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A survey on the performance of the Italian brewing companies

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Abstract. The paper analyzes the performance of a sample of Italian microbreweries. For small and very small companies, performance analyses represent an important tool for the investigation of both the efficiency and the survival chances of the companies in the medium and long term. The methodology used consists of calculating different profitability and productivity indexes followed by a DEA model for the evaluation of the companies' efficiency. The results show that the companies operate at significantly low productivity levels and in conditions of technical inefficiency, due to both the inability of the managers to manage the inputs and the fact that companies operate at sub-optimal levels of scale. Lastly, profitability turns to be positive for two out of three indexes examined.

Keywords: Italian brewing industry, economic performance, profitability indexes, productivity indexes, DEA model.
JEL codes: L25, L66, D24.

1. INTRODUCTION

In the last ten years, the Italian beer sector hasshowed a rapid growth (Aquilani *et al.,* 2015; Donadini *et al.*, 2016; Donadini, Porretta, 2017; Fastigi *et al.*, 2018; Garavaglia, 2018).

In 2015 the sector involved 649 companies, including multinationals, industrial and craft breweries, counting a total of 7,893employees (Chamber of Commerce, 2018). Between 2015 and the end of 2017, the number of production units increased by 55% (1,008 firms), while the number of employees increased by 16% (9,128 people) in the same period.

The significant growth that has affected the sector in terms of both production units and workforce is almost entirely related to the proliferation of craft microbreweries, which produce unfiltered and non-pasteurized craft products with heterogeneous beer styles characterized by exclusive recipes. According to statistics from both the Italian Chambers of Commerce and professional associations, in 2017, 91% of the firms counted less than10 employees each. In detail, 52% of the total number offirms countedonly one employee, while companies with 50 or more employees were 1.4% of the total (Unionbirrai ObiArt, 2018).

The rapid growth of microbreweries in Italy is not an isolated phenomenon on the European and international panorama (Colen, Swinnen, 2010; Garavaglia, 2018). It is a consequence of the microbreweries movement, born in the US in the 1970s (Carrol, Swaminathan, 2000; Swaminathan, 1998; Tremblay *et al*., 2005), which spread rather quickly over other continents, including Europe, in the following two decades (Fanelli, 2018; Fastigi *et al*., 2018; Fastigi, Cavanaugh, 2017; Fastigi *et al*., 2019; Garavaglia, 2018; Howard, 2010).

The phenomenon is the result of competitive forces acting on the sector at a global level (Argent, 2018). As in other countries, the growth of small craft breweries in Italy has also responded to the needs of a demand increasingly focused on both quantity and quality. In particular, the development of large multinational industrial groups supported growth in terms of quantity, while the demand for higher quality products accentuated the development of residual market niches, able to meet the tastes of an ever-increasing number of educated consumers (Donadini *et al*., 2016; Garavaglia, 2009; Garavaglia, 2018).

The aim of this paper is to carry out an analysis of the performance of Italian craft breweries according to the scientific literature that deals with the performance of small and medium enterprises in the manufacturing sector, with a focus on the food and beverage industry (Blackburn *et al*., 2013; Charoenrat, Harvie, 2014; Dimara *et al*., 2008; Pilar *et al*., 2018). A methodological approach that took into account the different aspects that contribute to defining company performance was implemented (Sellers Rubio, 2010) for the analysis of the craftbeer sector in Italy. A multidimensional concept of «performance» was adopted, which evaluated the performance of a sample of companies operating in the craft sector in terms of profitability, productivity and efficiency.

The analysis of the performance of the companies operating in the Italian craft beer segment is extremely important, asthe concept of performance is closely linked to that of survival. To achieve high performance levels is the fundamental prerequisite for the growth and survival of the small Italian brewing companies. Smaller companies are less likely to survive than large ones, especially if their birth and growth are linked to the development of new technologies or new products (Brock, Evans, 1989), as in the case of «craft beer». Moreover, the economic situation of the beer market calls for the development of analyses focusing onthe craft beer company's performance, as in the next few yearsthe reduction of both company costs and final product priceswill become fundamental objectives forbreweries.

1.1. Literature review

The scientific literature analyzing the performance of MSMEs is rather heterogeneous, extensive and varied, though most of it assesses the performance of MSMEs in terms of profitability (Aragón Sánchez, Sánchez Marín, 2005; Fernández *et al*., 2018; Foreman Peck *et al*., 2006; Hall *et al*., 2009; Padula *et al*., 2015, Pollack, Adler, 2016). The generation of income is an essential condition for them to remain on the market, although it is not the only objective MSMEs pursue. Poor profitability provesto be both a lack of profit for the owner/manager and a reduced availability of financial resources to invest in the company (Prowl *et al*., 2017). MSMEs generally operate with limited resources (Prowl *et al*., 2017), and their main objective is to achieve maximum productivity through the optimized use of the inputs (Hall *et al*., 2009; Kurniawati, Yuliando, 2015; Mahmood, 2004; Van Beveren, 2012). This optimized use depends on technical efficiency, which is a fundamental parameter for measuring company performance, as well as one of the main causes of MSMEs' lower productivity (Alvarez, Crespi, 2003; Taymaz, 2002; Setiawan *et al*., 2019).

The beer sector has aroused renewed interest from the scientific literature on a global level. In recent years, a growing number of studiesfocused on both the structure of the sector in different countries and on the entry of new small and very small companies in markets generally dominated by large multinationals (Beck *et al*., 2018; Cabras *et al*., 2018; Garavaglia, Castro, 2018; Hani, Cheriet, 2014; Howard, 2010; McLaughlin *et al*., 2014; Toro Gonzalez, 2017; Weersink *et al*., 2017).

Previous studies analysed the sector using the theory of strategic groups (Day *et al*., 1995; Tremblay, 1985). The phenomenon of the proliferation of micro breweries was considered as it refers to the industry life cycle model and the resource partitioning model (Carroll, Swaminathan, 2000; Horvarth *et al*., 2001; Swaminathan, 1998). Analyses of micro breweries' performance were developed mainly dynamically through survival analysis (Bentzen, Smith, 2018; Wessonand De Figueiredo, 2001). As far as Italy is concerned, Garavaglia (2009; 2018) developed surveys at a macro level, analysing the structure, performance and competitiveness of the brewing industry by calculating concentration and market powerindexes. Fanelli and Felice (2014) (ref. paragraph 1) examined the sector in the period 2008-2012 and, implementing a multivariate analysis and a cluster analysis, identified the economic indexes that can explain the differences among the different companies operating in the beer sector. The studies by Cannatelli *et al.* (2017) and Espositi *et al.* (2017) analysed the per-

formance of the companies operating in the craft beer segment. Cannatelli *et al.* (2017) carried out an analysis aimed at verifying the relationship between company performance, product quality and the brand management strategies adopted. On the other hand, Espositi *et al.* (2017) analysed the phenomenon of the proliferation of microbreweries in Italy from a dynamic point of view, considering the effect that spatial factors play on company performance.

In this paper, the performance of craft beer companies is investigated through the implementation of both specific productivity and profitability indexes and the DEA model (Cooper, 2006; Zhou *et al.*, 2018). The implementation of the DEA model allows to both analyze the company's performance in terms of technical efficiency and scale efficiency and determine if the causes of the company's inefficiency are due to managerial inabilities in organizing and governing the inputs or to the fact that they do not operate at the optimal production scale. The awareness of company inefficiency has important implications especially for micro, small and medium enterprises (MSME), as it provides the owner/manager with the information that allows him/her to best manage the company's often scarce resources, to avoid waste and reduce production costs, elements that contribute to improve the profitability of the company itself. To the best of our knowledge, such studies have not yet been carried out, at least not at a national level.

2. METHOD AND SAMPLING

2.1. Theoretical framework

This research was developed using the methodology proposed by Sellers Rubio (2010, pp. 76-77) and Sellers Rubio and Alampi Sottini (2016, p. 35) for the wine sector in Spain and Italy. In the papers cited above, the performance of production companies is investigated using different approaches, which involve calculating specific productivity and profitability indexes and a non-parametric frontier approach to evaluate the efficiency of production companies. In accordance with Sellers Rubio and Alampi Sottini (2016, p. 36), the evaluation of profitability and productivity was carried out using balance sheet indexes. Although part of the scientific literature has criticized the adoption of these indexes (De Andrés *et al.*, 2009), they are still widely used as representative indicators of company performance (De Andrés *et al.*, 2009; Chaudhuri *et al.*, 2016; Chenall, Smith, 2007).

Productivity was calculated in terms of relative productivity, using per-capita turnover (Sellers Rubio, 2010; p. 77), as an indicator of labour productivity. This indicator has been considered relevant for the analysis of small and very small companies because it allows to examine the relationship between labour factor and productivity. Even though a smaller number of employees may seem to lead to an increase in productivity, elements such as technological innovation (Baumann, Kritikos, 2016; Hall *et al.*, 2009) and staff skills (Alvarez, Crespi, 2002; Cassell *et al.*, 2002) can still influence the final result, both in a positive and negative manner.

The efficiency analysis was developed by formalizing an input-oriented DEA model 3+1 (3 inputs and 1 output), calculated considering both constant (CRS) and variable (VRS) returns to scale. We decided to adopt an input-based approach because we believed as more realistic to consider that micro breweries, operating with limited resources and carrying out their activities in niche markets might better improve their efficiency, starting from the reduction of costs and waste and with a better organization of production factors, rather than trying to maximize output. The calculations were elaborated within R (R Core Team, 2017), using both the «non paraeff» package (Dong yhun, Dukrok, 2013) and the «Benchmarking» package (Bogetoft, Otto, 2015).

The variables were selected referring to the contributions provided by Sellers Rubio and Alampi Sottini (2016).

The number of employees was selected as the representative input of the labor factor (Rubio, 2010; Rubio, 2016). The skills and professionalism of human resources are factors that strongly influence the quality of the final product, and consequently the company's performance in terms of profitability and income (Rose, Kumar, 2006). The number of employees is also considered one of the most critical parameters in terms of cost management, productivity and technical inefficiency in the case of small and very small companies (Alvarez, Crespi, 2002).

The debt/equity ratio characterises the financial structure of companies and provides information on the sustainability of the financial debt, by comparing it to the capital of the company (both the capital generated by the company and the shareholders' equity). This indicator was considered relevant to the model, given the importance that making investments has for small and very small companies and the difficulty that these companies generally face in obtaining loans from banks or other credit institutions (Alvarez, Crespi, 2002; Reid, 2003).

The Total debt variable (both short-term and long-term debt) has been introduced in the model as an input capable of monitoring the capital factor; this variable provides information about external financing and the related costs and is a key factor for the company's

competitiveness in the market (Reid, 2003). In the case of small companies, the «Total debt» variable provides useful information on the management of monetary advances (Reid, 2003). As for the output variable, Revenues from sales and services were selected: in monetary terms, it represents all the products sold on the market by the company. The variable was selected as an increase in sales and profit improvement is perceived to be one of the most important objectives for MSMEs.

The DEA model is based on the envelopment of data to identify an efficient frontier that is used to evaluate the performance of the production units under study (Cooper *et al.*, 2006).

The most efficient DMUs (Decision Making Units) determine the efficient frontier, against which the efficiency of the other DMUs is measured (Hoff, 2007).

Conceptually, the most efficient DMUs are those that can reduce their inputs while keeping the outputs at their current levels (DEA input-oriented model), or that can produce a higher amount of outputs while keeping the inputs at their current levels (DEA output-oriented model).

Given a set of DMUs, whose production process is described by a vector of input variables (I) and a vector of output variables (J) common to all units but distributed in different quantities among the different production units, the production efficiency of each of them is calculated as the maximum ratio between the weighted amounts of output and input (Serafini, 2009; p. 417):

$$\text{Max} \quad \sum_{j\in J} w_j Y_j^K \Big/ \sum_{i\in I} v_i X_i^k \tag{1}$$

With
X_i^k: quantity of inputs used in the production process by company k;
Y_j^K: quantity of output produced by company k;
$w_j>0$ and $v_i>0$ weights attributed to inputs and outputs.

The problem can easily be turned into a linear programming problem (and in its dual problem) by imposing the constraint $\sum_{i\in I} v_i X_i^0 = 1$ (Serafini, 2009; p. 418):

$$\begin{aligned} &\max \sum_{j\in J} w_j Y_j^0 \\ &\sum_{j\in J} w_j Y_j^k \le \sum_{i\in I} v_i X_i^k \quad k\in [n] \\ &\sum_{i\in I} v_i X_i^0 = 1 \\ &v_i, w_j \ge 0 \qquad\qquad j\in J,\ i\in I \end{aligned} \tag{2}$$

$$\begin{aligned} &\text{Min } \theta \\ &\sum_{k=1}^{n} \lambda^k X_j^k \ge Y_j^0 \quad j\in J \\ &\sum_{k=1}^{n} \lambda^k X_i^k \le \theta X_i^0 \quad i\in I \\ &\lambda^k \ge 0 \quad k\in [n] \end{aligned} \tag{3}$$

Where in (3) $X_j^k Y_j^k$ are, respectively, the vectorof inputs and the vector of output sand λ^k is a non-negative vector of variables.

The problem of linear programming in (1) refers to an input-oriented DEA model with constant returns to scale. It is possible to introduce the variable returns to scale hypothesis by adding a supplementary constraint(Serafini, 2009):

$$\Sigma_k \lambda^k = 1 \text{ for variablereturns to scale} \tag{4}$$

The methodology assigns each DMU an efficiency score between 0 and 1 (Cooper *et al.*, 2006). Efficient border companies show an efficiency score equal to 1, while totally inefficient units show an efficiency score equal to 0. However, efficient solutions can be detected even with some parameters of input or output equal to zero. DMUs for which this option occurs are defined as weakly efficient. The weakly efficient DMUs have excess input and output deficits called slacks. To detect weakly efficient DMUs, an infinitesimal constant ε>0, defined «non-Archimedean» is introduced.

Considering constant returns to scale, the dual problem in the case of an input-oriented modelis the following(Wen, 2015; p. 50):

$$\begin{aligned} &\text{Min}\theta - \varepsilon\left(\sum_{1=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \\ &\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = \theta x_{i0} \\ &\sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+ = y_{r0} \\ &\lambda_k \ge 0 \\ &s_i^- \ge 0 \\ &s_r^+ \ge 0 \end{aligned} \tag{5}$$

Where s_i^- are input slacks, s_r^+ are output slacks and θ is the efficiency score obtained for each DMU analysed.

The dual problem considering constant returns to scale can be formulated simply by adding the following constraint to (5):

$$\sum_{k=1}^{n} \lambda_k = 1 \tag{6}$$

A DMU is efficient only if θ^* is equal to 1, and the optimum value and all slacks are equal to zero (Serafini, 2009).

The CRS scoreprovides the so-called «global technical efficiency» (Cooper *et al.*, 2006), because it does not consider the scale effect (Banker *et al.*, 1984; Cooper *et al.*, 2006). The VRS score provides the so-called «pure technical efficiency» (Banker *et al.*, 1984; Cooper *et al.*, 2006). The ratio between «global technical efficiency» and «pure technical efficiency» is called «scale efficiency» (Banker *et al.*, 1984). The calculation of these scores allows identifying the source of inefficiency for each investigated DMU (Cooper *et al.*, 2006). Thus, efficiency can be broken into (Cooper *et al.*, 2006; p. 141):

[Technical Eff. (TE)] = [Pure Technical Eff (PTE)] x [Scale Eff. (SE)] (7)

Where the PTE score reveals inefficient operations or management and the SE scorereveals that the DMU does not operate at optimal scale (Cooper *et al.*, 2006).

Scale inefficiencies may be due to the fact that the DMU works at increasing or decreasing returns to scale. To obtainthis information, it is necessary to verify whether:

$\sum_{k=1}^{n} \lambda_k < 1 \rightarrow$ the DMU is working at increasing returns to scale (8)

$\sum_{k=1}^{n} \lambda_k > 1 \rightarrow$ the DMU is working at decreasing returns to scale. (9)

Then, Spearman's correlation indexes were calculated between the selected performance indicators to analyze the level of correlation between the variables and to highlight a possible relationship between them.

As a final step, the matrix containing the data relating to the various performance indexes was divided into three classes, according to the years of activity of the different production realities (less than 5 years, between 5 and 10 years, more than 10 years). The classes were divided as to create homogeneous groups in terms of number of observations per group. Finally, a Kruskal-Wallis test was carried out to point out whether there were significant differences between the medians relative to the different performance indexes in the three groups identified.

2.2. The sample

The economic information on the breweries was extracted from the «AIDA-Italian company information and business intelligence» database, the computerized database of Italian companies of Bureau van Dijk, updated to 2016. The database refers to the economic accounts and structural characteristics of Italian capital companies. The companies were selected according to the ATECO 2007 classification for economic activities (ISTAT, 2009). The selected firms belong to the class 11.05 «Beer production», which includes craft and industrial breweries, with their production facilities. Once the enterprises that did not have any information on the selected variables were discarded, the sample turned out to count a total of 163 production units, including multinationals and large, medium, small and very small companies operating in both the craft and industrial beer segments. Several definitions for «craft breweries» can be found in the scientific literature. In order to identify and extract only the craft breweries from the database, in this paper we have taken as reference the recent Italian Law 154/2016, thanks to which a unique definition of craft brewery has been provided at the national level. Breweries are defined as craft breweries (Chapter V, Article 35) according to the following factors: 1) the production size, defined within the limit of 200,000 hl per year, and the type of product obtained; 2) the economic and legal independence of the brewery from any other brewery; 3) the product characteristics: craft beers must not have undergone the process of filtration and pasteurization.

Since Law 154/2016 could theoretically include even large breweries (as the average annual production could reach up to 200,000 hl), we also verified that the craft breweries were consistent with Recommendation 2003/361 EC provided by the Ministry of Economic Development (OJ, 2003), which provides the definition for small and micro-enterprises. The criteria suggested by the Recommendation are consistent with those identified in the scientific literature for the definition of «Small Brewery» and «Micro brewery» (Cabras, Bamforth, 2015). Official statistics and sector studies describe the sector as composed mainly of small and very small businesses, with an average annual production of between 750 and 800 hl (Assobirra, 2016; ISTAT, 2001, Unionbirrai ObiArt, 2018).

In the present paper, the independence of the companies under study was verified by carrying out detailed verification on specialized sites (microbirrifici.org; cronachedibirra.it), checking companies' potential character as craft companies in terms of adopted techniques and production volumes and whether they had forfeited their «independence» through the sale of their business to large industrial groups. Once we verified this, which led to the exclusion of only one company, the data were processed in order to guarantee the correct application of the methodologies adopted (Cook *et al.*, 2014; Dyson *et al.*, 2001).

Tab. 1. Descriptive statistics on the variables used for the analysis.

Variable	Micro	Small	
Firm Size (num. of employees)	53	11	
	Mean	Median	Standard dev.
Firm Age	9	8	5
Per capita turnover (€)	136,266	134,738	136,711
ROI (%)	*3.90*	*3.81*	*3.97*
ROE (%)	*-3.22*	*-3.36*	*-2.78*
ROA (%)	*2.34*	*2.29*	*2.42*
Total Revenues (€)	635,765	613,124	623,026
Employees (num.)	5	5	5
Total Debt (€)	540,512	534,348	541,748
Debt/ Equity ratio	3.67	3.71	3.75

Source: our elaboration based on data from AIDA - Bureau van Dijk.

The final sample consisted of 64 companies, for which all the information on the extracted variables was available. The size of the sample was considered adequate for the purpose of the research, and in agreement with the indications given in the literature for the correct application of the DEA models (Cook *et al.*, 2014; Dyson *et al.*, 2001).

The characteristics of the sample and the descriptive statistics of the selected variables are shown in Table 1.

3. RESULTS

3.1. Profitability, productivity and efficiency analysis

The descriptive statistics of the selected indexes were calculated (Tab. 2) to analyse the performance of the breweries examined in terms of profitability and productivity. The mean values measured are positive for all the indexes analysed, with the exception of ROE.The median value, however, assumes positive and above average values for all three indexes examined: this means that half of the production units show positive performance regarding profitability. As for productivity, average revenues per employee amounted to 136,266.09 euros, for a median value of 124,600.00 euros per employee.

The descriptive statistics of CRS scores, VRS score and scale efficiency are listed in Table 3. In average terms, the global technical efficiency shows values equal to 0.53 in the sample examined, with a median value equal to 0.48. This result shows that, on average, companies can become efficient by reducing their inputs by 47%.

Tab. 2. Descriptive statistics for profitability and productivity indices.

	Per capita Turnover	ROI	ROE	ROA
Minimum value	1,440.00	-21.34	-135.90	-16.94
1th Quartile	65,615.00	-0.15	-1.54	-0.08
Median	124,600.00	4.60	3.58	3.05
Mean	136,266.09	3.90	-3.22	2.34
3th Quartile	160,827.50	9.85	10.38	5.93
Maximum value	505,790.00	27.59	56.17	18.48
Standard deviation	99,081.43	8.74	36.26	6.31

Source: our elaboration based on data from AIDA - Bureau van Dijk.

Tab. 3. DEA model: descriptive statistics for efficiency score.

	Overall efficiency	Pure tecnica efficiency	Scale efficiency
Minimum value	0.01	0.24	0.01
1th Quartile	0.33	0.50	0.57
Median	0.48	0.72	0.92
Mean	0.53	0.72	0.77
3th Quartile	0.73	1	0.99
Maximum value	1.00	1.00	1.00
Standard deviation	0.28	0.26	0.29

Source: our elaboration based on data from AIDA - Bureau van Dijk.

The pure technical efficiency assumes an average value of 0.72, while the scale efficiency is equal to 0.77. These values indicate that, on average terms, the pure technical efficiency has roughly the same weight as the scale efficiency in influencing the inefficiency of the investigated sample, showing a value slightly lower than the scale efficiency.

A more in-depth analysis (Tab. 4) highlights that 47% of the total DMUs show a global efficiency score between 0.5<=E<1, while 20% of the sample has values below 0.3, revealing substantial productive inefficiency. If we analyze the results for both the models implemented in greater detail, we also notice that the DMUs that show ES=1 and slack zero in relation to the CRS model number seven (11% of the total).

These DMUs have a strong global technical efficiency, and they are both technically and scale efficient. Moreover, they operate at the most productive scale size (Tab. 5).

25 out of the 64 DMUs (about 39% of the sample) show a pure technical efficiency (ES=1 according to

Tab. 4. DEA model: efficiency score classes and relative number of sample companies.

Efficiency range	CRS Number of DMU	CRS Number of DMU (percentage)	VRS Number of DMU	VRS Number of DMU (percentage)
0<=E<0,1	3	*5%*	0	*0%*
0,1<=E<0,2	2	*3%*	0	*0%*
0,2<=E<0,3	8	*13%*	2	*3%*
0,3<=E<0,4	13	*20%*	6	*9%*
0,4<=E<0,5	8	*13%*	5	*8%*
0,5<=E<0,6	6	*9%*	11	*17%*
0,6<=E<0,7	7	*11%*	8	*13%*
0,7<=E<0,8	4	*6%*	4	*6%*
0,8<=E<0,9	3	*5%*	2	*3%*
0,9<=E<1	3	*5%*	1	*2%*
E=1	7	*11%*	25	*39%*
TOTAL	64	*100%*	64	*100%*

Source: our elaboration based on data from AIDA - Bureau van Dijk.

the VRS model). Eleven DMUs (17% of the total) have strong efficiency (ES – VRS=1 and zero slack on input and output).

The other 4 DMUs, although technically efficient, show scale inefficiency. In detail, one DMU operates at decreasing returns to scale 3 DMUs at increasing returns to scale. This means that the first company can achieve global technical efficiency by decreasing its size, while the others can achieve global technical efficiency by increasing their production scale.

The remaining 14 DMUs, besides showing scale inefficiency (all operate under IRS conditions), show weak efficiency, having positive slacks in relation to two of the inputs used for the analysis. These DMUs can reach maximum efficiency by increasing not proportionally the inputs and their own production scale.

3.2. Correlation analysis

Observing the correlation matrices of Spearman (r_s), calculated on the variables analysed, and their rela-

Tab. 5. DEA model: Efficiency score and slack analysis.

DMU Id. Number	slack.x1	slack.x2	slack.x3	slack.y1	eff_CRS	eff_VRS	Se	Returns to scale
8	0.00	0.00	0.00	0	1.00	1	1	CRS
74	0.00	0.00	0.00	0	1.00	1	1.00	CRS
17	0.00	0.00	0.00	0	1.00	1	1.00	CRS
63	0.00	0.00	0.00	0	1.00	1	1.00	CRS
55	0.00	0.00	0.00	0	1.00	1	1.00	CRS
180	0.00	0.00	0.00	0	1.00	1	1.00	CRS
28	0.00	0.00	0.00	0	1.00	1	1.00	CRS
15	0.00	0.00	0.00	0	0.99	1	1.00	DRS
46	0.00	0.00	0.00	0	0.99	1	0.99	IRS
10	0.00	0.00	0.00	0	0.90	1	0.90	DRS
126	0.00	0.00	0.00	0	0.89	1	0.89	IRS
97	0.00	0.00	1.65	0	0.76	1	0.76	IRS
171	0.00	0.00	12.37	0	0.51	1	0.51	IRS
100	0.00	0.00	0.03	0	0.48	1	0.48	IRS
102	0.00	88,017.58	0.00	0	0.46	1	0.46	IRS
103	0.00	3,106.71	0.00	0	0.42	1	0.42	IRS
157	0.00	0.00	0.61	0	0.39	1	0.39	IRS
143	0.00	0.00	2.31	0	0.35	1	0.35	IRS
162	0.00	160,324.47	0.00	0	0.34	1	0.34	IRS
123	0.00	3,085.32	1.38	0	0.30	1	0.30	IRS
134	0.00	9,354.65	0.00	0	0.23	1	0.23	IRS
79	0.00	58,204.22	5.34	0	0.18	1	0.18	IRS
253	0.00	0.00	0.04	0	0.07	1	0.07	IRS
223	0.00	34,593.37	0.00	0	0.05	1	0.05	IRS
188	0.00	0.00	0.01	0	0.01	1	0.01	IRS

Source: our elaboration based on data from AIDA - Bureau van Dijk.

Tab. 6. Spearman correlation index.

	Per capita turnover	ROI	ROE	ROA	Efficiency score CRS	Efficiency score VRS
Per capita turnover	1					
ROI	0.21	1				
ROE	0.13	0.68****	1			
ROA	0.18	0.95****	0.69****	1		
Efficiency score CRS	0.55***	0.49***	0.19	0.46**	1	
Efficiency score VRS	0.49****	-0.03	-0.01	-0.03	0.42***	1

p< .0001=**** ; p < .001=***; p < .01=** p < .05= *
Source: our elaboration based on data from AIDA - Bureau van Dijk.

Tab. 7. Kruskal Wallis test.

	Age<5 n=16	5<Age<10 n=29	Age>10 n=18	Kruskal Wallis test (p-value)
ROI				
Mean	0.71	2.68	8.46	8.78*
Median	2.67	3.75	9.38	0.01
ROE				
Mean	-0.5	-14.0	11.0	10.47*
Median	3.0	1.1	9.7	0.00
ROA				
Mean	0.47	1.18	5.68	8.70*
Median	1.80	2.55	4.95	0.01
Per capita turnover				
Mean	119,622	154,208	122,897	0.74
Median	110,310	129,810	126,190	0.12
Es – CRS				
Mean	0.42	0.53	0.62	4.23
Median	0.41	0.57	0.58	0.12

The Chi-square critical value is 5.99 (df =2 and alpha=0.05)
Source: our elaboration on data from AIDA - Bureau van Dijk.

tive significance tests (Tab. 6), we can notice that the per capita turnover shows weak and not statistically significant relationships with the profitability indexes, while its relationships with the efficiency scores (ES) obtained from the CRS DEA and VRS DEA model are positive and statistically significant. On the other hand, the profitability ratios show strong relationships between them. In addition, ROI and ROA show positive, moderate and statistically significant relationships with the ES obtained by implementing the CRS DEA model. Lastly, the efficiency scores obtained by implementing the CRS DEA model show a moderate and statistically significant positive relationship with the ES obtained by formalizing the VRS DEA model.

3.3. Kruskall Wallis test

The results of the Kruskal Wallis test are shown in Table 7. This analysis shows that there is a significant difference among the core values forthe three groups in terms of profitability, but not in terms of efficiency and productivity.

4. DISCUSSION

The profitability analysis shows that on average ROA and ROI have positive values for the set of observations included in the present paper. However, the sample has a negative value for ROE, which means that, in average terms, the companies under study are running at a loss and their economic imbalance is eroding the equity capital invested in the company. Nevertheless, in median terms, the three profitability indicators show values higher than zero, highlighting that 50% of the enterprise shave higher performances than average and positive ones. The result confirms the findings highlighted in the scientific literature (Garavaglia, 2009), according to which companies operating in the craft beer segment are able to achieve rather high levels of profitability.

On the side of the productivity analysis, the average per capita turnover of the macro category for the brewing sector, i.e. «Beverage industry» (code 11-ATECO 2007 classification) can be considered as the reference term. Since the sample is mainly made up of micro enterprises, this information is calculated considering only the firms belonging to code 11, and that count less

than 9 employees: for the beverage industry, this value reaches 238,151 euro, twice the value of the companies operating in the brewing sector (ISTAT, 2014).

The efficiency scores of the DEA-CRS model show values of about 0.5 on average. The breakdown of the global technical efficiency into technical efficiency and scale efficiency reveals that on average, the sources of inefficiency are to be found both in the inability of the managers to govern the inputs and in the fact that companies operate at sub-optimal levels of scale. Moreover, only 7 out of 64 companies are both technically and scale efficient.

The results of the correlation analysis highlight a strong linear positive relationship between profitability ratios. The productivity and efficiency indexes show a positive correlation. The CRS efficiency scores show positive butmoderate correlations (Spearman rho <0.5) with ROI and ROA. The profitability and productivity indexes showa weak and not statistically significant correlation.

The result is in line with the scientific literature, which points out that a company that achieves good results in terms of profitability not necessarily attains good performance in terms of productivity or efficiency. Especially for small-sized companies, performance strongly depends on the entrepreneur's contribution in terms of personal resources (capital and labour): in this case the imputed costs are consistent, and the net income for the entrepreneur provesto be very low. In such companies, the entrepreneur settles with a lower return level than the one attainable in the market (opportunity cost) for his/her invested capital and labour. In such conditions, the company operates with negative profit levels but positive income levels.

The Kruskal Wallis test was included because in the scientific literature, company age is considered a variable that can influence the company's performance (Coad *et al.*, 2013). Generally, companies that have been operating on the market for longer are associated with higher performance, both in terms of profitability and productivity. The higher levels of performance are attributable to learning by doing and selection effects (Coad *et al.*, 2013). However, the results are not always consistent with these considerations. In fact, in some cases «older» companies may be affected by senescence and inertia (Coad *et al.*, 2013), with consequent negative effects on productivity and profitability. For such companies, the propensity to have a lower return of imputed costs becomes higher.

In the case of our study, however, the test revealed a significant difference in terms of profitability but not in terms of efficiency and productivity among the core values for the three different groups identified. The reasons behind this result need to be further investigated. However, the higher profitability of those companies that operate in the market for several years is confirmed in the literature.

The description and the analysis of the results in terms of productivity/efficiency is more complex. The limitation of the technical/economic resources that small businesses face and that prevent them from investing in the company in terms of both workforce and equipment might be one of the reasons that lead to this result.

However, as highlighted above, the DEA model revealed that technical inefficiency is linked to both management limitations and very small-scaleproduction. Nevertheless, the small production scale of these companies may reflect a precise strategic choice and not a limit.

5. CONCLUSIONS

In recent years, the proliferation of microbreweries has gained international relevance and become a significant phenomenon in Italy, where it highlighted a national beer tradition for years «squashed» by both the strong vocation of the Italian wine production (Esposti *et al.*, 2016; Fastigi *et al.*, 2017; Garavaglia, 2015) and the typical Mediterranean model of food consumption (Marinelli *et al.*, 2014). In this paper, a performance investigation of the companies operating in the beer market was carried out, associating the analysis of technical efficiency with the more traditional analyses of profitability and productivity. The study allowed us to obtain information on both the state of health of the companies and the choices that the entrepreneur makes, according to the characteristics of the production reality he/she manages and the market in which he/she operates.

In this regard, the results of the analyses revealed that, in average terms, the companies examined operate atsignificantly lower levels of productivity than the average for the reference sector. Moreover, they operate under a condition of technical inefficiency. The breakdown of the global technical efficiency into technical efficiency and scale efficiency reveals that, on average, the sources of inefficiency are to be found both in the inability of the managers to governthe inputs and in the fact that companies operate at sub-optimal levels of scale. An explanation for these results can be the limitation of the economic/technical resources that the small companieshave to deal with and that prevent them from growing. However, the fact that the companies decided not to increase their production scale can also reflect a precise strategic choice of the microbreweries them-

selves: even if one of the main short-term objectives of MSMEs is to increase their size to reach the optimum level of scale, for craft breweries their «small» size may represent, on the contrary, a survival strategy for continuing to operate in their niche market.

The results can also be justified by the level of utilization of the plants in relation to their technical and operational potential. In this regard, an analysis conducted by Obi Art (2018) at national level on a sample of about 100 micro breweries showed that only a small percentage (<75%) of companies is exploiting their plants to maximum potential, thus using the available capital and workforce at a high level of efficiency. On the contrary, most of the companies showed a level of plant utilization not above 75% of the maximum utilization potential. In some cases, the companies were still in a phase of growth, having started their business only recently; in other cases, the companies reported some problems in increasing their production volumes due to the difficulties of placing further quantities of final product on the market.

In contrast to the previous analyses, profitability proved to be positive for two out of three indexes. This can be explained by the fact that the micro breweries under study operate in the higher quality «specialty beers» segment, and that the prices of their products, for example in large retail outlets, are more than double those of high-quality «specialty beers» of industrial origin (Unionbirrai ObiArt, 2018).

The results of our analyses also showed the coexistence of companies operating at high levels of performance in terms of profitability, productivity and efficiency and companies that, on the contrary, are in critical conditions. This is confirmed by the scientific literature, according to which, in Western markets, few MSMEs are able to succeed and grow, while the majority remain small, or exit the market definitively (Birley, Westhead, 1990; Lewis, Churchill, 1983). As indicated in the literature for other countries (Cabras, Bamforth, 2015), Italy is also undergoing some transformations within the craft beer segment. These changes reveal thatonly a limited number of brewing companies are expanding significantly (both in terms of employees and turnover), while most of them remain very small and only operate in local markets. This phenomenon is still in an embryonic stage and represents a topic to develop with further studies, through which the factors that determine positive or negative performance for craft breweries can be identified.

A further development of this paper may consider the integration of further variables in the model, variables that can also be of a qualitative nature, and that take into account the characteristics of the entrepreneur/manager, the skills of the workforce and the investments that micro breweries make in research and innovation.

The scientific literature suggested different approaches for the evaluation of company performance, approaches based on the use offinancial, non-financial performance indexes or a combination of both (Chenall, Smith, 2017; Devinney *et al.*, 2009; Ndurupati *et al.*, 2011). Specific models have been proposed for small companies, in particular the Resource-Based View (RBV) has already been applied to the beer sector by Duarte Alonso *et al.* (2016).

The results of this further analysis might show how, in many cases, entrepreneurial choices are made not only to serve economic objectives, butare also inspired by non-economic personal aspirations and sometimes antithetical to profitmaximization. The apparent inconsistency of some of the results reported in this paper would then find detailed explanations, representing a form of resilience of the companies that compensate for lower performance by accepting lower levels of income for those production inputs directly provided by the entrepreneur.

It would be interesting to analyse the results obtained for specific categories of micro breweries. Among them, agri breweries (Francioni *et al.*, 2019) play an interesting role. These are a type of craft brewery only recently recognized by the Italian legal system, and represent a peculiarity because they are the link between the primary sector and the beer processing sector, the latter always considered as an exclusively industrial production system.

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