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Econometric Modeling of Turkey's Hazelnut Sector: Implications on Recent Policies*

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Abstract: The hazelnut is an important product in Turkey's economy as it is an important source of income for a large number of family farms and makes up around 75% of world production and 20% of total agricultural exports from Turkey. Hazelnut production has increased in recent years along with high levels of storage and expansion of planted areas from traditional steep lands to flat lands, where alternative cropping is possible. The aim of this study was to determine the major causes of these problems using an econometric model of Turkey's hazelnut sector. Estimation results of the model comply with economic theory and the equations in the model were explained well. The major implication of the model was that the high support price policy implemented for years caused an expansion in hazelnut-planted areas and an excess supply of hazelnuts. The proposed policy with respect to the results of the model is to determine a target price very close to production cost and market price so that farmers are just guaranteed to a certain price level. In addition, direct income support should be paid only to farmers who produce hazelnuts on land within the limits determined by the law and compensation payments should continue for the removal of hazelnut plantations.

Key Words: Turkey, hazelnut, econometric modeling, policies

Türkiye Fındık Sektörünün Ekonometrik Modellemesi: Güncel Politikalara Yönelik Çıkarımlar

Özet: Fındık, çok sayıda çiftçi ailesinin ana gelir kaynağını, dünya fındık üretiminin yaklaşık % 75'ini ve tarımsal ihracatın % 20'sini oluşturması nedeniyle Türkiye'nin önemli bir tarımsal ürünüdür. Fındık üretimi, destekleme fiyatı ve alımı, dikim alanlarının sınırlanması, doğrudan gelir desteği ve alternatif ürün desteği politikaları ile düzenlenmiştir. Bu düzenlemelere rağmen fındık dikim alanlarının eğimli geleneksel fındık alanlarından alternative üretimin yapılabildiği düz taban arazilerine yayılması sonucu arz fazlalığı ve aşırı stok oluşmuştur. Bu çalışmada, Türkiye fındık sektörünü temsil eden beş denklemli ekonometrik bir model kullanarak arz fazlalığı probleminin nedenleri araştırılmış ve sektör için alternatif bir politika önerisi sunulmuştur. Ekonometrik model üç basamaklı en küçük kareler yöntemi ile Shazam ekonometri programında tahmin edilmiştir. Tahmin sonuçları, modelin kullanılan değişkenler tarafından iyi bir şekilde açıklandığını göstermektedir. Fındık piyasa fiyatının önemli derecede destekleme fiyatı tarafından, fındık dikim alanlarının ise piyasa fiyatı tarafından belirlendiği model sonuçlarından anlaşılmaktadır. Ayrıca, üretim maliyeti ve iklim şartlarının fındık üretimini, reklam, fındık toptan fiyatı ve gelir seviyesinin fındık talebini ve dünya fındık fiyatı ve ihracat fonunun fındık ihracatını önemli derecede etkilediği belirlenmiştir. Bu sonuçların önemli bir kısmı literatürdeki sonuçlarla benzelik göstermektedir. Modelden çıkarılan ana sonuç, yıllardan beri uygulanan yüksek destekleme fiyatının fındık dikim alanlarının yayılmasına ve arz fazlalığına neden olmasıdır. Bu sonuçlara göre önerilen politika, üretim maliyetlerine ve piyasa fiyatına yakın bir hedef fiyatın, sadece üreticiye belli bir fiyatı garanti etmek amacıyla belirlenmesidir. Buna ilave olarak doğrudan gelir desteği, sadece kanunla sınırlanan alanlar içinde üretim yapan fındık üreticilerine yapılmalı ve taban arazilerindeki fındık alanlarını başka ürünler yetiştirmek için söken üreticilere alternatif ürün desteği devam etmelidir.

Anahtar Sözcükler: Türkiye, fındık, ekonometrik modelleme, politikalar

Introduction

Hazelnut cultivation is mainly performed on steep lands in Black Sea region of Turkey and it is being an important source of income for a large number of family farms (Dikmen, 1999). Turkey produces 73% of world production and exports 84% of its production, which accounts for around 20% of total agricultural exports from Turkey (Fiskobirlik, 2003).

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The major policies that have been implemented in Turkey's hazelnut sector are (1) price support, (2) restrictions on planted areas, (3) payment for alternative crops and (4) direct income support.

Price supports date to 1938, which was also the year in which Fiskobirlik (Hazelnut Agricultural Sale Cooperatives Union) was established (Bozoğlu, 1999). Continuous losses resulted in these cooperatives being converted into state-run cooperatives and the state becoming the purchasing agent. The hazelnut support price had worked as a floor for prices. But, since the government sometimes did not make payments on time, the producer may have sold to local private handlers and firms at a price lower than the support price level. Nevertheless, Fiskobirlik has made large purchases of hazelnuts at the support price level, resulting in an accumulation of large stocks by the government.

To control the accumulation of stocks, restrictions on hazelnut-planted areas were implemented in 1989 by enacting a new regulation (Başbakanlık, 1989). This regulation restricted hazelnut-planted areas to areas that are less than 750 m above sea level, with at least a 12% slope, and composed of 4th or higher class soil, excluding some specified areas (Başbakanlık, 1990). Despite this regulation, hazelnut production continued in forbidden areas. An additional regulation enacted in 1995 provided a program to pay producers to convert hazelnut-planted areas having young trees to alternative crops (Başbakanlık, 1995). Lack of funds has prevented this regulation from being implemented.

Recently, the Turkish government proposed a direct income support program (Başbakanlık, 2000). The primary reason for this change is Turkey's agreement with the International Monetary Fund and World Bank. The second reason was to bring Turkey's agricultural policy into compliance with the Uruguay Round provisions and to prepare Turkey for potential entry into the European Union. A third impetus is that the high price support has led to large holdings of stocks as the high supports have discouraged consumption and encouraged production (Yavuz et al., 1999). Prior to full implementation, a pilot direct income support program for hazelnuts was first applied in 21 villages in the eastern part of Black Sea region as a result of the cabinet decision enacted on March 14, 2000 (Başbakanlık, 2000). In the case of full implementation, direct income payments are calculated to be US$5.8 million per year for approximately 78,000 hazelnut producers and 115,839 ha of land (Demirci, 2000). According to another cabinet decision, which was enacted and put into effect in April 2001 within the framework of direct income support policy reform, hazelnut plantations in the areas with first, second and third class soil having less than 6% slope will be subject to removal with compensation payments for income losses, input subsidies, and removal costs for hazelnut plantations uprooted (Başbakanlık, 2001).

Hazelnut production has increased in recent years along with the marketing problems in the presence of high levels of storage (Yavuz and Birinci, 1996). There have been numerous debates on the high support price that generated excess hazelnut supply. Hazelnut producers in the western part of the region, who have large amounts of hazelnut-planted areas, have benefited more from the high level of support (Bozoğlu and Kızılaslan, 1999). Small farmers who are in need of cash usually sold their products to handlers or processors at lower prices since the government did not pay on time. Therefore, the market price had been less than the support price but had followed the support price very closely over the last 2 decades (Table 1). These prices have had a very important impact on production level and the expansion of planted areas toward the west of the region while storage levels have remained almost the same in the last 2 decades.

Hazelnut processors and exporters claim that a high support price increased the hazelnut exporting price and thus had a negative impact on the amount of hazelnuts exported because foreign food processing companies substitute almonds for hazelnuts. On the other hand, members of the chamber of agriculture in the region who represent hazelnut producers claim that a high price did not have an impact on the level of hazelnut exports, because the food processing industry does not have an alternative to hazelnuts and has to comply with the demands of consumers (Enderoğlu, 1999). It is also claimed that increased world hazelnut prices would attract competitors to increase their share in the world hazelnut market to the detriment of Turkey. The findings reported by Sarımeşeli and Aydoğmuş (2000) and Table 1 indicate that there is no relation between the demand of importing countries and the prices of hazelnuts and almonds supporting the idea that high hazelnut prices in foreign markets do not decrease Turkey's hazelnut export.

Table 1. Changes in selected indicators of the hazelnut sector, Turkey, 1980-200 (Annual means).

Indicators	1980-1983	1997-2000	Change (%)
Support price (TL kg^{-1}, 1988 = 100)	685.0	1686.7	146.2
Market price (TL kg^{-1}, 1988 = 100)	554.3	1516.8	173.6
World price ($. 100 kg^{-1})	286.5	389.8	36.1
Production (1000 tons, in shells)	322.0	518.0	60.9
Export (1000 tons, shelled)	111.8	193.9	73.4
Production share in the west of the region (%)	37.0	45.0	8.0
Ratio of annual stock to production (%)	25.9	23.4	-2.5

Source: Fiskobirlik, 1975-2001

Given the increased role that prices would assume under the proposed change in policy and the dominant position of Turkey in the world hazelnut market, the objective of this study was to determine the major causes of the problems of expansion of planted areas from traditional steep lands in the east to flat lands in the west, where alternative cropping is possible; excess hazelnut supply; and the high level of storage. A policy option is suggested that could contribute to solving these problems by estimating an econometric model of the sector that would have implications regarding existing policy applications.

Materials and Methods

The data used in this study were collected from institutions within the hazelnut sector such as the Black Sea Export Union, the Agricultural Sale Cooperative Union for Hazelnut, the Trade and Agriculture Chambers in the region and other institutions such as the Provincial Agents of the Ministry of Agriculture and Rural Affairs, research institutes, the United Nations Food and Agriculture Organization, Turkey's State Institute of Statistics and universities. The data are time series for the period of 21 years from 1980 and 2000. Some of the data were used as they are, others were processed into new data that can be used in the model and some others were indexed to real values such as prices and incomes. In addition, some calibrations were made on the data from different sources that were not identical.

The econometric model of Turkey's hazelnut industry includes a system of 5 equations representing market price, planted area, supply, domestic demand and export. Market price, which is an independent variable in the equation of planted area, is explained by support price. Planted area, which is an independent variable in the equation of supply, is explained by 1-year lagged market price. This is because yearly tree plantings are a function of last prices (Baritelle and Price, 1974). The hazelnut supply equation is explained by 5-year lagged planted area, production cost and the dummy variable of climate. The hazelnut demand equation is determined from the market prices of hazelnuts, income level, almond consumer prices and the dummy variable of advertising. This dummy variable represents the adverting since 1998 (Ze Research and Consultation Office, 2000). The last equation explains hazelnut exports by the variables of world hazelnut price, export fund, world almond price, and the initial stock level. Since hazelnut stock was calculated using the identity of (ending stock level) = (beginning stock level) + (domestic production) – (export) – (domestic consumption) assuming imports are zero, stock was not estimated as a behavioral equation in the model.

The econometric model of Turkey's hazelnut sector explained above is represented by the following 5 equations:

$$HMP = f(HSP)$$

$$HPA = f(MP1)$$

$$HPS = f(PA5, HPC, CLI)$$

$$HDC = f(HWP, INC, ACP, ADV)$$

$$HEX = f(HWP, EXF, WAP, IST)$$

where:

HMP: Hazelnut market prices (TL kg^{-1}), 1987 = 100

HSP: Hazelnut support prices (TL kg^{-1}), 1987 = 100

HPA: Hazelnut planted areas (ha)

MP1: One year lagged hazelnut market prices (TL kg^{-1}), 1987 = 100

HPS: Hazelnut production in shells (tons)

PA5: Five years lagged hazelnut planted areas (ha)

HPC: Hazelnut production cost (TL kg^{-1}), 1987 = 100

CLI: Climate impact on annual harvest level, dummy (1 or 0)

HDC: Domestic hazelnut consumption (tons)

HWP: Hazelnut wholesale market prices (TL kg^{-1}), 1987 = 100

INC: Income level (000 TL), 1987 = 100

ACP: Almond consumer prices, (TL kg^{-1}), 1987 = 100

ADV: Advertising dummy (1 or 0)

HEX: Shelled hazelnut exports (tons)

HWP: Hazelnut world prices ($. 100 kg^{-1})

EXF: Export fund (cent kg-1)

WAP: World almond prices ($. 100 kg^{-1})

IST: Initial hazelnut stock in shells (tons)

This simultaneous equation model was estimated in the Shazam econometric computer program (White, 1997) by using Three Stage Least Square (3SLS) estimation procedures (Judge et al, 1988; Maddala, 1992).

Results and Discussion

This model of Turkey's hazelnut market with 5 equations was explained well with a high R^2 (0.997) by the variables used in the model. The model was tested using a Hausman specification test for simultaneity (Pindyck and Rubinfeld, 1998). Simultaneity was not rejected at the 1% significance level and thus the model was estimated as a simultaneous equation model.

The first equation in the model, which identifies hazelnut market price, was explained with a high R^2 of 0.882 by the variable of hazelnut support price (Table 2). The coefficient for support price has a positive sign and is statistically significant. This result indicates that support price influences market price substantially. The second equation explains hazelnut-planted areas by 1-year lagged hazelnut price with an R^2 of 0.685 (Table 3). One-year lagged price of hazelnut affects hazelnut planted areas positively, in compliance with the findings of Bozoğlu and Kızılaslan (1999), and significantly. All these estimations comply with the economic theory, resulting in the specification of the equation being well defined.

The equations of hazelnut market price and hazelnut-planted areas have some implications on the policies that need to be implemented in the sector. The most important implication is that hazelnut market price is affected substantially by the support price level. That is, hazelnut market price is mainly determined by government intervention in the market. Hazelnut-planted areas are mainly determined by 1-year lagged market price. These 2 equations indicate that a high support price level determined by the government has been the most important factor affecting the expansion of hazelnut-planted areas, which is considered an important problem in the hazelnut sector. A high support price increases the hazelnut market price level, encouraging hazelnut-planted areas to expand to land where alternative cropping is possible.

The third equation in the model explains hazelnut supply with a high R^2 of 0.777, including the variables that have significant impact on production in a positive direction by planted areas and fair climate and in a negative direction by production costs (Table 4). These results are in line with the results of Yavuz and Birinci (1996). In fact, the first 2 equations in the model are somehow an expansion of this supply equation because hazelnut-planted areas and hazelnut market price, which

Table 2. Estimates of hazelnut market price equation.

Variables	R^2 = 0.882			
	Coefficient	Standard error	P value	Elasticity
Hazelnut support price	0.9132	0.0689	0.0000	0.9929
Constant	7.4909	84.340	0.9290	

Table 3. Estimates of hazelnut planted area equation.

Variables	R^2 = 0.685			
	Coefficient	Standard error	P value	Elasticity
Hazelnut market price	0.1035	0.0155	0.0000	0.2312
Constant	348.77	17.120	0.0000	

Table 4. Estimates of hazelnut supply equation.

Variables	R^2 = 0.777			
	Coefficient	Standard error	P value	Elasticity
Hazelnut planted areas	3.1636	0.4321	0.0000	3.2404
Hazelnut production cost	-0.3485	0.0775	0.0000	-0.6733
Climate dummy variable	116.66	19.550	0.0000	0.1241
Constant	-681.27	136.40	0.0000	

affects the hazelnut-planted areas, are explained by the first 2 equations. This equation shows that the most important factor affecting hazelnut supply is the expansion in hazelnut-planted areas. The equation also shows that fair climate conditions have a substantial positive impact on hazelnut production while production cost has a negative affect.

Hazelnut demand is the fourth equation in the model and is explained with a high R^2 of 0.905. All the coefficients of these variables have the correct sign complying with economic theory (Table 5). Income level, advertising and wholesale hazelnut prices are statistically significant in the equation while the price of almonds is not at the 5% significance level. The results from the demand equation imply that an increase in domestic consumption depends more on income level and advertising than prices. These results imply that domestic consumption is likely to increase when per capita income increases. The equation also implies that advertising in recent years has increased domestic consumption substantially. This result complies with the results of the Ze Research and Consultation Office (2000). Enhancements in income level with economic development increase hazelnut domestic consumption in the long run, while advertising increases domestic hazelnut consumption in the short run.

Hazelnut exports in the fifth equation are explained with a high R^2 of 0.718. All the coefficients of the variables in the equation have the correct sign complying with economic theory (Table 6). World hazelnut prices, world almond prices and stock level have a positive impact on hazelnut exports while the export fund affects them negatively. These results comply with the findings of Sarımeşeli and Aydoğmuş (2000). The hazelnut export fund, hazelnut world prices and initial stock have a statistically significant impact on hazelnut exports at the

Table 5. Estimates of hazelnut demand equation.

Variables	R^2 = 0.905			
	Coefficient	Standard error	P value	Elasticity
Hazelnut wholesale market price	-0.0035	0.0013	0.0100	-0.1214
Income level	0.0002	0.0001	0.0000	0.5726
Almond consumer price	0.0013	0,0007	0.0780	0.0778
Advertising (dummy variable)	5.1267	1.0760	0.0000	0.0245
Constant	13.349	1.3520	0.0000	

Table 6. Estimates of hazelnut export equation.

Variables	R^2 = 0.718			
	Coefficient	Standard error	P value	Elasticity
World hazelnut price	0.1424	0.0800	0.0750	0.2819
Export fund	-0.5033	0.0849	0.0000	-0.1775
World almond price	0.1966	0.1337	0.1410	0.2599
Initial hazelnut stock	0.0784	0.0463	0.0900	0.0851
Constant	88.620	38.700	0.0220	

10% significance level. The important implication of this equation is that a decline in world almond prices has a negative impact on exports. The equation also implies that ending the export fund, which has already declined from around $1.00 to $0.08 in the last 20 years, increases hazelnut exports. A higher price for hazelnuts in the world market increases hazelnut exports as well.

Conclusions

The main source of the problem of excess supply through the expansion of hazelnut-planted areas to flat lands in the western part of the Black Sea region where alternative cropping can take place is the high support price policy that had been applied for years. Therefore, a target price level should be determined close to the production cost and market price to just guarantee an income for hazelnut producers.

There should be some efforts to increase domestic consumption, which will decrease the excess supply problem in the hazelnut market. According to the results from the model, income level and advertising have a greater impact than the prices of hazelnuts and substitutes. Taking into consideration the fact, that increasing income level very much relies on economic development, advertising should continue to be carried out more intensively to increase domestic consumption.

The results from the model do not comply with the belief that an increase in world hazelnut prices would cause competing hazelnut producing countries to increase their share of the world market to the detriment of Turkey and would have a negative impact on the level of hazelnut exports because foreign chocolate companies would use almonds in place of hazelnuts. The most important activity that should be taken into consideration is the expansion of the world hazelnut market by increasing hazelnut consumption around the world. In addition, application of the export fund, which has a negative impact on hazelnut exports, should be ended.

An alternative policy is proposed in this study, combining the policies that have been in effect for years, such as hazelnut support price, restriction on hazelnut-planted areas, and the policies discussed recently in Turkish agriculture, such as direct income support and compensation payment for the removal of hazelnut plantations on flat land, based on the results of the model. The proposed policy is as follows:

A target price level should be determined very close to production cost and market price level established in the market so that producers are just guaranteed to a certain price level. Direct income support should be paid only to farmers who produce hazelnuts on land within the limits determined by the law. In addition, compensation payments should continue for the removal of hazelnut plantations.

Thus, farmers who produce hazelnuts on flat land where alternative cropping is possible would not be able to receive direct income support and would not be able to enjoy high support price anymore and would be at a disadvantaged. On the other hand, farmers who produce hazelnuts on land determined by the law would enjoy direct income support and would be at an advantaged. They would face a low target price but it would at least be guaranteed. Therefore, expansion of hazelnut plantations where alternative crops can be produced might be ended and hazelnut-planted flat land may decline because of the compensation payments for the removal of hazelnut plantations.

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