Key factors driving PDO olive oil prices at origin in Spain

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Abstract

Spain, the world's leading producer of extra virgin olive oil (EVOO), has 29 protected designations of origin (PDOs) in this sector in 2021. The objectives of this research are, first, to analyse the differences in the origin value of this product with differentiated quality, based on the geographic area of origin; and, secondly, using panel data methodology, to research how certain variables such as the age of the PDO, the production volume, the orientation of part of the supply towards international markets or the development of oleotourism activities in a territory influences the average price paid to the producer. The results show that age, export to non-EU countries and oleotourism positively affect the product's value. These findings should be taken into account in the design of possible actions by companies, PDO Regulatory Councils (RCs) and influential institutions in the sector, at European, national and regional levels. This article contributes to the evaluation of EU's agri-food product quality policy and examines the factors influencing the price at origin of certified products, which condition the sector's profitability and the future of PDO-certified production.

Keywords*: Extra virgin olive oil (EVOO), Protected Designation of Origin (PDO), Spain, Price at origin, Export, Oleotourism.*

1. Introduction

Foods with differentiated quality covered by a Protected Designation of Origin (PDO) or Protected Geographical Indications (PGI) have peculiar and specific characteristics due to the origin of the raw materials used (MAPA, 2014). European regulation 2024/143 on quality schemes for agricultural and food products defines "designation of origin" as a name identifying a product: a) from a specific place, region, or country; b) whose quality is due to its geographical environment; and c) all production stages occur there. It defines "geographical indication" as a name identifying a product: a) from a specific place, region, or country; b) with qualities attributable to its origin; and c) with at least one production stage there. The PDO and PGI recognize a product's origin, associating it with quality or reputation. This information differentiates goods in the market and can help develop a brand linked to its origin. Studies show these indications can contribute to rural development under suitable conditions (Bowen, 2010; Cei *et al.*, 2018), although not always (Neilson *et al.*, 2018), and promote the sale of local products

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Table 1 - Registered area and production of EVOO-PDO by designation of origin in Spain in 2021.

	PDO	*Registered area (ha)*		*Production of EVOO-PDO*	
		Ha	*%*	*Tn*	*%*
1	Aceite de La Rioja	1,256.00	0.17	315.61	0.29
2	Aceite de Navarra	2,691.00	0.37	173.27	0.16
3	Aceite de L'Empordà	884.00	0.12	75.88	0.07
4	Les Garrigues	16,260.00	2.22	3,890.00	3.52
5	Siurana	8,559.00	1.17	3,761.42	3.41
6	Aceite de Terra Alta	2,600.00	0.35	456	0.41
7	Aceite del Bajo Aragón	22,300.00	3.04	1,980.00	1.79
8	Aceite del Baix Ebre-Montsià	12,111.00	1.65	186.59	0.17
9	Aceite de Mallorca	40,114.00	5.47	349	0.32
10	Gata-Hurdes	30,000.00	4.09	57.58	0.05
11	Aceite de La Alcarria	28,335.00	3.87	193.74	0.18
12	Montes de Toledo	35,000.00	4.78	14,500.00	13.13
13	Aceite de la Comunitat Valenciana	4,248.00	0.58	0	0.00
14	Aceite Monterrubio	12,500.00	1.71	28	0.03
15	Aceite Campo de Montiel	26,325.00	3.59	7,638.00	6.92
16	Aceite Campo de Calatrava	22,123.00	3.02	112	0.10
17	Sierra de Segura	35,064.00	4.78	7,564.00	6.85
18	Montoro-Adamuz	22,546.00	3.08	272	0.25
19	Sierra Mágina	60,000.00	8.19	10,225.00	9.26
20	Sierra de Cazorla	37,700.00	5.14	3,500.00	3.17
21	Aceite Sierra del Moncayo	2,500.00	0.34	83.25	0.08
22	Montes de Granada	37,252.00	5.08	503.32	0.46
23	Poniente de Granada	39,407.00	5.38	1,460.00	1.32
24	Priego de Córdoba	29,628.00	4.04	6,704.00	6.07
25	Baena	60,000.00	8.19	41,066.71	37.20
26	Estepa	39,516.00	5.39	3,800.00	3.44
27	Aceite de Lucena	38,233.00	5.22	72	0.07
28	Antequera	42,606.00	5.81	1,617.60	1.47
29	Sierra de Cádiz	28,000.00	3.82	375	0.34

Source: MAPA (2023b).

in national and international markets (Galati *et al.*, 2017; Lubinga *et al.*, 2020). The right to use geographical indications belong to regional producers, adding value and protecting traditional knowledge. They also generate significant secondary benefits in tourism and gastronomy (Marcoz *et al.*, 2016), emphasizing that certified quality agriculture is presented as one of the main opportunities for the development of these rural environments (Consejo Económico y Social de España, 2018).

Spain, located on the western shores of the Mediterranean and with an olive grove area of 2,468 million hectares for the production of olive oil for oil mills, has traditionally been the world's leading producer of this foodstuff (Bull, 1936; García-Moral *et al.*, 2023). In 2021, the extent of olive plantations registered under a PDO is estimated at 732,927 hectares, representing 29.69% of the total area. This area is unevenly distributed across the different regions, as shown in Table 1 and Figure 1. This country, however, is not the EU partner with the highest number of PDOs in this agroindustry as of the

Figure 1 - EVOO from Spain with PDO.

Source: MAPA (2023b).

end of 2021 (12/31/2021), a position held by Italy with 42. Behind Spain, Greece ranks with 20, followed by France with 8.

In all cases, Spanish olive oil produced under a PDO must be of superior category—specifically, extra virgin olive oil (EVOO) — and the certified product must meet the specifications set out by the European Commission in the EU's legal register of names of agricultural products and foodstuffs "eAmbrosia"[1]. However, the fact that a product is certified by a PDO does not necessarily imply a homogeneous origin price, as it is noted in the case of coffee (Conley and Wilson, 2020). On the contrary, there are significant differences, which affect the income of olive producers and also the effectiveness of the PDO as an instrument of differentiated quality and economic growth of the territories in which they are located. Specifically, in 2021, the average price at origin of EVOO with PDO Priego de Córdoba reached 12.36 €/kg, while the corresponding price of EVOO with PDO Montes de Granada was 2.82 €/kg.

Based on the data provided by the Spanish Ministry of Agriculture, Fisheries and Food (MAPA) on different variables for the PDO-certified olive oil sector, data published by the RCs of the different PDOs in Spain and the arguments drawn from the literature review, this research aims, firstly, to analyse the heterogeneity in the average price of the PDO EVOO produced in the different territories between 2008 and 2021 and, secondly, using panel data methodology, to examine how the price paid at origin for the product is influenced by the age of the PDO, the production volume, the orientation towards international markets, the number of companies registered in the RC that produce and sell olive oil and the development of oleoturism activities. This research contributes to a better understanding of the effects of the EU's agri-food product quality policy, extending the existing evidence in several directions. In particular, the study aims to determine the factors that positively and negatively influence the price at origin of PDO EVOO produced in Spain. In contrast to much of the research on olive oil PDOs in Spain, Italy, Greece or Turkey, which largely consists of qualitative studies dealing with specific cases (Erraach *et al*., 2014; Egea and Pérez, 2016; Morillas and García-Quero, 2022; Kizos and Vakoufaris, 2011; Nizam, 2017; Tempesta and Vecchiato, 2019), this paper offers an aggregated view of the olive oil agro-industry with PDO-certified quality in the country that is the world's leading supplier of this foodstuff. The results obtained provided conclusions on the sector as a whole, which are useful for decision-making by companies and RCs, as well as by national and supranational institutions, such as the national government or the European Commission, whose actions and policies are aimed at the entire olive oil agro-industry.

2. Related literature and hypotheses

Geographical indications are linked to the notion of territory, under the assumption that the special quality and characteristics of an agri-food product are determined by the geographical place from which it originates (Gade, 2004; Bingen, 2012; Bowen and Mutersbaugh, 2014; Conley

[1] https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/geographical-indications-register/.

and Wilson, 2020). Roquefort cheese, Argan oil, French champagne, Mexican tequila, Galapagan island coffee or Darjeeling tea have qualities or a reputation derived specifically from their place of origin, which differentiate them in the market (WIPO, 2021; Zinsli, 2023; Besky, 2014). Likewise, EVOO has qualities derived from its place of production, influenced by specific local factors such as the variety of olive grown in the territory, the oil production system or the climate or type of soil, there being a link between the product and its origin, which is perceptible in its attributes and can influence consumer preferences (Caporale *et al.*, 2006; Espejel *et al.*, 2008, Kalogeropoulos and Tsimidou, 2014).

The main advantage of the system of valuation and protection of PDOs/PGIs and Traditional Specialty Guaranteed created by the EU in 1992, revised in 2006[2], 2012 and 2024, is that their production parameters or standards are published in a single harmonized register. The label or seal that certifies the product's quality informs consumers about it, as governmental and non-governmental institutions endorse the process that verifies the real origin of the product, the specific raw materials used and the traditional technical procedure applied in its production in a specific territorial area (Resano *et al.*, 2012; Mutersbaugh *et al.*, 2005; Moschini *et al.*, 2008). Such certification can give the producer an exclusive right to use the label, in principle offering a clear advantage over other producers (Teil, 2017; Sgroi and Modica, 2022). PDO foods are produced following specific processes, linked to local culture and traditions dating back at least 25 years (Sgroi and Modica, 2022). The valorization process starts with a clear definition of the values that revolve around the product, including its history, the identification of the geographical area in which it is produced, the process followed and the particularity of the territorial resources used (Mariani *et al.*, 2022). The combination of these elements determines the product's characteristics and enhances the reputation of products from the defined area, allowing producers to employ differentiation strategies, as argued by Altomonte *et al.* (2016).

Food certification by the RC favorably influences the quality perceived by the consumer (Aytop and Çankaya, 2022; Toma *et al.*, 2023). The consumer's knowledge of the certified product has a negative influence on the perceived risk and a positive influence on satisfaction (Fandos Herrera and Flavián Blanco, 2011), contributing to their preference for the certified food and willingness to pay a premium price (Aytop and Çankaya, 2022; Van Ittersum *et al.*, 2007; Van Zyl *et al*., 2013; Albayram *et al*., 2014). This in turn boosts the value of the product, the producers' income and the economic development of the territory (Crescenzi *et al.*, 2022; Poetschki *et al.*, 2021). Based on the reviewed arguments, it can be stated that the age or number of years a product has been marketed with the PDO label positively influences the potential consumer's knowledge of that food and, in parallel, its valuation and the price they are willing to pay. Therefore, the longer the PDO certifying the quality of the EVOO has been in effect, the more well-known it becomes, which favourably affects demand and, consequently, the price at origin. The hypothesis posed is as follows:

H1. The number of years that the EVOO has been marketed with the PDO label has a positive influence on the price at origin of the product.

The quality of the agri-food product associated with its certification by a PDO/PGI is perceived in many cases by consumers in other countries, fostering the growth of sales in international markets, both in traditional destinations such as EU countries and in new markets outside the EU, and is associated with higher prices (Raimondi *et al.*, 2020; De Filippis *et al.*, 2022). Such an effect is commonly seen in wine sector (Galati *et al.*, 2017, Lubinga *et al.*, 2020), es-

[2] The Council of the European Union. Council Regulation (EC) No 510/2006 of 20 March 2006 on the Protection of Geographical Indications and Designations of Origin for Agricultural Products and Foodstuffs. 2006. Available online: https://eur-lex.europa.eu/eli/reg/2006/510/oj (accessed on 6 November 2020).

pecially French wines (Agostino and Trivieri, 2016), but also in cheese sector (Duvaleix *et al.*, 2021), bourbon (Zhang *et al.*, 2023) or olive oil (Menapace *et al.*, 2011). However, other studies are less conclusive and vary according to the country of export destination (Sorgho and Larue, 2014) or the type of product (Chilla *et al.*, 2020). In line with the studies of Raimondi *et al.* (2020) and De Filippis *et al.* (2022), The sale of part of the AOVE-PDO production in international markets, both in EU countries and the rest of the world, increases the demand for the product and positively impacts the price paid at origin. Based on this, the hypotheses posed are as follows:

H2. The value of sales in EU markets has a positive influence on the price per kilogram of PDO EVOO paid at origin.

H3. The value of sales in non-EU markets has a positive influence on the price per kilogram of PDO EVOO paid at origin.

PGI and PDO certification can play a role in driving the local development of rural areas (Bonanno *et al.*, 2020; Crescenzi *et al.*, 2022), thus fostering the growth and diversification of the local economy toward higher value-added sectors, including gastronomy and tourism (Arjona-Fuentes and Amador-Hidalgo, 2017; Ciani *et al.*, 2019; Hadelan *et al.*, 2021). Tourists, in many cases city dwellers, value the quality certification represented by the PDO/PGI label and have shown a greater willingness to pay a higher price than local consumers for the certified product (Marcoz *et al.*, 2016, Sgroi and Modica, 2022). In addition, when they return to their place of origin, tourists may want to continue consuming these traditional food and beverage products (Alamanos *et al.*, 2013; Folgado-Fernandez *et al.*, 2019), positively influencing demand (Pulido-Fernández *et al.*, 2022). Based on the reviewed research, it is deduced that the purchase of AOVE-PDO by tourists visiting the production area or by those with whom they interact (family, friends, acquaintances, etc.) increases the product's recognition outside the region of origin, which positively affects demand and, in parallel, the price paid at origin for this food. Therefore, the following hypothesis is proposed:

H4. When companies registered in the RC of the PDO are involved in olive oil tourism activities, which attract citizens from other cities and countries, contributing positively to the price at origin of the product.

Spain, Italy and Greece, three EU countries, which account for 64.17% of world olive oil production in the 2021/2022 campaign, do not share a single market for this foodstuff, which leads to differences in the price per kilogram (kg) of virgin olive oil depending on the country of origin, as confirmed by Emmanouilides *et al.* (2014) and Panagiotou and Stavrakoudis (2023). The same situation is observed at the national level, particularly in Spanish PDO EVOO. In this country, the olives produced for milling are predominantly rainfed (MAPA 2023a) and the price charged by the producer depends on the yield of the fruit, its quality (Gutiérrez-Salcedo *et al.*, 2016; Mozas and Parra, 2018) and, above all, the total volume of production in each season in the sector as a whole. This amount is directly linked to the climatic conditions experienced in the different stages of the agricultural process in the different production areas (Rodrigo-Comino *et al.*, 2021; Arfaoui *et al.*, 2021), with an inverse relationship between the total number of tons produced in the sector and the price per kg paid to the producer. Thus, a higher volume of production increases the available supply and negatively affects the price paid at origin. Extrapolating this evidence to the Spanish olive oil agroindustry with differentiated quality, the following hypothesis is established, which inversely links two variables: tons of AOVE-PDO produced and the value at origin of the product. The following hypothesis is formulated:

H5. A higher production of AOVE-DOP increases the available supply, negatively affecting the price paid at origin for the product.

European regulations on quality regimes for agri-food products establish that PDO EVOO must be bottled in the area where it is produced.

This requirement breaks with the strategy followed by most of the mills located in rural areas of origin, which sell most of their supply in bulk, to be bottled and sold outside the territory where it is produced (Mozas-Moral, 2020; Gutiérrez-Salcedo *et al.*, 2016). The bottled PDO EVOO can be sold directly from the mill, but also through third-party trading companies registered in the RC of the PDO. In principle, a larger number of trading companies can have a direct effect on competition at origin and, therefore, on the price paid per kg of PDO EVOO. The works of Bonnet and Bouamra-Mechemache (2016) and Orsini *et al.* (2020) on organic products confirm a greater bargaining power of producers over retailers for products with the organic label, which positively influences the price perceived by the producer. In the case of AOVE-PDO, the bargaining power of olive mills over companies that only engage in commercial activities may have a direct effect on competition at origin, positively influencing the price paid per kg of AOVE-PDO. Based on this reasoning, the following hypothesis is proposed:

H6. A higher number of trading companies registered with the PDO Regulatory Council has a positive influence on the price at origin of PDO EVOO.

3. Material and methods

3.1. *Information and data*

The statistical information comes mainly from the report: "Data on Protected Designations of Origin (PDO) and Protected Geographical Indications (PGI) of Agri-Food Products", which is prepared each year by the Subdirectorate General for Food Quality Control and Agri-Food Laboratories of the General Directorate of the Food Industry (MAPA) in collaboration with the Regulatory Councils of Protected Designations of Origin and Protected Geographical Indications and similar entities. The time period of analysis is determined by MAPA's publication of data on the different variables: number of PDOs, number of industries, production, economic value of production and exports. In the case of EVOO, there is no PGI in Spain recognized by the Commission that registered production during the time period considered, so the study focuses on the productive and commercial activity between 2008 and 2021, both included, of 22 PDOs with activity in each of the years considered. These PDOs are the following: Aceite Campo de Montiel, Aceite Campo de Calatrava, Aceite de a Alcarria, Aceite de Mallorca, Aceite de Navarra, Aceite Terra Alta, Aceite Terra Alta, Aceite del Baix Ebre-Montsià, Aceite del Bajo Aragón, Antequera, Baena, Estepa, Les Garrigues, Montes de Granada, Montes de Toledo, Montoro-Adamuz, Poniente de Granada, Priego de Córdoba, Sierra de Cádiz, Sierra de Cazorla, Sierra de Segura, Sierrra Mágina and Siruana. PDOs that have not produced in two or three consecutive years, such as Aceites de la Comunitat Valenciana, Aceite de la Rioja, Aceite de Lucena, Aceite de l`Empordà, Aceite Monterrubio, Aceite Sierra del Moncayo and Gata-Hurdes, are not included.

The EU eAmbrosia Register provides information on the year the PDO was approved by the competent national body. Likewise, the information published by the RCs and the different entities registered in each PDO (mills, bottlers and trading companies) indicates whether or not they carry out oleotourism activities.

It should be noted that the information recorded in official statistics is in some cases incomplete or based on estimates, since, as Török *et al.* (2020) and different studies carried out by AND-International (2012a, 2012b) have shown, there is limited availability data to evaluate the effectiveness of EU PDOs/PGIs.

The dependent variable is the average price paid at origin per kg of PDO EVOO each year by the entities registered in the RC of the 22 PDOs considered, between 2008 and 2021. The determinants are specified in Table 2.

3.2. *Panel data analysis*

The aim of the study is to identify the factors that influence the average price paid at origin per kg of PDO EVOO, by carrying out an analysis of the relevant variables and testing the association between the independent variables and the dependent variable. The study sample consists of

Table 2 - Definition of variables.

Age	*Age of the PDO or years since its initial approval, indicative of its history*
Exports-EU	Value of production that all the entities registered in the RC export each year to EU-28 countries (in 2021, the UK was considered a member of the EU), expressed in millions of euros.
Exports-nonEU	Value of production that the set of entities registered in the RC exports each year to countries outside the EU-28—which allows for less dependence on the local and national market—expressed in millions of euros.
Oleotourism	Development of oleotourism activities by some of the entities registered in the RC, which promotes familiarity with the product among consumers outside the territory; a dummy variable.
Certified production	Volume of production certified by the RC each year, which quantifies the supply available each year, expressed in tons.
Olive oil trading companies	Number of olive oil trading companies registered in the PDO.

data from the 22 PDOs between 2008 and 2021. This time period was chosen due to the unavailability of data from 2021 onwards. A descriptive analysis of the variables was performed, as well as a panel data analysis, following the methodology applied in previous articles (Gallego-Valero *et al.*, 2018). The dependent variable in the model is the value of PDO EVOO, defined as the average price paid at origin of PDO EVOO, expressed in euro per kg. The six explanatory variables, which are presented in Table 1, were selected according to the hypotheses set out in the previous section. The following equation tests the relation between the independent variables and the dependent variable:

$$\text{PDO-EVOOvalue}_{it} = \alpha it + \alpha 1\text{Age}_{it} + \\ + \alpha 2\text{Exports-EU}_{it} + \alpha 3\text{Exports-nonEU}_{it} + \\ + \alpha 4\text{Olive-oil-tourism}_{it} + \alpha 5\text{Certified-prod}_{it} + \\ + \alpha 6\ \text{Olive-oil-trading-comp}_{it} + \alpha eit$$

where:
$\text{PDO-EVOOvalue}_{it:}$ is the price paid at origin per kg of PDO EVOO each year by the companies
$\alpha 1\text{Age}_{it:}$ age of the PDO or years since its approval
$\alpha 2\text{Exports-EU}_{it:}$ value of production exported to EU-28 countries
$\alpha 3\text{Exports-nonEU}_{it:}$ value of production exported to countries outside the EU-28
$\alpha 4\text{Oleotourism}_{it}$: development of oleotourism activities
$\alpha 5\text{Certified-prod}_{it}$: volume of production certified by the PDO
$\alpha 6$ Olive-oil-trading-$\text{comp}_{it:}$ number of olive oil trading companies registered in the PDO
α: estimated coefficients
Finally, αit measures the influence of other exogenous variables not included in the model, and αeit is the error term.

A panel data approach is appropriate due to the inclusion of time periods and the likely presence of unobserved individual effects. The use of this technique has multiple advantages, such as the fact that it reduces collinearity between variables, enables the construction of more complex models, eliminates or reduces bias in results when aggregating information, and identifies and evaluates effects not detected by cross-sectional or time-series analysis (Baltagi, 2005). However, drawbacks include problems with design and data collection, cross-sectional dependence and short time series. Stata software was used for the analysis.

4. Results

4.1. *Descriptive analysis*

Table 3 shows the descriptive statistics of the different variables considered. First and foremost, the high degree of dispersion in these variables stands out, particularly in the case of exports to the EU and non-EU countries. The minimum value registered is 0, representing no commercial activity in these destinations; by contrast, amounts of more than 15 million euros are registered for all the entities registered

Table 3 - Descriptive statistics of the variables.

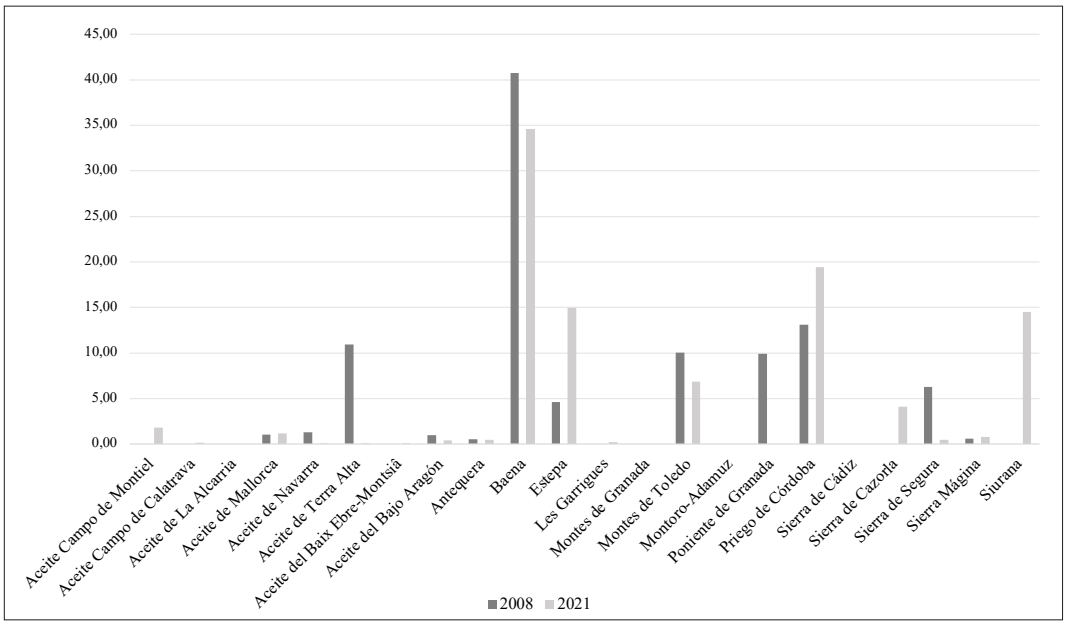
Variables	*Observations*	*Mean*	*Coefficient of variation*	*Minimum*	*Maximum*
Mean price (Y)	308	4.53 (2.16)	47.65	2.19	15.90
Age (X1)	308	4,229.26 (8439.98)	199.56	0	25.00
Production (X2)	308	11.87 (6.01)	50.65	0	62.03
Exports-EU (X3)	308	0.56 (1.43)	252.16	0	15.02
Exports-nonEU (X4)	308	0.73 (2.03)	278.31	0	15.61
Oleotourism (X4)	308	0.59 (0.49)	83.34	0	1.00
Olive oil trading companies (X5)	308	15.59 (12.08)	77.52	1	45.00

Source: Own elaboration based on MAPA (2023a), MAPA (2023b), eAmbrosia and the information from the RCs.

in the Baena PDO or Les Garrigues PDO. At the same time, the volume of PDO-certified production registers a minimum value of 0 tons, due to years with adverse weather conditions or the producers' decision; on the contrary, the highest volume of PDO-certified production is 62.03 tons. For the period as a whole, the average price paid at origin was 4.53 €/kg, with a coefficient of variation of 47.65%.

Figure 2 shows the percentage share of the different PDOs in the total production of PDO EVOO in Spain in 2008 and 2021. Two facts stand out. First, the high volume of supply concentrated in the PDO Baena, which accounts for

Figure 2 - Distribution by PDO of differentiated quality EVOO produced in Spain in 2008 and 2021 (in %).



Source: MAPA (2023b).

Table 4 - Average price paid at origin per kg of certified EVOO in the different PDOs of Spain between 2008 and 2021.

	2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
Aceite Campo de Montiel	3.52	2.60	2.80	2.20	2.60	3.73	3.68	3.70	3.71	3.90	3.80	2.99	3.01	3.81
Aceite Campo de Calatrava	6.67	5.75	5.82	4.95	3.50	3.25	3.39	3.82	4.59	4.66	4.48	3.96	4.45	4.29
Aceite de La Alcarria	4.44	5.50	5.62	3.18	2.97	3.49	3.32	3.85	4.58	5.91	6.56	5.13	4.68	5.55
Aceite de Navarra	3.69	4.00	4.25	4.40	4.22	4.21	4.09	4.60	4.19	3.99	4.02	3.14	3.18	3.41
Aceite de Terra alta	4.30	4.00	3.80	3.90	4.00	3.80	4.00	3.92	3.82	4.50	4.61	4.50	4.61	4.80
Aceite del Baix Ebre-Montsiâ	4.55	4.47	3.90	3.91	4.75	5.03	5.01	5.83	5.51	5.60	4.86	5.53	5.52	5.63
Aceite de Mallorca	10.65	12.10	10.41	11.88	12.81	12.59	13.08	11.93	15.80	15.90	15.71	11.84	11.64	11.04
Aceite del Bajo Aragón	4.00	3.75	3.30	3.20	4.00	4.00	4.51	4.20	3.56	3.50	3.50	3.50	3.50	3.60
Antequera	3.21	3.21	4.08	3.74	4.16	4.58	4.19	5.37	4.19	3.74	3.26	2.36	2.43	3.26
Baena	4.26	2.94	2.87	2.87	2.79	4.30	4.80	5.00	4.00	4.20	5.70	5.50	4.80	5.00
Estepa	3.20	3.50	3.00	3.80	4.00	4.40	5.00	4.80	5.00	4.30	3.30	2.60	2.78	2.90
Les Garrigues	4.80	4.80	4.59	3.24	4.47	4.47	4.47	4.58	3.45	3.60	5.24	5.24	3.83	4.22
Montes de Granada	2.98	2.98	2.35	2.76	4.55	2.57	2.78	3.46	3.87	5.10	5.09	2.31	2.54	2.82
Montes de Toledo	3.51	3.40	3.52	3.51	4.00	4.11	4.25	4.70	4.81	5.21	6.80	6.50	7.21	7.29
Montoro-Adamuz	5.79	5.81	5.00	4.47	3.25	3.36	3.30	5.71	5.83	5.22	4.00	3.60	3.60	3.60
Poniente de Granada	3.46	4.16	3.48	3.30	2.53	3.00	3.03	3.91	3.48	4.11	3.60	2.61	2.51	3.23
Priego de Córdoba	3.10	3.40	3.40	3.40	5.10	5.10	5.75	5.75	5.75	6.80	6.80	6.80	10.49	12.36
Sierra de Cádiz	3.00	2.60	2.38	2.50	2.80	2.71	2.75	2.88	3.29	3.63	3.59	3.66	3.80	4.02
Sierra de Cazorla	2.80	2.40	2.60	2.60	4.25	4.00	4.25	6.00	6.00	6.50	6.00	2.60	2.80	3.19
Sierra de Segura	4.00	4.01	4.01	4.02	3.54	3.67	3.84	5.05	5.16	6.05	6.04	6.04	3.68	4.19
Sierra Mágina	3.00	3.50	3.00	3.30	3.00	3.60	3.80	4.01	3.64	4.40	3.50	3.10	3.70	4.05
Siurana	4.40	4.40	4.40	4.40	4.40	4.00	4.21	4.40	5.00	5.00	5.00	4.38	5.00	5.00
Max	*10.65*	*12.10*	*10.41*	*11.88*	*12.81*	*12.59*	*13.08*	*11.93*	*15.80*	*15.90*	*15.71*	*11.84*	*11.64*	*12.36*
Mín	*2.80*	*2.40*	*2.35*	*2.20*	*2.53*	*2.57*	*2.75*	*2.88*	*3.29*	*3.50*	*3.26*	*2.31*	*2.43*	*2.82*
Average	*4.24*	*4.24*	*4.03*	*3.89*	*4.17*	*4.27*	*4.43*	*4.88*	*4.97*	*5.27*	*5.25*	*4.45*	*4.53*	*4.87*
Coef variation	*40.55*	*47.32*	*42.66*	*49.29*	*49.58*	*46.18*	*46.76*	*36.48*	*51.56*	*48.64*	*49.75*	*48.44*	*53.07*	*50.33*

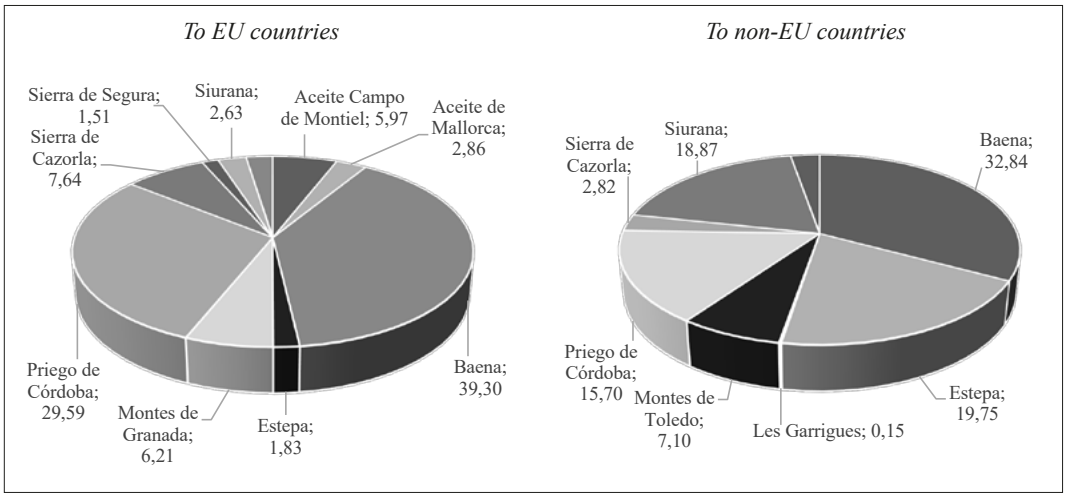
Source: MAPA (2023b).

37.22% of the total in 2021, followed by the PDO Montes de Toledo (13.14%) and Sierra Mágina (9.27%). A second group, with a percentage of the total between 3% and 8%, includes A. Montiel, Estepa, Les Garrigues, Priego de Córdoba, Sierra de Cazorla, Sierra de Segura and Siruana. The rest register a production in 2021 of less than 1,700 tons. Secondly, there are contrasting trends: some PDOs increase their weight in the total national of volume of certified EVOO, including A. Campo de Montiel, Baena and Montes de Toledo, Priego de Córdoba and Sierra de Segura; conversely, in many other cases the share of the certified volume in 2021 is lower than in 2008. This is the case in A. Campo de Calatrava, A. de Navarra, A. de Terra Alota, Montes de Granada, Sierra de Cádiz and Sierra Mágina.

Table 4 presents the average value per kg of AOVE-DOP paid at origin in Spain between 2008 and 2021 across the 22 PDOs analysed. The data first confirm the overall upward trend of the variable, reaching an average value of €4.24/kg in 2008 and €4.87 at the end of the period. However, the increase varies significantly across different cases, and in seven instances (A. De Campo de Calatrava, A. de Navarra, A. del Bajo Aragón, Estepa, Les Garrigues, Montro-Adamuz, Poniente de Granada), the price of AOVE-DOP in 2008 was higher than in 2021. In contrast, A. de La Alcarria, A. del Baix Ebre-Montsià, Mones de Toledo, Priego de Córdoba, and Sierra Mágina show increases of over 20% in the value of the variable between 2008 and 2021. Secondly, the significant dispersion in the average prices paid at origin is again evident, with significant differences depending on the geographical location of the production area and the conditions that influence both the supply and demand of the product in the local market, as will be discussed in the next section. A. de Mallorca is, by far, the PDO with the highest values in every year analysed, reaching a peak of €15.90/kg in 2017, compared to a low of €10.41/kg in 2010, with its value in 2021 being €11.04/kg. In contrast, Estepa and Montes de Granada did not exceed €3/kg in 2021, with values of €2.90/kg and €2.82/kg, respectively. This situation raises concerns about the business's viability, as according to Parras *et al.* (2023), the estimated average production and packaging cost for the 2020/21 season was €3.38/kg.

Figure 3 shows the distribution of Spanish PDO EVOO exports among the different PDOs considered, both to the EU and to countries outside the EU in 2021. Although Baena, with a high volume of production, accounts for almost 40% of total exports to the EU and 32.84% of exports to countries outside the EU, the large share corresponding to Priego de Córdoba is

Figure 3 - Distribution of PDO EVOO exports among the different PDOs in Spain in 2021.



Source: Own elaboration based on MAPA (2023b).

striking, both in sales to the EU and to non-EU countries. Also significant is the prominence of Siruana in sales of PDO EVOO to countries outside the EU, and, on the contrary, the minimal presence of Sierra Mágina in total exports, with this PDO being the source of just 9.27% of the total certified production in Spain in 2021.

4.2. *Panel data*

Table 5 shows the results of the estimations, using the feasible generalized least squares model (FGLS). The model is estimated using data from 22 entities, with a total of 308 observations, for the period 2008 to 2021. The optimum model is chosen by testing a number of econometric models to identify the best one:

a) *Pooled data estimation, Random Effects (RE) and Fixed Effects (FE) models*. First, the model is estimated with pooled data, comparing it with the RE model. To know whether to use the RE model or the clustered data model, Breusch and Pagan formulated the test known as the Lagrange Multiplier Test for RE. The null hypothesis of this test is that the variance is equal to zero. If the test is rejected, there is a difference between the model estimated with pooled data and the RE model, and it is preferable to use the RE method. As can be seen in Table 5, the p-value indicates that the null hypothesis can be rejected; therefore, the RE are relevant, and it is preferable to use the RE estimation rather than the pooled estimation. The same applies when using the FE model. The F test for the significance of the FE is used to assess whether this model or the pooled model is preferable. The p-value indicates that we can reject the null hypothesis, making the FE method more preferable than the pooled model.

b) *FE vs. RE model*. The FE model is another way to model the "individual" nature of each state. This model does not assume that the differences between states are random, but rather constant or "fixed." Once estimated, the Hausman test is used to choose between the FE model and the RE model. The null hypothesis of the Hausman test is that the RE and FE estimators do not differ significantly. If the null hypothesis is rejected, the estimators do differ, and the conclusion is that FE are more appropriate than RE. In this case, as Table 5 shows, the null hypothesis is not rejected; therefore, it is preferable to use the RE method.

c) *Detection of problems in the model*. Once the RE model has been chosen, it is necessary to check for the existence of autocorrelation, heteroscedasticity and contemporaneous correlation problems to correct them if their existence is confirmed. To control autocorrelation or first-order serial correlation we need to apply the Wooldridge test, for groupwise heteroscedasticity the modified Wald test has been used and the Breusch-Pagan test for cross-sectional independence (for contemporaneous heteroscedasticity). The null hypothesis of this tests is that these problems do not exist. Table 5 shows the absence of autocorrelation (Wooldridge test) and heteroscedasticity (Wald test). However, the Breusch-Pagan test for cross-sectional independence shows that the correlation matrix of residuals is singular, meaning it is not possible to use this test. In this case, the Pesaran's test for cross-sectional independence has been used, as it is a valid alternative, robust, and can be used to assess autocorrelation in panel data models, especially when the model has a complex structure that could lead to issues in estimating the residual correlation matrix. Table 5 indicates that it is necessary to correct the contemporaneous correlation.

d) *FGLS: preferred model*. The detected problems can be solved jointly with Feasible Generalized Least Squares (FGLS) estimators, or with Panel Corrected Standard Errors (PCSE). To solve the contemporaneous correlation in this case, the FGLS model is applied, since it is the recommended option for RE (Andreß *et al.*, 2013).

The variables capturing age, exports to non-EU countries and oleoturism are all significant at 5%. The variable certified production is also significant at 5%, showing a negative relationship with the average price paid at origin per kg of PDO EVOO. All of them confirm the expected relationship.

Table 5 - Panel data estimates.

PDO-EVOOvalue	*FGLS*		
	Coef.	*Z*	*P-value*
Age	0.04	3.21	0.001
Exports-EU	- 0.03	-1.83	0.068
Exports-nonEU	0.16	9.29	0.000
Olive-oil-tourism	0.98	2.25	0.024
Certified-prod	- 0.01	-4.42	0.000
Olive-oil-trading-comp	- 0.01	-0.58	0.564
Constant	3.53	25.42	0.000
Observations	308		
N. of entities	22		
Breusch and Pagan Lagrangian multiplier test for RE	$Chi^2(1) = 1102.25$ $Prob > chi^2 = 0.0000$		
F test for FE	F(4,282) = 13.08 Prob > F = 0.0000		
Hausman test	$Chi^2(4) = (b-B)'[(V\_b-V\_B)^{(-1)}](b-B) = 3.17$ $Prob>chi^2 = 0.53$		
Wooldridge test	F(1, 21) = 74.341 Prob > F = 0.0000		
Wald test	Wald chi^2 (22) = 5060.97 $Prob>chi^2 = 0.00$		
Pesaran's test	5.445, Pr = 0.0000		

Source: Own elaboration.

- The variables age and certified production both present a strong and significant relationship with the dependent variable, supporting hypotheses 1 and 5.
- Exports to non-EU countries and oleotourism have a direct impact on the average price paid for PDO EVOO. Hypotheses 3 and 4 are thus confirmed.
- Finally, there are two variables with a non-significant relationship with the dependent variable, which are exports to EU countries and number of olive oil trading companies, meaning that hypotheses 2 and 6 are not supported.

5. Discussion

The quality policy for agricultural products and foodstuffs in the EU, established in Regulation (EU) No 1151/2012, which regulates the PDO regime, aims to highlight the attributes of these products as a result of the agricultural techniques used, processing methods or place of origin (Mutersbaugh *et al.*, 2005; Moschini *et al.*, 2008). This differentiated quality should contribute to the producers receiving a higher price at origin for their harvest (Poetschki *et al.*, 2021). Spain, the world's leading producer of olive oil, had 29 PDOs in this sector in 2021, 22 of which have been continuously developing their production and commercial activity since 2008. In this country, the average paid at origin for PDO EVOO presents important differences depending on the origin of this foodstuff (García-Moral *et al.*, 2023). This paper studies the variables that may influence this situation.

The analysis supports hypotheses 1, 3, 4 and 5. On the contrary, hypothesis 2, on exports to the EU, and hypothesis 6, referring to the number of olive oil trading companies registered in the PDO RC are not supported, because these variables are not found to have a significant influence. The

development of oleotourism activities in the production area helps to improve visitors' familiarity with the product. This means that tourists—from other regions in Spain or other countries—are well aware of the specific characteristics of the product, learn to value them (Folgado-Fernández *et al.*, 2019) and are willing to pay a higher price, which in turn has a positive impact on the average price at origin. These results coincide with the arguments made by Marcoz *et al.* (2016) for the case of Fontina cheese. Additionally, oleotourism helps to diversify the activity of olive oil mills and improve their total income (Arjona-Fuentes and Amador-Hidalgo, 2017).

The age of the PDO, and therefore its history, contributes to the dissemination of knowledge about the differentiating features of the food and, specifically, among those consumers interested in buying the product, this knowledge makes them more willing to pay a higher price, as concluded by Van Ittersum *et al.* (2007), Van Zyl *et al.* (2013) and Albayram *et al.* (2014). Likewise, the fact that part of the PDO-certified production is destined for markets outside the EU contributes positively to the price at origin. Countries outside the EU that receive Spanish exports of PDO EVOO include economies with a high per capita income, such as the USA, Japan, Switzerland, South Korea and Canada (Menapace *et al.*, 2011) and also other high middle-income countries such as China, Brazil and Mexico, where there is a growing demand for this food, largely justified by the health benefits it offers (Mili and Bouhaddane, 2021). The positive relationship identified between exporting PDO EVOO to non-EU countries and the average price paid at origin aligns with the research results of Raimondi *et al.* (2020).

The fact that the variable "export to the EU" is not significant may be due to three different situations or realities that, together, determine a limited role of demand in EU partner countries and, simultaneously, the lack of influence of this component on the value at origin of the product. On the one hand, in countries with a long tradition of producing PDO EVOO—such as Italy and Greece—consumers may prefer the local product to the one imported from Spain (Aprile *et al.*, 2012; Perito *et al.*, 2019), negatively influencing the price they are willing to pay for the foreign product, which has an impact on the price of Spanish PDO EVOO at origin. On the other hand, in non-producing EU countries or those with low levels of olive oil production—such as Germany, the United Kingdom or France—Italian olive oil is more prevalent (Tasdogan, 2005; Pomarici and Vecchio, 2013; Ali *et al*., 2018), which can negatively influence the degree of knowledge, appreciation and willingness to pay for the Spanish PDO EVOO. Lastly, it is worth taking into account the lower tradition of PDO food consumption in in Northern and Eastern European countries (Krystallis *et al.*, 2017; Kos Skubic *et al.*, 2018), which negatively influences the import of these types of products (Sorgho and Larue, 2014).

Contrary to the arguments put forward by Bonnet & Bouamra-Mechemache (2016) and Orsini *et al.* (2020) for organic food producers, in the Spanish olive oil agroindustry with PDO labels, there is no confirmation of greater market power by the olive mills (producers) over the retail entities that only commercialize the product, which would positively influence the price perceived by producers at origin. The diversity of situations across the PDOs in the sector helps to explain these results. In some cases, the majority of the product is distributed and sold directly by the producers or an entity they are associated with, with no companies solely dedicated to bottling and commercializing the product. This is the case for A. Campo de Calatrava, A. Campo de Montiel, A. de la Alcarria, Sierra de Segura, or Estepa. In the latter case, there are 17 olive mills registered in the PDO, with 2 companies responsible for commercializing the entire product, both domestically and internationally. In contrast, the PDO Baena, the largest in national production, has 19 registered factories and more than thirty bottling and marketing companies. However, further research in this area is warranted.

Among the 22 Spanish PDOs of AOVE that form the basis of this research, there are significant differences, including in their size, registered olive grove area, number of registered agricultural, industrial, and commercial producers, production volume, market diversity in which their offer is commercialized, and the age

of the PDO. However, the analysis developed in the preceding pages allows us to affirm that certain variables, both on the demand side and the supply side, condition the price paid at origin for AOVE certified by a PDO in Spanish territory. On the demand side, this includes the consumer's knowledge of the product, which is enhanced by the PDO's temporal history and the presence of olive tourism activities in the production area. On the supply side, the commercial activity carried out by PDO operators in distant markets outside the EU has a favourable influence, while the production volume has a negative effect on the product's price at origin.

6. Conclusions

In Spain the price paid per kg of PDO EVOO shows wide dispersion, with variations ranging in 2021 from 12.36 €/kg in the PDO Priego de Córdoba to 2.90 €/kg. for the EVOO from the PDO Estepa. Based on the data provided by MAPA, the information from the RCs of the PDOs and using panel data analysis, this study aims to identify the variables that influence the price. The results obtained allow to conclude that the price paid at origin for this foodstuff is positively influenced by oleotourism in the producing areas, which promotes familiarity with and knowledge of the certified product; the ongoing tradition of the PDO, maintained year after year through a strict control procedure for which the RC is responsible; and the sale of PDO-certified EVOO outside the EU. On the other hand, exports to EU markets, which are closer but more competitive and where the Italian product is the most sought-after and increases in the volume of production in the PDO do not lead to higher prices at origin.

Several economic implications can be drawn from the results. First of all, the production efforts needed to achieve a certified quality food must be accompanied by a clear promotion and marketing strategy from the place of origin. It is only consumers' familiarity with the product that will build their trust, set the product apart from others, and make them willing to pay a premium price, which will influence the price paid at origin. Secondly, it is advisable to take advantage of promotion linked to oleotourism. To this end, it is essential to collaborate with local companies that run this type of activity and even to implement actions in this field from RCs. Finally, it is a priority to direct part of the production towards markets outside EU, where the demand for EVOO is growing, offering an opportunity to take advantage of this dynamic market.

The main limitation of this study is that it uses data aggregated by PDO, which are published each year by the MAPA in collaboration with the RCs. The information gathered has allowed an analysis of the sector as a whole, although it does not consider particular aspects of the different PDOs, which should be dealt with in further research. In this respect, future research on the determinants of the price paid at origin for PDO EVOO should seek to exploit microdata obtained from entities certified by a PDO. An analysis in this direction could complement the understanding of the mechanisms governing the price paid at origin for products of differentiated quality. Despite this limitation, this study contributes to the knowledge on the PDO-certified olive oil sector in the world's leading supplier of this foodstuff.

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References

Agostino M.R., Trivieri F., 2016. European wines exports towards emerging markets. The role of geographical identity. *Journal of Industry, Competition and Trade*, 16: 233-256.

Alamanos E., Kuznesof S., Ritson C., 2016. The influence of holidays on wine purchasing behaviour: Marketing and tourism insights based on a holiday experience in Greece. *International Journal of Tourism Research*, 18(3): 228-235.

Albayram Z., Mattas K., Tsakiridou E., 2014. Purchasing local and non-local products labeled with geographical indications (GIs). *Oper. Res.*, 14: 237-251.

Altomonte C., Colantone I., Pennings E., 2016. Heterogeneous firms and asymmetric product differentiation. *The Journal of Industrial Economics*, 64(4): 835-874.

AND-International, 2012a. *Study on Economic Value of EU Quality Schemes, Geographical Indications (GIs) and Traditional Specialities Guaranteed (TSGs)*. AND-International.

AND-International, 2012b. *Value of Production of Agricultural Products and Foodstuffs, Wines, Aromatised Wines and Spirits Protected by a Geographical Indication (GI)*. AND-International.

Andreß H., Golsch K., Schmidt A.W., 2013. *Applied panel data analysis for economic and social surveys*. Cham: Springer Science & Business Media.

Aprile M.C., Caputo V., Nayga R.M. Jr., 2012. Consumers' valuation of food quality labels: the case of the European geographic indication and organic farming labels. *International Journal of Consumer Studies*, 36(2): 158-165.

Arfaoui F., Cohen M., Oudin L., Ronchail J., 2021. Évolution, modélisation et cartographie des rendements de l'oliveraie dans la province de Jaen en Espagne (1959-2018). *Climatologie*, 18(4).

Aytop Y., Çankaya D., 2022. Do Consumers Intend to Purchase the Food with Geographical Indication? *New Medit*, 21(4): 41-50.

Baltagi B.H., 2005. *Econometric analysis of panel data*. New York: John Wiley & Sons.

Besky S., 2014. The labor of terroir and the terroir of labor: Geographical indication and Darjeeling tea plantations. *Agriculture and Human Values*, 31: 83-96.

Bingen J., 2012. Labels of origin for food, the new economy and opportunities for rural development in the US. *Agriculture and Human Values*, 29: 543-552.

Bonanno A., Sekine K., Feuer H.N., 2020. *Geographical indication and global agri-food: Development and democratization.* Milton Park: Taylor & Francis.

Bonnet C., Bouamra-Mechemache Z., 2016. Organic label, bargaining power, and profit-sharing in the French fluid milk market. *American Journal of Agricultural Economics*, 98(1): 113-133.

Bowen S., 2010. Embedding local places in global spaces: Geographical indications as a territorial development strategy. *Rural Sociology*, 75(2): 209-243.

Bowen S., Mutersbaugh. T., 2014. Local or localized? Exploring the contributions of Franco-Mediterranean agrifood theory to alternative food research. *Agriculture and Human Values*, 31: 201-213.

Bull W.E., 1936. The olive industry of Spain. *Economic Geography*, 12(2): 136-154.

Caporale G., Policastro S., Carlucci A., Monteleone E., 2006. Consumer expectations for sensory properties in virgin olive oils. *Food Qual Prefer*, 17(1-2): 116-125.

Cei L., Stefani G., Defrancesco E., Lombardi G.V., 2018. Geographical indications: A first assessment of the impact on rural development in Italian NUTS3 regions. *Land Use Policy*, 75: 620-630.

Chilla T., Fink B., Balling R., Reitmeier S., Schober K., 2020. The EU food label 'Protected Geographical Indication': economic implications and their spatial dimension. *Sustainability*, 12(14): 5503.

Ciani S., Mason M.C., Moretti A., 2019. Geographical indications and tourism destinations: An overview. *The Routledge Handbook of Gastronomic Tourism*, 527-537.

Conley J., Wilson B., 2020. Coffee terroir: Cupping description profiles and their impact upon prices in Central American coffees. *GeoJournal*, 85: 67-79.

Consejo Económico y Social de España, 2018. *El medio rural y su vertebración social y territorial.* http://www.ces.es/documents/10180/5182488/Inf0118.pdf/6d616668-0cb8-f58c-075b-2251f-05dad9f (accessed on June, 2023).

Crescenzi R., De Filippis F., Giua M., Vaquero-Piñeiro C., 2022. Geographical Indications and local development: the strength of territorial embeddedness. *Regional Studies*, 56(3): 381-393.

De Filippis F., Giua M., Salvatici L., Vaquero-Piñeiro C., 2022. The international trade impacts of Geographical Indications: Hype or hope? *Food Policy*, 112: 102371.

Duvaleix S., Emlinger C., Gaigné C., Latouche K., 2021. Geographical indications and trade: Firm-level evidence from the French cheese industry. *Food Policy*, 102: 102118.

Egea P., Pérez y Pérez L., 2016. Sustainability and multifunctionality of protected designations of origin of olive oil in Spain. *Land Use Policy*, 58: 264-275.

Emmanouilides C., Fousekis P., Grigoriadis V., 2014. Price dependence in the principal EU olive oil markets. *Spanish Journal of Agricultural Research*, 12(1): 3-14.

Erraach Y., Sayadi S., Gomez A.C., Parra-Lopez C., 2014. Consumer-stated preferences towards Protected Designation of Origin (PDO) labels in a traditional olive-oil-producing country: The case of Spain. *New Medit*, 13(4): 11-19.

Espejel J., Fandos C., Flavián C., 2008. The influence of consumer degree of knowledge on consumer

behavior: the case of Spanish olive oil. *Journal of Food Products Marketing*, 15(1): 15-37.

Folgado-Fernández J.A., Campón-Cerro A.M., Hernández-Mogollón J.M., 2019. Potential of olive oil tourism in promoting local quality food products: A case study of the region of Extremadura, Spain. *Heliyon*, 5(10).

Gade D.W., 2004. Tradition, territory, and terroir in French viniculture: Cassis, France, and Appellation Contrôlée. *Annals of the Association of American Geographers*, 94(4): 848-867.

Galati A., Crescimanno M., Abbruzzo A., Chironi S., Tinervia S., 2017. The premium price for Italian red wines in new world wine consuming countries: the case of the Russian market. *Journal of Wine Research*, 28(3): 181-193.

Gallego-Valero L., Moral-Pajares E., Román-Sánchez I.M., 2018. The tax burden on wastewater and the protection of water ecosystems in EU countries. *Sustainability*, 10: 212.

García-Moral A., Moral-Pajares E., Gallego-Valero L., 2023. The Spanish Olive Oil with Quality Differentiated by a Protected Designation of Origin. *Agriculture*, 13(11): 2169.

Gutiérrez-Salcedo M., Murgado-Armenteros E.M., Torres-Ruiz F.J., 2016. La influencia de la calidad en el precio de los aceites de oliva en origen. *Revista de Estudios Regionales*, 107: 157-175.

Hadelan L., Rogelj M.J., Mikuš O., Zrakić Sušac M., 2021. Food geographical indication in enhancing agricultural and tourism performance. *Sci. Pap. Ser. Manag. Econ. Eng. Agric. Rural. Dev.*, 21: 361-369.

Kalogeropoulos N., Tsimidou M.Z., 2014. Antioxidants in Greek virgin olive oils. *Antioxidants*, 3(2): 387-413.

Kizos T., Vakoufaris H., 2011. Valorisation of a local asset: The case of olive oil on Lesvos Island, Greece. *Food Policy*, 36(5): 705-714.

Kos Skubic M., Erjavec K., Klopčič M., 2018. Consumer preferences regarding national and EU quality labels for cheese, ham and honey: The case of Slovenia. *British Food Journal*, 120(3): 650-664.

Krystallis A., Chrysochou P., Perrea T., Tzagarakis N., 2017. A retrospective view on designation of origin labeled foods in Europe. *Journal of International Food & Agribusiness Marketing*, 29(3): 217-233.

Lubinga M.H., Ngqangweni S., Van der Walt S., Potelwa Y., Nyhodo B., Phaleng L., Ntshangase T., 2020. Geographical indications in the wine industry: does it matter for South Africa*? International Journal of Wine Business Research*, 33(1): 47-59.

MAPA, 2023a. *Anuario de Estadísticas*. https://www.mapa.gob.es/es/estadistica/temas/publicaciones/anuario-de estadistica/default.aspx (accessed on June, 2023).

MAPA, 2023b. *Datos de las Denominaciones de Origen Protegidas (D.O.P.), Indicaciones Geográficas Protegidas (I.G.P.) y Especialidades Tradicionales Garantizadas (E.T.G.) de Productos Agroalimentarios.* https://www.mapa.gob.es/es/alimentacion/temas/calidad-diferenciada/ (accessed on June, 2023).

Marcoz E.M., Melewar T.C., Dennis C., 2016. The value of region of origin, producer and protected designation of origin label for visitors and locals: the case of fontina cheese in Italy. *International Journal of Tourism Research*, 18(3): 236-250.

Mariani M., Cerdan C., Peri I., 2022. Cultural biodiversity unpacked, separating discourse from practice. *Agriculture and Human Values*, 39(2): 773-789.

Menapace L., Colson G., Grebitus C., Facendola M., 2011. Consumers' preferences for geographical origin labels: evidence from the Canadian olive oil market. *European Review of Agricultural Economics*, 38(2): 193-212.

Mili S., Bouhaddane M., 2021. Forecasting Global Developments and Challenges in Olive Oil Supply and Demand: A Delphi Survey from Spain. *Agriculture*, 11(3): 191.

Morillas Del Moral J.A., García-Quero F., 2022. Valorization of food products in a knowledge-based economy: analysis of the PDO "Sierra Mágina" olive oil cooperatives. *Food, Culture & Society*: 1-19.

Moschini G., Menapace L., Pick D., 2008. Geographical indications and the competitive provision of quality in agricultural markets. *American Journal of Agricultural Economics*, 90(3): 794-812.

Mozas-Moral A., 2020. *El Sector Oleícola y el Papel Protagonista del Cooperativismo Como Agente de Cambio*, Instituto de Estudios Giennenses. Valencia: CIRIEC-España.

Mutersbaugh T., Klooster D., Renard M.C., Taylor P., 2005. Certifying rural spaces: quality-certified products and rural governance. *Journal of Rural Studies*, 21(4): 381-388.

Neilson J., Wright J., Aklimawati L., 2018. Geographical indications and value capture in the Indonesia coffee sector. *Journal of Rural Studies*, 59: 35-48.

Nizam D., 2017. Place, food, and agriculture: the use of geographical indications in olive oil production in western Turkey. *New Perspectives on Turkey*, 57: 3-30.

Orsini S., Padel S., Gambelli D., Lernoud J., Sanders J., Solfanelli F., Stolze M., Willer H., Zanoli R., 2020. Beyond "mainstream" and "alternative" in organic food supply chains: Empirical examples of

added value distribution from eight European countries. *British Food Journal*, 122(3): 798-812.

Panagiotou D., Stavrakoudis A., 2023. Price dependence among the major EU extra virgin olive oil markets: a time scale analysis. *Review of Agricultural, Food and Environmental Studies*, 104(1): 1-26.

Parras-Rosa M., Bernal-Jurado E., Colombo S., Gutiérrez-Salcedo M., Mozas-Moral A., Murgado--Armenteros E.M., Torres-Ruiz F.J., Ruz-Carmona A., Vega-Zamora M., 2023. *Cadena de valor del aceite de oliva virgen extra. Campaña 2020-2021*. Ministerio de Agricultura, Pesca y Alimentación. https://www.mapa.gob.es/va/alimentacion/temas/observatorio-cadena/estudiodelacadenadevalor-2020-2021mapadefinitivo_tcm39-650710.pdf. (accessed on June, 2023).

Perito M.A., Sacchetti G., Di Mattia C.D., Chiodo E., Pittia P., Saguy I.S., Cohen E., 2019. Buy local! Familiarity and preferences for extra virgin olive oil of Italian consumers. *Journal of Food Products Marketing*, 25(4): 462-477.

Poetschki K., Peerlings J., Dries L., 2021. The impact of geographical indications on farm incomes in the EU olives and wine sector. *British Food Journal*, 123(13): 579-598.

Pomarici E., Vecchio R. 2013. The Italian olive oil industry in the global competitive scenario. *Agricultural Economics*, 59(8): 361-372.

Pulido-Fernández J.I., Casado-Montilla J., Carrillo--Hidalgo I. Pulido-Fernández M.C., 2022. Evaluating olive oil tourism experiences based on the segmentation of demand. *International Journal of Gastronomy and Food Science*, 27: 100461.

Raimondi V., Falco C., Curzi D., Olper A., 2020. Trade effects of geographical indication policy: The EU case. *Journal of Agricultural Economics*, 71(2): 330-356.

Resano H., Sanjuán A.I., Albisu L.M., 2012. Consumers' response to the EU Quality policy allowing for heterogeneous preferences. *Food Policy*, 37(4): 355-365.

Rodrigo-Comino J., Senciales-González J., Yu Y., Salvati L., Giménez-Morera A., Cerdà A., 2021. Long-term changes in rainfed olive production, rainfall and farmer's income in Bailén (Jaén, Spain). *Euro-Mediterranean Journal for Environmental Integration*, 6(2): 58.

Sgroi F., Modica F., 2022. Localized agri-food systems: the case of Pecorino Siciliano PDO a food product of the tradition of Mediterranean gastronomy. *International Journal of Gastronomy and Food Science*, 27: 100471.

Sorgho Z., Larue B., 2014. Geographical indication regulation and intra-trade in the European Union. *Agricultural Economics*, 45(S1): 1-12.

Tasdogan C., 2005. Country market power in EU olive oil trade. *South-Eastern Europe Journal of Economics*, 3(2): 211-219.

Teil G., 2017. Protecting appellations of origin: one hundred years of efforts and debates. In: Van Caenegem W., Cleary J. (eds), *The importance of place: geographical indications as a tool for local and regional development*. Cham: Springer, pp. 147-171.

Tempesta T., Vecchiato D., 2019. Analysis of the factors that influence olive oil demand in the Veneto Region (Italy). *Agriculture*, 9(7): 154.

Toma P., Manta F., Morrone D., Campobasso F., 2023. Familiar worldwide: how PDO products reflect quality in consumers' appraisal and behaviour. *The TQM Journal*, 35(2): 470-491.

Van Ittersum K., Meulenberg M., Van Trijp H., Candel M., 2007. Consumers' appreciation of regional certification labels: a Pan-European study. *J Agric Econ*, 58(1): 1-23.

Van Zyl K., Vermeulen H., Kirsten J.F., 2013. Determining South African consumers' willingness to pay for certified Karoo lamb: An application of an experimental auction. *Agrekon*, 52(4): 1-20.

WIPO, 2021. *Geographical Indications*. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_952_2021.pdf (accessed on June, 2023).

Zhang W., Saghaian S., Reed M., 2023. Investigation of export-driving forces and trade potentials of the US bourbon whisky industry. *Applied Economics*, 1-21.

Zinsli M.J., 2023. Authorizing the 'taste of place' for Galápagos Islands coffee: scientific knowledge, development politics, and power in geographical indication implementation. *Agriculture and Human Values*, 40(2): 581-597.