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An Econometric Analysis of Apricot Supply and Export Demand in Turkey

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Abstract: This study estimates a supply model for apricots and an export demand model for dried apricots for Turkey to provide unit-free measure coefficients for better supply and marketing management. Using parameter estimates from the models and sample average data, elasticities of long-run supply, price-yield and export of dried apricots were computed as 0.72, 0.54 and -0.87 respectively. From the price dependent export demand model, the price flexibility of dried apricots was calculated as –0.71. In this study, the import demand elasticities of dried apricots for major destination countries were estimated and found to be inelastic. An evaluation of aggregated household consumption expenditure data indicates that the demand for fresh apricots will increase as per capita real income, population and urban population go up, but the growth in domestic demand for dried apricots and apricot jam will gradually increase as per capita income, population and urban population go up. According to the supply and export demand elasticities of dried apricots, without either supply control or demand expansion, apricot growers' income will not be stabilized.

Key Words: Apricot, Turkey, Supply, Export Demand Analysis

Türkiye Kayısı Arz ve İhracat Talebinin Ekonometrik Analizi

Özet: Bu çalışmada, Türkiye'de kayısı pazarlamasında karar alıcıların politika belirlemelerine yardımcı olacak bazı temel ekonomik analiz araçları (esneklik) tahmin edilmiştir. Çalışmada arz ve ihracat talep modellerinin tahmininden elde edilen parametreler ve dönem ortalamasına ait değerlerden, kayısının uzun dönem arz, fiyat-verim ve ihracat talep esneklikleri sırasıyla 0.72, 0.54, ve -0.87 olarak hesaplanmıştır. Fiyat bağımlı ihracat talep modelinden kuru kayısı ihracatının fiyat esnekliği -0.71 olarak tahmin edilmiştir. Önemli ithalatçı ülkeler için talep esneklikleri tahmin edilmiş ve bunlar az esnek bulunmuştur. Toplulaştırılmış tüketim harcamaları verilerinin değerlendirilmesi kişi başına gelir, nüfus ve kentli nüfus artışının taze kayısı tüketimini artıracağını, buna karşın kuru kayısı ve kayısı reçeli talebinin ise çok az artış göstereceğini göstermektedir. Kuru kayısı arz ve ihracat talep esnekliklerine göre, kuru kayısı arzını kontrol etmeden veya talebini artırmadan, kayısı yetiştiricilerinin gelirleri stabilize edilemeyecektir.

Anahtar Sözcükler: Kayısı, Türkiye, Arz, İhracat Talep Analizi

Introduction

Turkey has been the largest apricot producing and exporting country in the world for decades (FAO, 2002). According to the annual average of the 1999-2001 crop years, Turkey's annual apricot production accounted for 20.6% of world production. As seen in Table 1, apricot production, numbers of fruit-bearing trees and non-fruit bearing trees in Turkey increased 4.2-2.4-and 2.2-fold between the 1979-1981 and 1999-2001 periods. Malatya province in Eastern Anatolia supplies the largest portion of apricot production (Table 1), particularly dried apricots, which accounted for 58% of Turkey's annual production during 1999-2001.

According to FAO trade statistics, Turkey's share of the world's dried apricot exports in terms of volume was 77.8% annually in 1999-2001. Turkey's dried apricot exports quantity progressively increased 10.7-fold during the last 2 decades, and reached 76,900 thousand in 1999-2001 (see Table 2).

However, export revenues obtained from dried apricots did not increase at the same magnitude over the last 2 decades. Indeed, they only increased 5.1-fold

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Table 1. Apricot supply in Turkey and Malatya Province.

Periods	Turkey			Malatya		
	1	2	3	1	2	3
1979-1981	105	4.533	1.197	37	1.012	226
1999-2001	445	10.678	2.635	257	5.620	969
Increase Ratio (times)	4.2	2.4	2.2	6.9	5.6	4.3

Source: Tarımsal Yapı ve Üretim, DİE Yayınları, Çeşitli Yıllar, Ankara.
1: Production (thousand tons), 2: Fruit bearing trees (thousand), 3: Non-fruit bearing trees (thousand)

Table 2. Dried apricot exportation of Turkey and Malatya Province.

Periods	Turkey		Malatya*		
	Exportation Tons	$ 1000	Production Tons	Exportation Tons	$ 1000
1979-1981	7.174	21.469	10.167	7.014	21.127
1999-2001	76.889	109.480	59.024	70.598	100.523
Increase Ratio (times)	10.7	5.1	5.8	10.1	4.8

Source: Dış Ticaret İstatistikleri, DİE Kayıtları, Çeşitli Yıllar, Ankara.
* Malatya Tarım İl Müdürlüğü Kayıtları

between the two periods and reached $109 million (Table 2). According to FAO trade statistics, in terms of volume, the USA is the largest dried apricot importing country with a (15.9) (%) global market share (Table 3), followed by England (8.6) (%), France (6.2) (%), Australia (5.0) (%), Holland (2.7) (%), Canada (2.4) (%), Japan (1.3) (%), Italy (1.2) (%) and Israel (1.1) (%).

Apricot Producer and Export Prices in Turkey

According to the producer price in Figure 1, the total market demand growth for fresh apricots has been greater than supply growth during the last 3 decades. However, the export price trend of dried apricots exhibited a downward trend over the last 2 decades, particularly in the last half of the most recent decade (Figure 2). Turkey's dried apricot export price can be assumed to equal the world price due to its higher share in world trade. This, in turn, implies that fluctuations in world dried apricot prices mainly depend on Turkey's export quantity. Exchange rates may be another source of dried apricot export price fluctuations in Turkey.

Apricot Consumption in Turkey

The data in Table 4 implies that per capita fresh apricot consumption increases as per capita income and population go up. Dried apricot and apricot jam

Table 3. World dried apricot importation (metric tons).

Periods	US	England	France	Australia	Canada	Israel	Italy	Japan	Holland	World
1979-1981	1712	1.146	1.361	88	582	-	347	-	742	14500
Share (%)	11.8	7.9	9.4	0.6	4.0	-	2.4	-	5.1	100.0
1999-2001	16082	8.707	6.282	5.038	2.454	1.111	1.264	1.327	2.757	101.182
Share (%)	15.9	8.6	6.2	5.0	2.4	1.1	1.2	1.3	2.7	100.0

Source: FAO, 2002a. http://www.fao.org

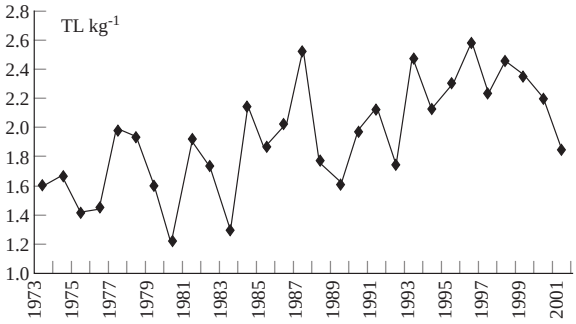

Figure 1. Fresh apricot producer price trend in Turkey (deflated by WPI 1968 = 100).

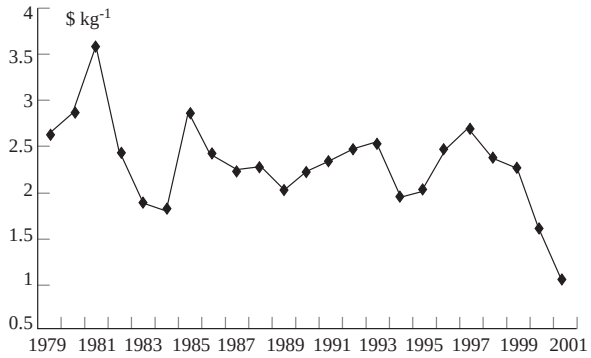

Figure 2. Dry apricot export price in Turkey.

Table 4. Household apricot and apricot products consumption in Turkey (kg y^{-1}).

Income Percentile	Fresh	Dried	Jam
		Rural	
Lower	2.14	0.54	0.29
Lower-Middle	2.51	0.73	0.33
Middle	2.03	0.47	0.53
Upper-Middle	3.50	1.03	0.50
Upper	3.48	0.89	0.67
Average	2.73	0.73	0.46
		Urban	
Lower	1.60	0.27	0.26
Lower-Middle	2.59	0.38	0.20
Middle	3.24	0.39	0.34
Upper-Middle	3.61	0.48	0.23
Upper	4.78	0.82	0.30
Average	3.17	0.47	0.26
		Country Average	
Lower	1.84	0.47	0.25
Lower-Middle	2.61	0.45	0.36
Middle	2.46	0.54	0.37
Upper-Middle	3.55	0.61	0.41
Upper	4.42	0.85	0.36
Average	2.98	0.58	0.35

Source: Authors' calculation from "1994 Household Consumption Expenditure Survey Results" (DİE, 1997).

consumptions also increases with per capita income growth, but dried apricot consumptions declines as urban population increases. Another conclusion that can be drawn from the table is that per capita income growth and urbanization will increase per capita fresh apricot consumption. However, controversially, per capita income growth and urbanization will reduce the consumption of dried apricots and apricot jam. The consumption data given in Table 5 shows that fresh, dried and apricot jam consumptions are positively associated with income, but differences in consumption across provinces seem to be an indicator of consumption habits that can be considered another significant demand shifter in the consumption decision.

It is expected that the recent past trend in the apricot trees inventory number is likely to continue in the near future; therefore production is likely to increase. As is well known, the stability of apricot growers' profitability depends on shifts in both supply and demand curves and also the elasticity of demand. A supply shock will be a serious problem for growers trying to maintain profitability in the near future if the demand for apricots is inelastic. For an exporting country such as Turkey, the demand elasticity of apricots consists of both domestic demand and export demand since a significant portion of apricots are exported, particularly the dried form. In this case, quantitative supply and demand analysis is useful for supply management and market strategies for apricots. For instance, according to standard microeconomic theory, price competition among exporters reduces the total revenue obtained from apricot exportation if export demand is inelastic or less responsive to price changes. However, recent trade statistics indicated a decline in the total revenue obtained from apricots although total exportation significantly increased in terms of volume. This recent evidence in trade data was the motivation behind this study. The aim of this study is to provide quantitative information for apricot growers (growers association), agricultural and trade policy makers and other related parties such as exporters. After this long introductory section, the second section of the study

Table 5. Household apricot consumption in selected provinces (kg y^{-1}).

	Income Percentile											
	Fresh				Dried				Jam			
Province	Lower	Middle	Upper	Average	Lower	Middle	Upper	Average	Lower	Middle	Upper	Average
Ankara	1.28	3.29	3.10	2.64	0.23	1.85	1.68	1.14	0.46	0.45	0.13	0.33
Antalya	3.06	3.41	6.14	3.84	0.00	0.13	0.24	0.13	0.16	0.18	0.09	0.15
Bursa	1.13	1.34	1.94	1.28	0.00	0.19	0.15	0.10	0.16	0.04	0.09	0.10
Diyarbakır	2.32	3.14	5.75	3.65	0.88	0.55	0.85	1.09	0.05	0.75	0.65	0.58
Erzurum	2.35	1.95	3.91	3.11	1.78	1.37	1.22	1.11	1.11	0.43	0.44	0.65
Eskişehir	1.26	3.78	2.41	2.06	0.25	0.17	0.40	0.42	0.18	0.00	0.23	0.09
İstanbul	1.99	2.72	3.01	2.95	0.44	0.02	1.15	0.50	0.15	0.04	0.04	0.23
İzmir	2.51	3.54	5.32	3.97	0.00	0.08	0.46	0.21	0.04	0.00	0.16	0.04
Kayseri	1.48	3.32	4.87	3.91	0.43	2.53	0.43	1.06	0.09	0.00	0.00	0.09
Malatya	6.58	8.09	5.16	6.45	0.60	0.00	0.00	0.22	0.00	0.10	0.00	0.02

Source: Authors' calculation from "1994 Household Consumption Expenditure Survey Results" (DİE, 1997).

explains the methodology employed in the study and the data sources used. The final section presents the main findings of the empirical models and discussions.

Methodology and Data

Apricot Supply Model

Fruit bearing tree inventory numbers change over time due to new planting (YP) and the removal of non-productive trees (K). As is well known, fruit bearing trees may lose their production capability over time due to aging. Externalities, such as frost and pest damage, can also cause a decrease in the production capability of trees. These inherent characteristics of perennial crops and an alternative use of land are the main reason for removing trees. Fruit bearing trees in any given year can be formulated by equation (1). According to this equation (1), the fruit bearing tree number in the current year can be obtained from numbers in the previous year plus new planting numbers in k years before (time requiring from planting to fruit bearing: at least 3 years for apricots in Turkey) and subtracting the numbers of removed trees in the previous year. Equation (1) can be modified into equation (2) if we assume that a new planting decision (YP) depends on the producer price 3 years before (P_{t-3}) and data for removed tree numbers are not available. It is assumed that the effect of removed trees (K) in the regression can be accounted for by a constant and error term. In this study, another econometric model was specified for apricot yield since production is the result of fruit bearing tree numbers multiplied by yield. Equation (3) indicates the yield model for apricots that is specified in terms of expected price (naive expectation or previous year price) and a climate variable (frosty days during March and April). Equation (4) is the product of yield multiplied by fruit bearing trees and indicates apricot production.

In empirical studies, perennial crop supply was specified in terms of crop planting area and yield (Baritelle and Price, 1974; Caman and Green, 1991; Alston et al., 1995; Roseen, 1999). Unfortunately, since crop planting area data are not available in Turkey, we are forced to specify the supply model in terms of tree numbers. This, in turn, implicitly assumes that land is covered by a single variety of trees over time. This assumption may not hold in the long run due to plant variety changes from conventional (tall) varieties to a new one (short and more productive), because the new variety covers less land than conventional ones. Nevertheless, we assume that the historical variety of apricot trees is

homogeneous in terms of size and land requirements. This assumption does not distort the validity of our empirical results, because we did not use data more recent than 2000 and 2001 and we estimated the supply models for only a single major producing province to avoid tree heterogeneity problems.

$$MY_t = MY_{t-1} + YP_{t-k} - K_{t-1}. \quad (1)$$

$$MY_t = f(MY_{t-1}, P_{t-3}) \quad (2)$$

$$V_t = f(P_{t-1}, DG). \quad (3)$$

$$Q_t = (MY_t * V_t) \quad (4)$$

where

MY is the fruit bearing tree numbers in Malatya province, P is the price received by apricot growers deflated by wholesale price index (WPI; 1968 = 100), DG is the frosty days during March and April in the province, V is yield per tree in the province and Q is the fresh apricot production in the province. Karagölge and Peker (1996) specified and estimated an apricot supply function for Malatya province. They used production quantity as a dependent variable, and fruit bearing trees, producer price, meteorological variables, export share in production, and machine numbers used for pest control as explanatory variables. This specification is not consistent with the data generation procedure in Turkey since production is calculated by multiplying fruit bearing trees by yield per tree. The numbers of fruit bearing trees can be equal to production quantity if yield per tree is assumed to be constant for every consecutive year, except periodicity. Consequently, it is meaningless to use other explanatory variables in the equation since the equation is already an approximate identity.

Dried Apricot Export Demand Model

Turkey's dried apricot export demand was specified as a function of export unit value \$ kg^{-1} and trend variables as given in equation (5). An inverse or price (unit value) dependent export demand model was also specified in order to measure the impact of quantity exported on export price (equation (6)). In addition to the total export demand model for dried apricots, individual country import demand models were specified for major countries importing from Turkey (equations (7) and (8)). In these import demand models, quantity imported from Turkey was normalized by the population of the destination country and the model specified as a function of import unit value \$ kg^{-1} and trend (either linear or autoregressive form) variables.

$$Q_t^{Ex} = f(P_t^{Ex}, T) \quad (5)$$

$$P_t^{Ex} = f(Q_t^{Ex}, T) \quad (6)$$

$$Q_{t,c}^{PC} = f(Q_{t-1,c}^{Pc}, P_{t,c}) \quad (7)$$

or

$$Q_{t,c}^{PC} = f(P_{t,c}, T) \quad (8)$$

where

Q^{ex} is Turkey's total dried apricot export quantity, P^{ex} is the unit value of dried apricots exported by Turkey (\$ kg^{-1}), $Q_{t,c}^{PC}$ is the imported quantity of dried apricots by a destination country from Turkey normalized by the country's population (i.e. US dried apricot quantity imported from Turkey divided by US population), $P_{t,c}$ is the unit value of dried apricot export by the destination country (\$ kg^{-1}) and T is the time trend that represents the demand shifter in the destination country. Alston et al. (1995) used a similar import demand specification for almonds for each destination country. They used per capita net imports of each destination country as a dependent variables and almond price, filbert price as the price of a substitute good, and per capita GDP at constant prices in the destination country as explanatory variables. They ignored filbert price in the models specified for some countries. In equations (7) and (8), the substitute good price was not used since a direct substitute does not exist for dried apricots and the trend variable was used as a proxy for per capita income.

Data

The data used in this study were gathered from different domestic public and international institutions. Data concerning domestic fresh apricot production, fruit bearing trees and non-fruit bearing trees were obtained from the Agricultural Summary Statistics and the Agricultural Structure and Production Statistics of the State Institute of Statistics (DİE). Dried apricot production data were obtained from the Ministry of Agriculture and Rural Affairs, Provincial Directorate of Malatya. Producer price, price indexes and export data

(value and quantity in total and break down by country) were obtained from the DİE electronically. The climate variable (frosty days) was obtained from the General Directorate of Meteorology in Ankara. The population numbers of major destination countries were obtained from international statistics (International Monetary Fund). Other data such as world apricot production and major producing- importing countries were obtained from the web page of the FAO. All supply and export demand models were estimated by ordinary least squares (OLS) in best-fitted functional form* .

Discussion and Conclusion

The supply model estimation results are given in Table 6. The price variable (3 year lagged) in the fruit bearing trees equation (second column in Table 6) is statistically significant at the 1% level and the price variable is also significant in the yield equation (1 year lagged) at the 5% level. These results confirm that price is an important factor influencing apricot supply as expected. As seen in the yield model in Table 6, the climate variable (frosty days in March and April) is statistically significant at the 5% level and its coefficient is negative as expected. The supply elasticity of own-price can be assumed as 0.72 (0.18 plus 0.54), but exact supply elasticity is obtained from a simulation model due to the lag structure of price in the models. This supply elasticity can be compared with the elasticity estimation (0.74) given by Karagölge and Peker (1996) although their model specification is not consistent with the existing literature and production theory.

The results of Turkey's total dried apricot exportation are given in Table 7, in which both quantity and price dependent models have relatively high explanatory power. Price explains 96% of the change in quantity exported and unit value explains 62% of the change in export price. The trend variable is also significant (at the 1% level) in both equations. The elasticity of export demand and price flexibility evaluated at the sample mean are -0.87 and -0.71 respectively. To the authors'

Table 6. Apricot supply models (data period: 1976-1999).

	Fruit Bearing Trees (MY: 1000 trees)	Yield Kg Per Fruit Bearing Tree
Variables	Lin-Log	Lin-Log
Intercept	-248.1 (-1.46)	0.00988 (4.16)
Ln (MY_{t-1})	0.55 (3.97)	
Ln P_{t-3}	248.9 (3.30)	
Ln P_{t-1}		0.0217 (2.31)
Frosty Days in March and April		-0.00078 (-1.91)
R^2	0.99	0.28
Adjusted R^2	0.98	0.21
F		3.78
DW		2.03
D (h)	1.25	
Elasticity (Short-run)	0.08	0.54
Elasticity (Long-run)	0.18	

Note: t statistics in parentheses.

* Functional forms selected based on Theil forecast statistics.

Table 7. Dried apricot export demand model estimates (data period: 1980-1999).

	Total Export Quantity (Linear)	Export Unit Value ($ kg^{-1}) (Linear)
Intercept	25872 (3.9)	2.008 (15.3)
Export Unit Value (P_t)	-12978 (-4.6)	
Export Quantity (Qt)		-0.000048 (-4.6)
Trend	3072.9 (18.6)	0.148 (4.5)
R^2	0.96	0.62
Adjusted R^2	0.95	0.56
F	175.3	10.7
DW	1.62	1.99
Elasticity and Flexibility	-0.87	-0.71

Note: t statistics in parentheses.

knowledge there is no other export demand study on apricots in Turkey, but Frenc et al. (1991) estimated the price flexibility for dried apricot in the United States, at the processor level for 1988, as -0.24 and –0.28 using different estimation techniques. Their price flexibility coefficient below 1 suggests that processors are facing an elastic demand (Frenc et al., 1991). The demand elasticity for dried apricots export can also be obtained using the relationship between elasticity and flexibility, such as (e = (1 / flexibility)). According to this relation, the demand elasticity can be calculated as –1.41 if the flexibility model fits data better than the demand model. However, country level demand estimation gives an elasticity that is generally lower than –1.41. In this case, -1.41 can be assumed to be the upper level of the export demand elasticity.

The results of export demand models by destination countries are presented in Tables 8 and 9. All of the models are estimated with precision in terms of determination coefficients, except for Holland. The sign of the price coefficient in all equations is negative and significant at either 1 or 5% levels, except for France. The import price elasticity of Turkish dried apricots for each destination country is presented at the bottom of the tables. Except for Australia and Italy, all other countries have an inelastic demand for dried apricots.

Empirical results obtained by the supply model estimates show that apricots have an inelastic supply in Malatya province in Turkey. According to the price elasticity of apricot supply, production increases by 7.2% in the medium term if producer prices rise by 10% in real terms. This result implies that an increase in the real price will bring more supply to the market in the long run. This, in turn, reduces export prices and the total revenues obtained from dried apricots. This result can also be verified by recent trade data in which Turkey earned $ 110 million with 73,000 t of product (1.52 $ kg^{-1}) in 2000, whereas the previous year's gain was approximately $ 130 million with 58,000 t of product (2.25 $ kg^{-1}). According to the export demand elasticity of dried apricots, quantity exported can be increased by 8.7% if the export price declines 10%. On the other hand, according to the price flexibility (-0.71), export price decreases by 7.1% if the quantity exported increases 10%. These results are indicators of simultaneity in apricot exportation and imply that supply management is required in order to maintain apricot export revenues since the total revenue does not increase with inelastic demand when the price declines in real terms. The import price elasticity of dried apricots by destination countries is also inelastic. According to the results, Turkey cannot earn more from dried apricot exportation if its export price is lowered just like it was in 2000 due to a supply shock and

Table 8. Dried apricot export demand model estimation by countries (data period: 1987-2000).

	USA (LOG-LIN)	Germany (LOG-LOG)	England (LOG-LIN)	France (LOG-LIN)
	1.04	4.197	4.28	4.05
Intercept	-1.89	-12.42	-15	-18.7
	0.954			
Ln Export (t-1)	-5.99			
	-0.385	-0.718	-0.252	-0.16
Export Price (P_t)	(-2.15)	(-1.93)	(-2.1)	(-1.76)
			0.08	0.071
Trend			-10.2	-12.3
		0.289		
Ln (Trend)		-5.51		
R^2	0.8	0.78	0.91	0.95
Adjusted R^2	0.76	0.73	0.9	0.94
F	17.99	17.3	52.4	92.9
DW		1.78	2.79	2.04
D (h)	0.93			
Elasticity	-0.84	-0.71	-0.59	-0.41

Note: t statistics in parentheses.

Table 9. Dried apricot export demand model estimates by countries (data period: 1987-2000).

	Australia (LOG-LIN)	Holland (LOG-LIN)	Canada (LOG-LIN)	Italy (LOG-LIN)
	5.86	5.67	4.11	2.98
Intercept	-8.4	-11.7	-10.8	-15.4
	-0.79	-0.45	-0.38	-0.44
Export Unit Value (P_t)	(-2.8)	(-2.1)	(-1.98)	(-5.7)
	0.1	0.022	0.058	0.099
Trend	-6.2	-1.82	-4.65	-14.9
R^2	0.83	0.4	0.69	0.96
Adjusted R^2	0.79	0.28	0.63	0.95
F	24.8	3.4	11.2	120.9
DW	1.64	1.89	1.2	1.58
Elasticity	-1.87	-0.99	-0.84	-1.09

Note: t statistics in parentheses.

the uncoordinated behavior of exporters. Revenue obtained from dried apricot exportation can be sustained using demand shifters such as advertising and promotion, market diversification, product quality and safety, and product diversification such as fresh product and apricot juice exports.

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