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A Composite Index to Measure the Italian "Enological Vocation"

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Abstract

The Italian wine industry is going through, during a general economic crisis, a period of strong growth and expansion in the world markets. The quality of products, characterized by tradition and innovation, has defeated the involution of the Italian entrepreneurial system. The variety of wines produced represents the peculiarities of the Italian territory. The aim of this paper is to measure a multidimensional phenomenon, the "Enological vocation" of the Italian provinces, through the use of a composite index. The results highlight both areas of the territory for which it is known the strong vocation and less known areas where you need to do further investigation.

1. Introduction

The aim of the paper is to try to measure the "Enological Vocation" of the Italian provinces (NUTS 3) using data from the census of 2010. This is clearly a multidimensional phenomenon since it is not possible to represent it only with a descriptive indicator; in fact, the phenomenon is composed of different dimensions that need to be considered contextually. In this regard, we have represented the phenomenon by three pillars: Structural, Entrepreneurial, and Qualitative. And each of the three pillars is composed of several individual indicators. In order to obtain a measure of each pillars and a "unique number" that represents the phenomena it is necessary to apply a composite index, combining the individual indicators. In fact, it is common awareness that multidimensional phenomena cannot be

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measured by a single descriptive indicator and that, instead, they should be represented with multiple dimensions. Phenomena such as development, poverty, social inequality, well-being, quality of life, and enological vocation, require, to be measured, the 'combination' of different dimensions, to be considered together as the proxy of the phenomenon. This combination can be obtained by applying methodologies known as composite indices. The paradigm of work for the measurement of these phenomena is developed as: 1) identification of a theoretical framework; 2) selection of the representative dimensions; 3) selection of individual indicators; 4) definition of the synthesis methodology (standardization and aggregation function).

The recent context of Italian wine industry is described in section 2; the application about the Italian enological vocation is presented in Section 3; the composite index methodology for the application is defined in Section 4 and the measurement of the enological vocation, at the provincial level, is reported in Section 5.

2. General context

The economic crisis that hit Italy in recent years has certainly depleted many social classes and damaged numerous business sectors. The major macro-economic indicators have certified, since 2008, a steady (and not too slow) decline of the country which, hopefully, will resume as soon as possible. The Italian wine industry, during the crisis, has developed considerably in going against the trend of many economic sectors.

A sector that has grown in the last 10 years and that attracts a lot of young people throughout Italy. The wine professions are really numerous and involve very different fields, from direct contact with the grape to the distribution in Italy and in the world, until you get to wine tourism which, last years, reached 1.8 billion euro turnover. In Italy the "wine world" employs 1.2 million people, who have found employment in the vineyards, cellars or in commercial distribution. And every year the number of guys who want to specialize in the study of viticulture and enology increases more and more. Italy is also confirmed in 2013 the largest producer of wine in the world with 44.9 million hectoliters against 44.1 million in France and 40 in Spain. Italian production has increased, compared to 43.8 million hectoliters in 2012, representing 17% of the world total and 30% of the EU: the value of production is estimated at 9.1 billion euro (Censis, 2014).

The latest Census of agriculture has certified that the cultivation of the grapevine has spread on 5.2% of the national UAA. All provinces of Puglia and Friuli show values above the national average. The maximum value is the Veneto (9.6 percent), followed by Friuli (8.9 percent) and the lowest in Valle d'Aosta (0.8 percent of the UAA). The maximum at the provincial level is the Province of Trapani with a percentage of the grapevine land equal to 45.1% of the Utilized Agricultural Area (UAA), the minimum is the Province of Lodi with 0.04% (Istat, 2014).

3. Italian "Enological vocation"

In the general context described in the previous Section, the study and measurement of the enological vocation of the Italian provinces seems a necessary step in order to understand such an important sector for the economy and the Italian culture. Among many factors, the structural characteristics of the viticulture, of the vineyard holding' management and of the quality production vocation are relevant and crucial in defining the capability of producing and marketing wine in a certain area. Therefore, three pillars have been chosen in this study, to represent the phenomenon: Structural, Entrepreneurial, and Qualitative. Variables used are reported in Table 1 (Istat, 2012; Istat, 2013).

Their relevance in regard to the pillar and the availability in official statistics of the parameters used have been the main criteria for choosing the elementary indicators. In fact, in order to select the individual indicators a formative approach is chosen: the selected individual indicators are causes of an underlying latent variable, rather than its effects. Therefore, causality is from the indicators to the concept and a change in the phenomenon does not necessarily imply variations in all its measures. In this model, the concept is defined by, or is a function of, the observed variables. In this case, indicators are not interchangeable (omitting an indicator is omitting a part of the underlying concept), the correlations between indicators are not explained by the measurement model (Diamantopoulos *et al.*, 2008) and then their level is substantially negligible.

Table 1. List of indicators of enological vocation

Pillar	Indicator	Source
Structural	Area under vines/utilised agricultural area	2010 agricultural Census
Structural	Vineyard holdings/agricultural holdings	2010 agricultural Census
Structural	Active enterprises in the wine sector/active enterprises in all sectors	2011 census of Industry and Services
Structural	Workers in the active enterprises in the wine sector/resident population	2011 census of Industry and Services
Structural	Wine Production / resident population	2011 annual agricultural surveys/2011 Population census
Entrepreneurial	Area of the specialised vineyard holdings/utilised agricultural area	2010 agricultural Census
Entrepreneurial	Specialised vineyard holdings/vineyard holdings	2010 agricultural Census
Entrepreneurial	Standard Output of the specialised vineyard holdings/Number of Specialised vineyard holdings (euro)	2010 agricultural Census
Entrepreneurial	Number of Specialised vineyard holdings with Standard Output >50.000 euro/vineyards holdings (%)	2010 agricultural Census
Entrepreneurial	Vineyard holdings marketing wine and must/agricultural holdings	2010 agricultural Census
Entrepreneurial	Vineyard holdings with agricultural studies of the farm manager /agricultural holdings	2010 agricultural Census
Entrepreneurial	Vineyard holdings organised as corporation(incl. Cooperatives)/agricultural holdings	2010 agricultural Census
Entrepreneurial	IT vineyard holdings/agricultural holdings	2010 agricultural Census
Entrepreneurial	Vineyard holdings with area under vines > 50 ha/Vineyard holdings	2010 agricultural Census
Entrepreneurial	Vineyard holdings with other gainful activities/Vineyard holdings	2010 agricultural Census
Qualitative	DOC/DOCG area under vines/utilised agricultural area	2010 agricultural Census
Qualitative	Organic area under vines/utilised agricultural area	2010 agricultural Census
Qualitative	Organic vineyard holdings/agricultural holdings	2010 agricultural Census
Qualitative	DOC/DOCG wine/wine production	2012 Annual agricultural surveys
Qualitative	Number of DOC/DOCG denominations (percentage composition)	2013 Administrative data
Qualitative	Number of DOCG denominations/ Number of total denominations	2013 Administrative data

4. Mazziotta-Pareto Index

The composite indices of enological vocation were constructed by the MPI (Mazziotta-Pareto Index). The MPI is a non-compensatory composite index that can be used to measure multidimensional phenomena, such as development and poverty (De Muro *et al.* 2011).

The index is designed in order to satisfy the following properties: (i) normalization of the indicators by a specific criterion that deletes both the unit of measurement and the variability effect; (ii) synthesis independent from an 'ideal unit' (i.e., a hypothetical geographical unit represented by the best values of the individual indicators), since a set of 'optimal values' is arbitrary, non-univocal and can vary with time; (iii) simplicity of computation; (iv) ease of interpretation.

The steps for computing the MPI are given below.

Let us consider a set of individual indicators positively related with the phenomenon to be measured. Given the matrix $\mathbf{X}=\{x_{ij}\}$ with n rows (provinces) and m columns (indicators), we calculate a standardized matrix $\mathbf{Z}=\{z_{ij}\}$ as follows:

$$z_{ij} = 100 + \frac{(x_{ij} - \mathrm{M}_{x_j})}{\mathrm{S}_{x_j}} 10 \tag{1}$$

where M_{x_j} and S_{x_j} are the mean and standard deviation of the indicator *j* respectively.

Denoting with M_{z_i} and S_{z_i}, respectively, the mean and the standard deviation of the standardized values of the province *i*, the composite index is given by:

$$MPI_i^- = M_{z_i} - S_{z_i} cv_i \qquad (2)$$

where $cv_i = S_{z_i}/M_{z_i}$ is the coefficient of variation for the province *i*.

This approach is characterized by the use of the product $S_{z_i} cv_i$ to penalize the provinces with unbalanced values of the indicators. The 'penalty' is based on the coefficient of variation and it is zero if all the values are equal. The purpose is to favor the provinces that, mean being equal, have a greater balance among the different indicators. Therefore, the MPI decomposes the score of each unit in two parts: mean level (M_{z_i}) and penalty ($S_{z_i} cv_i$). The penalty is a function of the indicators' variability in relation to the mean value ('horizontal variability') and it is used to penalize the units. The aim is to reward the units that, with equal mean, have a greater balance among the indicators values. In general, the greater the discordance among individual indicators, the higher the 'horizontal variability' (i.e., the penalty) for each unit, with consequent increasing of the difference between MPI and arithmetic mean (Mazziotta and Pareto 2015).

The method provides a 'robust' measure and less 'sensitive' to inclusion or exclusion of individual indicators. In fact, over the past few years, the method has been subjected on several occasions both to influence analysis that to robustness analysis (through the introduction of a stochastic disturbance in the matrix) in order to verify the "goodness of fit" compared to many other composite indices. The results have always been the "strength" of the method thanks to its statistical and mathematical structure (Mazziotta C. et al. 2010).

Three composite indices of Structural, Entrepreneurial and Qualitative enological vocation were computed by (1) and (2). Then, a global composite index was obtained by applying (2) to the three previous indices.

5. The results

The results of the global composite index, at NUTS 3 level in Italy, are showed in Figure 1.

The provinces with highest values of the composite index are located in the Centre-North area, with the exception on Trapani and Chieti. Asti has reaching the highest score of the composite index in Italy performing higher in the list of each pillar (first in the quality index, second in the entrepreneurial and fourth in the structural index). Asti is located in a district with high enological vocation because other three neighboring provinces are ranking in the highest class: Cuneo, Alessandria and Pavia. From this area important quality wines are produced and commercialized over the world as Barbera, Dolcetto, Barolo, Barbaresco, Nebbiolo, etc. Other two important districts for the wine industry in Italy can be distinguished in the Regions of Veneto (Verona and Treviso) and of course, Toscana (Siena and Firenze) where is produced Chianti wine.

In the South Trapani fulfill the second highest score among everything after Asti and Chieti reaches the eights position. Trapani is the province with most area dedicated to the grapevine and most number of vineyard holdings in Italy. It is famous overall for producing quality dessert wines (Marsala, Moscato among them) thanks to its Mediterranean climate and their islands of volcanic origins. It is interesting to notice that the three provinces with highest scores are characterized by a different wine market strategy. Asti is more inclined to the quality dimension, Trapani to the structural aspect and Gorizia to the entrepreneurial feature. This is more evident analyzing the three simple indices forming the composite index.

The highest values of the structural index (Figure 2) are more distributed in the territory than the composite index. Southern Italy reaches 6 provinces included in the first class (Trapani, Chieti, Foggia, Benevento, Barletta-Andria-Trani and Taranto). Trapani scores the highest value of the index and Puglia is the Region with most number of provinces (3) included in the first class. But after Trapani the following two provinces in the ranking are located in the North (Asti and Treviso).
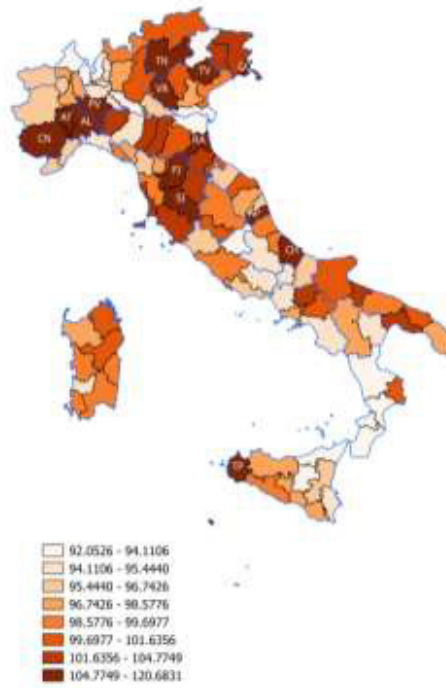
92.0526 – 94.1106
94.1106 – 95.4440
95.4440 – 96.7426
96.7426 – 98.5776
98.5776 – 99.6977
99.6977 – 101.6356
101.6356 – 104.7749
104.7749 – 120.6831

Fig. 1. Global index of enological vocation.

91.2466 – 93.0873
93.0873 – 94.6287
94.6287 – 96.0171
96.0171 – 97.5904
97.5904 – 99.5361
99.5361 – 101.9320
101.9320 – 107.1246
107.1246 – 140.7633
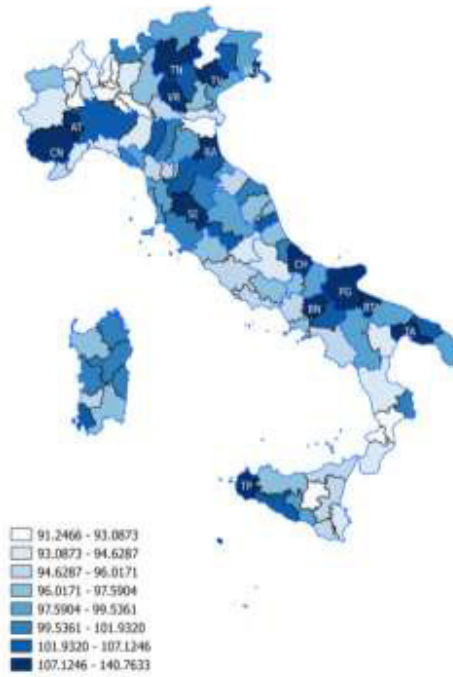
Fig. 2. Structural index of enological vocation.

☐	92.1551 - 94.2258
☐	94.2258 - 95.7089
☐	95.7089 - 97.0683
☐	97.0683 - 97.8779
☐	97.8779 - 99.2471
☐	99.2471 - 102.1864
■	102.1864 - 105.3661
■	105.3661 - 127.4354
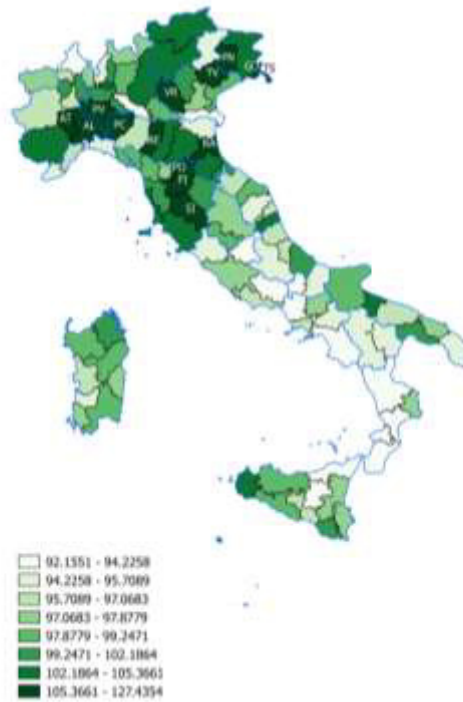
Fig. 3. Entrepreneurial index of enological vocation.

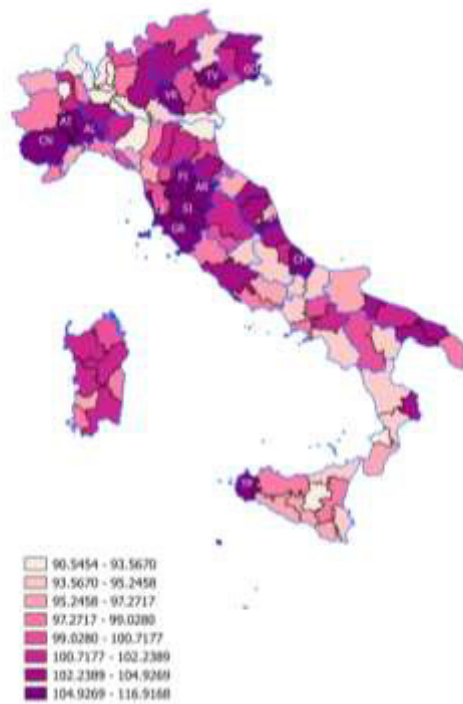|	
☐	90.5454 - 93.5670
☐	93.5670 - 95.2458
☐	95.2458 - 97.2717
☐	97.2717 - 99.0280
■	99.0280 - 100.7177
■	100.7177 - 102.2389
■	102.2389 - 104.9269
■	104.9269 - 116.9168

Fig. 4. Quality index of enological vocation.

The areas with the highest scores of the entrepreneurial index (Figure 3) are all located in the Center-North. Toscana and Emilia Romagna are the Regions with most provinces (3) included in the first class (Siena, Firenze, Prato for Toscana and Ravenna, Reggio nell'Emilia e Piacenza for Emilia-Romagna) followed by Piemonte (Asti and Alessandria), Veneto (Verona and Treviso) and Friuli-Venezia-Giulia (Gorizia and Pordenone). Gorizia is the province with the highest score in the ranking followed by Siena and Firenze.

The distribution of the quality index (Figure 4) is more similar to the composite index than the other two. Also in this case, the provinces with highest values of the composite index are located in the Center-North areas with the two exceptions of Trapani and Chieti. Considering the regional level Toscana includes most provinces in the highest class (5) Siena, Firenze, Livorno, Grosseto, Arezzo) even if the two provinces with the highest score among all are located in Piemonte (Asti) and Marche (Ascoli Piceno).

6. Final remarks

The study proposes a composite index to measure the "Enological Vocation" of the Italian provinces (NUTS 3) combining individual indicators distributed in three pillars: Structural, Entrepreneurial and Qualitative. We start from the assumption that the phenomenon considered is multidimensional and then it is necessary to reduce the dimensions.

The results, derived from the MPI method, classify the provinces of the Country in eight classes, from the most devoted to the less devoted in the wine sector. They show the presence of some districts with more enological vocation in Italy (in the Regions of Piemonte, Veneto and Toscana) and some surprises for provinces that are less known for the wine sector, as Gorizia and Chieti.

Further developments of the work could be the evaluation of the temporal trend in each area.

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