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Dynamic Behavior of Onion Prices in Turkey

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Abstract: This study analyzes the onion market and the dynamic behavior of real onion prices in Turkey. The price responsiveness of the supply, demand and export of dry onions was determined. The equilibrium price for producers was derived using the market closing condition of the partial equilibrium model. Price flexibility was also estimated using wholesale market data. The results verified the existence of cyclical behavior of onion prices in the market. The elasticities evaluated at the sample mean were 0.26, -1.02, and -0.24 for supply, export demand and flexibility respectively. The household consumption data indicates that per capita consumption of onions increases as income grows and decreases as the urban population rises.

Key Words: Turkey, Onion Markets, Dynamic behovior of the Onion Price, Price Dynamism, Price Flexibility

Türkiye'de Soğan Fiyatlarının Dinamik Davranışı

Özet: Bu çalışmada, Türkiye'de kuru soğan pazarını ve fiyatlarının dinamik davranışını analiz edilmektedir. Çalışmada kuru soğanın talebi, ihracatı ve arzının fiyat duyarlılığı belirlenmiştir. Kısmi denge modeli ile denge şartından üretici denge fiyatları türetilmiştir. Çalışmada aynı zamanda "Ankara Toptancı Hal'inden" alınan veriler kullanılarak soğanın fiyat fleksibilitesi de tahmin edilmiştir. Çalışma sonuçları soğan fiyatlarının devresel hareket sergilediğini doğrulamıştır. Gözlem değerlerinin ortalamasından arz ve ihracat talep esnekliği ve fiyat fleksibilitesi sırasıyla 0,26, -1,02 ve –0,24 olarak hesaplanmıştır. Hane halkı tüketim verileri kişi başına kuru soğan tüketiminin gerilin büyümesiyle artacağını ve şehirleşme ile azalacağını göstermektedir.

Anahtar Sözcükler: Türkiye, Soğan Pazarı, Soğan Fiyatlarının Dinamik Davranışı, Fiyat Hareketliliği, Fiyat Fleksibilitesi

Introduction

The onion is an important staple in the Turkish diet. It is generally consumed with different vegetable dishes, salads and staple dishes like beans, rice, and bulgur dishes Dry onions are only stored within the year of production in Turkey. Therefore, they are not stored for more than one production year. They are an annual crop in Turkey and are produced once a year. All of the production is consumed or exported within the production year (not calendar year). DRY onions are generally produced by small and medium-sized farms (20-49 decares) in Turkey (Anonymous, 1994). This is an indication for commercial production. According to statistics (Anonymous 1998), 80 percent of the production is supplied to the market (Ağaoğlu et al., 1987).

Two types of onion production system can be distinguished in Turkey. These are backyard and commercial production. The backyard production is for home consumption. The commercial production is realized in agricultural fields (Ağaoğlu et al., 1987). According to the average of recent years, onion cultivated areas comprise approximately 0.56 percent of the total sown area and 13 percent of the vegetable production area (Anonymous,1998).

The production, disappearance consumption, yields and export of onions have increased substantially since the reference period given in Table 1. As can be seen from the Table, the onion planted area increased 41 percent from the beginning of the last decade to the1996-98 period. This percentage growth is 3.4 times greater than the expansion of the total cultivated area in agriculture over the last 20 years. The onion yield per hectare increased from 14.2 tons to 20.7 tons over the same period. The percentage change in yield is also substantial (45.3%) from 1979-81 to 1996-98. Onion

production also rose from 1016 thousand tons in 1979-81 to 2090 thousand tons in the 1996-98 period.

The increase in production is approximately 106 percent between the two periods. It is clear that the source of the production growth is the expansion in area and yield. The growth in total domestic market demand is 105 percent between the two base periods (see Table 1). The per capita annual disappearance also increased from 21.3 kg per year to 30.9 kg per year during the same period. Trade volume is 7.2 percent of production during the 1996-98 annual average. Annual earnings from this export were 23.3 million $ U.S. for the same years. However, trade statistics indicate that trade volume has increased more than trade value. This means that the export price has declined since the 1980's.

Table 2 presents information about household onion consumption. As seen in this Table, per capita consumption at home is considerable lower than disappearance. If we consider losses (during the harvest and marketing channel) in the calculation of disappearance, differences between two sets of consumption data are still very high. Although we do not have enough information to adjust disappearance consumption with the losses during the harvest and marketing channel, we doubt the accuracy of the disappearance data. Nevertheless, adjustment of the disappearance consumption with losses at fixed percentage does not change the empirical results of the study. Table 2 shows that per capita consumption increases as per capita income rises and it decreases with migration from rural to urban areas.

Except in 1983, the dry onion price is determined by competitive market conditions. This means that changes in the supply, trade and domestic disappearance consumption of onions determine the change in the real price of onions in Turkey. Figure 1 displays the price received by farmers, the retail price and the gross margin between farm and retail. It can be seen in Figure 1 that changes in real prices are very dynamic, they vary from one year the next, and display cobweb behavior. The retail onion price was equal to or lower than the farm price in 1985, 1986 and 1990. This is a good indication of the lack of information about supply and demand conditions, and also an indication of asymmetric information in the market. Although the onion market is very dynamic and onion farming is a very important activity in Turkey, the empirical analyses are very few and also some of them are very simple.

Özsoy and Güneş (1990) studied the onion market with the cobweb framework and estimated the supply elasticity to be 0.154. They also estimated the demand elasticity of onion to be –0.158. Şengül and Erkan (1994) studied the seasonal behavior of prices and the supply of onions. They found that the current onion price is related to population. The correlation coefficient in

Table 2. Household Onion Consumption in 1994 (Per capita Kg/Year)

Income Quintile	Rural	Urban	Turkey
Lower	9.4	6.8	8.5
Lower Middle	11.1	7.4	9.3
Middle	10.8	8.8	9.9
Upper Middle	11.8	8.7	9.9
Upper	12.3	10.7	11.0
Average	11.2	8.5	9.8

Source: Anonymous, 1997/a.1994 Hane Halkı Gelir ve Tüketim Harcama Anketi Sonuçları, DİE Yayınları, Ankara.

Table 1. Dry Onion Supply and Usage During the Last Two Decades.

	1979-81	1996-98	Percentage Growth
Area (Thousand Hectares)	71.3	101.0	41.6
Yield (Metric Ton/Hectares)	14.2	20.7	45.3
Production (Thousand Metric Tons)	1016.7	2090.0	105.6
Consumption (Thousand Metric Tons)	947.4	1940.3	104.8
Per Capita Disappearance (Kg/Year)	21.3	30.9	45.0
Net Trade Volume (Metric Tons)	69.3	149.7	116.1
Net Trade Value (Million $ U.S.)	12.5	23.3	86.6

Source: www.fao.org.
İGEME Kayıtları 2000.
Anonymous, İstatistik Yıllığı, DİE Yayınları (Çeşitli Yıllar), Ankara.

their study was 0.7484 between the current onion price and population. Bayaner (1996) estimated area response for onion and calculated short-run and long-run price responses. Dağdemir (1998) found the correction coefficient to be 0.88 between onion price and onion sowing area.

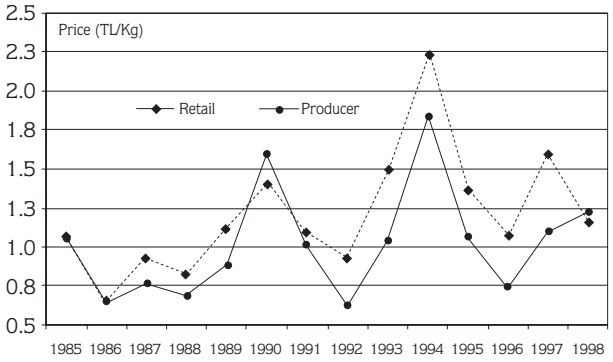

Figure 1. Producer and Retail Prices of Onions (WPI:1968=100)

The lack of structural coefficients and elasticities of onion supply, demand, and trade motivated us to analyze the onion market in Turkey in order to get information about the price responsiveness of supply, domestic disappearance consumption and net trade (net export), and to determine the equilibrium price. The following section describes the methodology and data for the partial equilibrium analysis. Model estimation results for the components of the market equilibrium are given in section three. Some important findings and concluding remarks are given in the final section.

Model Specification

The indirect profit function proves that supply is a function of output price, factor prices and the level of technology. In accordance with the indirect profit function and Nerlovian supply specification, we specified the supply function in terms of area and yield response in order to obtain more plausible statistical and structural results, because the output price response of area and yield may be interest for some other purposes.

$$A_t = f\,(A_{t-1}\,,\, GR_{t-1}\,,\, T) \qquad (1)$$

$$Y_t = f\,(T) \qquad (2)$$

$$Q_t^s = [A_t * Y_t] \qquad (3)$$

$$Q_t^d = f\,(M_t\,,\, P_t^r) \qquad (4)$$

$$Q_t^{NT} = f\,(P_t^f\,,\, T) \qquad (5)$$

Where A is the area sown for onions, Y is the yield per hectare, GR is gross return (yield multiplied by producer price), M is the per capita gross domestic product, P^r is the retail price and P^f is the farmer price (in real terms), and T is the linear time trend (representing technological advances in the supply equation and external factors for the net trade). It is commonly assumed that cobweb phenomena exist in agriculture. According to this assumption, the level of current supply is determined by the lag of the output price and other supply shifters or exogenous variables. The current price of the output is determined by the level of current output and some other explanatory variables. Primarily we tried to estimate a recursive model for onions, but we did not manage to achieve a correct and significant response for the price equation. Our recursive model estimation effort indicated that own-price does not have the correct sign. This result may be due to measurement errors in disappearance consumption and consumer price. However, if the product makes up a small percentage of the food budget and its consumption is associated with some other demand shifters, the consumption of this good does not give a significant response to price changes. For instance, we employed bean prices as an explanatory variable and we obtained a significant complementary relationship. However, since one of the purposes of this study was to provide an equilibrium projection for the near future, we did not use bean prices in the demand equation. Consequently, in this study, the synthetic demand equation was defined in log-linear form (Equation 6). The constant term of the synthetic demand model is the minimum consumption measured in the observation period. Own-price and income elasticities of onions reported by the Turkish Ministry of Agriculture and Rural Affairs (MARA) and FAO (the Food and Agricultural Organization of the United Nations) are -0.20 and 0.60 respectively. We also found the income elasticity to be around unity from the primary demand model estimation. We assume that the exclusion of some other explanatory variables may cause overestimation of the income elasticity. Therefore, we assumed income elasticity to be 0.30.

Given the intercept term and price elasticity, the assumed income elasticity produces a lower adjustment term than the income elasticities used in other studies (Anonymous, 1997).

$$ln\ Q_t^d = 2.9 - 0.2\ ln\ P_t^r + 0.30\ ln\ M \quad (6)$$

All of the data was obtained from SIS, and the ordinary least squares (OLS) method was used for model estimation. We also tested the simultaneity in the market with different supply and demand specifications but we did not obtain any evidence of simultaneity.

We further investigated the monthly price behavior of onions with wholesale market level data. We obtained monthly price and quantity data from the Fresh Vegetable and Fruit Wholesale Market of Ankara. The following equation was estimated for price response*:

$$p_t^{WAN} = f\ (p_{t-1}^{WAN}\ ,\ Q_t^{SWAN}) \quad (7)$$

where pWAN is the monthly onion price at Ankara Wholesale Market and QSWAN is the quantity of onions sold in the corresponding month at the same market. Equation (7) was also estimated by OLS.

Table 3. Area Response Model Estimation for Onions (1979-1998)

	Ln (Sown Area)
Intercept	10.57
	(57.6)
Lag of the Dependent Variable	0.000065
	(3.5)
Ln (Gross Return) t-1	0.263
	(3.6)
Ln (Time Trend; 1979 =1)	0.118
	(2.9)
R^2	0.76
Adjusted R^2	0.71
D(h)	0.11
F	16.5
Theil Inequality (U)	0.61
Theil Decomposition	
Bias	0.0000
Variance	0.0690
Covariance	0.9301
Regression	0.0000
Disturbance	1.0000
Elasticity with Respect to Gross Return	0.26

Model Estimation Results

Statistical results of the models are presented in the tables below. As can be seen, the determination coefficients show that the dependent variables are significantly explained by the independent variables. All of the t statistics and F statistics are significant at 1 or 5 percent. D.W. and D (h) statistics do not confirm the presence of serial correlation. Significant coefficients and high determination coefficients are an indicator of the absence of multi-collinearity between explanatory variables (Gujarati, 1988). Elasticities evaluated at the sample mean are presented at the ends of the tables.

The area response elasticity with respect to gross return indicates that a 10 percent increase in gross return will extend the sown area by 2.6 percent. If we assume yield is constant or does not respond to price changes then area response elasticity becomes the supply elasticity of onions.

Bayaner (1996) specified a similar area response model for onions and found short-run and long-run elasticities with respect to gross return to be 0.17 and 0.37 respectively. He included input price in his model and found a significant response. The result of growth model estimation for onion yield shows that the annual average growth rate was 2.3 percent during the observation period. The price elasticity of net trade is negative unity (see Table 5). This implies that net exports are also sensitive to domestic price change. Since the intercept term of the price transmission model is significant, producer price varies proportionally with retail price. This result also means that the gross marketing margin is proportional (Kohls and Uhl, 1998).

Table 4. Yield Response Model Estimation for Onions; Growth Model (1979-1998)

	Ln (Yield)
Intercept	2.602
	(119.3)
Time Trend (1979 =1)	0.0233
	(12.8)
R^2	0.90
Adjusted R^2	0.89
D.W.	1.41
F	163.9
Theil Inequality (U)	0.75
Theil Decomposition	
Bias	0.0000
Variance	0.0260
Covariance	0.9739
Regression	0.0000
Disturbance	1.0000
Annual Average Growth Rate	2.3

* As is known, the equation is consistent with Nerlove's partial adjustment hypothesis.

Table 5. Net Trade Model Estimation for Onions (1979-1998).

	Ln (Net Trade: mt)
Intercept	6.74
	(8.73)
Ln (Producer Price / WPI)	-1.017
	(-6.64)
Time Trend (1979=1)	0.0238
	(2.57)
R^2	0.75
Adjusted R^2	0.71
D.W.	2.25
F	22.1
Theil Inequality (U)	0.34
Theil Decomposition	
Bias	0.0000
Variance	0.0729
Covariance	0.9271
Regression	0.0000
Disturbance	1.0000
Elasticity with Respect to Producer Price	-1.02

Table 6. Price Transmission Model Estimation From Retail to Farm (1979-1998)

	Ln (Farm Price)
Intercept	-0.32
	(-3.32)
Ln (Retail Price)	1.00
	(77.3)
R^2	0.99
Adjusted R^2	0.99
D.W.	1.88
F	5970.1
Theil Inequality (U)	0.22
Theil Decomposition	
Bias	0.0000
Variance	0.0007
Covariance	0.9993
Regression	0.0000
Disturbance	1.0000
Price Transmission Elasticity	1.00

The results of the flexibility model are presented in Table 7. As seen in this table, statistical fits of the flexibility model seem sufficient for consistent economic results. Flexibilities were calculated to be –0.24 and –1.09 at the sample mean for the short run and long run respectively. This means that quantity of onions supplied reduces its own-price substantially.

Since stocks of onions do not exist, estimated and synthetic models are sufficient to close the market or satisfy the equilibrium condition. Figure 2 shows the historical and ex-post behavior of retail prices. Exogenous

Table 7. Price Flexibility for Onions at Wholesale Market Level (1994-1999; Monthly Data; Fresh Vegetable and Fruit Wholesale Market in Ankara)

	Monthly Wholesale Price /WPI*
Intercept	28.68
	(3.50)
Lag of the Dependent Variable	0.78
	(10.6)
Quantity of Onions Sold in Corresponding Month	-0.0000185
	(-2.46)
R^2	0.64
Adjusted R^2	0.63
D (h)	0.84
F	59.6
Theil Inequality (U)	0.90
Theil Decomposition	
Bias	0.0000
Variance	0.1120
Covariance	0.8888
Regression	0.0000
Disturbance	1.0000
Flexibility (Short-Run)	-0.24
Flexibility (Long-Run)	-1.09

*Monthly Price Index of the SIS.

variables (WPI, CPI and exchange rate) are necessary for the baseline projection. These are consistent with the agreement between the Turkish government and the International Monetary Fund on Turkish macro economic data for 2000-2003. The population projection was obtained from the State Planning Organization.

The partial equilibrium model was calibrated from 1998 prices**. It seems that the constructed equilibrium model produces correct behavior of onion prices for the ex-post period. The behavior of the prices also satisfies the cobweb theorem and trend growth.

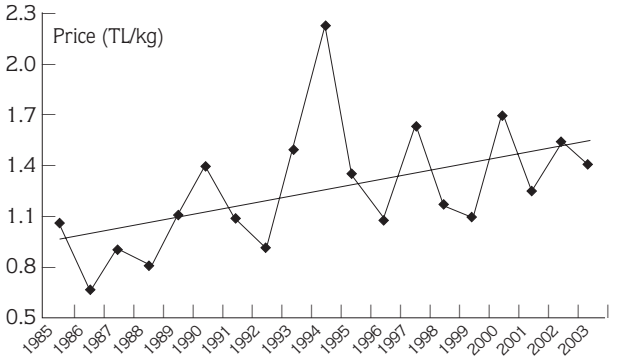

Figure 2. Equilibrium Price Solution Retail Level (1968=100)

** All of the estimated equations are linked in an Excel file in order to derive the equilibrium price of dry onions.

Table 8. Baseline Projection for Onion Supply and Usage

Year	Area (Thousand Hectares)	Yield (Ton Per Hectaares)	Production (Thousand Tons)	Net Trade (Thousand Tons)	Per Capita Consumption (Kg/Year)
1997*	105.0	20.0	2100	109.9	31.8
1998*	100.0	22.7	2270	143.9	33.5
1999	107.1	21.0	2249	172.6	32.3
2000	96.2	21.3	2044	110.8	30.1
2001	109.1	21.5	2345	155.3	32.6
2002	101.1	21.8	2199	126.2	31.7
2003	107.8	22.0	2373	138.6	32.7

* recorded statistical data.

Table 9. Nominal Prices and Marketing Margin (%)

Year	Retail	Producer	Relative Marketing Margin in Terms of Producer Price
1990	1004	1143	-0.12
1991	1210	1125	0.08
1992	1654	1110	0.49
1993	4252	2949	0.44
1994	14290	11777	0.21
1995	16427	12710	0.29
1996	22735	15605	0.46
1997	59732	41066	0.45
1998	75548	79886	-0.05
1999	108073	85996	0.26
2000	234242	186449	0.26
2001	202838	161443	0.26
2002	275932	219648	0.26
2003	266984	212522	0.26

Conclusion

The dynamic behavior of onion prices in Turkey was determined in this study. It seems that the behavioral path of price is warranted and the existence of the cobweb theorem is verified by the partial equilibrium model. Although the cobweb phenomena are not verified by behavioral equations, we found that the cobweb theorem exists for the onion market in Turkey. Furthermore, monthly price movements are very dramatic. Price flexibility indicates that as the quantity of onions supplied increases 10 percent, the price of onions will decline 2.4 percent in the short run and 10.9 percent in the long run. Our results imply that supply has to be managed in order to reduce dramatic price movements from one year to another and within the same year. Thereby, inefficiency in the market may also be reduced with supply management. Price information for producers may be another useful tool for reducing price movements.

Our experience with this study suggests that the onion market in Turkey requires more detailed research using more accurate secondary and survey data in order to better understand the market dynamics.

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