What is the value of extrinsic olive oil cues in emerging markets? Empirical evidence from the U.S. e-commerce retail market

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Abstract

Olive oil consumption in the USA has more than tripled over the past two decades and imports have grown considerably, in particular from Mediterranean countries. This is due to the spread of the Mediterranean diet and increasing consumer awareness about the health benefits of olive oil. We investigated the role of the main extrinsic quality cues (size of container, product category, organic certification, geographical indications, country of origin, and brand) in affecting the price of olive oil sold in the U.S. e-commerce retail market. Using data from amazon.com, the leading e-retailer in the United States, a hedonic price model was estimated. Results show that all the considered extrinsic quality cues have a significant impact on the price of olive oil, with interesting implications for both practitioners and policy makers. (**Q110, Q130, Q170)**

1. Introduction

Over the past two decades, the world olive oil market has been evolving rapidly and is becoming more complex. Global olive oil consumption has almost doubled from 1.66 million tons in 1990 to 3.03 million tons in 2013 (IOC, 2014). Currently, both the production and consumption of olive oil remain concentrated in the countries surrounding the Mediterranean Sea ("traditional" markets). Three countries, Spain, Italy and Greece, produce 68% and consume 45% of the world olive oil (IOC, 2014). However, olive oil consumption is also growing rapidly outside the Mediterranean basin, and significant production has also been starting in many other countries such as Australia, New Zealand, China, South Africa, Argentina, Chile, Brazil, Mexico, and the USA ("non-traditional" or "emerging" markets). Over the past two decades, world olive oil trade (intra-EU

trade excluded) has more than doubled, from 337 thousand tons in 1990 to over 800 thousand tons in 2013 (IOC, 2014).

The increasing demand for olive oil seems to be mostly linked to increasing consumer awareness of the health benefits provided by the Mediterranean diet, in particular olive oil consumption (Mili, 2006; Clodoveo et al., 2014; Xiong et al., 2014). Medical studies have revealed that regular olive oil consumption is significantly associated with lowering blood cholesterol, reducing the risks of certain kinds of cancer, and helping calcium absorption (Owen et al., 2000; Sofi et al., 2008; Tuck & Hayball, 2002). Estruch et al. (2013) provided further evidence that a Mediterranean diet supplemented with extra virgin olive oil resulted in a substantial reduction in the incidence of major cardiovascular events among high-risk people. The extensive dissemination of these findings supported by mass media campaigns has been a decisive help in creating an excellent image of olive oil as a healthy food product (Delgado & Guinard, 2011; Santosa et al., 2013; Xiong et al., 2014).

Since olive oil has been a staple food product of the Mediterranean countries for centuries, there is a wide economic literature on various aspects of olive oil consumption in traditional markets (Aprile et al., 2012; Caporale et al., 2006; Carlucci et al., 2014; Cicia et al., 2005; Chan-Halbrendt et al., 2010; Dekhili & d'Hauteville, 2009; Di Vita et al., 2013; Fotopoulos & Krystallis, 2001; Gázquez-Abad & Sánchez-Pérez, 2009; Imami et al., 2013; Jiménez-Guerrero et al., 2012; Mtimet et al., 2013; Krystallis & Ness, 2005; Scarpa & Del Giudice, 2004; Siskos et al., 2001; Tsakiridou et al., 2006; van der Lans et al., 2001; Yangui et al., 2014).

However, generalizing the results of these studies to the emerging markets, where olive oil is not a traditional food, may be misleading. Recent studies have therefore focused on specifically exploring the emerging markets of the United Kingdom (García et al., 2002), the Netherlands (Kalogeras et al., 2009), Japan (Mtimet et al., 2008), Canada (Menapace et al., 2011), and Chile (Muñoz et al., 2015).

The present study focuses on the U.S. olive oil market, which is one of the most important emerging markets in terms of both its dimension and growth rates. The U.S. is the third largest olive

68 oil consumer in the world, after Italy and Spain, and the second largest importer, after Italy. Over
69 the past two decades, U.S. olive oil consumption has more than tripled from 88 thousand tons in
70 1990 to over 300 thousand tons in 2013 (IOC, 2014).
71 Some studies have already investigated the demand for olive oil and consumer preferences in this
72 fast growing market (Delgado & Guinard, 2011; Delgado et al. 2013; Santosa et al., 2010; Santosa
73 & Guinard, 2011; Santosa et al., 2013). However, these studies have only surveyed consumers
74 living in northern California and have focused on extra virgin olive oil, paying little attention to
75 other kinds of olive oil products.
76 We analyzed the U.S. olive oil market by including different kinds of olive oil products rather than
77 focusing exclusively on extra virgin oils. The aim was to investigate the role of the main extrinsic
78 quality cues (size of container, product category, organic certification, geographical indications,
79 country of origin, and brand) in affecting the retail price of olive oil. Extrinsic quality cues are
80 primarily used in purchasing choices by American consumers who are still not skillful enough to
81 assess the intrinsic quality attributes of olive oil, such as sensory properties (Delgado & Guinard,
82 2011; Delgado et al., 2013; Santosa et al., 2010; Santosa et al., 2013). We used the hedonic price
83 method to estimate the implicit prices associated with the main extrinsic quality cues of olive oil.
84 Because the U.S. olive oil market is very large and heterogeneous, a specific retail channel
85 represented by e-commerce business-to-consumers (e-tailing) was considered. We used data
86 collected via direct observation of the grocery section of Amazon's U.S. website
87 (www.amazon.com).
88 The hedonic price model has been successfully employed to analyze the markets of several food
89 products, including wine (Nerlove, 1995; Oczkowski, 1994; Schamel, 2006; Steiner, 2004; Boatto
90 et al., 2011; Panzone, 2011), carbonated beverages (Martínez-Garmendia, 2010), fresh meat
91 (Loureiro & McCluskey, 2000; Ward et al., 2008), pasta (Cembalo et al., 2008), eggs (Karipidis et
92 al., 2005b; Satimanon & Weatherspoon, 2010), apples (Carew et al., 2012), yogurt (Carlucci et al.,
93 2013), and coffee (Schollenberg, 2012). The hedonic approach has also been used to analyze the

94 domestic markets of olive oil in Italy (Cicia et al., 2013; Carlucci et al., 2014), Greece (Karipidis et
95 al., 2005a), Portugal (Ribeiro & Santos, 2005), and Chile (Muñoz et al., 2015).
96 Estimates of the implicit prices of extrinsic olive oil cues can provide useful insights for both
97 practitioners and policy makers. First, domestic and foreign producers interested in selling olive oil
98 in the U.S. market, aware of their production costs, can use implicit prices to devise an optimal mix
99 of attributes and more profitable marketing strategies. Second, the hedonic approach isolates the
100 premium for "credence" attributes such as product category (e.g. extra virgin), organic certification,
101 geographical indications and country of origin, which consumers cannot verify even after purchase.
102 When credence attributes have high premium prices, interesting policy and regulatory implications
103 can also be deduced considering that, in the absence of regulations, some producers may make a
104 false claim and pocket the premium at a zero production cost with negative effects on both
105 consumers and producers.
106 This article is organized as follows. Section 2 overviews the U.S. olive oil market. Section 3 details
107 the methodology employed (data collection, data set, hedonic price equation). Section 4 discusses
108 the results highlighting elements of convergence and divergence compared to other studies
109 analyzing olive oil market. Section 5 summarizes the findings and highlights the main practical
110 implications.
111
112 **2. An overview of the U.S. olive oil market**
113 In 2013, the U.S. olive oil consumption was over 300,000 tons, the third highest in the world after
114 Italy (620,000 tons) and Spain (530,000 tons) (IOC, 2014). U.S. olive oil consumption is also
115 increasing with very high rates, tripling in the last two decades (IOC, 2014).
116 However, the U.S. olive oil market should still be considered as an "emerging" market. The U.S.
117 annual per capita olive oil consumption (0.9 Kg) remains much lower than other vegetable oils (27
118 Kg) (FAO, 2014), and the household penetration rate of olive oil is only 44% (Datamonitor, 2010).
119 In traditional consumer countries, annual per capita olive oil consumption is much higher (16.9 kg

120 in Spain, 14.7 kg in Greece, and 11.6 kg in Italy) as well as more widespread (FAO, 2014).
121 While consumption has grown considerably, U.S. olive oil production remains low and mostly
122 concentrated in California (USITC, 2013). However, U.S. olive oil production has been
123 experiencing significant progress from about 1,000 tons in 2006 to over 10,000 in 2013 (IOC,
124 2014). Because this is only 3.4% of domestic consumption, the rising demand for olive oil in the
125 U.S. is mostly satisfied by imports from Mediterranean countries. In fact, more than half of the U.S.
126 olive oil imports are shipped from Italy (about 140,000 tons) and Spain (about 60,000) while the
127 remaining imports come mainly from Greece, Tunisia, Morocco and Turkey (FAO, 2014).
128 The success of olive oil in the United States is also generating concerns regarding the governance of
129 this fast growing market. One of the main concerns is related to the management of public quality
130 standards and compliance issues (USITC, 2013). While most countries, including many non-
131 traditional consumer countries, have adopted mandatory grading standards for olive oil using the
132 commercial grades of International Olive Council (IOC, 2013) as a benchmark, the U.S. has not
133 followed this approach. In 2010, the U.S. Department of Agriculture (USDA) revised the "U.S.
134 Standards for Grades of Olive Oil and Olive-Pomace Oil" in order to provide U.S. consumers with
135 certain guarantees, and to support the competitiveness of domestic producers (USDA, 2010).
136 Nevertheless, USDA standards for grades of olive oil remain voluntary and there are no mandatory
137 quality control measures.
138 Studies carried out in northern California (Delgado & Guinard, 2011; Delgado et al., 2013; Santosa
139 et al., 2010; Santosa & Guinard, 2011; Santosa et al., 2013) have investigated consumer attitudes
140 and preferences as well as sensory perceptions of extra virgin olive oil. Firstly, the health benefits
141 and pleasant flavor were clearly identified as the key drivers of the increasing olive oil consumption
142 in the U.S.A., while, as expected, cultural/traditional habits were poor indicators in explaining
143 consumers purchasing choices (Delgado & Guinard, 2011; Santosa & Guinard, 2011; Santosa et al.,
144 2013).
145 Secondly, the studies revealed a strong discrepancy between consumers' and experts' assessments of

olive oil sensory properties. Most consumers seemed to dislike “bitterness” and “pungency” in the olive oil taste, despite being associated with the compounds that are responsible for some of the important health benefits of olive oil (Delgado & Guinard, 2011; Delgado et al., 2013). These findings highlighted that Americans are ‘‘new consumers” and have relatively little knowledge, experience and expertise in assessing the intrinsic quality attributes of olive oil. Therefore, purchasing choices of olive oil seem to be mostly affected by extrinsic cues such as price, packaging, labeling and branding (Delgado & Guinard, 2011; Delgado et al., 2013; Santosa et al., 2010; Santosa et al., 2013).

Finally, another interesting finding is that Americans usually purchase different types of olive oil for different purposes (Santosa & Guinard, 2011; Santosa et al., 2013). In general, cheaper olive oils with a mild flavor and in bigger containers are mostly preferred for cooking, while more expensive olive oils which are perceived to be of a higher quality (extra virgin, organic, imported from Italy or locally produced, small packaging) are usually consumed as unprocessed (e.g. salad dressing, dips) in order to better appreciate the flavors (Santosa et al., 2010; Santosa & Guinard, 2011; Santosa et al., 2013).

3. Data and methodology

3.1 Hedonic price model

To analyze the relationship between the price and the main extrinsic quality cues of olive oils sold through the e-tailing channel in the U.S. market, a hedonic price model was estimated. This methodological approach is borrowed from Lancaster’s theory of demand (1966), which states that consumers derive utility directly from the characteristics or quality attributes embedded in a product rather than from the product itself. In other words, any differentiated product can be considered to be a bundle of several quality attributes that are independently valued by consumers at the time of purchase. Additionally, Rosen (1974) developed a theoretical model demonstrating that the observed price of a product can be considered as the sum of the prices associated with each of its

quality attributes. Although these prices cannot be directly observed in the market, they can be estimated by employing a regression function, i.e. the hedonic price model, which expresses the price of a product (directly observable) as a function of its quality characteristics (directly or indirectly observable).

According to Rosen's (1974) formulation, a hedonic price model can be specified as follows:

$$P(Z) = P(z_1, z_2, . ., z_j , . . . , z_n) \quad (1)$$

where P is the price of a product and $Z = z_1, z_2, . ., z_j , . . . , z_n$ is a vector of *n* objectively measured attributes that completely describe product quality.

After estimating the hedonic price equation, a partial derivative with respect to the attribute *j*, $\partial P(Z)/\partial z_j$, can be interpreted as the "implicit" or "shadow" price of the specific attribute *j*.

This theoretical model assumes that the market is in equilibrium and there is perfect competition. In this situation, consumers maximize utility by choosing available products under budget constraints, and firms maximize profits given the available technology and factor prices (Rosen, 1974). Therefore, since implicit prices are related to both supply and demand, they cannot be directly interpreted as general measures of consumers' willingness to pay for product attributes. As emphasized by Costanigro and McCluskey (2011), it is incorrect to infer that the attributes with the highest implicit prices are those that consumers prefer the most, since high implicit prices may also be due, for example, to high production costs.

3.2. Data collection

Data on the prices and characteristics of olive oils sold through e-tailing channels in the U.S. market were collected via direct observation of Amazon's website. Amazon.com, Inc. is an international e-commerce company offering worldwide online retail, computing services, consumer electronics, digital content as well as groceries. According to recent figures, Amazon is the fourth most visited website in the USA and is the leading e-tailer with more than US$ 74 billion net sales in 2013 (Statista, 2014). In addition, Amazon has separate retail websites for each country, and thus, it was possible to choose the website specifically addressed to the U.S. market (www.amazon.com). It is

198 important to underline that product prices are essentially fixed throughout the country although,
199 after choosing the product, shipping costs and sales taxes are further charged depending on several
200 factors, in particular the destination of shipment.
201 Online data have previously been used to estimate hedonic price models in the food sector (e.g.,
202 Carlucci et al., 2014; Panzone & Simões, 2009) mainly because they are highly transparent and
203 freely available. In the U.S., e-commerce retailing is a very fast growing market although the "food
204 and beverage" category still has less importance than others (U.S. Census Bureau, 2014). However,
205 the great importance of this innovative retail channel, specifically in terms of selling olive oil in the
206 United States, is underlined by two facts. First, the subcategory "olive oils" included in the U.S.
207 website of Amazon showed a much wider variety of products than Amazon's websites for other
208 countries. Second, all top brands of the U.S. olive oil retail market (USITC, 2013) were present on
209 Amazon's website with a high number of products.
210 Data search and collection were carried out in October 2013. Starting from the homepage of
211 amazon.com, we searched for and selected the subcategory "olive oils". Amazon's search engine
212 then returned 3,604 results organized into 64 web pages which were immediately and
213 simultaneously saved. Each result was related to a specific product, identified by a picture and a
214 brief description.
215 Many results consisted of products containing olive oil as an ingredient such as fish or vegetables in
216 olive oil, and biscuits with olive oil, and these we thus excluded. We also excluded flavored oils,
217 that is olive oils infused with spices or herbs such as garlic, basil, chili pepper, lemon, rosemary,
218 and truffles, because they are a specific food category with a different function compared to non-
219 flavored olive oils.
220 For the remaining results, product details were carefully extracted and recorded in a database.
221 Within this database, products with incomplete information (e.g. price or other key information)
222 were excluded. All product details recorded were clearly indicated in the virtual shop, which also
223 provided a readable copy of the label of each product available for purchasing. Therefore, all

recorded information is easily recognizable by e-shoppers at the time of purchase.

3.3 Data set

Using the criteria described above, we collected a dataset containing 1,375 observations. Each was related to a specific olive oil product available for purchasing with the following information: price and size of the minimum lot available for purchasing, size of container(s), product category, organic certification, geographical indications, country of origin, and brand.

The prices of the olive oils were expressed in U.S. dollars and referred to the minimum lot available for purchase (excluding shipping and sales taxes). Given that the size of the minimum lots as well as the size of containers are expressed in different capacity measures, we converted them all into liters. The remaining attributes (i.e., product category, organic certification, geographical indications, country of origin, and brand) were recorded according to the statements specifically provided on the label.

We distinguished the three product categories of olive oils commonly used in the U.S. market: i) "Extra Virgin Olive Oil" (EVOO), when this claim was clearly indicated; ii) "Light Olive Oil" (LOO), when the statements "light" or "extra-light" were found; iii) "Ordinary Olive Oil" (OOO), when the only indication "olive oil" was provided or there was the additional statement "pure". Two types of origin labels were also considered, geographical indications and country of origin. Olive oils with geographical indications were identified according to the Regulation (EU) No. 1151/2012 by searching for "Protected Designation of Origin" (or PDO) and "Protected Geographical Indication" (or PGI). The country of origin was recorded only when it was clearly specified with statements such as "made in", "product of", "imported from" or by using adjectives such as "Italian", "Spanish", "Greek", etc. Note that compared to the country of origin, geographical indications are certified designations which denote a smaller geographical area of origin (e.g. Tuscany in Italy, Cordoba in Spain, Crete in Greece), as well as specific quality features of the product derived from a special link with the area of production ("terroir").

A preliminary analysis of the data set was carried out by calculating descriptive statistics regarding

both the total sample and specific sub-samples grouped according to particular quality attributes (Table 1).

Table 1 - Summary statistics of the sample

	N. cases	Price/liter*			
		Min	Max	Mean	Std dev
Total sample	1,375	4.56	159.96	36.75	24.40
Minimum lot size					
< 0.750 L	522	9.12	159.96	52.50	26.80
0.750 - 1.500 L	344	8.39	133.32	35.58	18.72
1.501 - 5.000 L	307	4.83	73.00	22.08	12.28
> 5.000 L	202	4.56	77.31	20.31	11.32
Container size					
< 0.251 L	202	10.36	159.96	55.14	29.99
0.251-0.500 L	633	7.75	159.68	42.47	22.71
0.501-0.750 L	162	4.56	133.32	32.44	18.21
0.751-1.000 L	203	7.05	89.99	23.53	12.15
>1.000 L	175	4.83	51.33	14.12	7.32
Product category					
EVOO	1,204	4.56	159.96	38.12	24.72
OOO	129	4.83	124.44	29.77	20.65
LOO	42	7.75	67.96	18.78	11.32
Production method					
Organic	223	4.56	159.52	40.00	24.45
Conventional	1,152	4.83	159.96	36.12	24.34
Geographical Indications					
with PDO/PGI	104	14.95	125.90	52.30	25.39
without PDO/PGI	1,271	4.56	159.96	35.47	23.87
Country of Origin					
Italy	451	5.67	159.96	43.51	28.70
Spain	126	7.95	97.90	38.68	20.54
Greece	52	7.90	149.90	38.45	28.55
California	76	9.24	124.44	32.96	19.48
Other countries	61	11.39	133.32	51.87	24.03
Not specified	609	4.56	149.75	30.15	19.20
Brand					
Private labels	46	6.73	46.60	21.24	10.47
Bertolli	36	5.67	43.65	14.85	7.62
Filippo Berio	22	6.82	55.98	19.98	12.95
Pompeian	12	7.05	29.58	19.31	7.48
Colavita	69	9.12	81.05	35.30	18.90
Crisco	16	10.40	39.40	16.57	8.11
Lucini	25	16.42	65.98	40.18	11.20
California Olive Ranch	17	15.11	124.44	33.20	24.91
Other brands	1,132	4.56	159.96	38.93	25.16

*Prices are expressed in US$.

There was a wide variability of prices in the overall sample. The unit price ranged from a minimum

of 4.6 US$/liter to a maximum of 160 US$/liter, while the average was 37 US$/liter. This range seems to be firstly related to the size of the minimum lot available for purchasing and the size of the container(s). The average price of olive oils declined with the increasing size of the minimum lot available for purchasing, and it was substantially higher for olive oils in the smallest containers (< 0.25 liter) than olive oils in the largest containers (larger than 1 liter). The average price of olive oils also showed a progressive decrease from EVOO to OOO and LOO, while the average price of products with an organic certification and geographical indications were higher than products without these cues. There were also large price differences between the products with a different country of origin and brand.

3.4 Empirical Model

We specified and estimated the following hedonic price equation:

$$ln\ price = \alpha + \beta\ ln\ lot\ size + \gamma_m\ container\ size_m + \delta_n\ product\ category_n + \theta\ organic +$$
$$+ \lambda\ geographical\ indications + \rho_i\ country\ of\ origin_i + \varphi_j\ brand_j + \varepsilon \quad (2)$$

The variables included in the empirical model are described in Table 2.

The price of the minimum lot available for purchasing is the dependent variable *(price)*, which is a continuous variable. The first explanatory variable, the size of the minimum lot available for purchasing *(lot size)*, is also a continuous variable, while the other explanatory variables, being categorical, were transformed into one or more dummy variables.

Given the non-linear relationship between the price and the size of the minimum lot available for purchasing[1], we considered two possible functional forms of the equation: double-log and log-linear. We present the results of the double-log equation since this formulation showed a better fit to the data.

Table 2 - Variables of the empirical model

[1] The relationship between the price and the size of the minimum lot available for purchasing is expected to be not linear because vendors usually give a discount on the unit price when a larger amount of product is purchased. Therefore, if the minimum lot size increases, a less-than-proportional increase in its price is expected. Double-log and log-linear functional forms seem to be capable to describe this relationship taking into account that: i) in the double-log model, parameter estimates are a direct measure of elasticity, ii) in log-linear model, coefficients express the percentage change in dependent variable when a unit change in independent variable occurs.

Variables	Type	Description
Dependent variable		
price	continuous variable	price of minimum lot (US$)
Regressors		
lot size	continuous variable	size of minimum lot (liters)
container size	dummy	very small (0.000 - 0.250 L) = 1; otherwise = 0
	dummy	small (0.251 - 0.500 L) = 1; otherwise = 0
	dummy	medium (0.501 - 0.750 L) = 1; otherwise = 0
	dummy	large (0.751 - 1.000 L) = 1; otherwise = 0
	dummy	extra-large (> 1.000 L) = 1; otherwise = 0 (baseline)
product category	dummy	LOO = 1; otherwise = 0
	dummy	EVOO = 1; otherwise = 0
	dummy	OOO = 1; otherwise = 0 (baseline)
organic	dummy	organic certification = 1; conventional = 0
geographical indications	dummy	with PDO/PGI = 1; without PDO/PGI = 0
country of origin	dummy	Italy = 1; otherwise = 0
	dummy	Spain = 1; otherwise = 0
	dummy	Greece = 1; otherwise = 0
	dummy	California = 1; otherwise = 0
	dummy	other countries = 1; otherwise = 0
	dummy	not specified = 1; otherwise = 0 (baseline)
brand	dummy	Bertolli = 1; otherwise = 0
	dummy	Filippo Berio = 1; otherwise = 0
	dummy	Pompeian = 1; otherwise = 0
	dummy	Colavita = 1; otherwise = 0
	dummy	Crisco = 1; otherwise = 0
	dummy	Lucini = 1; otherwise = 0
	dummy	California Olive Ranch = 1; otherwise = 0
	dummy	other brands = 1; otherwise = 0
	dummy	store brands = 1; otherwise = 0 (baseline)

4. Results and Discussion

Estimation results of the hedonic price equation are summarized in Table 3, which also includes the most important performance indicators of the empirical model. This shows a good overall significance (F-statistic equal to 289, with a P-value much lower than 0.01) and a high capability to explain the variability of the data set (adjusted R-squared equal to 0.80).

Table 3 – Estimation results for the hedonic price function

	Coefficient	*Standard Error*	*Marginal effect*
Constant	2.53 ***	0.06	N/A
ln lot size	0.82 ***	0.01	N/A
container size			
very small	0.87 ***	0.05	139.7%

small	0.69	***	0.04	99.5%
medium	0.54	***	0.05	71.4%
large	0.31	***	0.05	36.8%
product category				
EVOO	0.12	***	0.04	12.9%
LOO	-0.06		0.06	N/A
organic	0.10	***	0.03	10.9%
geographical indications	0.18	***	0.04	19.8%
country of origin				
Italy	0.15	***	0.03	15.7%
Spain	0.06		0.05	N/A
Greece	-0.06		0.07	N/A
California	0.04		0.05	N/A
other countries	0.27	***	0.06	31.0%
brand				
Bertolli	-0.04		0.08	N/A
Filippo Berio	0.04		0.11	N/A
Pompeian	-0.15	**	0.08	-14.0%
Colavita	0.36	***	0.08	43.2%
Crisco	-0.38	***	0.08	-30.5%
Lucini	0.24	***	0.07	27.1%
California Olive Ranch	0.20	*	0.12	22.6%
other brands	0.17	***	0.04	19.1%

Dependent variable = *ln price*
F-Statistic (22 / 1,352) = 289.00 P-value (F) <0.0001
R^2 = 0.80 Adjusted R^2 = 0.80
Log-likelihood = -771.465

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The size of the minimum lot available for purchasing (*lot size*) is a significant variable, with a coefficient equal to +0.82. Taking into account the logarithmic form of the equation, the coefficient of a continuous variable can be directly interpreted in terms of elasticity. Therefore, the positive (but less than one) coefficient of the *lot size* variable means that an increase in the size of the minimum lot leads to a less-than-proportional increase in its price. This was expected because a discount on the unit price is usually given when a larger amount of product is purchased.

The size of the containers (*container size* variable codified by the dummies *extra-large, large, medium, small* and *very small*) also has a significant effect on the olive oil price. In particular, the dummies *large, medium, small* and *very small* have positive and increasing coefficients equal to +0.31, +0.54, +0.69 and +0.87, respectively. Considering the functional form of the equation, the

298 coefficient of a dummy variable can be transformed into the percentage change in price[2] due to the
299 presence of a given quality attribute (marginal effect). It follows that, assuming the largest
300 containers as the baseline, the price increases by +37%, +71%, +99% and +140%, respectively,
301 when olive oil is sold in progressively smaller containers (0.751-1.000, 0.501-0.750, 0.251-0.500,
302 <0.251 liters). This was also expected given that the packaging for smaller containers is more
303 expensive and because consumers in the U.S. seem willing to pay higher prices for olive oils
304 packaged in small containers which are perceived to be of better quality (Delgado et al., 2013;
305 Santosa et al., 2010; Santosa & Guinard, 2011; Santosa et al., 2013). Some studies carried out in
306 traditional markets, specifically Italy (Carlucci et al., 2014) and Greece (Karipidis et al., 2005a),
307 also found a similar effect of package size on the price of olive oil, although more moderate.
308 When investigating the other extrinsic cues of olive oils, *product category* also showed a substantial
309 influence on price. Compared to *OOO* used as a baseline, EVOO had a significant premium price
310 equal to +13%, while LOO did not have any premium or discount price (all other characteristics
311 being equal). The premium for EVOO was not a certain result. Despite EVOO being typically
312 associated with higher production costs and objectively superior in quality than other olive oils,
313 many U.S. consumers do not seem to know what "extra virgin" really means (Santosa et al., 2013).
314 However, this designation seems to be often associated with positive attributes of olive oil such as
315 first press or cold pressed, more flavor, less processing, and with no solvents or chemicals being
316 used in the extraction process (Santosa et al., 2013). In addition, "extra virgin" is the item of highest
317 interest when reading olive oil labels (Delgado et al. 2013; Santosa & Guinard, 2011). These
318 considerations, together with the observation of a premium for extra virgin olive oils (which also
319 represent the large majority of products included in the sample, probably because they are sold the
320 most), support the hypothesis that many consumers in the U.S. are willing to pay a premium for
321 extra virgin oil.
322 Organic certification and geographical indications are further important quality cues affecting the

[2] The following formula was applied: *% change = {exp (coefficient) - 1}*.

price of olive oil. All other characteristics being equal, organic olive oils have a premium price of +11% compared to conventional products, while olive oils with a PDO/PGI designation have a premium price of +20% compared to the products without geographical indications. There were relatively few organic olive oils and oils with geographical indications in the whole sample, which suggests that these products have limited sales specifically addressed at satisfying the needs of specific consumers. In fact, the premium for organic olive oils can be explained by considering, in addition to the relatively higher production costs, the preferences of many U.S. consumers who seem to use an organic certification as an important choice criterion also for olive oil purchases (Delgado et al., 2013; Santosa & Guinard, 2011; Santosa et al., 2013). Studies conducted in Italy (Cicia et al., 2013; Carlucci et al., 2014), Greece (Karipidis et al., 2005a) and Portugal (Ribeiro & Santos, 2005) also found high premium prices for organic olive oils.

Similarly, the premium gained by olive oils with geographical indications could be related to both additional production costs and the preferences of consumers who are more interested in buying olive oil with a specific origin and quality standards. The consistency of this result with other European studies, specifically Italy (Cicia et al., 2013; Carlucci et al., 2014), Greece (Karipidis et al., 2005a) and Portugal (Ribeiro & Santos, 2005), was not expected for a non-EU country like the United States. Previous studies conducted in northern California (Delgado & Guinard, 2011; Delgado et al., 2013; Santosa et al., 2010; Santosa & Guinard, 2011; Santosa et al., 2013) showed that many consumers considered imported olive oils to be of a better quality, and preferred them mainly for special purposes (e.g. salad dressing), even if they were more expensive. However, these studies did not specify in depth how U.S. consumers distinguish between imported olive oils and domestic olive oils, and whether they believe that all imported olive oils have the same quality. The premium price we found for olive oils with geographical indications supports the hypothesis that PDO/PGI designation is an effective tool used by those U.S. consumers who are more knowledgeable about olive oil, to associate imported oils with higher quality standards, although outside the EU context. This is corroborated by a recent study carried out in Canada (another

emerging market very close to the United States), where a significant willingness to pay for olive oils with a PDO/PGI designation was measured directly on a sample of olive oil consumers (Menapace et al., 2011). It is worth noting that both organic olive oils and those with geographical indications are also certified products and thus characterized by a higher level of guarantee for consumers.

The price of olive oil was also strongly related to the country of origin indicated on the label. Compared to the olive oil products without any specified country of origin, products from countries that had a limited olive oil production (France, Lebanon, Israel, Palestine, Chile, etc.) had a significant and relevant premium price (+31%). This could be related to the beliefs of many American consumers who associate better quality with the niche olive oils rather than olive oils produced in larger quantities (Santosa et al., 2010). Conversely, among the olive oils from the most important producer countries (Italy, Spain and Greece), including those locally produced (California), only the products with an Italian origin showed a significant and relevant premium price (+16%). This can mostly be explained by considering the positive reputation of Italian olive oils in the U.S. (Delgado et al., 2013; Santosa et al., 2013; Xiong et al., 2014) as well as in other neighboring countries such as Canada (Menapace et al., 2011).

Finally, the price of olive oil was strongly related to brand. Compared to the store brands used as a baseline, only some brand dummies were statistically significant with both positive and negative coefficients. It is important to highlight that store branded olive oils are typically the most popular and cheaper olive oils sold in the U.S. market (Datamonitor, 2010; Santosa et al., 2013; USITC, 2013). Three brands, i.e. *Colavita*, *Lucini* and *California Olive Ranch*, which are among the most important brands on the U.S. olive oil retail market (USITC, 2013), had relevant premium prices equal to +43%, +27%, and +23%, respectively. Conversely, other major brands of the U.S. olive oil retail market, i.e. *Crisco* and *Pompeian* (USITC, 2013), offered discounts of -30% and -14%, respectively. Surprisingly, minor brands of the U.S. olive oil retail market also had an important premium price equal to +19%.

It is difficult to explain the price variability related to brands because many factors may be involved e.g. market share, brand equity, and advertising strategies. Nevertheless, of the brands gaining a premium, Colavita stresses the authentic Italian origin of some of its own products. It is stated on its website that: "*the Italian government, through the CERMET organization, granted Colavita the much-coveted ability to declare «Certified Authentic Product of Italy» on its extra virgin olive oil labels. This seal assures consumers worldwide that Colavita Extra Virgin Olive Oil is obtained exclusively from Italian olives, generally regarded as the source of the finest olive oils in the world*" (Colavita, 2015). Similarly, Lucini emphasizes its linkage with Italy by stating on its website: "*Lucini Italia Company was founded on the philosophy that great tasting food comes from only the most cared-for, high-quality ingredients. Our passion is creating authentic, handcrafted gourmet foods inspired by the culinary traditions of Italy"* (Lucini, 2015).

Conversely, California Olive Ranch highlights the local identity of own products starting with the terms used for its brand name. Additionally, on its website, it states: "*We're California farmers with a strong connection to the land…We're transforming the olive oil industry...We do it by growing on California ranches, finding innovative ways to plant and harvest olives...All of our extra virgin olive oils are certified extra virgin by the California Olive Oil Council (COOC)"* (California Olive Ranch, 2015). On the other hand, the brands with discount prices, *Crisco* and *Pompeian*, are popular brands on the U.S. olive oil retail market (USITC, 2013) clearly not using origin labels to differentiate their products. The Pompeian Olive Oil Company states on its website: *"Unlike many olive oils sold in the U.S., Pompeian is a blend of olive oils produced in various regions rather than from a single locale or company-owned grove. Since each year's olive crop varies, Pompeian can select the season's best olive oils and then blend them to the same quality standards and consistent taste, year after year"* (Pompeian, 2015).

5. Conclusions

400 The United States is a relatively new olive oil producer and consumer (Vossen, 2007). Despite being
401 a small global producer, it ranks third in olive oil consumption, after Italy and Spain, and most
402 domestic consumption consists of imports, mainly from Mediterranean countries. In the last few
403 years, as consumption of olive oil has rapidly grown, interest in quality issues and market regulation
404 has also been increasing (USITC, 2013).
405 We believe that we have contributed to a better understanding of the U.S. olive oil market by
406 investigating the role of the main extrinsic olive oil cues (size of container, product category,
407 organic certification, geographical indications, country of origin and brand) in affecting retail
408 prices. A hedonic price model was estimated using data from amazon.com, the biggest online retail
409 store in the United States.
410 The results of the study show that all the extrinsic olive oil cues led to significant differences in
411 price which also exhibited a wide variability, ranging from a minimum of 4.6 to a maximum of 160
412 US$/liter. Interestingly, all other characteristics being equal, olive oils in containers of 0.5 liters or
413 less are sold at almost double the price of olive oils in containers over 1 liter. Even considering the
414 higher production costs associated with small packaging, the huge price difference can only be
415 explained by the demand, assuming that consumers use container size as an important indicator of
416 olive oil quality and are willing to pay higher prices for olive oils in small containers. This is an
417 important insight for producers interested in selling olive oil on the U.S. market. They should use
418 more expensive small containers to enhance the image of high quality olive oils and reserve large
419 containers only for the cheapest olive oils mainly used for cooking.
420 We found that high premium prices were associated with cues related to “credence” attributes (extra
421 virgin, organic, PDO/PGI, some countries of origin such as Italy). These premium prices take into
422 account production cost differentials as well as reputation effects. Since consumers cannot assess
423 the quality of olive oil even after consumption, but are aware that a large range in quality and prices
424 exists, quality assurance policies are needed to provide consumers with truthful information and
425 discourages producers from making false claims in order to save on production costs and take

advantage of the reputation effect.

The regulation of the olive oil market in the United States is different from the regulations of the European Union which is, however, the most important olive oil supplier to the United States. In addition, the labeling of olive oil products, although very important for influencing consumer choices, is perhaps misleading. Two main certification schemes for organic olive oils (USDA and EU) coexist, while geographical indications (PDO/PGI designations) are restricted to olive oils only imported from the EU, excluding those locally produced or imported from non-EU countries. In addition, USDA standards for grades of olive oils also coexist with private standards established by organizations such as the North American Olive Oil Association, the California Olive Oil Council, and the Texas Olive Oil Council. This definitely does not help American consumers, who are still not experienced in olive oil consumption, to become familiar with and trust some designations such as extra virgin, virgin, olive-pomace, light, etc..

Another important question concerns the statement of the country of origin on the labeling of olive oils, which has not undergone any specific U.S. legislation, unlike in the EU (Regulation (EC) No. 182/2009). Therefore, on the U.S. olive oil market, the indication of the country of origin on the labeling of imported olive oils often refers to the country of dispatch, which may be different from the country where the olives were actually harvested and pressed. For example, Italy is the second most important global exporting country of olive oil and, at the same time, the most important global importing country (FAO, 2014). It is easy to deduce that great quantities of olive oils from different producer countries transit across Italy where they are blended, repackaged and then exported to different consumer countries, including the United States, as “Italian” products thus gaining a premium. Aware of this uncertainty, Colavita USA Company clearly specifies its own conduct for labeling olive oils on its website: “Product of Italy” identifies olive oil obtained exclusively from olives harvested and pressed in Italy; “Made in Italy” indicates that the blending and packaging occurred in Italy, however the oils were sourced from olives harvested and pressed in any country where olives are grown (Colavita, 2015). However, in the absence of a specific

452 regulation, other companies may use different approaches and terminologies. Also, without
453 complying with control measures, the risk of fraudulent practices (adulteration and mislabeling) is
454 very high (USITC, 2013).
455 In conclusion, this study provides empirical evidence that highlights the importance of quality
456 assurance policies and compliance control measures to improve the functioning of the U.S. olive oil
457 market. The main limitation of this study is related to the specificity of the retail channel considered
458 in the analysis. Further research is thus needed to investigate the other retail channels such as large-
459 scale stores, gourmet stores, farmers markets, etc. By combining the current results with further
460 information regarding supply and demand, it would be possible to assess the very important
461 implications of potential U.S. quality regulations and trade policy for the olive oil market.
462
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