100.0	100.0	100.0	100.0
2007	100.0	99.6	99.6	100.0	100.0	100.0	100.0	100.0	100.0
2008	100.0	94.4	94.3	100.0	100.0	100.0	100.0	100.0	100.0
2009	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2010	100.0	60.6	60.6	100.0	100.0	100.0	100.0	36.1	36.1
Constant return to scale									
2000	70.4	59.1	83.9	92.1	87.0	94.4	100.0	100.0	100.0
2001	100.0	93.4	93.4	100.0	85.7	85.7	100.0	100.0	100.0
2002	100.0	86.9	86.9	100.0	100.0	100.0	100.0	76.9	76.9
2003	98.5	80.6	81.8	100.0	100.0	100.0	27.9	12.1	43.4
2004	100.0	100.0	100.0	63.1	61.3	97.2	100.0	80.7	80.7
2005	100.0	100.0	100.0	100.0	87.7	87.7	100.0	89.0	89.0
2006	100.0	93.9	93.9	98.8	93.8	94.9	100.0	100.0	100.0
2007	100.0	97.4	97.4	100.0	95.1	95.1	100.0	100.0	100.0
2008	100.0	74.7	74.7	100.0	100.0	100.0	100.0	57.7	57.7
2009	100.0	83.8	83.8	100.0	100.0	100.0	100.0	43.6	43.6
2010	100.0	44.9	44.9	100.0	100.0	100.0	97.7	25.3	25.9

Data source: Italian FADN database

Table 2: Technical, economic and allocative efficiencies of the usable agricultural area of Italian farms during the period 2000-2010.

Usable agricultural area (ha)	Technical	Economic	Allocative
Variable return to scale			
<5	100.0	89.9	89.9
5-10	99.3	98.1	98.7
10-20	94.1	89.7	94.9
20-50	91.9	84.6	88.8
>50	100.0	100.0	100.0
Constant return to scale			
<5	100.0	82.7	82.7
5-10	90.1	79.5	87.8
10-20	91.1	84.5	92.2
20-50	86.9	78.3	88.9
>50	86.7	70.7	80.3

Data source: Italian FADN database

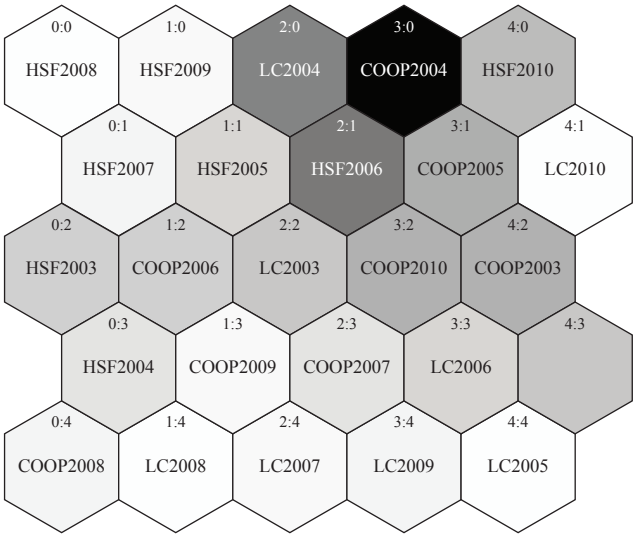

Figure 7: Typology of Italian farms in terms of net farmer's income stratified in three clusters, i.e. limited company (LC), cooperative (COOP) and *diretto coltivatrice* farms (HSF). The black hexagon (COOP2004) is the 'winner' neuron and the white ones are the 'losers'. The different scales of grey describe different levels of efficiency: dark grey hexagons are more efficient than light grey ones.
Data source: Italian FADN database

Self-organising maps

The first phase of Kohonen's map compares Italian *diretto coltivatrice* farms, co-operative farms and limited company farms. In 2004 the co-operative farms (indicated by a black hexagon) had the best performances in terms of farmer's net income (Figure 7). In 2006 the family farms and limited company farms, (indicated by dark grey hexagons), had high levels of farmers' net incomes. The *diretto coltivatrice* farms and limited company farms had the worst results in two years out of twelve (2008, 2009 and 2005, 2010 respectively).

In order to assess if the land capital in terms of usable agricultural area is a fundamental factor in influencing farmer's net income Italian family farms were stratified according to size. Farm size is the most important factor affecting the economic efficiency of Italian family-owned farms. The Kohonen's maps highlighted that the best results in terms of farmer's net income were achieved in 2003 by farms with a usable agricultural area of 20-50 ha (Figure 8); the worst results were achieved by family farms with an area of less than 5 ha.

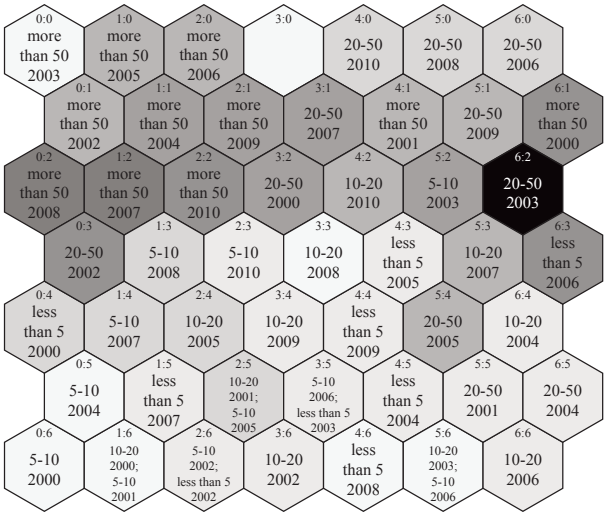

Figure 8: Effect of usable agricultural area on the farmer's net income of Italian family farms. In each hexagon the usable agricultural area per farm and year is indicated. The black hexagon (20-50 ha in 2003) is the 'winner' neuron. The different scales of grey describe different levels of efficiency: dark grey hexagons are more efficient than light grey ones.

Data source: Italian FADN database

Discussion

The analysis has identified usable agricultural area as one of the most important factors in farm economic performance. The findings have highlighted that property is another pivotal tool in influencing the economic results of Italian farms and specifically of Italian *diretto coltivatrice* farms. Over the study period, Italian farms have to some extent changed from being small farming units managed and owned by one person to farms with a usable agricultural area of around 50 ha that are able to guarantee adequate levels of income to farmers. In order to complement the farmer's income, to improve their efficiency and to stabilise farm net income, many dynamic farmers in Italy have diversified their agricultural revenues with some extra farm activities such as rural tourism and agritourism (Galluzzo, 2014b).

The efficiency of Italian farms is sensitive to the model of ownership even if the smallholder family farms have been efficient enough compared to co-operatives and limited companies, refuting the common view according to which smallholder family farms are not economically and technically efficient. Furthermore, the Italian *diretto coltivatrice* farms have given a positive return on EU funds by reducing the marginalisation of rural territories by means of diversification of on-farm activities such as agritourism.

The substantial drop in the scale efficiencies of co-operative farms and family farms in 2005 (Figure 3) can be attributed to the enforcement of changes in Pillar I of the CAP, which reduced the direct supports towards agrarian commodities, with the consequences that family farms and co-operative farms have been less sensitive than limited companies. In general the impact of changes in weather conditions has not been significant over the time of study. Even in 2003 the dry spring and summer weather did not have any negative impacts on scale efficiency of farms with the exception of the limited companies.

The findings from the SOM highlighted an increase of land capital in co-operatives as an important strategy in bettering the level of technical results. Furthermore, the economic crises in 2007-2008 had several consequences for the *diretto coltivatrice* farms, pointing out the pivotal role of farm size in countering new economic challenges. In fact, 20 ha of land is an efficient dimension in order to maximise a farmer's income, corroborating the role that financial supports should have in terms of increasing the usable agricultural area of farms.

In order to implement technical and allocative efficiency, family farms should also increase their land capital through the unification of their fragmented parcels as these do not allow greater capital investments to be made, and other labour saving technologies aimed at reducing the cost of inputs to be used. Some actions in the 2000-2006 and 2007-2013 Italian Rural Development Programmes were designed to stimulate a growth of more efficient farm production and management processes, strengthening the power of family farms in the countryside by means of specific subsides. The purpose of this financial aid was to raise the levels of scale efficiency and allocative efficiency through the introduction on the farm of new production technologies, and by farm consolidation and enlargement. Among the priorities of the Italian Rural Development Plan (RDP) 2014-2020 is to support a radical change in the production process by the introduction of new technologies that are able to reduce variable costs, even if findings from the previous RDP (2007-2013) have identified a poor tendency among family farms to adopt innovative technologies and to diversify their agricultural production.

In conclusion, Italian *diretto coltivatrice* farms are not obsolete enterprises but entities that require different multidisciplinary approaches aimed at protecting them from marginalisation and from isolation in the countryside. If the target of public investments in the primary sector is to enhance technical and economic efficiency in family farms by increases in usable agricultural area it is necessary to incentivise the generation turnover. The average age of Italian farmers, at close to 56 years (Istat, 2011), is a bottleneck in enhancing farm efficiency and is also linked to difficulties in taking over farms and in buying land capital by young farmers. Loans with a fixed low interest rate can help to increase the level of technical efficiency through investments in technology on family farms and in purchasing land. Furthermore, in order to restrict land fragmentation, a law and regulations to ensure the indivisibility of an inherited estate during the process of succession could be introduced, following the examples of other EU Member States such as Austria and Germany.

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