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Full Research Article

The hedonic contents of italian super premium extra-virgin olive oils

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Abstract. This study focuses on the Italian market for high quality olive oil and seeks at assessing the value of a set of emerging quality clues. To this aim a hedonic price model is proposed where the price is regressed on various product attributes using a quantile regression that allows for deeper insights. The analysis covers about one thousand Italian extra-virgin olive oils reviewed by Slow Food guide. Overall, results indicate that various quality clues (e.g.: variety of the olives, the production area, the certification of origin, the organic certification) are associated with relevant price premiums. Moreover, the quantile regression reveals the values associated to quality changes at different price levels. It is worthwhile to underline that the usual negative price premium against olive oils produced in Southern Italy tends to decrease in higher market segments.

Keywords. Hedonic price, extra-virgin olive oil, quantile regression, quality clues.

JEL. Q11, Q13.

1. Introduction

Olive oil is an important component of the Mediterranean diet, it is used as a seasoning and as such it is basically eaten in association with many different foods. More than half of the world olive oil production and consumption are concentrated in EU and other Mediterranean countries which traditionally are both producers and consumers. However, olive oil is increasingly appreciated worldwide as a healthy and tasty vegetable fat and its use is growing all around the world given the increased popularity of the Mediterranean diet, especially among consumers in North America, Australia and large parts of Asia (Bottcher *et al.*, 2017; Romo Muñoz *et al.*, 2015).

Over the last years several new quality features started playing an important role for enhancing product differentiation and market segmentation both in traditional and newer

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consumption countries. This process not only leads to a segmentation of consumers based on taste and other personal variables, but also differentiates olive oils on the basis of different consumption occasions and of the kind of foods that olive oil is going to match. Olive oil is becoming a trendy seasoning with a hedonic connotation so that its market started resembling that of wine (Cacchiarelli *et al.*, 2016b; Cabrera *et al.*, 2014). Traditionally, differences in olive oils were mainly related to chemical attributes (i.e. acidity or polyphenols) that are, in turn, related to cultivation and olive-picking techniques as well as to the technology adopted for extracting oil from olives. Besides, in the Italian market olive oil quality is also largely associated to the production area (particularly to soil, climate and olive varieties that are associated to the place of production). The area of production may be defined at different levels such as country level, regional level, or even with reference to smaller areas (Menapace *et al.*, 2011; Van der Lans *et al.*, 2001; Verbeke *et al.*, 2012).

In this changing market the importance of some quality clues is emerging, although these may have different roles in different demand segments. Among the others, it is worth recalling: i) the environmental impact of the production process and the related certifications (Cacchiarelli *et al.*, 2016a; Marette, 2017) including organic that has gained momentum as a relevant quality feature also for olive oil (Schleenbecker and Hamm, 2013; Cabrera *et al.*, 2014; Martinez *et al.*, 2002); ii) the kind of flavor that may match different foods (i.e. intense or mild fruity); iii) the color (i.e. green vs. yellow) and the turbidity; iv) the shape, the size and the color of the bottle or the design of the label.

All these quality features generate a complex system of both vertical and horizontal differentiation, as some attributes (i.e. acidity) can be ranked from the best to the less preferred ones, while for other attributes consumers' preferences are not aligned (i.e. filtered vs non-filtered olive oil, oils from Tuscany vs. Umbria Regions).

In countries where the use of olive oil is traditional and common, the consumers' ability to choose quality attributes is widely based on buying habits. In newer markets consumers need to collect information in different ways and many quality clues have been developed at different stages of the value chain and by different stakeholders (Roselli *et al.*, 2016). Relevant quality clues are mainly experience and credence attributes, implying that the market is affected by a significant degree of asymmetric information (Mastronardi *et al*, 2015). As the sophistication of the product and the complexity of the market increase, additional information is required and the effectiveness and reliability of each quality attribute can be questioned (Hassan and Mornier-Dilhan, 2002). In this context, reviews by experts in journals and guides as well as testing events and prizes, become a relevant source of information. They also provide comparisons between individual preferences and external, more competent and objective judgments, thus contributing to increase product value (Spiller and Belogolova, 2017). These reviews are used not only by the final consumers but also by many different kinds of stakeholders along the chain (Poroissien and Vissier, 2018; Cacchiarelli *et al.*, 2016b; Delgado and Guinard, 2011).

Such a complex market implies that also prices are diversified and span over a large range; as a consequence, price itself further segments the market and contributes to convey information about quality and safety (Haws *et al.*, 2017). In order to fully understand the crucial role of price in this market it is useful to keep in mind that olive oil, besides being itself a differentiated good, has also many cheap substitutes among other vegetable oils. This means that when purchasing olive oil and particularly extra-virgin ones

(EVOO), consumers are already in high segments of the wider vegetable oil market and are seeking for a quality product for which they carefully consider price and attributes (Martinez *et al*., 2002).

Following these premises, this study aims at assessing the role of different quality clues in the creation of value in higher segments of the Italian olive oil market. On the one side, this focus allows to get insights on one of the oldest and largest EVOO market; on the other side, we argue that looking at the higher and more sophisticated segments of the market contributes to understanding which tendencies will spread in the near future in the wider EVOO market. To meet this goal, a hedonic price model is estimated where price is regressed on different quality clues (Rosen, 1974; Thrane, 2004). Most works employing the hedonic price approach have focused on wine (Benfratello *et al*., 2009; Schamel, 2006; Cacchiarelli *et al*., 2016a). However, in recent years, various studies aimed at identifying the more effective variables in creating value in the olive oil markets, both in EU Mediterranean Countries (Italy, Greece and Spain) and in the so called "New Countries" (Chile and US) (Romo Muñoz *et al*., 2015; Gazquez-Abad and Sanchez-Perez, 2009; Roselli *et al*., 2016; Carbone *et al*., 2018).

In literature, the hedonic price models have been usually estimated by using ordinary least squares (OLS) regression. However, over the last few years the quantile regression model (QRM) has also been applied in order to establish whether the relationship between price and other product characteristics and quality clues varies at different price levels (Cacchiarelli *et al*., 2014; Costanigro *et al*., 2010). While the former shows how the various quality clues affect, on average, prices, the latter detects additional patterns (location, scale and skewness shifts) related to the effects of the covariates and, thus, allows to investigate consumer behaviour at different price levels.

The paper is organized as follows. Section 2 illustrates the source of data, the model specification and the methods employed in the estimations. Section 3 reports and discusses results, while section 4 concludes.

2. Methodology

2.1 The source of data

Data used for estimating the hedonic price model comes from one of the major Italian olive oil guides: Slow Food guide (2014 edition).This guide has been chosen for three basic reasons: i) the data set is quite large as it includes 1024 EVOOs (of which 1001 have been utilized for the analysis due to missing data for the remaining 23); ii) coverage of Italian production areas is wide; iii) information released about each product is rich and relevant for stakeholders. For each reviewed producer/oil the guide reports a set of information about the product, about the farm/mill and about the production process. Olive oils included in this guide account for about 3% of EVOO national production (in volume) and represent the top segment of the market with an average price that is about 5 times higher than the average unit value of bulk production. This focus on top quality EVOOs allows us to investigate on a quite peculiar market segment where quality and attention to quality clues are very high (Slow Food, 2014). Evidences from such a peculiar market segment cannot be extended *sic et simpliciter* to the whole EVOO market. However, considering that market niches and especially high market segments tend to anticipate upcoming trends that spread out over time, these findings bring interesting insights on what will likely be general future trends (Yeoman and McMahon-Beattie, 2006; Latacz-Lohmann & Foster, 1997).

2.2 Model specification

2.2.1 The Model

In the analysis of differentiated products, several studies have adopted hedonic price models in which the price is described as a function of product characteristics (Deselnicu *et al.*, 2013; Oczkowski, 2001). In this study, with the aim of measuring the price premiums associated to different quality clues in the Italian olive oil market we use a hedonic price model specified as follows:

$$Log\ P_{OILi} = \alpha_0 + \alpha_{1i}Cu_i + \alpha_{2i}Pi_i + \alpha_{3i}Mi_i + \alpha_{4i}Vol_i + \alpha_{5i}Or_i + \alpha_{6i}Sz_i + \alpha_{7i}Gi_i + \alpha_{8i}MR_i + \varepsilon_i \quad (1)$$

where: $Log\ P_{OILi}$, the logarithm base 10 of the EVOO price, is the dependent variable; Cu_i indicates a set of dummy variables accounting for olive variety; Pi_i is a dummy variable that indicates the technique of harvesting; Mi_i is an ordinal variable indicating the degree of vertical integration; Vol_i is an ordinal variable measuring production volumes by class; Or_i is the dummy for organic EVOOs; Sz_i accounts for bottle size (ordinal); Gi_i assesses the presence of the certification of origin; MR_i is a categorical variable for the macro-area of origin.

It is worth to underline that not all the quality cues here considered have the same visibility for consumers. In fact, while some appear in the label of the bottle, other do not. However almost all can be found in the producer/seller website and all of them are released by Slow Food Guide. The model assumes that consumers in this super premium market segment are so interested in quality features that, not only are willing to pay very high prices but also devote time and expertise in collecting and evaluating these less visible pieces of information. Besides, it should also be taken into account that retailers in these premiums market segments are usually willing and committed to release additional information they consider valuable to customers (Clerides *et al.*, 2008).

2.2.2 The variables.

The variables included in the model are described below while Table 1 reports frequencies and descriptive statistics of price distribution for all the selected explanatory variables.

1) Prices are released by producers at the final consumers' price (in Euros, VAT included). Each price is referred to the actual bottle size used for packaging (250/500/750 ml and 1 liter) so that, in order to allow for correct comparisons, the dependent variable was transformed in Euros per liter. The mean and the median values (respectively 16 and 18.7 Euros/Lt. as shown in Table 1) confirm that the market reviewed by the guide is correctly defined as super premium[1].

[1] The maximum price value, as evidenced in table 1, is very high due to an outlier present in the sample, as it is also confirmed by the price value at 90th quantile (30 Euros).

2) *Cu* relates to olive variety (i.e. the cultivar of the tree). Mono-cultivar oils were not so common in Italy until a few years ago though presently their number is increasing as a mean for differentiation and following consumers' interest for variety based also on sensory features and their inclination for (re)discovering old traditional varieties. Slow Food guide devotes much attention to mono-cultivar oils. The model includes three categories of mono-cultivar oils that are distinguished according to the territorial diffusion of the olive variety: i) national olives such as Pendolino, Moraiolo, Leccino, and a few others (14% of the sample); regional varieties such as Itrana, Carolea, Carboncella and many others (13% of the sample); and local varieties that are hundreds each cultivated in a very limited area (altogether these account for 23% of the sample). This distinction is aimed to get information about the value that consumers may attach to diversification and strong territorial roots vs wider diffusion and more general reputation of more common and better-known varieties. The remaining half of the oils reviewed in the guide are blend of different cultivars; this dummy act as benchmark for the other cases.
3) *Pi* indicates the technique of harvesting: where 100% hand picking and machine aided hand picking are both included in the same dummy (that accounts for 77% of the sample) as opposed to complete machine picking (23%), as the latter has a different impact on product quality and on cost level and structure.
4) *Mi* is an ordinal variable reflecting the degree of vertical integration and, thus, measuring the strengths of the relation among stakeholders in charge of olive production and oil processing and packaging. The stricter relation holds when there is an on-farm

Table 1. Frequencies and descriptive statistics of price distribution for the different quality clues.

	Variable	obs	freq	min	10th Quantile	30th Quantile	50th (median)	mean	70th Quantile	90th Quantile	max
Cu	National Cultivar	141	0.14	7.5	10.5	14	16.5	19.88	20	30	52
	Regional Cultivar	134	0.13	8	10.5	14	16.5	19.16	20	30	80
	Local Cultivar	227	0.23	6.5	10.5	14	16.5	19.48	20	30	100
	Olive oil blend	499	0.50	5.5	10.5	14	16.5	18.71	20	30	100
Pi	Hand picked	778	0.77	5.5	10.5	14	17	19	20	30	100
Mi	Cooperative mill	133	0.13	5.5	10.5	13.5	16	18.3	20	30	50
	Mill on farm	394	0.39	6.5	10	13.5	17.25	19.4	21.5	30	100
	Mill off farm	474	0.47	6	10.5	14	16	18.3	20	30	80
Vol	1-50 hl	562	0.56	5.5	10.5	14	17	19.1	20	30	100
	51-100 hl	154	0.15	7	10	13	17	18.6	20	28	52
	101-500 hl	94	0.09	8	10	13	15.75	17.2	20	28	42
	>501 hl	191	0.19	6	9.5	13	16	18.25	20	30	48
Or	Organic	475	0.47	5.5	10.5	14	16.5	18.5	20	30	80
Sz	Bottle of 250 ml	30	0.03	12	19.5	30	32	37	40	54	100
	Bottle of 500 ml	583	0.58	9	13	16	20	21.2	24	30	60
	Bottle of 750 ml	329	0.33	5.5	9.5	10.5	13.5	13.9	15.5	20	48
	Bottle of 1 litre	59	0.06	6	7.5	9	12	11.4	13	16	20
Gi	PDO-PGI	183	0.16	5.5	10	14	17	20.4	20	30	60
MR	North	147	0.15	10	14	20	24	24.7	28	37	100
	Centre	361	0.36	8	12	16	18	20.0	22	30	50
	South	492	0.49	5.5	9.5	12	14	15.8	18	24	80
	Total	1001	1.00	5.5	10.5	14	16	18.71	20	30	100

Source: Our elaborations on Slowfood 2013.

mill (39% of the sample), the second level refers to farms cooperatives that mill olives conferred by members (which are 13%) and the third case is represented by private mills (47% of the sample) that process olives bought from different farms (that are mostly located, nearby). In this case we estimate the price premiums associated to oils from on-farm mills, or from cooperatives in comparison with oils from off-farm mills (the benchmark for the estimation of the PP).

5) *Vol* expresses the production scale as follows: 1-50 hl (56%), 51-100 hl (15%), 101-500 hl (9%) and more than 500 hl (19%). Although the most of the producers in the sample are small or medium-small, the relation between production volumes and price may be complex due to possible diverging reputational effects as it will be discussed later on in the text.
6) Organic oils (*Or)* represent a bit less than half of the Slow Food selection (47%). Organic production is quite established in the Italian olive oil sector thanks to the favorable climatic conditions in many areas and to the emerging consumers' interest for this attribute.
7) Variable *Sz* represents the following bottle size: 250 ml (3%), 500 ml (58%), 750 ml (33%) and 1000ml (6%). The size of the bottle affects the use of the product; smaller bottles are preferred for making presents, for trying new products (Martinez *et al*., 2002), for special occasions and in case of difficult transport conditions (e.g. in case tourists buy EVOO when travelling). Conversely, larger bottles are preferred for domestic every-day consumption.
8) *Gi* is the European certification of origin which includes PDO (Protected Designation of Origin) and PGI (Protected Geographical Indication); however, since in Italy there is only one PGI olive oil but many PDOs, for the purposes of this analysis they have been all gathered in one dummy that distinguish between GI (PDO and PGI) certified EVOOs (16%) and non-certified ones (84%).
9) *MR* represents the area of origin defined at the following macro-area level: Northern (15%), Central (36%) and Southern Italian regions (49%). In the Italian EVOO market, especially in segments where quality is relevant, the macro-area of production matters for consumers as it is also confirmed by significant and persistent price differences for both bulk and bottled oils. Although the reputation of EVOOs from different regions varies significantly within the country, stricter area definition was not possible due to the small size of some regional sub-samples in the guide.

As it can be seen from Table 1, the mean of the price distribution is higher than the median, for many quality clues, thus suggesting that the dependent variable is positively skewed (the value of the Fischer coefficient is 2.35). Moreover, the range values (max-min) suggest a great heterogeneity of prices in the sample. Figure 1 shows the distribution of prices through a probability density function, which is a powerful tool to describe several properties of a variable of interest (Cowell and Flachair, 2013). Although this function seems basically unimodal (about 18 euros), it also presents a few additional, much less pronounced, modes (see in the highest quantiles) and a stretched shape of the right-side tail of the distribution. Such a distribution suggests exploring the relationship between prices and the selected quality clues as they might change along the different quantiles and particularly at the two extremes (Table 1).

The choice of the functional form of the hedonic model is essential because it determines the way marginal prices will be related to attributes (Rasmussen and Zuehlke, 1990). A RESET test (Regression Equation Specification Error Test) was run in order to explore a series of possible transformations of the dependent variable (e.g. log, inverse square root). The test has revealed that the log-linear specification performs better than other functional forms so that it has been chosen for estimating equation (1). Log-linear specification presents a twofold advantage with respect to other ones: i) it allows obtaining residuals that are approximately normally distributed as required by the selected regression models; ii) the interpretation of regression coefficients is immediate: the dependent variable changes by 100*(e^{coef} -1) percent for a one-unit increase in one of the regressors, holding all other variables fixed. Last, heteroskedasticity proportional to the predicted values was tested via Goldfeld–Quandt statistics (Goldfeld and Quandt, 1965).

2.3 Estimation Methods

Clearly, even in this super premium market segment, the impact of quality attributes on price may differ across price levels. Therefore, following the prices distributions described in Table 1 and shown in Figure 1, a QRM was run to go deeper into the analysis of the market segmentation mechanism. Selected quantiles are: 0.1, 0.30, 0.50, 0.70, 0.90 percent[2]. Quantile regression (Koenker, 2005) is used for estimating the functional relationship between olive oil price and quality attributes at different points in the conditional distribution of y. Moreover, quantile regression is more robust than OLS regression in response to large outliers which may be present in the olive-oil top market segment. Consequently, we estimate model (1) over the various quantiles which are of interest in our research context.

The QRM analyzes the effects of the explanatory variables at different quantiles of the price distribution as opposed to focusing on the mean of the distribution (Cameron and Trivedi, 2005). Although its computation requires linear programming methods, the quantile regression estimator is asymptotically normally distributed.

Moreover, QRM is a semi-parametric approach since it avoids assumptions concerning the parametric distribution of the regression errors. This technique specifies the conditional quantile as a linear function of covariates (Koenker, 2005).

Quantile regression has several advantages over OLS. Indeed, OLS can be inefficient if errors are highly non-normal while QR is more robust to non-normal errors and outliers.

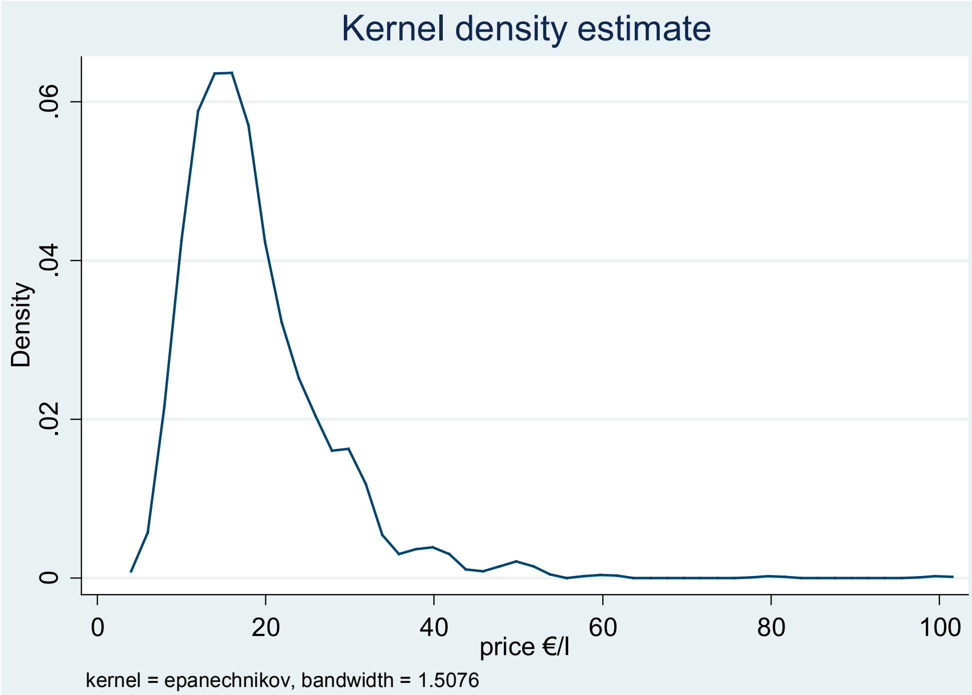
In the present case, the θth quantile regression can be written as:

$$Q_\theta\left(y_i \mid \mathbf{x}_i\right) = \mathbf{x}_i^{'}\beta_\theta + \varepsilon_\theta \tag{2}$$

where y_i (i=1,…,n) is the dependent variable (logarithm of the price), x_i is the sequence of the k-vector of regressors while β_θ is an unknown vector of regression parameters associated with the θ_{th} quantile and εθ is an unknown error term. The quantile regression estimator for quantile $0<\theta<1$ minimizes the sum of absolute deviation residuals:

[2] For quantile estimates, standard errors were calculated by bootstrapping and, specifically, 400 random draws were taken. Moreover, by using Wald test, comparing pairwise at each fifth quantile within the 5th and 95th, we formally verify whether the effect of each variable statistically differs across quantiles (Hao and Naiman, 2007).

Figure 1. Prices distribution.



Source: Our elaborations on Slowfood 2013.

$$\min_{\beta \in R^K} \left\{ \sum_{i:y_i \geq \mathbf{x}^i \beta} \theta | y_i - \mathbf{x}_i^{'} \beta | + \sum_{i:y_i \geq \mathbf{x}^i \beta} (1-\theta) | y_i - \mathbf{x}_i^{'} \beta | \right\} \tag{3}$$

which is solved by linear programming methods. When θ is continuously increased from 0 to 1, we obtain the entire conditional distribution of y conditional on x.

3. Results

Table 2 reports estimation results from quantile models at the selected points of the price distribution. Figure 2 provides a graphical view of the QRM estimates where, for each selected quality clue, the vertical axis shows the PPs associated to the different quantiles[3] (horizontal axes).

The fit of the model, measured by pseudo R^2, is quite good. These values indicate that the model takes into account the effects of important quality clues related to prices

[3] In figure 2, the gray-shaded area illustrates the bootstrap 95% confidence interval while the line shows QRM estimates.

in the Italian market for sophisticated EVOOs. Nevertheless, the model proposed clearly focuses on the value of quality features captured by the market while leaves out of the picture other features that, altogether, may be relevant and able to influence consumers' prices.

Coming to detailed estimation results, we start from those that generate the higher PPs, even if in some cases the effects in the different price quantiles vary and generate an uneven ranking.

First, bottle size confirms to be an important leverage for price. As a matter of fact, smaller sizes get, on average (i.e. 50^{th} quantile), always a positive price premium compared to larger bottles: 750 ml worth +23.7% compared to 1000ml, while they get, respectively, -80.5% compared to 250 ml and -32.9% compared to 500 ml. These results are in line with findings of other studies (Cabrera *et al.*, 2014). Results for different quintiles provide additional insights by showing that the mentioned price differentials are higher and more significant in the highest market segments where packaging matters more; in particular the smallest bottle size is associated with the highest PPs observed in the sample (+89%) (see also the bottom of figure 2). Wald test confirms these results showing that in case of bottles both from 250 ml and 500 ml the 30th, 50^{th} and 70th quantiles are statistically different from 90th (at 5% level of significance).

Second, variables related to the place of origin are all associated with significant and large price premiums. Olive oils from northern and central regions worth more compared to products from southern regions (46.1% and 18.4%, respectively). This result reflects the widely known segmentation of the Italian olive oil market and it is in line with the findings of other studies focused on high quality EVOO markets (Carbone *et al.*, 2014; Di Vita *et al.*, 2013). Moreover, the QRM provides additional non-trivial insights also confirmed by Wald test (see the upper part of figure 2). The price premiums associated to Northern and Central regions decrease in the upper quantiles (70^{th} and 90^{th}), indicating that in the higher market segments consumers are less influenced by the macro-area of origin. This is probably due to the higher consumers' willingness to collect detailed information about producers and their products before buying more expensive bottles instead of using proxies such as those related to the production area. This result suggests that olive oil producers from Southern regions that seek at marketing excellent EVOOs might reduce the negative price gap that affects EVOOs from the South, provided they are able to select appropriate information and quality clues for each market segment.

According to the important role played by the area of origin, our findings show that also the certification of the place of origin (*Gi*) affects prices. In line with findings from other works (Carlucci *et al.*, 2014), PDO/PGI EVOOs get, on average, a price premium of +12.5% compared to non-certified olive oils, showing that this certification is a much-appreciated quality clue. Looking at the different quantiles (at the top right of figure 2) it appears how the certification of origin plays a greater role in the highest market segment (+ 18.9% at the 0.90 quantile). Wald test confirms this result proving that the 70th quantile is statistically different from the 90th at 10% level of significance.

Organic certification affects positively EVOO prices (on average +9.3%) as well. The result holds at any price quantile without relevant differences in the size of the PP. This outcome confirms the positive role played by organic certification in the EVOO market as emerged in other works (Delmas and Lessem, 2017).

Table 2. QRM estimation results for various conditional quantiles.

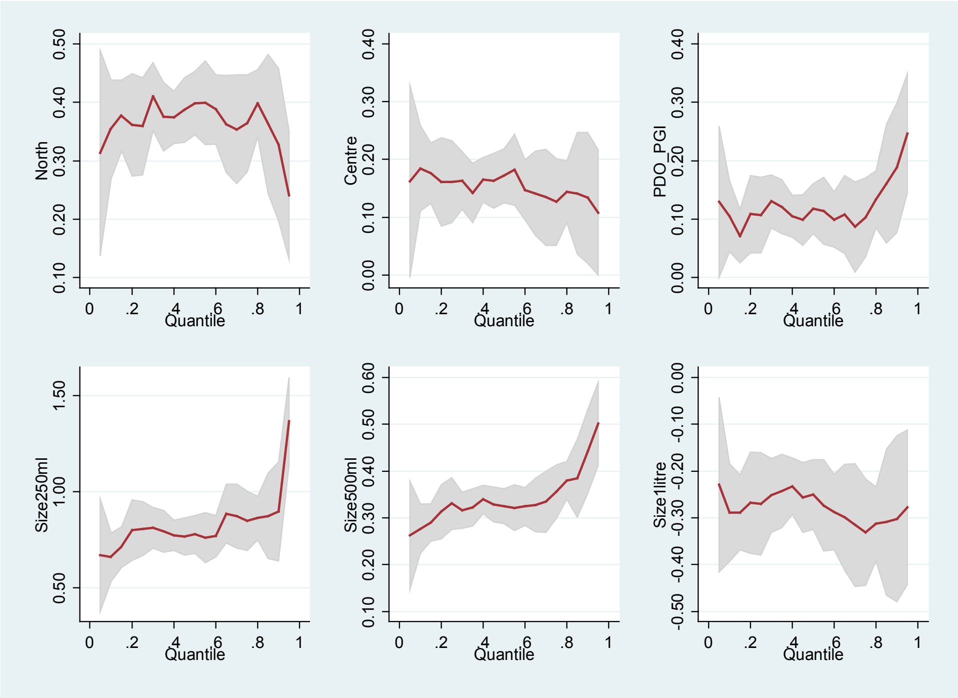
	Variable	10th Quantile	30th Quantile	50th Quantile	70th Quantile	90th Quantile
Cu	National cultivar	0.091*	0.089*	0.098*	0.121*	0.102
		(0.0241)	(0.0283)	(0.0238)	(0.0318)	(0.0682)
	Regional cultivar	0.067**	0.091**	0.110*	0.158*	0.093*
		(0.0284)	(0.0216)	(0.0219)	(0.0272)	(0.0272)
	Local cultivar	0.088*	0.106*	0.085*	0.051*	0.093*
		(0.0263)	(0.0243)	(0.0253)	(0.0342)	(0.0343)
Pi	Hand picked	-0.002	-0.027	-0.032***	-0.051**	-0.082**
		(0.0192)	(0.0259)	(0.0226)	(0.0284)	(0.0282)
Mi	Coop Mill	-0.022	-0.042	-0.024	-0.024	-0.056***
		(0.0425)	(0.0325)	(0.0261)	(0.0263)	(0.0317)
	Mill on farm	-0.016	-0.003	0.032	0.047***	0.103**
		(0.0232)	(0.0243)	(0.0258)	(0.0334)	(0.0321)
Vol	51-100 hl	-0.019	-0.027	0.011	0.095**	0.100*
		(0.0370)	(0.0361)	(0.0341)	(0.0362)	(0.0342)
	101-500 hl	-0.024	0.010	0.003	0.021	-0.005
		(0.0382)	(0.0364)	(0.0352)	(0.0323)	(0.0612)
	>501 hl	0.006	-0.027	-0.032	-0.005	0.027
		(0.0231)	(0.0252)	(0.0325)	(0.0554)	(0.0323)
Or	Organic	0.073*	0.086*	0.093*	0.079*	0.068*
		(0.0172)	(0.0275)	(0.0192)	(0.0248)	(0.0241)
Sz	Bottle of 250 ml	0.677*	0.811*	0.805*	0.867*	0.892**
		(0.1128)	(0.0372)	(0.0613)	(0.1352)	(0.4127)
	Bottle of 500 ml	0.281*	0.317*	0.329*	0.335*	0.452*
		(0.0196)	(0.0218)	(0.0223)	(0.0283)	(0.0291)
	Bottle of 1 litre	-0.285*	-0.249*	-0.237*	-0.316*	-0.313*
		(0.0243)	(0.0623)	(0.0321)	(0.0363)	(0.0372)
Gi	PDO/PGI	0.121*	0.137*	0.125*	0.080*	0.189*
		(0.0182)	(0.0277)	(0.0253)	(0.0318)	(0.0512)
MR	North	0.430*	0.484*	0.461*	0.418*	0.366*
		(0.0413)	(0.0372)	(0.0314)	(0.0451)	(0.0421)
	Centre	0.207*	0.179*	0.184*	0.150*	0.138*
		(0.0312)	(0.0272)	(0.0269)	(0.0334)	(0.0417)
	cons	2.143*	2.332*	2.414*	2.607*	2.733*
		(0.0362)	(0.0382)	(0.0381)	(0.0551)	(0.0524)
	Pseudo R^2	0.325	0.335	0.321	0.305	0.287

Source: Our elaborations on Slowfood 2013.

[1] Table reports coefficients and standard errors (in brackets).

[2] *means significant at 1%; **means significant at 5%; ***means significant at 10%.

Figure 2. QRM estimates of place of origin, PDO and bottle size.



With respect to the role of the cultivar, the model provides interesting findings. First, mono-cultivar oils are always associated with positive PPs ranging between 8% and 11%, regardless to the size of the diffusion area of the cultivar itself and regardless to quantiles. Since usually labels explicitly claim whether the oil is made with one olive variety, regardless to the specific cultivar utilized, mono-cultivar oils are appreciated and valued as such. As this kind of product is almost new in the Italian market and introduces a new factor of differentiation, the result seems to indicate that consumers in this market segment appreciate novelty and variety. This finding is in line with recent literature (Carlucci *et al.*, 2014).

Moving to the next set of variables, results show that the scale of the production process affects prices in a quite complex fashion. In particular, the estimates show that production volumes have limited or non-significant impacts on price in the lower price quantiles, while at 70th and 90th quantiles medium-small producers are favored compared both to very small producers and to larger ones, with a PP of around 10%. This is probably due to a complex reputational effect, according to which very small producers are hardly visible in larger markets where they find difficult to establish their own reputation and to get a PP; at the other extreme, very large companies may give an image of a more standardized less valuable product compared to medium and medium-small producers who can be associated to a sense of rarity, exclusivity and preciousness that pushes price up (Eisend, 2008; Kristofferson *et al.*, 2017).

As for other features of the production process, and, in particular, the way olives are picked, results show that hand picking negatively affects prices (on average, -3.2%). The price premium becomes even more negative in the highest market segments (-8.2% in the 90th quantile). Even considering that most consumers may not be aware of the methods adopted for harvesting, this result is hard to explain and requires further explorations. In fact, so far, hand picking has been considered a superior technique in terms of preserving sensorial qualities and avoiding high acidity rate. However, more recently, technological change has improved the performance of harvesting machinery also in terms of plant health and product quality. Besides, machine harvesting requires shorter time than hand picking; this, in turn, allows for processing fresher olives, thus contributing, other things being equal, to push up oil quality. Summing-up, the role of this feature shall be further explored and/checked also looking at different datasets.

Finally, concerning vertical integration, again, this does not seem to significantly affect price on average. However, in the highest market segments the presence of on-farm mill is statistically associated with a positive price premium between 5% (70th quantile) and 10% (90th quantile); while, on the other hand, a negative PP (-5.6%) is associated to cooperative mills at the 90th quantile. The first of these results can be explained by the deeper interest of consumers in buying an EVOO strictly connected to the farm –and as such, regarded as to more genuine, traditional and so forth - when they are spending more. The negative PP associated to the coop mills may be explained by the negative reputation that surrounds coops in some Italian regions, where, due to different reasons whose analysis is beyond the scope of this paper (Carbone *et al.*, 2010), coops are not regarded as able to provide quality products.

4. Concluding remarks

Trends in consumers' demand as well as marketing strategies in the olive oil sector seem to increasingly push towards product differentiation, following to some extent the wine market. The increasing role of different quality clues creates different and inter-related layers of horizontal and vertical differentiation that frame the market as progressively sophisticated.

In the present study a hedonic price model has been built for exploring the Italian high-quality olive oil market in order to identify the price-quality relation for different quality features. Quantile regression has been used for analyzing the functional relationship between olive oil price and quality attributes at different points in the conditional distribution of price. Data used have been collected from Slow Food olive oil guide that portraits the Italian high quality EVOO market.

In particular, our model specification brings about some interesting insights that in some cases confirm results already discussed in the literature; while in others provide original indications.

The quantile regression estimates indicate that overall the quality clues included in the model have a significant impact on price at the different price quantiles. However, in the lower quantiles there are some clues that do not impact prices while they are effective at higher price levels. Among these there are clues that are not released by the labels such as the kind of olive-picking, the size of the production units and the degree of vertical integration. This can be explained by the deeper interest of consumers in some quality features when they are spending more money. This more demanding attitude towards quality may push them to collect additional information with respect to that released in the label. As for the remaining quality attributes, all have a significant impact on price and this impact significantly increases with price.

While price differentials between Italian macro-regions are well known and represent no novelty at all, the finding that these differences reduce in higher price quantiles is original and valuable. This may suggest that southern producers shall use different communication strategies, with respect to the place of origin, when targeting at different market segments.

Also results about certifications of origin (PDO/PGI), showing a higher PP in the highest price quantile, are not trivial. This is especially true when comparing them to those found for the wine market where the certifications of origin are more rewarding at medium-low price levels. In fact, in the case of wine, they seem to act more as a minimum quality standard than as a clue for excellence. The explanation of this difference between the two sectors is given by the extreme sophistication of the wine market where quality clues are many and diverse and wine producers have reached a greater visibility and reputation in the marketplace, while, on average, olive oil producers are far less reknown (except large industrial firms that do not belong to the kind of market we are looking at). Besides, the certification of origin is relatively less used and more recent in the olive oil market compared, for example, to wine, so that it has not yet become a trivial quality clue as it is in some cases for wines where it also suffers from a lack of trust.

As expected, bottle size is associated with the highest PP evidenced by the model estimates. Specifically, smaller sizes cost more compared to bigger ones. Again the QRM brings additional insights: just as in the case of the place of origin, the quantile estimates show that PP increases in higher quantiles.

One more original result of the study concerns the value associated to olive varieties, with mono-cultivar and the nationally widespread olive cultivars that add values to the oil. These results can be taken by producers in order to adopt relatively easy differentiation strategies based on the separation of olive varieties before milling, hence increasing the value of their oil.

Results on harvesting methods were unexpected and remain unexplained, thus shedding light on an area that requires further explorations for improving our knowledge of this changing market.

Besides, the overall results obtained also indicate that some factors - that were not included in the model due to lack of data- may play an important role in the olive oil market, so that more work is needed for a better understanding of additional relevant and more recent tendencies.

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