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ECONOMIC AND TECHNICAL EFFICIENCY IN LESS FAVOURED SLOVENIAN AREAS

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Abstract

Slovenian farms are predominantly characterized by small utilized agricultural areas scattered in several rural villages. The poorer the endowment of land capital, the poorer the net farm income and technical and economic efficiency. To assess the economic impact of financial subsidies allocated by the Common Agricultural Policy (CAP) in the early 1960s the European Union established a specific survey carried out in a sample of European farms called Farm Accountancy Data Network (FADN). The purpose of this paper was to investigate in Slovenia farms part of the FADN dataset over the period 2004-2013, as well as the technical, allocative and economic efficiency using a quantitative approach throughout the Data Envelopment Analysis (DEA). The methodology for the efficiency analysis applied a non-parametric model such as DEA, capable of estimating in an input-oriented model the evolution of technical, allocative and cost efficiency in Slovenian farms over a ten-year period.

The FADN dataset has been stratified in function of the localization of farms both in underdeveloped rural areas and also in not disadvantaged rural areas, creating three different clusters: farms located in less-favoured areas, mountainous farms and not disadvantaged agricultural enterprises. Findings have pointed out a positive effect of the financial subsidies allocated to less favoured areas in implementing the level of efficiency in farms, corroborating the hypothesis, according to which farms located in underdeveloped rural areas are more efficient than enterprises located in not disadvantaged areas due to significantly deeply rooted family farms. Summing up, the European Union, by specific funds, should ameliorate the level of capital land which, linked to the skillful use of labour capital, is pivotal in improving the technical and economic efficiency.

Keywords: Farm Accountancy Data Network, rural development, disadvantaged rural areas, Slovenia.

INTRODUCTION

According to the Slovenian Statistical Institute, the main data have pointed out as the utilizable agricultural area (UAA) in Slovenian farms is in average below 8 hectares which are rather poor if compared to the mean of agricultural surface equal to 14.2 hectares in the European Union (EU), 50.1 hectares pointed out in the European north-western regions and 12.0 hectares assessed in the south European rural areas (European Union, 2014).

Since the early 2000s there has been an increase of the level of investments in several Slovenian farms as a consequence of the accession of Slovenia to the European Union, which has implied a severe and intense transition of its own socio-economic fabric, direct consequence of the collapse of the Communist regime, towards a new open economy more competitive and demanding without trade barriers. Before becoming a new member state, part of the EU, lots of financial subsidies correlated to the pre-accession process have been addressed in implementing the socio-economic context in rural areas (Erjavec et al., 2003; Galluzzo, 2011). In order to reduce economic imbalances during the transition phase and afterward the accession to the European Union, the amount of financial subsidies allocated by the European Union and by Slovenian public authorities has been similar in terms of amount disbursed by other European countries throughout direct supports specifically addressed towards direct payments or financial supports allocated in favour of a more balanced rural development economic growth (Erjavec et al., 2003; Tankosic and Stojsavljevic, 2014). The role of a specific agricultural policy to newcomers eastern countries and financial supports in Slovenian farms have been fitted on the specific territorial peculiarities made by small family farms (Bojnec et al., 2014) even if many farmers needed specific actions in ameliorating both the rural credit system and also in making better rural infrastructures aimed at implementing their competitiveness previously straightened, during the pre-accession time, by the

SAPARD, that is a financial initiative tailored in supporting the next stage of the enlargement which occurred in 2004 (Fernandez, 2002; Tankosić and Stojsavljević, 2014). Considering the different allocation of financial subsidies disbursed by the European Union in the seven year time 2007-2013, main findings have pinpointed as 51% of the total subsidies has been addressed to the second axe of the Rural Development Plan and particularly in favour of the improvement of environment and farm productivity throughout the implementation of competitiveness in the agricultural and forestry sector (Gorton et al., 2009).

In general, payments allocated towards disadvantaged rural areas are a pivotal tool in downsizing the socio-economic marginalization in Slovenian rural areas where more than 70% of usable agrarian areas belong to the less favourable areas (Bavec and Bavec, 2011).

In literature, several studies have been carried out in European Western countries in order to assess if there is a nexus between dimension of farm and technical, allocative and economic efficiency in different European countries in particular in some of them in phase of transition as a consequence of the collapse of Communist regime towards an open agriculture (Galluzzo, 2013; Bojnect and Latruffe 2011; Gorton and Davidova, 2004; Brümmer, 2001). These authors have highlighted as the efficiency is correlated to the farm dimension, an altitude of farm and productive specialization even if family farms are less inefficient than large size farms managed by corporative enterprises due to a different level of utilization of labour force and exploitation of capital invested.

Bojnec and Latruffe in 2013 have pointed out as Slovenian farms are considered in the common opinion as small enterprises over financed by the European Union. The farm dimension, regarding utilized agricultural areas, has implied effects on technical efficiency even if financial subsidies produce on the one hand a growth of profitability but on the other a worsening of technical efficiency (Galluzzo, 2014; Galluzzo, 2013; Bojnect and Latruffe 2011; Bojnec and Latruffe in 2013). These latter authors in 2011 have argued using the Farm Accountancy Data Network (FADN) dataset as the labour capital in family farms is the main constraint in order to improve the efficiency, corroborating the hypothesis, according to which, the shift from a planned economy to a new open economy has strengthened, as a consequence of its transition, investments and a greater farm specialization. In contrast, other studies have argued as the level of technical inefficiency in small, and family farms are significant (Brummer, 2001; Bojnect and Latruffe, 2008) due to not an efficient level of land capital.

Before the enlargement of the European Union in Eastern states, analysis has pinpointed as family farms, and corporate farms have had the same level of efficiency (Gorton and Davidova, 2004) even if in many cases because of dimension and management peculiarities, the family farms are less inefficient than the large and corporate ones. In the literature review, farms located in less-favoured areas and run by part-time entrepreneurs in Slovenia have pointed out a low level of efficiency (Brümmer, 2001). An assessment of the level of efficiency in function of the level of crop specialization has highlighted as in average value technical, allocative and economic efficiency in farms part of the FADN dataset has been lower than 0.90 which clearly corroborates as the level of management is correlated to the best use of technologies (Bojnec and Latruffe, 2008).

AIM OF THE RESEARCH

Farm Accountancy Data Network is an instrument established by the Council Regulation of the European Union number 79 and published in 1965 aimed at assessing the income of agricultural holdings and impacts of the Common Agricultural Policy actions towards farmers. FADN has been set up to gather accounting data in a sample of European farms. According to the European Commission, this dataset is an annual survey which covers approximately 80.000 farms and a population of almost 5.000.000 farms located in all countries part of the European Union able to represent more than 90% of utilized agricultural area (UAA). Farm Accountancy Data Network dataset also represents almost 90% of the total European agricultural production.

The main purpose of this research was to estimate if there is a relationship between technical, allocative and economic efficiency in some Slovenian farms, belonging to the FADN dataset, and their location in less favoured rural areas, predominately mountainous and hilly territories, or alternatively in not disadvantaged rural areas.

The research question was addressed to assess, using a quantitative approach by a non-parametric method, the different level of technical, allocative and economic efficiency in all farms part of the FADN Slovenian dataset after 2004 to 2013 stratifying the dataset FADN in function of the geographical and socio-economical localization of farms in less favoured rural areas strict sense, mountainous areas and hilly territories, and not disadvantaged areas as proposed by the European Economic Community Directive 268 published in 1975.

In general, a poor level of land capital regarding utilized agricultural area is typical of farms situated in less favoured rural areas which in contrast have received financial subsidies to compensate their economic and social disadvantage.

In literature many authors have pointed out as some farms specialized in their own crop production have been fully efficient compared to mixed enterprises (Bojnect and Latruffe, 2008); this has implied as a higher level of investments finalised in increasing the productive specialization correlates directly to the best performances of agrarian enterprises in terms of technical, allocative and economic efficiency (Bojnect and Latruffe, 2008).

Afterward the enlargement of the European Union, Slovenian farms have increased their level of technical efficiency as a consequence of an expansion of investments in land capital and a growth in their own farm size but findings about the impact of the financial subsidies in favour of small farms seem not act positively on technical efficiency (Bojnect and Latruffe, 2013). In contrast, comparing small farms to the medium-size farms findings have highlighted as the medium-size farms have been less efficient than small farms that are mainly family owned (Bojnect and Latruffe, 2013).

METHODOLOGY

In order to study by a quantitative methodology the technical, economic and allocative efficiency there are two different approaches: a parametric or deterministic approach, which needs a knowledge in depth of the specific production function and other parametric variables, and a non-parametric model or DEA (Data Envelopment Analysis) aimed at defining in function of the distance from the frontier of an hypothetical function of production an index of technical and economic efficiency (Bielik and Rajcaniova, 2004).

In general, if the technology or productive process indicate a constant returns to scale (CRS) both a non-parametric input model and also an output-oriented model are identical in terms of measurement of technical efficiency but if the technology is characterized by variable returns to scale (VRS) it is pivotal to asses it using a dual approach as proposed by Banker, Charnes, and Cooper in 1984.

In this paper has been used an input-oriented model in a nonparametric model such as the DEA efficiency analysis. An input-oriented model is based on the hypothetical framework according to which an inefficient unit is made efficient through a proportional increase of its inputs, while the output proportions remain unchanged.

In the nonparametric model deviations from the frontier of the function of production are caused by inefficiencies, and they are not in connection with errors thus, the technical efficiency is described as capabilities of farmers in maximizing the output minimizing used inputs or vice versa (Bojnec and Latruffe, 2008).

Following the hypothetical framework proposed by lots of authors (Farrell 1957; Battese 1992; Battese and Coelli, 1992; Coelli 1996) as mentioned above the efficiency has been estimated by a non-parametric model applied to a specific assumption according to which the model has used a constant return to scale (CRS) in an input-oriented model estimated by the PIM-DEA software.

The purpose of the DEA linear programming model on Slovenian farms belonging to the FADN dataset is to minimize in a multiple-input oriented model, over the time 2004-2013, the input variables able to act on the level of output (net farm income). The FADN dataset has been stratified by the altimetric positioning of farms considering whether they have benefited from financial subsidies allocated towards disadvantaged rural areas. The assessment of the efficiency can be written (Papadas and Dahl, 1991):

$$\max h = \Sigma_r u_r y_{rjo} / \Sigma_i v_i x_{ijo} \quad (1)$$

$$\text{s.t. } \Sigma_r u_r y_{rj} / \Sigma_i v_i x_{ij} \leq 1 \quad (2)$$

$$j = 0, 1, ...n \text{ (for all j)}$$

$$u_r, v_i \geq 0$$

The efficiency is a ratio between produced output and used inputs, and it is a pivotal tool to define the capability of each Decision-Making Units (DMU) to be efficient; in this case the farmer in order to produce a well-defined quantity of output has to use a specific combination of input in different cross sections data over the time of investigation.

In term of productivity, if there are two DMUs such as A and B able to produce two different levels of output such as y_a or y_b using a specific quantity of input x_a and x_b hence, the productivity is a simple ratio y_a/x_a and y_b/x_b.

The non-parametric linear model throughout the Data Envelopment Analysis has been elaborated for the first time in 1978 (Charnes et al., 1978) and it has been useful to estimate the relative efficiency in each Decision Making Units based on a different level of input and output (Hadad et al., 2007) with the purpose in an input-oriented model, used in this research, to minimize the level of input (Doyle and Green, 1994) in different specialized farms part of the Slovenian FADN dataset.

The goal of a non-parametric input-oriented model, such as in our research, is to minimize in a multiple-input model the multiple-output in each farm that is a ratio of efficiency; hence, this model has many possible solutions and u_r* and v_i* are variables of the problem and the value of efficiency have to be greater to 0 or another small but positive quantity thus, any input and output can be ignored in estimating the efficiency in the quantitative model (Bhagavath, 2006; Papadas and Dahl, 1991). If h is 100 there are not issues because this unit ($DMUh_1$) is more efficient compared to other $DMUh_n$, but whether h is above 100 there are many units that are more efficient than this unique unit ($DMUh_1$) then, every unit is tightly linked to the level of input and output making each unit efficient (Bhagavath, 2009). To solve this downside is appropriate to transform the model to a linear one by a linear programming methodology called CCR used in FADN dataset (Charnes and Cooper 1962; Bhagavath, 2009; Galluzzo, 2014) written in this way:

$$\max h=\Sigma_r u_r y_{rjo} \quad (3)$$

$$\text{s.t. dual variable } \Sigma_i v_i x_{ijo} = 100\%\ Z_o$$
$$\Sigma_r u_r y_{rjo} - \Sigma_i v_i x_{ij}o \leq 0 \text{ with } j = 0, 1, ...n \text{ (for all j) } \lambda_j \quad (4)$$
$$- v_i \leq -\varepsilon_i = 0, 1,\ldots.m \text{ and } \varepsilon \text{ is a positive value } s_{i+}$$
$$u_r \leq -\varepsilon_r = 0, 1, \ldots t \text{ and } \varepsilon \text{ is a positive value } s_{r-}$$

RESULTS AND DISCUSSION

Since early 2000, there has been an expansion of utilized agricultural area in Slovenian family farms which is anyway underneath the average value detected in the European Union, equal to 12 hectares, due to a significant drop of agrarian enterprises (Tab. 1). Most of them are held by farmers with age between 55 to 64 years; less than 4% of Slovenian Farms are managed by farmers with age under 35 years (Tab. 2). According to the European Commission, Rural Development Programme 2007-2013 has allocated totally more than 590 million of Euro to Slovenian farms involving 84,000 hectares located in less favoured rural areas.

In all farms part of FADN dataset not located in stayed behind rural areas, the average value of technical efficiency has been lower than the optimal value equal to a threshold of 100% even if results have pointed out a worsening of technical efficiency since 2011 (Tab. 3). Focusing the attention on the comparison between cost efficiency and allocative efficiency, findings have highlighted as the cost efficiency has been lower in average value than allocative efficiency. In 2006 and 2013 the analysis of cost efficiency has pinpointed the lowest values. Hence, it is important for farmers to diminish some inputs, such as fertilizers, seeds, labor capital, and products for crop protection, with the purpose to lessen the cost of production. Allocative efficiency, except the year 2006, has pointed out a significant fluctuation of its value even if in two years as 2008 and 2009 findings have highlighted the highest values in allocative efficiency.

Slovenian farms located in stayed behind hilly rural areas have pointed out an average value of technical efficiency over the time on the investigation under 100%; in 2007 and in 2011 only and partially in 2010 findings have pointed out the best performances in technical efficiency with values close to 100% (Tab. 4). The worst value of technical efficiency was found out in 2008 due to the lowest value of cost efficiency, instead, the best value of cost efficiency was found in 2007. On the contrary, the estimation of allocative efficiency has pointed out in 2008 the highest value and in 2006 the lowest result.

The analysis of dataset in Slovenian farms, part of FADN dataset, located exclusively in less favoured rural areas, such as hilly and mountainous territories, has pinpointed in average values close to the threshold of 100% over the time of study which has implied an optimal situation in terms of efficiency in all investigated farms part of FADN dataset (Tab. 5). In fact, in 5 years out of 10, there have been the best values of technical efficiency, near to the threshold of 100%, and only in 2006 has been assessed the lowest performance in term of technical efficiency.

Analysis of cost efficiency in Slovenian farms located in less-favoured areas, such as in hilly and mountainous territories, in 2006, 2010 and in 2012 has pointed out the lowest value instead the allocative efficiency has highlighted higher performances than the cost efficiency except the year 2010, which has been the worst one. Summing up, allocative and cost efficiency has been 9 years out of 10 below the threshold of 100% which implies an optimal level of efficiency.

Comparing the average values of the dataset, stratified in function of the positioning of Slovenian farms in stayed behind rural areas, findings have pointed out as farms situated in not mountainous areas, such as in hilly ones and classified as disadvantaged territories as well, the lowest level of technical efficiency. By contrast, agrarian enterprises located in less favoured areas strictly sense, such as mountainous territories, have had the best performances both in economic and also in allocative terms of efficiency. Drawing the attention on the analysis of allocative efficiency, results have pointed out as the highest value has been found out only in farms located in hilly areas classified as disadvantaged areas; instead, farms positioned in mountainous ones have highlighted the lowest value of allocative efficiency.

Table 1. Evolution of family farms in Slovenia (Source: Statistical office of the Republic of Slovenia on the website http://www.stat.si/statweb/en/home)

Variable	Year					
	2000	2003	2005	2007	2010	2013
Family farms (n°)	86.336	77.037	77.042	75.209	74.425	72.176
Utilized agricultural area (ha)	456.215	459.578	459.986	463.182	447.851	450.946
Average utilized agricultural area (ha)	5,28	5,97	5,97	6,16	6,02	6,25

Table 2. Agricultural holdings by age of holder in different year of investigation. (Source: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tag00029)

Class of age	Year			
	2005	2007	2010	2013
Less than 35 years	3.420	2.990	2.940	2.700
From 55 to 64 years	17.660	17.670	19.180	20.090
Total	77.170	75.340	74.650	72.380

Table 3. Analysis of efficiency in Slovenian farms not located in less favoured areas (Source: our elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm)

Year	Technical Efficiency	Cost Efficiency	Allocative Efficiency
2004	97,95	44,34	45,26
2005	71,44	37,29	52,2
2006	100	28,87	28,87
2007	100	71,49	71,49
2008	100	97,96	97,96
2009	100	100	100
2010	80,5	53,94	67
2011	80,77	64,03	79,27
2012	61,38	40,07	65,28
2013	45,61	35,85	78,61
Average	*83,765*	*57,384*	*68,594*

Table 4. Analysis of efficiency in Slovenian farms located in less favoured areas but not in mountainous areas (Source: our elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm)

Year	Technical Efficiency	Cost Efficiency	Allocative Efficiency
2004	94,32	65,07	68,99
2005	66,26	52,11	78,65
2006	51,98	30,15	58
2007	100	100	100
2008	24,07	14,02	58,24
2009	76,99	62,82	81,59
2010	99,25	79,62	80,23
2011	100	79,11	79,11
2012	82,14	62,96	76,65
2013	83,26	57,82	69,44
Average	*77,827*	*60,368*	*75,09*

Table 5. Analysis of efficiency in Slovenian farms located in less favoured areas (Source: our elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm)

Year	Technical Efficiency	Cost Efficiency	Allocative Efficiency
2004	100	80,4	80,4
2005	80,01	66,28	82,83
2006	73,49	45,53	61,95
2007	82,76	73,2	88,45
2008	100	100	100
2009	100	67,11	67,11
2010	100	51,59	51,59
2011	97,65	60,12	61,57
2012	87,85	51,8	58,96
2013	100	72,43	72,43
Average	*92,176*	*66,846*	*72,529*

Table 6. Differences between target and real variables of input investigated in Slovenian farms (Source: our elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm)

	Input cost				
	Labour	Machinery	Seeds	Fertilizers	Crop protection
Farms located in less favored areas	-16.932	-13.101	-15.016	-19.409	-13.063
Farms located in mountainous areas	-32.412	-35.433	-35.868	-31.182	-37.522
Farms not located in less favored areas	-25.864	-30.067	-21.648	-26.398	-32.278

This has corroborated the hypothesis according to which small farms have been more efficient than other placed in not disadvantaged rural areas due to a different level of investment in land capital and a more efficient use of other factors of production.

Comparing the theoretical target function of efficiency to the real investigated inputs detected in the FADN dataset, farms located in stayed behind rural areas strictly sense, such as farms in mountainous areas, need to reduce more than other clusters of stratified farms classified as disadvantaged ones and located in hilly areas their input costs as labour costs, seed and fertilizers (Tab. 6). In fact, findings have pinpointed as farms placed in mountainous areas and plane areas have to cut down on one third labour capital, costs of cultivation and costs of fertilizers (Tab. 6); hence, farms located in mountainous areas have to improve their economical performances by a decrease of input costs and an improvement in the management.

CONCLUSIONS

Farm Accountancy Data Network is a useful tool to estimate the impact of financial actions carried out by the European Union comparing a level of efficiency in different states of the European Union over the time. By the FADN it has been possible to assess the impact of payments allocated throughout the Common Agricultural Policy towards Slovenian farms.

In general, findings have pointed out the best performances in term of technical efficiency in enterprises located in stayed behind rural areas than in mountainous ones due to a different use of invested capitals (land, machinery) and productive inputs (costs of seeds, fertilizers, and quotas). This has corroborated the hypothetical framework, according to which, financial subsidies in favor of rural areas are positively correlated partially to the growth of farm dimension and mainly to the diversification in a perspective of multifunctionality in farms.

Main results have highlighted as payments allocated towards disadvantaged rural areas are an essential tool in lessening the socio-economic marginalization in the Slovenian countryside where

are scattered in small units of production more than 70% of usable agrarian areas as argued by Bavec and Bavec in 2011. In contrast, findings have been able to demonstrate as there has been a trend reversal, comparing the efficiency in Slovenian farms before the EU enlargement and afterward the accession of Slovenia to the European Union. Hence, the variable part time in the management of farms is not the main reason for the decline in farm's efficiency as proposed by Brümmer in 2001 because a pivotal role in improving efficiency in small family farms should be ascribed to the pre-accession funds and initiatives put into action by national and local authorities in order to ameliorate and to adapt agrarian enterprises to a new socio-economic context.

The majority of farms located in stayed behind rural areas are managed by family farms. This is one of the main reason to explain as farms located in less favored rural areas have pointed out the highest level of efficiency with a more efficient level of invested capitals provided by the family of agrarian entrepreneurs even if the level of efficiency, in average close to 90%, has implied the best use of technologies as argued by Bojnec and Latruffe in 2008.

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