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# Economic analysis and marketing margin of pistachios in Turkey



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## Abstract

**Background:** In this study, producer and consumer prices and the marketing structure of pistachios in Turkey were examined. Between 2003 and 2017, production, consumption, foreign trade, price fluctuations, and marketing were emphasized. It was determined that the number of fruit trees in pistachios increased. According to current and real prices, pistachio marketing margins are calculated, and producer and consumer chain indexes are calculated according to current prices and compared with annual inflation rates. Supply and demand models related to pistachio were estimated and interpreted statistically.

**Results:** As a result, the real price of walnut and periodicity on the amount of pistachio production, on the consumption of Pistachio, the costumer real price of pistachio, population, and periodicity were determined to be effective.

**Conclusion:** Demand elasticity in pistachio (1.055) was found to be greater than supply elasticity (0.306), and consumers' sensitivity to price changes was much higher than that of producers.

**Keywords:** Pistachio, Marketing structure, Price fluctuations

## Introduction

Pistachio (in Turkish Antep Fıstığı) is an edible fruit and the tree that it grows on is from cashew family (Anacardiaceae). This tree takes its name from the city Gaziantep where it commonly grows. Pistachio ingredients are 22.6% protein, 15.6% carbohydrate, and 3250 calories when it is compared with fat-containing fruits. It is in the second rank after the hazelnut in terms of fat. Since the high nutrition rate and as a cookie that is generally consumed, the pistachio can find purchaser both in domestic and foreign markets (Republic of Turkey Ministry of National Education 2015).

Pistachio is a fruit which tends to periodicity. Trees give little fruits or no fruit after the productive year. (Ertürk et al. 2015). Since the periodicity, production quantity changes year after year.

The production of the pistachio in 770,861 ha is 1,115,066 tonnes in the whole world in 2017. Iran is the leader producer with the share of 51.57%. Iran is in the first rank with the production of 574,987 tonnes in 429,535-ha area with the 1.339 tonnes/ha productivity rate. The

USA is second in the ranking with the 272,291 tonnes of production in 101,171-ha area with the 2.69 tonnes/ha productivity with the 24.42% share. While China is getting 95,294 tonnes of pistachio from an area of 30,077 ha with 3.17 tonnes/ha productivity, Turkey is at the fourth rank with its fluctuating production structure with the 78,000 tonnes of harvest in an area of 68,237-ha land and 1.14 tonnes/ha rate. (Food and Agriculture Organization 2019).

Since the Iranian origin pistachio's price is relatively low and the seeds are large with high-level splitting range, those pistachios are demanded worldwide. The pistachio which grows in China is from a different family; thus, it is not proper for the human consumption. In the last few years in China, producing of pistachio has been given weight but this plant is cultivated for biodiesel purposes (Pistachio Sector Report, Republic of Turkey Ministry of Trade 2016).

Although Turkey originated smaller pistachios and their price is high, the taste is more intense and thus it gains advantage in the international market. It is evaluated that stressing this merit in marketing is important. As evidence to this, the USA became an importer in Turkish origin pistachio in recent years which shows

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that this merit has to be stated (Pistachio Sector Report, Republic of Turkey Ministry of Trade 2016).

According to the 2016 data, pistachio export globally reached to the \$2.811 billion. While the USA is the first in ranking with the rate 32.22% (\$1.084 billion), Iran is the second with the rate 24.43% (\$686 million). Turkey ranked seventh (\$66 million) with the 2.37% (Food and Agriculture Organization 2019).

According to the 2016 data, Hong Kong, China is ranked as first with the 25.20% and \$721.5 million worth of import which globally reaches \$2.863 billion. Germany 12.82% (\$367.1 million), Vietnam 12.08% (\$345.8 million), and Italy 4.67% (\$133.8 million) come after China respectively. Turkey has the share 0.02% in importing countries with the worth of \$496,000 (Food and Agriculture Organization 2019).

According to the Turkish Statistical Institute 2017 data, Gaziantep has 136,347-ha area for the pistachio with a share of 41.47%. Şanlıurfa follows Gaziantep with the 25,809 ha (7.85%), and Adıyaman 18,807 ha (5.72%) and Siirt respectively. 93.18% of the total production is produced in Gaziantep, Şanlıurfa, Adıyaman, and Siirt. In total, Şanlıurfa is ranked as first with the rate of 36.55% with 28,507 tonnes, and Gaziantep produces 14,762 tonnes with the rate of 18.92% (Turkish Statistical Institute 2019).

In this study, both economic analyses have been done by taking into account the producer-consumer figures, and marketing situation is analyzed. Additionally, factors that have effect on pistachio supply and demand are determined by estimating models of supply and demand functions of the pistachio.

## Materials and methods

### Materials

In this study while production quantity, number of the trees, productivity, manufacturer, and consumer prices annual data, in the 2003–2017 period, obtained from Turkish Statistical Institute (TSI) web site, export-import amounts are from Food and Agriculture Organization (FAO) and Agricultural Economic and Policy Development Institute (AEPDE). Price of the fertilizer, diesel, agricultural labor costs are obtained from TSI and AEPDE (2019). Additionally other sources also used in the study.

### Methods

Producer and consumer current prices of pistachio are converted to real prices by taking 2017 = 100. Fluctuations in the prices year by year, at first are shown as absolute values and then stated as percentage of the first in the compared 2 years. Averages are calculated disregard to their sign (Altundağ and Güneş 1992; Dağdemir and Birinci 1999).

Difference between the prices that are obtained by farmers (manufacturer prices) and prices that are paid by consumers (consumer prices) is calculated as marketing margin (Aşkan and Dağdemir 2015; Topcu 2003; Topcu 2004).

Chained price index is calculated by comparing manufacturer and consumer prices by taking the 2003–2017 period. In the chain price index, there is no base year. The main goal in the chained price index is analyzing annual changes in the time, in other words, specifying the increase or decrease in the prices in the following year with respect to the former (Dağdemir 1998).

Supply quantities of annual plants are the function of the former year. However, while pistachio is a multi-year plant production, decision cannot be changed. Thus, the production decision of the pistachio is imagined as hypothetically 1-year delay (Özkan et al. 2011:2). While the relation between the producers earning and pistachio production was inquired, it is taken into consideration that the given price of a year ( $t$ ) could have effect only after a year ( $t-1$ ) on the production decision; pistachio production series are kept in that vein; price series are analyzed counted by 1 year backwards.

While the supply and demand function models are estimated, series are proved one by one with linear, log-log and semi-log models. Linear models (Lin-Lin) are used which gives the best results in analysis. Prices in all independent variables are taken into consideration as real prices (2017 = 100). In the models formed in order to understand if there is an autocorrelation problem which can be seen in time series analysis, Durbin-Watson test is implemented and no autocorrelation problem is detected.

Model which is estimated for pistachio supply function is at the formula 1.

$$PP_{(t)} : \alpha + \beta_1 PPP_{(t-1)} + \beta_2 HPP_{(t-1)} + \beta_3 WPP_{(t-1)} + \beta_4 FP_{(t)} + \beta_5 LP_{(t)} + \beta_6 DP_{(t)} + \beta_7 T_{(t)} + \beta_8 P_{(t)} + \epsilon \quad (1)$$

PP: Pistachio Production Quantity (tonnes)

PPP: Pistachio Producer Real Price (£/kg)

HPP: Hazelnut (shelled) Producer Real Price (£/kg)

WPP: Walnut (shelled) Producer Real Price (£/kg)

FP: Fertilizer Real Price (£/ton)

LP: Agricultural Labour Real Price (£/day)

DP: Diesel Real Price (£/lt)

T: Trend (years 2003–2017; 1,2,3, ... , 15)

P: Periodicity<sup>1</sup> (high productivity year: 1, low productivity year: 0)

<sup>1</sup>Technical definition of fruit species and varieties which yield fruit for 1 year and give little or no fruit in the following year. In other words, different productivity from 1 year to other year.

Model which is estimated for the pistachio supply function is at the formula 2.

$$PC_{(t)} : \alpha + \beta_1PCP_{(t)} + \beta_2HCP_{(t)} + \beta_3WCP_{(t)} + \beta_4NP_{(t)} + \beta_5NI_{(t)} + \beta_6T_{(t)} + \beta_7P_{(t)} + \epsilon \tag{Eq.2}$$

PC: Pistachio Consumption Amount (tonnes) (production + Import – Export)

PCP: Pistachio Consumer Real Price (₺/kg)

HCP: Hazelnut (shelled) Consumer Real Price (₺/kg)

WCP: Walnut (shelled) Consumer Real Price (₺/kg)

NP: Population (person)

NI: National Income (₺/person) (converted to real income)

P: Periodicity (high productivity year: 1, low productivity year: 0)

**Results**

Between 2003 and 2017, the number of the fruitful tree increased 81.62%. Since the pistachio is a fruit which tends to periodicity, production quantity and productivity fluctuate year by year (Table 1). In the 15-year period, average annual production is 101,062 tonnes; average productivity per tree is 3.04 kg.

Between 2003 and 2017 while it can be seen, fluctuations in the consumption in pistachio, as a trend, an increase can be seen. In the 15-year period average annual consumption is calculated as 1.34 kg. Pistachio import is

so small that can be negligible. While the export level has fluctuations, it increased year by year (Table 2).

In general, pistachio current prices are tend to increase despite fluctuations. Between 2003 and 2017, producer prices increased approximately 281% (3.81 times), and consumer prices increased 376% (4.76 times). In current prices, consumer prices increased more than the producer prices (Table 3).

Difference between the prices that are obtained by farmers (manufacturer prices) and prices that are paid by consumers (consumer prices) is called marketing margin. It is the yield that is obtained by commissioners. According to current prices, while commissioner yield changes between 48.32 and 67.26%, producer yield changes between 32.74 and 51.68% (Table 3).

In general, pistachio real prices are tend to increase despite fluctuations. Between 2003 and 2017, producer real prices increased approximately 22.14%, and consumer real prices increased 59.4%. In real prices, consumer prices increased more than the producer prices. According to real prices, while commissioner yield changes between 45.00 and 67.74%, producer yield changes between 32.26 and 55.00% (Table 4).

In Table 5, producer- and consumer-chained indexes have been calculated in current prices, and the differences have been taken and compared with the inflation rates. With this comparison, it has been seen that producer yield is above the inflation rate in the years 2009, 2010, and 2014. Just in those years, prices are in favor of producer. When we analyze the consumers’ purchasing

**Table 1** Fruitful tree number, production, and productivity in Turkey

Years	Fruitful tree number (1000 - adet)	Production (tonnes)	Productivity (kg/per tree)
2003	26,300	90,000	3.42
2004	26,500	30,000	1.13
2005	28,000	60,000	2.14
2006	28,264	110,000	3.89
2007	28,464	73,416	2.58
2008	28,668	120,113	4.19
2009	30,144	81,795	2.71
2010	29,617	128,000	4.32
2011	30,868	112,000	3.63
2012	37,150	150,000	4.04
2013	38,116	88,600	2.32
2014	39,330	80,000	2.03
2015	40,597	144,000	3.55
2016	42,570	170,000	3.99
2017	47,766	78,000	1.63
Average	33,490	101,952	3.04

Source: TSI, 2019

**Table 2** Consumption of pistachio per capita and marketing in Turkey

Years	Import (tonnes)	Export (tonnes)	Total consumption (tonnes)	Consumption per capital (kg/year)
2003	68	1 038	89,030	1.33
2004	120	757	29,363	0.43
2005	37	823	59,214	0.86
2006	79	864	109,215	1.57
2007	84	975	72 525	1.03
2008	84	2 621	117,576	1.64
2009	197	2376	79,616	1.10
2010	14	717	127,297	1.73
2011	10	1160	110,850	1.48
2012	0	2328	147,672	1.95
2013	266	3948	84,918	1.11
2014	15	821	79,194	1.02
2015	15	3154	140,861	1.79
2016	29	4 710	165,319	2.07
2017	8	2 706	75,302	0.93
Average	68	1933	99,302	1.34

Source: FAO, 2019; TSI, 2019

power for pistachio, while in 2005, 2009, 2010, and 2014, consumers' purchasing power decreased; in other years, it increased.

According to the signs which are estimated in the model for the pistachio supply function, there is a linear relationship among the hazelnut producer real price, fertilizer real

price, diesel real price, trend (time), and periodicity; and there is an adverse relationship between walnut producer real price and agricultural laborer price. Additionally, it can be seen that there is a linear relationship among the pistachio production and hazelnut producer real price, fertilizer real price, and diesel real price. This situation

**Table 3** According to current prices: marketing margin in Turkey

Years	Producer prices (£/kg)	Consumer prices (£/kg)	Marketing margin	Producer yield (%)	Commissioner yield (%)
2003	5.01	12.25	7.24	40.87	59.13
2004	6.03	11.67	5.64	51.68	48.32
2005	6.23	13.73	7.51	45.34	54.66
2006	6.53	15.82	9.29	41.25	58.75
2007	6.99	15.32	8.32	45.67	54.33
2008	6.81	17.32	10.51	39.31	60.69
2009	7.85	19.46	11.61	40.33	59.67
2010	11.07	26.20	15.13	42.25	57.75
2011	11.19	26.21	15.03	42.67	57.33
2012	10.08	26.76	16.68	37.67	62.33
2013	11.23	29.63	18.40	37.89	62.11
2014	19.12	47.96	28.83	39.87	60.13
2015	17.46	51.32	33.86	34.02	65.98
2016	15.79	46.97	31.18	33.61	66.39
2017	19.09	58.31	39.22	32.74	67.26

Source: Authors' own calculations

**Table 4** Pistachio marketing margin according to real prices in Turkey (2017 = 100)

Years	Producers prices ( /kg)	Consumer prices ( /kg)	Marketing margin	Producers income (%)	Commissioners income (%)
2003	15.63	36.58	20.95	42.73	57.27
2004	17.33	31.51	14.18	55.00	45.00
2005	16.55	34.26	17.72	48.29	51.71
2006	15.82	35.96	20.14	44.00	56.00
2007	15.59	32.74	17.15	47.62	52.38
2008	13.74	32.84	19.11	41.83	58.17
2009	14.91	36.45	21.54	40.90	59.10
2010	19.37	45.24	25.87	42.81	57.19
2011	18.38	40.74	22.36	45.12	54.88
2012	15.21	39.21	23.99	38.80	61.20
2013	15.76	41.55	25.78	37.94	62.06
2014	24.66	60.99	36.33	40.43	59.57
2015	20.92	62.00	41.08	33.74	66.26
2016	17.55	54.40	36.85	32.26	67.74
2017	19.09	58.31	39.22	32.74	67.26

Source: Authors' own calculations

does not fit with the economics theory. After using the time series data, it is possible to occur adverse results for the economics theory in the signs of the coefficients.

In the model while  $R^2$  value is high (0.952), in the  $F$  test, pistachio supply function model is statistically significant in the 1% ( $P = 0.002$ ) significance level. Additionally, it is determined that independent variables, walnut producer real prices, and periodicity are statistically significant in 10% significance level; other independent variables are insignificant.

Results of regression analysis about pistachio supply function

PP	Coefficient	Standard error	$P$ (t)	$P$ (F)
$\alpha$	223021	161094	0.216	0.002
PPP	1812	1834	0.361	
HPP	12185 *	5254	0.060	
WPP	- 19700 *	8594	0.062	
FP	57808	45881	0.255	
LP	- 4787	3785	0.253	
DP	6541	11670	0.595	
T	14301	8069	0.127	
P	26620 *	12959	0.086	

Significant in \*10%, \*\*5 %, and \*\*\*1% significance level

According to the signs which are estimated in the pistachio demand function, there is an adverse relationship among the pistachio consumer and pistachio consumer real price with national income, and there is a linear relationship among the hazelnut consumer real price, walnut consumer

real price, population, and periodicity. While it was expected a positive relationship between pistachio consumption and national income, the relationship occurred as negative.

In the model while  $R^2$  value is high (0.924), in the  $F$  test, pistachio demand function model is statistically significant in the 1% ( $P = 0.000$ ) significance level. Additionally, it is determined that independent variables, pistachio consumer real price, and population in the 5% significance level and periodicity in the 1% significance level are statistically significant, other independent variables are insignificant. Periodicity has influence not only in production but also in consumption.

Results of the regression analysis about pistachio demand function

PC	Coefficient	Standard error	$P$ (t)	$P$ (F)
$\alpha$	- 780821 **	259881	0.017	0.000
PCP	- 2442 **	881	0.024	
HCP	611	483	0.242	
WCP	1789	1364	0.225	
NP	15 **	5	0.017	
NI	- 9 *	4	0.063	
P	532826 ***	7426	0.000	

Significant in \*10%, \*\*5%, and \*\*\*1% significance level

### Discussion

Aksoy et al. (2002) determined that in the case of Pistachio supply equality, there is a positive relation between pistachio productivity per ha and producer's income ( $R^2 = 0.988$ ).

**Table 5** Producer-and consumer-chained index in current prices in Turkey and inflation rates

Years	Producer-chained index	Producer index difference	PPI	Consumer-chained index	Consumer index difference	CPI
2003	100.0	-	13.9	100.0	-	18.4
2004	110.9	10.9	13.8	86.2	- 13.8	9.3
2005	95.5	- 4.5	2.7	108.7	8.7	7.7
2006	95.6	- 4.4	11.6	104.9	4.9	9.7
2007	98.6	- 1.4	5.9	91.1	- 8.9	8.4
2008	88.1	- 11.9	8.8	100.3	0.3	10.1
2009	108.5	8.5	5.9	111.0	11.0	6.5
2010	129.9	29.9	8.9	124.1	24.1	6.4
2011	94.9	- 5.1	13.3	90.1	- 9.9	10.5
2012	82.8	- 17.2	2.5	96.2	- 3.8	6.2
2013	103.6	3.6	7.0	106.0	6.0	7.4
2014	156.5	56.5	6.4	146.8	46.8	8.2
2015	84.8	- 15.2	5.7	101.7	1.7	8.8
2016	83.9	- 16.1	9.9	87.7	- 12.3	8.5
2017	108.8	8.8	15.5	107.2	7.2	11.9

Source: Authors' own calculations

Additionally, according to the analysis results, pistachio retail price, income, and walnut retail price parameters' coefficients are adverse to the economics theory.

In the study of Karacan and Ceylan (2017), an analysis on Turkey's amount of pistachio fruit, particularly in Turkey, prices, and growing area of the historical background shows influence along with other non-price factors, affecting the Turkey's Food and Agriculture Organization used by the Statistics Authority. Partial correlation coefficients were observed, together with the amount of pistachio production, price, production area, number of trees, and competitor countries. Periodicity in production, delay of production amount, is seen in negative parameter value. It was understood that 30% of the production amount of the previous year was variable as the number of trees used experimentally. According to the *F* statistic, all independent variables together were significant in 99% assurance.

Özkan et al. (2011) expected production and price for agricultural products can be correlated with the quantity and prices of previous years. Producers are making changes on production decisions considering the realizations of previous years because it is not possible to change the product supply in the same period as the figures of the current year. This also applies to non-price factors. Producers cannot change production decisions when faced with a seasonal price shock, climate change, or legal change. Accordingly, in order to decide the production of the current year, they have to observe the price levels and market movements of the previous years. The supply of single-year agricultural products is a function of the price of the previous year, but pistachios are multi-

annual and the production decision cannot be changed. Therefore, it is thought that the production decisions of Pistachio nuts give a hypothetical 1-year delay response. The same approach was used in my study.

According to the study of Dağdemir (1998), in the period from 1975 to 1994, economic analysis study is focused on measuring fluctuations and fluctuations in the price of onions. Marketing margins are calculated according to current and real prices. Producer and consumer chain indexes were calculated according to real prices and compared with annual inflation rates. The relationship between onion production amount and producer real price was examined, and "Cobweb Theorem" was applied to determine cyclical movements. The supply elasticity of  $De > Se$  onion was found to be greater than demand elasticity. As a result, angry cobweb has emerged. In pistachio,  $Se < De$  was determined.

### Conclusion

According to the pistachio supply and demand functions, supply elasticity is ( $Se$ ) 0.306, demand elasticity ( $De$ ) is 1.055. According to the Cobweb theory when the  $Se < De$ , prices approaches to the periphery from the core, cycle moves decreases as the fluctuations shrinks. Consumers' sensibility to price is much more than the producers in the pistachio.

### Abbreviations

TSI: Turkish Statistical Institute; FAO: Food and Agriculture Organization; AEPDE: Agricultural Economic and Policy Development Institute; Se: Supply elasticity; De: Demand elasticity

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