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EFFECT OF VOLATILITY IN REAL EXCHANGE RATES AND PRICE CHANGES ON TURKEY'S OLIVE OIL EXPORT: AN EMPIRICAL STUDY

In this study, the effects of volatility on real exchange rates and changes in the prices for extra virgin olive oil and refined olive oil at Turkey's olive oil export market are studied using the GARCH model. Monthly data covering the periods from January 2004 to December 2009 are used for the analysis. The worldwide economic crisis of 2008 is factored in as a dummy variable in the two models established separately for extra virgin olive oil and refined olive oil. This study shows that domestic and international prices, aside from fluctuations in exchange rate, directly affect Turkey's olive oil export. The results suggest that floating rate policy, which has been in use in Turkey since 2001, is more advantageous for olive oil export. The study concludes by suggesting that Turkey's olive oil export is not adversely affected by the worldwide economic crises.

Keywords: *extra virgin olive oil, refined olive oil, exchange rate volatility, prices, economic crises, multivariate GARCH-in-mean.*

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ВПЛИВ ВАЛЮТНИХ КОЛИВАНЬ І ЗМІН ЦІН НА ЕКСПОРТ ОЛИВКОВОЇ ОЛІЇ В ТУРЕЧЧИНІ: ЕМПІРИЧНЕ ДОСЛІДЖЕННЯ

У статті оцінено вплив валютних коливань і змін вартості олії першого віджиму і рафінованої олії на експорт оливкової олії в Туреччині. GARCH-модель побудовано на щомісячних даних з січня 2004 р. по грудень 2009 р., враховано вплив світової економічної кризи 2008 р., для двох видів олії побудовано дві моделі. Показано, що вітчизняні і міжнародні ціни, незалежно від валютного курсу, прямо впливають на експорт турецької оливкової олії. Результати передбачають, що політика плаваючого валютного курсу, застосована у Туреччині з 2001 р., позитивно позначається на експорті оливкової олії. Зроблено висновок, що світова економічна криза незначно вплинула на експорт оливкової олії з Туреччини.

Ключові слова: *оливкова олія першого віджиму, рафінована оливкова олія, коливання валютних курсів, ціни, економічна криза, модель GARCH-в-середньому з багатьма змінними.*

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ВЛИЯНИЕ ВАЛЮТНЫХ КОЛЕБАНИЙ И ИЗМЕНЕНИЙ ЦЕН НА ЭКСПОРТ ОЛИВКОВОГО МАСЛА В ТУРЦИИ: ЭМПИРИЧЕСКОЕ ИССЛЕДОВАНИЕ

В статье оценено влияние валютных колебаний и изменений стоимости масла первого отжима и рафинированного масла на экспорт оливкового масла в Турции. GARCH-модель построена на ежемесячных данных с января 2004 г. по декабрь 2009 г., учтено влияние мирового экономического кризиса 2008 г., для двух видов масла построены две модели. Показано, что отечественные и международные цены, независимо от валютного курса, прямо влияют на экспорт турецкого оливкового масла. Результаты предполагают,

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что политика плавающего валютного курса, применяемая в Турции с 2001 г., положительно сказывается на экспорте оливкового масла. Сделан вывод, что мировой экономический кризис незначительно повлиял на экспорт оливкового масла в Турции.

Ключевые слова: *оливковое масло первого отжима, рафинированное оливковое масло, колебания валютных курсов, цены, экономический кризис, модель GARCH-в-среднем со многими переменными.*

Introduction. Olive is a perennial tree that grows in Mediterranean countries because of the climate. There are 42 countries producing olive in today's world, including Spain, Italy, Greece, Turkey, Tunisia, Syria, Morocco and (France FAO, 2011). Olive cannot be consumed directly; it must be processed into oil and table olives. Olive oil is the most important product of the olive fruit and therefore, it is consumed and traded significantly more than table olives.

The top 5 ranking countries in global olive oil production are Spain, Italy, Greece, Tunisia and Turkey with 40%, 20%, 12%, 6 % and 5% shares in global production respectively. The respective rates for olive oil exports for these countries are 26%, 29%, 2%, 18% and 6%. Olive oil is one of Turkey's most important agricultural exports (TEC, 2011; AEA, 2011). Turkey produces 130 ths tons of olive oil per year and exports 50% of it (IOC, 2011). Olive oil by international standards is divided into several quality classes. The most important two are extra virgin oil and refined olive oils, traded at stock markets (IOC, 2009; TCMB1, 2010). Turkey conforms to these standards and therefore integrates well into the European Union market and the International Olive Council.

The EU applies policies within the framework of the Common Market to protect its olive producing members — Spain, Italy, and Greece. High tax rates are imposed on the import of olive oil from non-member countries. The EU's import regime on olive oil gives privilege to many countries but it is also very protective (Guldogan, 2006). The EU offers discounted tariff quotas to some non-EU countries that are some of the largest producers of oil per annum such as Tunisia (56,000 tons), Jordan (12,000 tons) and Syria (10,000 tons). Nearly all these countries prefer to use most of their quotas for bulk olive oil. Naturally, this situation gives an advantage to the EU countries because each year the EU has the potential to process 110,000 tons of olive oil at the packaged-branded market through the quotas it imposes on the non-members. In other words, the EU can quarantine 17% of the total world olive oil exports through the non-EU countries (Tunalioglu, 2010).

The EU allows Turkey import up to 100 tons of olive oil under Regulation 119/2005 (10/28/2005, OJL). Until this quota expires, the 7.5% tax on the value will be deducted, and after the quota expires, the 1120.50 Euro per ton tariff will be applied (Guldogan, 2006). Turkey prefers to export to the EU because of geographical proximity. Turkey's competitiveness in export also affects other significant non-EU olive oil producing countries. However, these countries can overcome this problem using the discount tariff quotas specified by the EU (Karray, 2007).

Due to domestic market prices being higher than at the external markets, the olive oil produced in Turkey is exported more than sold for the national market, which is not a viable strategy for the olive oil sector. Turkey is not in competition with packaged-brands, but it provides them with bulk olive oil with low value-added exports (bulk: 70%; packaged: 30%) (AEA, 2010). Turkey's olive oil exports are directly related to olive oil prices at external and internal markets and to the currency exchange rates.

The real foreign exchange rate is one of the indicators used for measuring the international competition and to reflect the relative price of foreign produced goods as compared to locally produced goods (TCMB2, 2011).The real foreign exchange rate is calculated by the deflation of nominal currency to local-foreign relative prices because of difficulties in separation of goods subject to trade and not subject to trade (Kotan, 2002). The change in exchange rates affects many macroeconomic variables such as interest rate, prices, payment balances and employment. The uncertainties occurring due to foreign exchange rate fluctuations affect foreign trade of the countries differently. Therefore, in different studies, foreign exchange rate uncertainties are stated to have a positive effect (Albeni et al., 2006; Sukar and Hassan, 2001); a negative effect (Arize, 1997; Hudson and Keith, 1999), no effect at all or a mixed effect (Aristotelous, 2001, Gul and Ekinci, 2006) on foreign trade. Cushman (1983) stated that uncertainty in foreign exchange rates has a negative effect on the import of agricultural goods and Bonroy et al. (2007) stated that low volatility effects export positively, but this effect becomes negative after a certain threshold. Regarding the change in foreign exchange rates, Yanikkaya (2001) stated in his study about the effect on Turkish agricultural products that the change affects the exports of wool and tobacco products, while Buguk et al. (2003) found no significant relation between foreign exchange rate uncertainty, except for a few agricultural products and countries.

Using the GARCH method, this study examines the effect of the real foreign exchange rates on the export performance of refined and extra virgin olive oil in Turkey, an important olive oil producer. Also, the effect of price difference between Turkey and the rest of the world for exports during the crisis period was examined and it was understood that real foreign exchange rate uncertainty has a positive effect on the extra virgin and refined olive oil export.

Materials and methods. The olive oil trade is done at the stock exchanges in 3 countries, Italy, Spain and Greece and in 2 quality grades, extra virgin olive oil and refined olive oil. Extra virgin olive oil is traded at Bari (Italy), Heraklion/Messinia (Greece) and Jaen (Spain), stock exchanges and refined olive oil is traded at Bari (Italy) and Cordoba/Sevilla (Spain), stock exchanges. The extra virgin and refined olive oil prices are created at the Izmir stock exchange in Turkey. Since these 3 stock exchanges have a bigger impact on the world olive oil market than the Izmir stock exchange in Turkey, the average of olive oil prices on these 3 stock exchanges were used.

Extra virgin olive oil and refined olive oil prices at the stock exchanges between January 2004 and December 2009 were included in the study. The arithmetic means of monthly prices of olive oils listed at these stock exchanges were calculated and a 72-month time series was used (IOC, 2010). The obtained price data were expressed in Euros/100 kg; therefore, the exchange rate purchase price was converted into Turkish lira and international real olive oil prices were converted into TL/kg through the consumer price index (TCMB1, 2010), whose basic period covered 2004.

The monthly average export prices of extra virgin and refined olive oil (TL/kg) in Turkey were calculated with the consumer price index by using the data taken from the Assembly of Turkish Exporters for the same period (January 2004 to December 2009) (TEC, 2010). Data on the prices for extra virgin olive oil in Turkey was provided by the Izmir Commodity Exchange Market; however, because refined olive oil is not traded at Turkey's stock exchange, the prices were obtained as the consumer prices data (ITB, 2010; TSI, 2010). The real exchange rate assumed a real effective exchange rate index with 1995 as the base year on the producer price index of the Republic of Turkey Central Bank.

This study used two models, and two sets of data were produced separately for extra virgin and refined olive oil. Table 1 gives descriptions and data resources of the variables used in the model.

Table 1. **Variables used in the models**

Dependent variables	
EVO = Extra virgin olive oil export	ROE = Refined olive oil export
Independent variables	
IEOP = International olive oil price for extra virgin olive oil (TL/Kg)	IROP = International olive oil price for refined olive oil (TL/Kg)
TEOP = Turkish stock exchange price for extra virgin olive oil (TL/Kg)	TROP = Turkish stock exchange price for refined olive oil (TL/Kg)
REI = Real Effective Exchange Rate Index GARCH value (1995=100)	
DU = Dummy variable (2008 worldwide economic crisis)	

Volatility in exchange rates is important because it affects the prices of marketed goods subject to international trade (Hatirli et al., 2008). Volatility is calculated by obtaining the standard deviation of a data series. The generalised autoregressive conditional heteroscedasticity model (GARCH), introduced by Engel (1982) and Bollerslev (1986), has been used recently to deal with such calculations.

The GARCH (1,1) model for the logarithmic real exchange rate variable may be expressed as follows:

$$\Delta LR_t = \alpha_o + \alpha_1 \Delta LR_{t-1} + \alpha_2 \Delta LR_{t-2} + \mu_{t.} \quad (1)$$

In (1), μ_t is a conditional variance following a normal distribution win $N(0,h_t^2)$ where h_t^2 is calculated as:

$$h_t^2 = \beta_o + \beta_1 \mu^2_{t-1} + \beta_1 \mu^2_{t-1.} \quad (2)$$

If the variables meet the conditional variance conditions that is $\alpha>0$, then square roots are obtained to find volatility values. The autoregressive conditional heteroscedasticity model (ARCH) effect must be available in the series to produce the series related to the volatilities and this effect is determined by the ARCH LM (Lagrange multiplier test).

ARCH LM test was applied to the exchange rate volatility variable produced by ARCH (1,1) from the series relating to exchange rates, and it found that ARCH effects are statistically significant at the ratio of 1%.

This study calculated the natural logarithmic values of all the variables. According to the trend of the real export data versus time, it was observed that, although low, there is an increasing trend that corresponds to volatilities, which increases in time and seasonal changes (Figure 1). Because the trend in seasonal change applies to the multiplicative structure, seasonal change should be removed from the time series according to the moving averages method-multiplicative structure (Kose et al., 2008). Therefore, the real export data used in the analysis is free from seasonal change used in the econometric analyses.

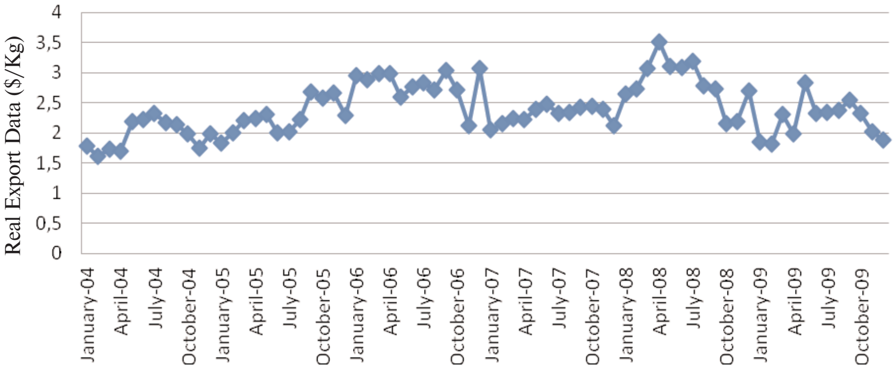

Figure 1. **Real export data versus time**

Since time series models include trends, false regression problems may occur if known linear econometric models are used. The unit root test is a method used to determine if a time series is stationary. If a time series includes a unit root, then it is not stationary. Non-stationary series have longer memories than stationary series; the effects of a stationary series disappear while the effects of a non-stationary series change the structure of the series (Ozer et al., 2006). The uses of non-stationary time series have been problematic in econometric analyses. Granger and Newbold (1974) reported that false regression is likely to occur in predictions based on non-stationary series. According to the regression outputs, R2 is high enough and t-statistics are significant; however, the Durbin-Watson statistical value is low. If regressions based on lagged values of the two variables include a unit root (non-stationary), then the usual t- and F-tests will not be valid. The regression model formulated using these two variables will be false (Halac, 2003, Gunes et al., 2010). In this study, the stability of time series is tested using the augmented Dickey-Fuller (ADF) test (Gujarati, 2001).

Two methods are used prevalently for examining the cointegration between series. These are methods proposed by Engel and Granger (1987) and Johansen and Juselius (1990). The Johansen cointegration test is a multi-variable cointegration method used in researching the cointegration relationship between more than two variables. There are two stages in researching by Johansen's cointegration method. The first is to determine the maximum cointegrated vector quantity between the variables examined and the second is guessing the coefficients of these cointegrated vectors. This study only dealt with the cointegrated vector quantity determination process.

The cointegration relations between series creating Zt was tested with the help of common cointegration vector quantity probability test statistic by using Eigen values (μ's). This test statistic is called a trace test that is realized by the equation below (Yurdakul, 1995):

$$-T \sum_{r+1}^{p} \ln(1-\mu_i)$$

The hypothesis determined for the trace test is as follows:

H_0: r = 0 (there is no cointegration)

H_1: r+1 (there is cointegration)

The critical values of this test statistic are seen in the studies by Johansen and Juselius (1990) and Osterwald-Lenum (1992) (Saatcioglu et al., 2004).

Since cointegration measures whether a linear component of the variables is stationary or not, it is identical to determining whether error predictions based on the estimated regression models are stationary. In other words, if an error term is stationary, then cointegration exists between the variables. In this study, an ADT test was applied to the error terms produced by the predicted models to examine any cointegration between the variables (Engel and Granger, 1987; Hatirli et al., 2008).

Results. Establishing whether an economic series is stationary or non-stationary is very important because they work under the stability assumption of the theories developed for time series. Table 2 shows the unit root test results produced by applying ADF in the level and first-order differences of the variables. According to the result, the price variables do not meet the stationary condition at the 5% significance level. According to the calculations of the first-order differences, none of the variables meet the stationary condition within the 1% confidence interval.

Table 2. **Test results about stability**

Variables	Levels	1st order difference
EVO	$-2.546214_{k=1}$	$-13.08047_{k=0}$
RVO	$-2.955047_{k=1}$	$-12.94873_{k=0}$
IEOP	$-2.495829_{k=1}$	$-6.859202_{k=1}$
IROP	$-2.814797_{k=1}$	$-6.372980_{k=1}$
TEOP	$-3.410467_{k=0}$	$-13.08295_{k=0}$
TROP	$-1.701918_{k=1}$	$-4.496960_{k=0}$
REI	$-2.878695_{k=1}$	$-7.025289_{k=1}$

* Critical values are -4.094550, -3.475305 and -3.165046 for $P < 0.01$, $P < 0.05$ and $P < 0.10$ respectively. k; lag length (own calculations)

All the variables were stationary at the first order difference so an ADF test was applied to the error terms produced based on the model to test whether they were cointegrated before differentiation. The test results were statistically significant at the level of 1% (-8.732884) for extra virgin olive oil and 1% (-8.497828) for refined olive oil. The study concluded that cointegration exists between the variables. Therefore, the data were used in the logarithmic regression model without a differentiation of the variables.

For Johansen's cointegration model, the latency length is K=1 according to Akaike criteria and k = 1 again according to Schwartz criteria. Table 3 shows the results obtained from the solution of the Johansen model with 1 latency and track statistics test result values used to test the reliability of the Johansen model calculated depending on latency length. When extra virgin olive oil cointegration analysis was examined, the track statistic was calculated as 56.16102 for the H0 hypothesis asserting that no cointegration vector is present (r = 0). The study found two cointegration vectors. When the refined olive oil cointegration analysis was examined, the track statistic was calculated as 49.3819 for the H0 hypothesis and one cointegration vector was found. According to this result, the test denies the H0 hypothesis that asserts that cointegration is not present. The findings show a long-term balance between olive oil exports, real exchange rates and domestic and foreign prices.

Table 3. **Johansen cointegration model track statistic and med statistic test result**

	Extra virgin olive oil				Refined olive oil export			
	Eigen-value	Trace Statistics	0.05 Critical Value	Prob*	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob*
r 0	0.307365	56.16102	47.85613	0.0069	0.272758	49.3819	47.85613	0.0357
r 1	0.226537	30.45336	29.79707	0.042	0.201819	27.08718	29.79707	0.0995
r 2	0.129783	12.4719	15.49471	0.1357	0.115352	11.30775	15.49471	0.1933
r 3	0.038401	2.741052	3.841466	0.0978	0.038224	2.728194	3.841466	0.0986

*According to 5% critical value, there are 2 cointegration vectors for extra virgin olive oil and there is 1 cointegration vector for the refined olive oil (own calculations).

According to the analysis, the variables included in the model behave according to theoretical expectations and the extra virgin and refined olive oil export price variables were statistically significant. The certainty coefficients of the model were 0.679 and 0.680 for extra virgin olive oil and refined olive oil respectively. Therefore, a false regression was not formed for the predicted models and descriptive capacity is moderate.

Durbin-Watson (DW) test statistics should be used to solve the autocorrelation problem that might occur in time series analyses. The DW test statistic was 2.1075 for extra virgin olive oil and 2.039 for the refined olive oil. Therefore, no autocorrelation exists in the model.

Tables 4 and 5 show the results related to the two models produced for extra virgin olive oil and refined olive oil based on logarithmic regression. Since the predicted model is in logarithmic form, the coefficients express periodical elasticity for the directly relevant variables. According to the model, an increase of 10% in the international olive oil price causes an increase in Turkey's extra virgin olive oil export by 4.26%. Similarly, an increase of 10% in the domestic olive oil price causes an increase in olive oil export by 4.42%. This suggests that extra virgin olive oil is exported after it is traded at the stock exchange and supports the results in practice. Volatilities in the exchange rate based on the GARCH model are positive and it was calculated that an increase of 10% would cause an increase of 53.12% in extra virgin olive oil. This result supports the positive correlation between devaluation and export according to economic theories.

Similar results were obtained for the refined olive oil model. In particular, an increase of 10% in the international refined olive oil price causes an increase in Turkey's refined olive oil export by 5.01%. Similarly, an increase of 10% in the domestic olive oil price causes an increase in olive oil export by 6.80%. Volatility that might occur in exchange rates has a positive effect on refined olive oil exports, like extra virgin olive oil exports.

Table 4. **Extra virgin olive oil model**

Variables	Coefficients	F-test
C	0.307281	2.97642
DU	0.168419	5.30976
IEOP	0.426244	5.606468
TEOP	0.442218	5.878272
REI	5.311975	1.932722
r-square	0.679628	
F-test	35.53292	
DW	2.107552	

* own calculations

Table 5. **Refined olive oil model**

Variables	Coefficients	F-test
C	-0.85955	-4.17283
DU	0.0814	2.401355
IROP	0.501307	7.541905
TROP	0.686091	7.863593
REI	4.062079	1.758939
R-square	0.680025	
F-test	35.59778	
DW	2.039412	

* own calculations

Discussion. This paper examined the effects of exchange rate volatility on Turkish olive oil exports. It found that the exchange rate elasticity is higher than the one in the two models established for extra virgin and refined olive oil. This indicates the flexibility of the exchange rate in olive oil exports. In agreement with the studies that pointed out the significance of elasticity as an important factor in export (for example, Saatcioglu, 2001; Hatirli et al., 2008, Bayoumi, 2009), this study found that the higher the elasticity is, the more the positive impact is on exports. Furthermore, it indicates that volatility in real exchange rates directly affects olive oil export and the exchange rate nominal anchor is more advantegous as an exchange rate regime. An increase in exports is a consequence of an increase in exchange rates. However, this issue is of particular importance for Turkish economy where the floating exchange rate system was implemented after the 2001 financial crisis. This policy has brought about benefits for exporters by reducing the uncertainty and mitigating risk (Albeni et al., 2006).

A number of studies examined the impact of exchange rate volatility on exports and imports (for example, Mckenzie and Brooks, 1997; Kroner and Lastrapes, 1993; Mcpherson, 2000; Sercu and Uppal, 2003; Aurangzeb et al., 2005; Choudhry, 2005). The findings of Kroner and Lastrapes' study (1993) using the GARCH model indicated a significant relationship between the nominal exchange rate volatility and international trade in 5 countries, including the US. This relationship was found as negative for the UK and the US and positive for France, Germany and Japan. Similarly, Choudhry (2005) analysed the impact of exchange rate volatility on the exports of the US to Canada and Japan during the flexible exchange rate period that lasted from 1974-1998. Applying the GARCH model, he suggested a negative relationship between the exchange rate volatility and real exports. Employing another analysis technique, ARDL, De Vita and Abboot (2004) also found a negative relationship between these two variables.

The application of such models and associated analyses in Turkish context is evident. Such studies include works by Albeni et al. (2006); Hatirli et al. (2008) and Kose et al. (2008). For example, Kose et al. (2008) investigated the influence of exchange rate volatility on exports by analysing monthly data in the period of 1995-2008 using the Johansen's cointegration technique. Their findings indicate a negative relationship between exchange rate volatility and Turkish exports in short and long terms, in contrary to this study that looked specifically at Turkey's olive oil exports. This product-based analysis (that is olive oil export) forms the core contribution of our study, because there has not been previous research in this area. Hatirli et al. (2008) examined the issue for Turkish hazelnut exports to Germany. Their findings illustrate that price transmission and exchange rate elasticities in both short and long runs are less than one, indicating an incomplete pass through. As a result of these findings (Poon et al., 2005), it can be claimed that the exchange rate volatility has a statistically significant negative impact on real exports in most countries. In order to reverse the risks, exporters can reduce their activities, switch sources of supply and demand or change prices in order to minimize their exposure to the influence of exchange risk.

Another contribution of our study is the inclusion of changes in olive oil prices at domestic and international markets as an influence on Turkish olive oil exports. The global financial crisis in 2008 has been added to the determinants of Turkish olive oil export as a dummy variable in this analysis. This dummy variable has a positive sign consistently in the models for both grades of olive oil (extra virgin and refined). This shows that the 2008 crisis has led to an increase in Turkey's olive oil export. In such economic crisis, retailers and consumers tend to lower their demand or prefer inexpensive supplies. This study has concluded that foreign buyers show a tendency to purchase a higher volume of Turkish olive oil in times of rising international prices in order to offset increasing costs at their domestic markets. The reason why Turkish olive oil is relatively cheaper for such buyers is because Turkey exports both grades of olive oil in bulk. Although this type of export provides immediate advantages for Turkish exporters compared to packaged and branded exporting, it has negative implications for establishing a market presence and the power of Turkish olive oil producers, who remain "invisible" producers of high quality olive oil.

In conclusion, our results indicate that Turkish export of both extra virgin and refined olive oils has been affected positively by the introduction of the floating exchange rate system in 2001 as an outcome of the national financial crisis, which created real exchange rate volaitility. Our results also show some other significant effects of real exchange rate volaitility on the olive oil trade prices. In addition, this study found that the global financial crisis has not adversely affected Turkish exports in this product category. Both results can be interpreted positively for Turkey's olive oil export in the short term. Future research should examine the topic in the context of changing national and international agricultural policies and consequent practices in Turkish olive oil production and marketing.

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