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Factors affecting competition in olive oil exports: Panel data analysis of selected countries. Case study

Ferhat Pehlivanoğlu[1], Cemil Erarslan[2], Sedanur Demir[1]*

[1]Department of Economics, Faculty of Economics and Administrative Sciences, Kocaeli University, Kocaeli, Turkey
[2]Department of Economics, Faculty of Economics and Administrative Sciences, Yalova University, Yalova, Turkey

**Corresponding author: fpehlivanoglu@kocaeli.edu.tr*

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Abstract: Recently, the growing interest in healthy and organic nutrition has led to an increase in both the consumption and production of olive oil. The fact that olive and olive oil production is mostly concentrated in the countries with a coastline on the Mediterranean has rendered their olive oil exports important in meeting the increasing demand for olive oil. For the exporting countries, this has raised the issues of having a large share in the international olive oil market and increasing their competitiveness. The importance of increasing competitiveness, especially for countries that generate income from agricultural production, is the driving force for conducting this study. The aim of the study was to determine the factors affecting the comparative advantages of the leading olive oil-exporting countries. In this context, the olive oil production, consumption and unit export prices of Turkey, Spain, Italy, Portugal, Greece and Tunisia for the 2000–2019 period were tested with a panel data analysis method to ascertain whether these variables have any significant effect on the revealed comparative advantage (RCA) index. According to the findings, olive oil production affects the RCA index positively, whereas olive oil consumption affects it negatively in a statistically significant way.

Keywords: agricultural economics; international food sector; random effects model; revealed comparative advantage (RCA) index

Olives and olive oil provide important nutrients demanded by people who want to eat healthily and thus improve their quality of life because of these products' health benefits. Recently, the increasing interest in healthy and organic nutrition has led to an increase in both the consumption and the production of olive oil, which has been used for centuries. Olive oil production reached 3.38 million t in the 2017/18 crop year and has tripled during the period from the 1950s to the present (IOC 2019).

Because olives and olive oil are mostly produced in the countries with a coastline on the Mediterranean Sea, they are among the important foodstuffs of the people living in these regions, and these products are also of economic importance because they provide these people with income. In addition, it is very important for the economic development of the producer countries, especially the developing countries where agricultural production is intensive, to export the olive oil they produce. The leading olive oil-producing countries are Spain, Italy, Greece, Tunisia, Turkey and Portugal (IOC 2019).

The average olive oil production over the last 5 years (2014–2019 crop year) is 2.96 million t (IOC 2019). Considering the average of the last 5 years, Spain accounts for 45% of total olive oil production, followed by Italy with 10% and Greece with 9%. Tunisia, which ranks fourth among the most producing countries in the world according to the average for the last 5 years, has a share of 7% within total production,

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and Turkey, which ranks fifth, has a share of 6% (IOC 2019). The fact that olive oil production is regional and its trade is global, and that the European Union (EU) is both the largest producer and the largest consumer, and the fact that some major exporters are also among the major importers shows that the olive oil market has a complex structure. In addition, the small scale of olive oil-producing companies, the cost of olive oil production and the need for quality standardisation reduce the international competitiveness of the companies (Pomarici and Vecchio 2013; Klonaris and Agiangkatzoglou 2017).

Olive oil is important for Mediterranean countries because of the large income and share of exports it provides. Those that gain international competitiveness among the leading countries in olive oil production ensure that their export revenues increase, which affects their economies positively. The more important it is to have a comparative advantage in the export of a product, the more important it is to determine the factors affecting that advantage in order to direct policy. Therefore, in this study, we aimed to identify the factors affecting the revealed comparative advantage (RCA) index in olive oil exports and to determine the magnitude of those effects.

Literature. Several academic studies were conducted to measure the market power in the international olive oil industry, to determine the determinants of olive oil exports and to perform competition analyses of the producing countries. In this section, we list some of these studies in chronological order.

Ramon Muñoz (2010) investigated the process of entry into the American market by Mediterranean exporters of packaged olive oil in the 1880s and 1930s, along with its determinants. The results of the analysis showed that product differentiation was a statistically significant variable in explaining the concentration levels of companies and, thus, barriers to entry. The results also indicated that the companies that had entered the market early gained significant advantages in the international olive oil market.

Mane-Kapaj et al. (2010) used the policy analysis matrix method to measure the comparative advantage of olive oil production in Albania, and they conducted two different surveys, one for the producers and the other for the processors, for the 2005–2006 production year. The results of the analyses showed that olive oil production was profitable for the farmer/producer; however, Albania did not have a comparative advantage in the olive oil production industry for the period examined. Furthermore, olive and olive oil prices and the amount of olive oil production were indicated as important factors for profitability.

Türkekul et al. (2010) conducted their study to determine the competitiveness of Turkey, Spain, Italy, Greece and Tunisia in the US, Australia, Canada, Brazil and Japan olive oil markets in the periods from 2000 to 2004 and from 2005 to 2008. They used the constant market share analysis. The results indicated that Tunisia was the most competitive country; however, the competitiveness of all the discussed countries decreased during the periods studied. At the end of the study, the results showed that ensuring permanent and sustainable competitiveness in the international market depended on production, organisation and trade policies.

Kavallari et al. (2011) used the gravity model to analyse the factors determining the olive oil demand of the non-olive oil-producing countries of Germany and the United Kingdom (UK). The results of the analysis showed that Germany and the UK had the most significant effects on olive oil import demand because they are Mediterranean partner countries. Furthermore, the exporters with greater economies had a higher export potential.

In their study for the Italian olive oil industry, Pomarici and Vecchio (2013) associated the difficulties of the Italian industry in competing in the global market with the Spanish industry, which provides stagnant demand and strong competition. Nevertheless, they emphasised that the companies were small scale in olive oil production (both at the agricultural and processing levels), the olive farms in hilly regions were unable to meet rising costs, and the increasing market power of retail chains reduced the global competitiveness of the Italian olive oil industry.

Klonaris and Agiangkatzoglou (2017) performed a two-stage analysis in which they calculated the RCA index and estimated the import demand to analyse the competitiveness of Greek extra virgin olive oil in the Italian, German, UK and US markets. According to the results, the competitive advantage of Greek extra virgin olive oil in the German market was clear; however, it was not clearly visible in other markets. Their results also indicated that structural problems such as high production costs and small farms, and difficulties in quality control standardisation, reduced the competition of Greek extra virgin olive oil in the Italian market.

Kashiwagi et al. (2020) used panel data with the gravity model to analyse the increasing olive oil exports and intra-industry trade in Mediterranean countries for the period from 1998 to 2016. The results of the analysis supported the view that an increase in country size

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positively affected the olive oil trade. Furthermore, the investigators concluded that the difference in factor endowment negatively affected olive oil exports and positively affected olive oil imports. Simultaneous increases in both import and export volumes indicated the existence of a growing intra-industry trade in Mediterranean countries.

To examine the effect of the source country on the preference structure of olive oil importers, Chamorro-Mera et al. (2020) studied non-producing countries with different cultural structures (i.e. the US, Germany and Mexico) as importing countries. As a result of the survey study conducted with 31 olive oil importing companies, the investigators determined that the effect of the source country in the preference structure was very significant, followed by the olive oil price.

In their study, Gambella et al. (2021) examined the spatial transformation of olive trees in Italy because of climate changes and concluded that olive cultivation areas increased in northern Italy and decreased in central and southern Italy because of land abandonment. The investigators determined that poor land management led to permanent climate changes and thus the changes in land use affecting the vegetation and land quality.

MATERIAL AND METHODS

Purpose and method of research. In our review of the literature, we observed that empirical studies of the international olive oil market were conducted by using different analysis methods (RCA index, policy analysis matrix, constant market share and gravity model). In this study, we aimed to determine the factors affecting the comparative advantages of the countries with a significant share in olive oil exports, so we performed a panel data analysis. Abolagba et al. (2010), who investigated the factors affecting the export of agricultural products, determined that production (positive effect), consumption (negative effect) and producer prices (positive effect) had significant effects on exports. Türkekul et al. (2010) emphasised that supply and demand conditions led to a competitive environment in the international market. From this point of view, the factors affecting exports are also expected to affect the RCA index, which is used to measure international competition. Therefore, the main hypotheses of the study were as follows:

H_1: Olive oil production affects the RCA index for olive oil.

H_2: Olive oil consumption affects the RCA index for olive oil.

H_3: Olive oil export unit price affects the RCA index for olive oil.

In terms of a specific product, the discovery of new natural resources, the technological innovations and the governmental policies implemented may change the international competitiveness of countries over time. In addition to these factors, the factors determining the domestic and foreign demand for a product, the changes in export prices and the developments regarding production may also affect the international competitiveness of this product. For this reason, the aim of this study was to analyse the factors that are considered to affect the international competitiveness of a country in olive oil exports and to find the coefficients of this effect. Thus, the results of the study should be able to direct the agricultural policies to be implemented to improve international competitiveness according to the magnitude and importance of the variables discussed.

Data set of research. In this study, we used the annual data of Turkey, Spain, Italy, Portugal, Greece and Tunisia, which are among the leading countries in olive oil production, for the period from 2000 to 2019. The variables used in the model are the RCA index, the olive oil production and consumption values and the olive oil export unit prices (Table 1). The RCA index was the dependent variable, and the other variables were used as independent variables. Olive oil production and

Table 1. Description of variables and sources

Variable	Description	Data source
rca	RCA index	calculated by the authors with data obtained from UN Comtrade Database (2020) and World Bank (2020)
lprod	olive oil production (logarithmic)	IOC (2020)
lcons	olive oil consumption (logarithmic)	IOC (2020)
ex_uprice	olive oil export unit price	calculated by the author with data obtained from UN Comtrade Database (2020)

RCA – revealed comparative advantage

Source: Own calculations based on UN Comtrade Database (2020), World Bank (2020) and IOC (2020)

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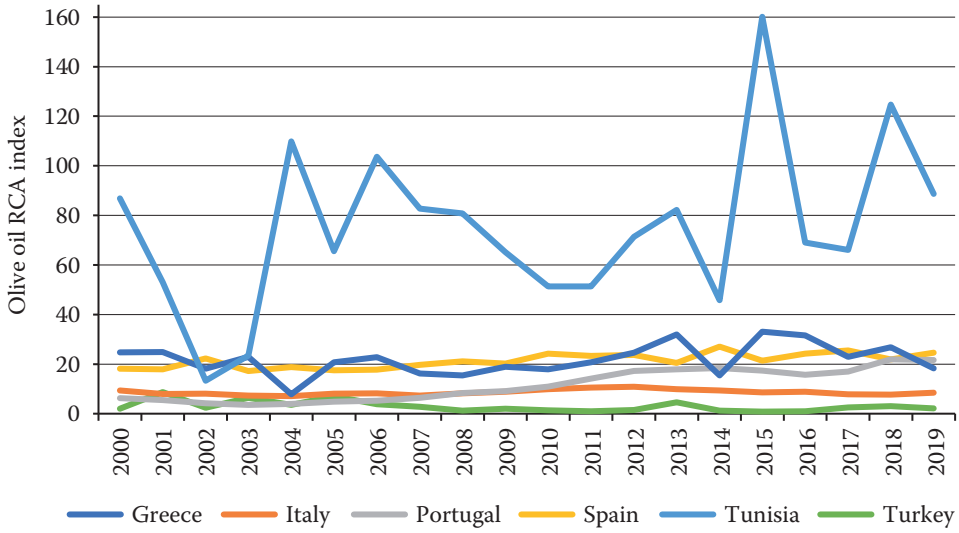

Figure 1. Olive oil RCA index values of countries (2000–2019)

RCA – revealed comparative advantage
Source: Own calculations based on UN Comtrade Database (2020) and World Bank (2020)

consumption values were included in the model by taking their logarithm.

The RCA index developed by Balassa (1965) indicates the commercial performance of each country regarding a manufactured product; the RCA index measures the competitiveness of a country in exports of a commodity. The formula of the RCA index, which constitutes the dependent variable of the model, is as in Equation (1):

$$RCA_{ij} = \frac{\left(X_{ij} / X_{it}\right)}{\left(X_{wj} / X_{wt}\right)} \quad (1)$$

where: RCA_{ij} – country i's RCA index of product j; X_{ij} – country i's exports of product j; X_{it} – country i's total exports; X_{wj} – world's exports of product j; X_{wt} – world's total exports.

Figure 1, which shows the RCA index values of the countries by year, shows that, in general, the competitiveness of Tunisia in olive oil exports was higher and more volatile than those of the other countries. The RCA indexes of the five countries other than Tunisia have a more stable structure. The index values of Spain and Greece are higher than those of Italy, Portugal and Turkey.

Figure 2 shows the annual olive oil production values of the six countries for the period from 2000 to 2019. Spain had the highest production, followed by Italy, Greece, Tunisia, Turkey and Portugal. There was a downward trend in the production in Italy and Greece, and an evident upward trend in the production in Portugal.

According to Figure 3, which shows the annual olive oil consumption values of the six countries, the highest consumption was in Italy and Spain, and the lowest was

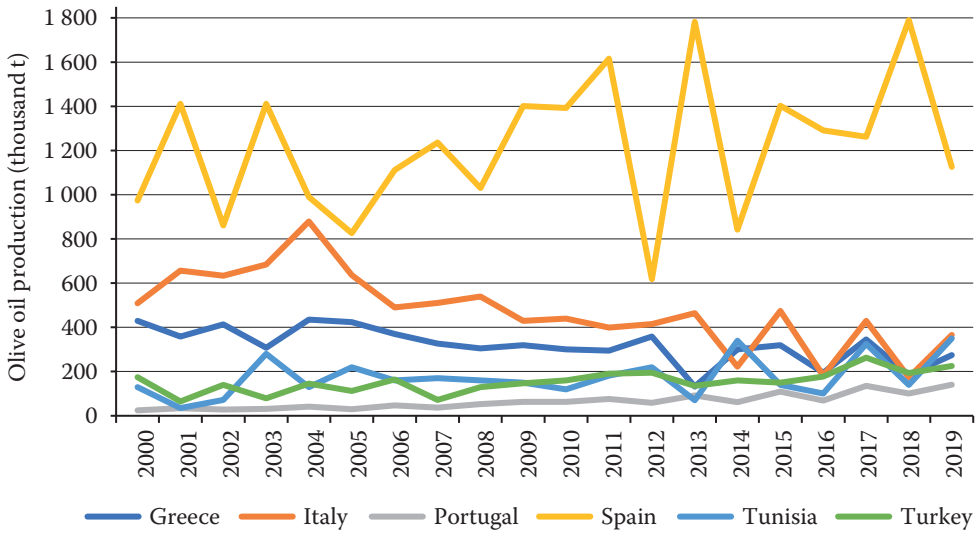

Figure 2. Olive oil production values of countries (2000–2019)

Source: IOC (2020)

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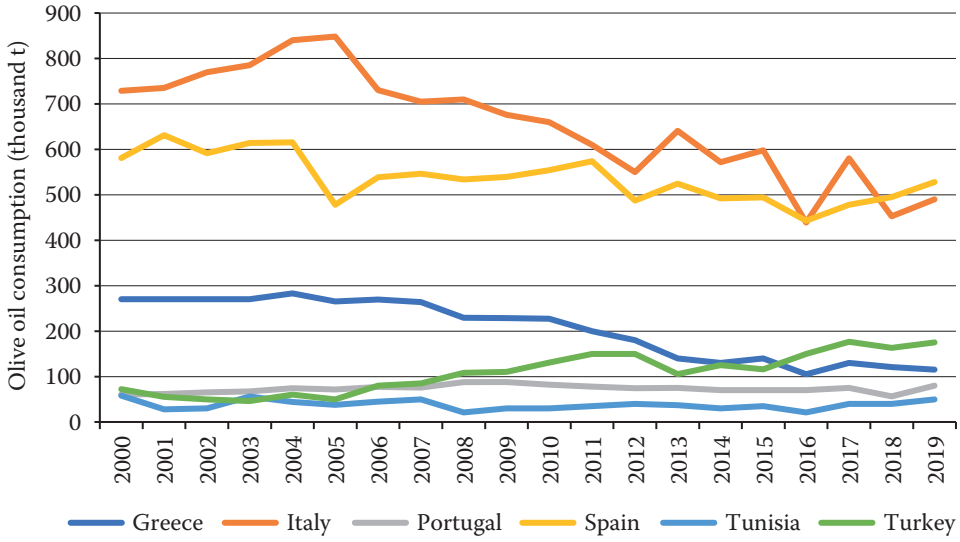

Figure 3. Olive oil consumption values of countries (2000–2019)

Source: IOC (2020)

in Tunisia. Although there was a decrease in the consumption in Italy and Greece, there was a clear upward trend in the consumption in Turkey.

According to Figure 4, which shows the olive oil export unit prices of the countries in US dollars, the olive oil export unit prices were at similar levels for all six countries. Between 2000 and 2005, there was a significant increase in all of these countries, followed by a decrease until 2010. The countries with the highest unit prices in more recent periods were Italy, Greece and Portugal.

Method of research. Because the analysis performed in the study involved both the six leading countries in olive oil export (a unit dimension) and the data of these countries between the years 2000 and 2019 (a time dimension), we performed a panel data analysis including these two dimensions. First of all, the model was created as in Equation (2) to test whether there was a unit and/or time effect in the model, and if there was, whether the effects in question were fixed effects or random effects.

$$rca = \beta_0 + \beta_1 lprod - \beta_2 lcons + \\ + \beta_3 ex\_uprice + \mu_i + \lambda_t + u_{it} \quad (2)$$

where: i = 1, 2, 3, …, 6; t = 1, 2, 3, …, 20; *rca* – RCA index; *lprod* – olive oil production; *lcons* – olive oil consumption; *ex_uprice* – olive oil export unit price; μ_i – unit effect of i; λ_t – time effect of t; u_{it} – error term of *it*.

Taking into account whether the model was a classical model or a model with fixed or random effects, we performed tests of the assumptions. In case of deviations from the assumptions, the model was re-estimated using robust estimators.

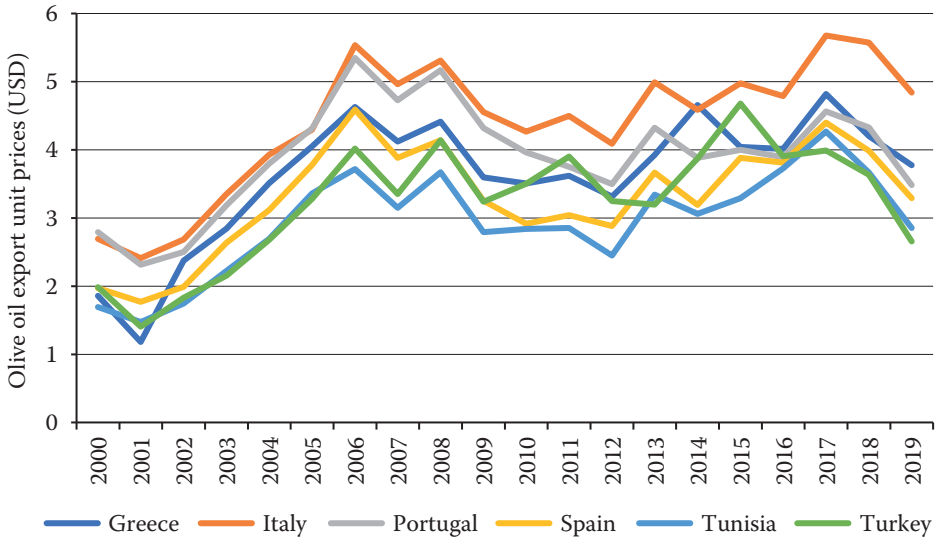

Figure 4. Olive oil export unit prices of countries in USD (2000–2019)

Source: Own calculations based on UN Comtrade Database (2020)

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RESULTS AND DISCUSSION

The data set, consisting of 120 observations in total, contains 20 years of data from six countries. The average of the RCA index was 23.49; the logarithmic averages of the production and consumption variables were 12.40 and 11.99, respectively; and the average of the olive oil export unit price was USD 3.57 (Table 2).

For analysis, a regression model was first created, and a likelihood ratio test was performed to measure the presence of a unit and/or time effect. According to the test results, there was a unit effect in the model ($P = 0.00 < 0.05$), but there was no time effect ($P = 1.00 > 0.05$). We then performed a robust Hausman test, the results of which showed that the unit effect in the model was more effective with random effects ($P = 0.79 > 0.05$).

After deciding on the type of model, we examined the deviations from the assumptions. First, we checked whether the model fit the normal distribution. According to the test results, we determined that both error terms ($P > 0.05$) and unit effect ($P > 0.05$) were normally distributed. We used a variance inflation factor (VIF) test to analyse whether there were multiple linear connections in the model. Because the mean VIF of 2.23 was less than 5, there were no multiple linear connections in the model (Table 3).

We conducted Brown and Forsythe's (Brown and Forsythe 1974) test to analyse whether there was a heteroscedasticity problem for the random effects model. According to the test result, the H_0 hypothesis was rejected ($P < 0.05$). In other words, the model has heteroscedasticity (i.e. the problem of changing variance). We then examined the problem of autocorrelation, which was another assumption, so we performed Baltagi-Wu's (Baltagi and Wu 1999) locally best invariant (LBI) autocorrelation test. Because the Durbin-Watson result was 2.01 and the Baltagi-Wu LBI result was 2.04, which is greater than 2, the H_0 hypothesis could not be rejected, and there was no autocorrelation in the model. In addition, we used Friedman's (Friedman 1937) inter-unit correlation test to see whether there was a correlation between units in the model. According to the test results, the H_0 hypothesis was rejected, and a correlation between units was found in the model (Table 3).

In creating the final version of the model, we used robust estimators because of deviations from the assumptions. In the case of heteroscedasticity and inter-unit correlation problems, the final version of the model was created by using the robust estimators that were able to solve these problems. According to the final model, the overall significance of the model was significant ($P < 0.05$), and the ratio of explanation of dependent variables by independent variables (R^2) was 42% (Table 4).

Table 2. Descriptive statistics for variables ($n = 120$)

Variable	Mean	SD	Minimum	Maximum
rca	23.49	27.76	0.83	160.14
lprod	12.40	1.05	10.11	14.40
lcons	11.99	1.08	9.95	13.65
ex_uprice	3.57	0.97	1.18	5.68

rca – RCA index; *lprod* – olive oil production; *lcons* – olive oil consumption; *ex_uprice* – olive oil export unit price
Source: Own calculations based on UN Comtrade Database (2020), World Bank (2020) and IOC (2020)

Table 3. Tests of assumptions and their results

Assumption	Test name	Hypothesis	Test statistics	*P*-value
Normal distribution	D'agostino, Belanger and D'agostino test (D'Agostino et al. 1990)	H_0: skewness = 0, kurtosis = 3 (error terms are normally distributed)	chi2(2): 4.83	0.09
Multiple linear connection	VIF criterion	if VIF is < 5, there is no multiple linear connection	mean VIF: 2.23	–
Heteroscedasticity	Brown and Forsythe test (Brown and Forsythe 1974)	H_0: there is no heteroscedasticity	W_0: 23.62 W_{50}: 17.25 W_{10}: 21.58	0.00 0.00 0.00
Autocorrelation	Baltagi-Wu LBI test (Baltagi and Wu 1999)	H_0: there is no autocorrelation	Durbin-Watson: 2.01 Baltagi-Wu: 2.04	–
Inter-unit correlation	Friedman test (Friedman 1937)	H_0: there is no inter-unit correlation	18.73	0.00

VIF – variance inflation factor; LBI – locally best invariant; W – test statistic developed for testing heteroscedasticity
Source: Own calculations based on UN Comtrade Database (2020), World Bank (2020) and IOC (2020)

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Table 4. Final version of the random effects model

Dependent variable: *rca*	Number of observations: 120		Wald chi2(3): 35.30	Probe > chi2: 0.00*	Overall R^2: 0.42	
Explanatory variables	coefficient	RSE	*t*	*P* > |*t*|	95% confidence interval	
lprod	12.40	2.66	4.66	0.00*	6.82	17.97
lcons	–19.43	3.75	–5.18	0.00*	–27.28	–11.57
ex_uprice	0.81	1.30	0.62	0.54	–1.92	3.53
cons	99.84	38.48	2.59	0.02*	19.31	180.38

*Statistically significant at the level of α = 0.05; *rca* – RCA index; *lprod* – olive oil production; *lcons* – olive oil consumption; *ex_uprice* – olive oil export unit price; *cons* – constant; RSE – robust standard error

Source: Own calculations based on UN Comtrade Database (2020), World Bank (2020) and IOC (2020)

The final model obtained according to Table 4 is as in Equation (3):

$$rca = 99.84 + 12.40\,lprod - 19.43\,lcons + \mu_i + u_{it} \quad (3)$$

where: i = 1, 2, 3, …, 6; t = 1, 2, 3, …, 20.

According to the results of the panel data analysis, H_1 and H_2, which are the main hypotheses of the study, were confirmed, but H_3 was not. According to the final model, olive oil production positively affected the dependent variable (RCA index), and this effect was statistically significant. A 1% increase in olive oil production would result in an increase of 12.4 in the RCA index. Olive oil consumption affected the RCA index negatively, and this effect was also statistically significant. A 1% increase in olive oil consumption would result in a decrease of 19.4 in the RCA index. In addition, according to the analysis results, olive oil export unit prices did not have a statistically significant effect on the RCA index.

CONCLUSION

According to the data and analysis results for Spain, Italy, Portugal, Greece, Tunisia and Turkey, which are at the forefront in world olive oil production and export, for the years from 2000 to 2019, the effects of olive oil production and consumption on the RCA index were significant; however, the effect of export unit price was not significant. This result is consistent with the results obtained by Abolagba et al. (2010) in their study, as well as the hypothesis that supply and demand lead to a competitive environment, as Türkekul et al. (2010) showed in their study. Nevertheless, our results support the hypothesis of Mane-Kapaj et al. (2010) indicating that there is a significant relationship between olive oil production and profitability.

The results of the analysis revealed that policymakers' implementation of agricultural support policies for olive oil production would play a significant role in a country's greater share of exports. For this reason, various legal regulations and support policies are implemented in the leading EU countries in the olive oil sector for Tunisia and Turkey. Among these policies implemented in the EU are the promotion of olive oil production and creation of financial support programs for it, determining standards for the olive oil market, and making special arrangements for competition laws. In Tunisia, the Food and Agriculture Organization and the European Bank for Reconstruction and Development provide support for the olive oil sector to be sustainable, to become more competitive and to increase the quality and efficiency of the production process. In Turkey, an olive oil standard has been compulsorily put into practice in foreign trade, and a communiqué (Turkish Official Gazette 2004) describing the required techniques and hygienic practices has been published that determines the conditions and product characteristics related to the production, preparation, processing, labelling, preservation, storage, transportation and placing on the market of olive oils.

Implications. Olive oil production and consumption amounts have a significant effect on the olive oil-exporting countries in terms of their specialising in olive oil production and gaining competitiveness; therefore, increasing production quality standards will also increase competitiveness. Furthermore, supporting producers will increase employment opportunities. Also among policies that can be implemented are providing state-of-the-art machinery and equipment support to reduce costs and encourage production. Moreover, the rapid increase in the demand for organic products shows the importance of policies that encourage the development of organic agriculture in particular. In the export of olive oil, the comparative advantage is mostly present in Tunisia; therefore, other producer countries should turn

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to good agricultural practices that will make production more efficient and should increase producer incentives to increase their competitiveness. A 1% increase in olive oil production through increased olive oil cultivation, subsidies, agricultural supports and tax reductions for the producer will result in approximately a 12.4% increase in the olive oil RCA index. The fact that domestic olive oil consumption has a negative effect on international competition (a 19.4% decrease in the RCA index) shows the importance of balancing olive oil production to meet both domestic and foreign demand. Thus, ensuring that olive oil production meets both domestic and foreign demand in a way that tolerates the effect of reducing the comparative advantage of domestic consumption.

Limitations of the study. The main aim of this study was to determine the factors affecting international competition in olive oil exports. However, because of limited data, not all exporting countries but only the six countries with the highest exports were included in the study. Investigators in future studies may contribute to the literature by including factors that may affect competition, other than production, consumption and price, such as trade policies, production costs and agricultural supports.

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