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The Impacts of Beef Prices and VAT on Chicken Meat Consumption: A Partial Equilibrium Approach

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Abstract: This study examines the impact of beef prices and taxes on chicken meat consumption in Turkey. The model presents a partial equilibrium approach for beef prices and chicken meat consumption in Turkey that can be used for simulation and forecasting. The structure of the model follows the vertical chain of the chicken meat sector, allowing equations for the supply, demand and net trade of chicken meat. The price, income, cross-price and tax elasticities of chicken meat were estimated to determine the impacts of beef prices and VAT. According to the analysis, for slaughtered chicken, the price elasticity was 0.37, the income elasticity was 0.95 and the elasticity of chicken meat/beef was -0.81. The tax elasticity was -0.23. The simulation results show that chicken meat consumption will increase during the simulation periods in Turkey.

Key Words: Beef prices, chicken meat, simulation, chicken meat consumption, chicken meat supply

Sığır Eti Fiyatları ve KDV'nin Tavuk Eti Tüketimi Üzerine Etkisi: Kısmi Denge Yaklaşımı

Özet: Bu çalışma vergiler ve sığır eti fiyatlarının tavuk eti tüketimi üzerine olan etkisini araştırmaktadır. Model Türkiye'de sığır eti fiyatları ve tavuk eti tüketimi için simülasyon ve tahminlerde kullanılabilir bir kısmi denge yaklaşımını sunmaktadır. Modelin yapısı, müsaade edilen tavuk eti arz, talep ve net ticaret eşitlikleri ile tavuk eti sektörünün yataysal bağıni izlemektedir. Sığır eti fiyatlarının ve KDV'nin tavuk eti tüketimini belirlemek için tavuk etinin fiyat, gelir, çapraz ve vergi elastikiyeti de tahmin edilmiştir. Analize göre tavuk eti talebinin fiyat elastikiyeti 0,37, gelir elastikiyeti 0,95 ve tavuk eti/sığır eti elastikiyeti -0,81'dir. Vergi elastikiyeti -0,23 olarak bulunmuştur. Simülasyon sonuçları Türkiye'de tavuk eti tüketiminin simülasyon periyodu dönelerinde artacağını göstermektedir.

Anahtar Sözcükler: Sığır eti fiyatları, tavuk eti, simülasyon, tavuk eti tüketimi, tavuk eti arzı

Introduction

In Turkey, 70-80% of chicken enterprises are integrated farms and 70% of them have the capacity of 5,000 chicks per period. These farms are mainly located in peri-urban areas where the population density is high. The number of households raising chickens is 8,038 and they are mainly located in Bolu province (1).

Chicken meat differs from beef in terms of its nutritional properties. Chicken meat per kilo comprises 20.1% protein and 4.7% fat and gives 1,260 calories. On the other hand, beef per kilo contains 9.6% protein and 0.4% carbohydrate and gives 1,720 calories (2). In spite of these differences, consumers in Turkey decide on the basis of price rather than nutritional properties. Being competitive goods, changes in the price of either product lead to different meat preferences. Therefore, attempts

to understand the substitution of chicken meat for meat consumption have concentrated mainly on the analysis of the Turkish chicken meat market.

Chicken meat is of primary importance to Turkey's economy, making it worthwhile to investigate the behaviour of production and consumption decisions of producers and consumers, respectively.

One of the most important problems in this sector is the instability of the price of chicken meat. According to Aykut (3), supply does not usually match demand. This relation between supply and demand has paved the way for a cobweb model where no stable market equilibrium is reached for producers and consumers.

Chicken meat cannot be stored for a long time since it spoils rather quickly and consumers in Turkey prefer fresh chicken meat. On the other hand, the ebb and flow

in chicken meat consumption deriving from seasonal conditions affects chicken meat production. With declining consumer prices, stocks of live chickens rise rapidly. Increasing feed prices also raise the cost of production (4).

The purpose of this study was to estimate the supply, demand, income, cross-price and tax elasticities of chicken meat to determine the impacts of beef prices and VAT. In addition, this study presents a partial equilibrium model for chicken meat consumption in Turkey that can be used for forecasting and simulation purposes.

The rationale for modelling Turkey's chicken meat sector comes from the opportunity to provide policy makers with an analytical tool, mainly for simulating the impact of livestock policies at national level and/or of specific interventions during market crises. The model can also be used for annual price forecasting.

The following section describes the methodology and data used in the analysis. The possible effects of beef price on chicken meat consumption are analysed and empirical results are given. Concluding remarks are provided in the final section.

Materials and Methods

The data used in this study were obtained from the State Institute of Statistics (SIS), Food and Agriculture Organisation (FAO) and State Planning Organization (SPO). Data series are spread over the period 1980 to 1998.

The indirect profit function proves that supply is a function of output price, factor prices, and level of technology (5). The supply function is derived from the profit function and is specified as the number of slaughtered chickens and stocks. The stock level and the number of slaughtered chickens were converted to chicken meat equivalent. In this convention, it is assumed that meat yield per chicken is 1.2 kg (6). The number of slaughtered chickens (SCN_t) is affected by the prices received by farmers (P_t^f) and the time trend (T), as shown in Equation 1. All the price variables were indexed in real terms (1979 = 100 Turkish liras) and world prices were stated in terms of Turkish liras.

$$SCN_t = f(P_t^f, T) \tag{1}$$

Since the growing period of a chicken is generally between 42 and 50 days, production is possible 5 times

a year in this respect, the lag price of chicken meat was not included in this model (7). Stock level (ST_t) is explained by prices received by farmers and the time trend (Equation 2).

$$ST_t = f(P_t^f, T) \tag{2}$$

By using the Nerlovian supply approach, the supply equation can be written as given below (Equation 3). This approach (8) assumes that the supply function is derived from the profit function. Chicken meat supply (Q^s) is defined by the number of slaughtered chickens (SCN_t) and the stock level (ST_t). LW is the live weight per chicken.

$$Q_t^s = [SCN_t LW + ST_t LW] \tag{3}$$

The quantity demanded (Q^d) for chicken meat depends on its own retail price (P^r) and per capita income (PGP). In this model, the value added tax enacted in 1984 was taken as a dummy variable (D) in the demand function to see the extent of its effect on consumption (5). BP^r is beef retail price.

$$Q_t^d = f(PGP_t, P_t^r/BP_t^r, D) \tag{4}$$

Exports and imports of chicken meat mainly depend on changes in the world price of chicken meat (9). In addition, the domestic supply and demand of chicken meat is affected by its domestic price. Here, net trade can be modelled as shown in Equation 5. Net trade (Q^{NT}) is also explained by the domestic price (DP^r) and world price of chicken meat (WP). D is the dummy variable and it has a value of 1 whenever net trade is zero or negative and is 0 otherwise.

$$Q_t^{NT} = f(DP_t^r/WP_t, D) \tag{5}$$

The supply function is defined by factor prices. It is expected that the sign of factor prices will be negative (10). However, firstly an attempt is made to estimate the supply equation, adding chicken feed price as a supply shifter to this equation. Since this variable did not show the correct sign and was insignificant, it was excluded from the analysis (11).

The ordinary least square (OLS) method was used to estimate the parameters. The test of simultaneity of different supply and demand specifications did not provide any evidence of simultaneity (12,13).

In the simulation exercise, the baseline projection begins in 2000 and is calibrated in 1999. Several trials were used in the simulation model. The market is cleared under the conditions of equilibrium. Percentage changes

in the variables used in this study in relation to baseline estimates are presented in the simulation results. In the simulation study, the ex-post behaviour of the equilibrium price is also examined.

Results

With the law that became effective on October 25, 1984, chicken meat prices were made subject to value added tax. As seen in Table 1, the production, consumption, slaughtered chicken stocks and exports substantially increased during the period 1980/82-1996/98. Production of chicken meat during this period increased by 73.08% and caused the prices of chicken meat to decrease. Although consumption of chicken meat increased by 88.80%, the stock of chicken meat could not be reduced; it increased by 165.16%. The increase in per capita chicken meat consumption was 35.13% during this period.

According to the average figures for 3 years, at the beginning and end of the period from 1980 to 1998, the real prices of chicken meat and beef increased by 37%, and 60%, respectively. In the same period, chicken meat consumption rose by 89%. A comparison of prices for the

period concerned shows that the price of chicken meat has a positive correlation with the price of beef, and hence it displayed a dynamic trend rather than maintaining equilibrium. This means that in order to increase the consumption of chicken meat its price compared to beef price has to be lowered by one-third.

Chicken meat prices are determined by market forces. Besides changes in supply, net trade of chicken meat, domestic consumption of chicken meat and changes in beef prices affect chicken meat demand, and hence the price of chicken meat.

The Figure demonstrates real beef and chicken meat prices. Changes in beef prices had a more dynamic character than those in chicken meat prices. This was very clear in 1995 when beef prices rose in real terms, while chicken meat prices decreased.

Table 2 shows that wholesale prices of chicken meat fluctuated more in 1994-98 than in 1988-93. However, the average real price of chicken meat decreased to 0.898 compared to 1.080 maintained in 1988-93. This was in contrast to the case of the average wholesale prices of beef (Table 2). The impact of price fluctuations was limited 1994-98 compared to 1988-93. The coefficients

Table 1. Growth in chicken meat supply and demand during the last 2 decades.

Variables	1980-82	1996-98	Percentage Growth
Slaughtered chickens (number)	221,129,330	382,748,666	73.08
Stock (in thousands)	56,348	149,415	165.16
Production (metric tons)	265,355	459,298	73.08
Consumption (metric tons)	331,477	625,843	88.80
Per capita consumption (kg/year)	7.3	9.8	35.13
Net trade (metric tons)	748	6,328	746.07

Table 2. Descriptive statistics (WPI = 1979).

Year/item	Chicken Meat Price				Beef Price			
	Mean	Median	St. Dev.	CV*	Mean	Median	St. Dev.	CV*
1988-93	1.080	1.1350	0.1606	14.87	2.055	2.155	0.392	19.08
1994-98	0.898	0.900	0.255	28.39	2.504	2.360	0.338	13.50

* The coefficients of variation

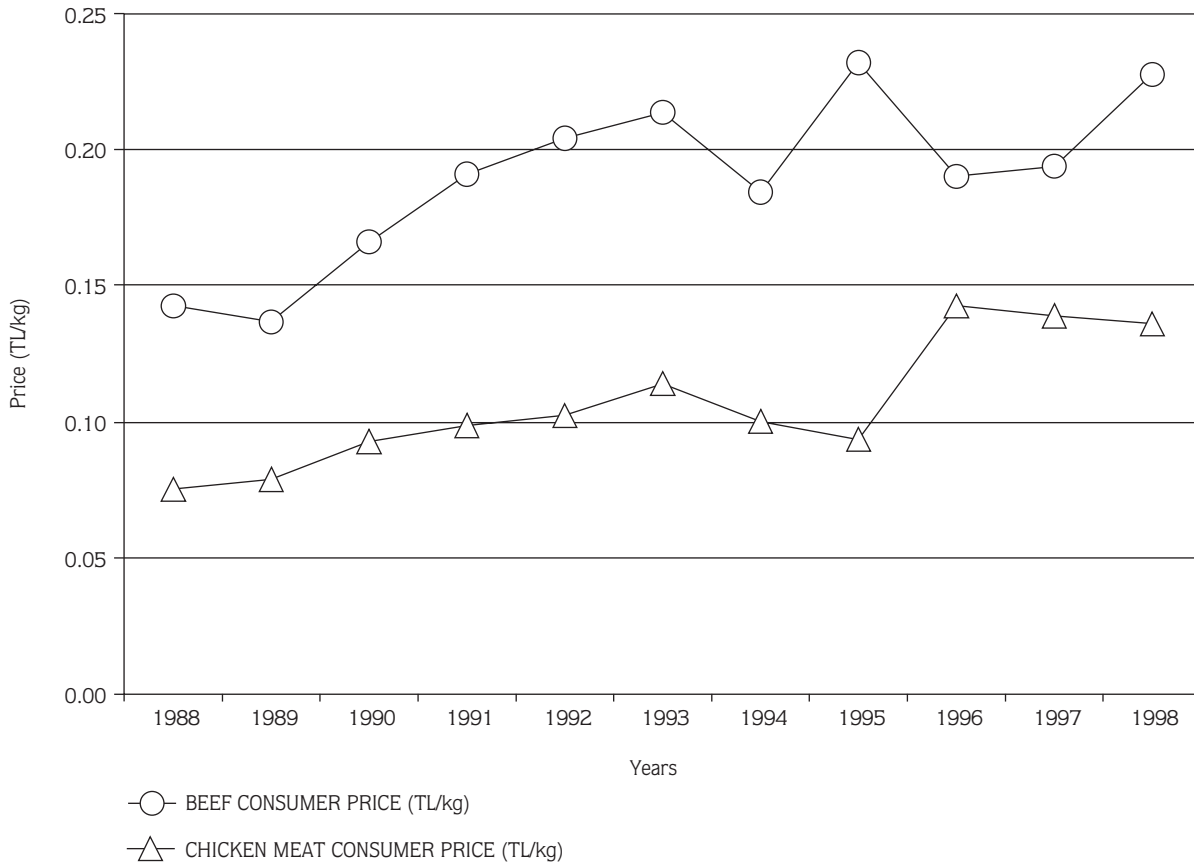


Figure 1. Real beef and chicken meat prices (WPI = 1968).
 Note: (1 US \$ = 1,420 in 1988; 2,120 in 1989; 2,607 in 1990; 4,169 in 1991; 6,868 in 1992; 10,985 in 1993; 29,704 in 1994; 61,054 TL in 1995; 107,505 TL in 1996; 204,750 in 1997; 312,720 in 1998)

of variation were 19.08 and 13.50 during 1988-93 and 1994-98, respectively. Furthermore, producers of beef received a higher price (2.504) in 1994-98 compared to that (2.055) in 1988-93. At the same time, however, chicken producers received less in terms of real prices during 1994-98 (0.898) compared to 1988-93.

Statistical results from the model are presented in Table 3. The coefficient of multiple determinations shows that the dependent variable is significantly explained by independent variables. All F statistics are significant at the 1% level. Except for the variable of chicken meat prices paid by the consumer/beef prices paid by the consumer (P^i/BP^i), the dummy in the demand equation and the variables of domestic price/world price (DP/WP) in the NT equation, the coefficients of the other variables are significant at the 1% level. The variable of P^i/BP^i is

significant at 10%. Their forecast statistics show that the estimation is nearly consistent and unbiased. According to the DW test at 1% significance, the price transmission model, the slaughtered chicken equation and the NT equation give no evidence of serial correlation. However, no decision was made about serial correlation in the other equations since they were in the area of indecision.

Simulation Results

Simulation I: The effects of expectation in the Turkish economy

The macroeconomic expectations of Turkey's economy are presented in Table 4. They are taken from the SPO and SIS. It is assumed that average annual population and GDP growth rate will be 1.1 and 5%,

Table 3. Estimation of the model (coefficients).

Dependent variable	Independent variable	R ²	DW	F
SCN _t	17.90 + 0.37103 Ln (P _t ^f / WPI) + 0.28715 Ln (T) (62.57) (2.99) (794)	0.90	1.48	74.31
ST _t	7.3380 + 0.13522 Ln (P _t ^f /WPI) + 0.4340 (T) (8.56) (3.690) (3.465)	0.87	1.11	55.90
Q _t ^d	-1.3120 + 0.9545 Ln (PGP _t /WPI) - 0.8139 Ln $\left(\frac{P_t^r}{BP_t^r}\right)$ - 0.2303 (D) (-2.05) (5.69) (-1.71) (-2.023)	0.81	1.23	21.72
Q _t ^{NT}	7.5532 - 0.47457 Ln $\left(\frac{DP_t^r}{WP_t^r}\right)$ - 7.2981 (D) (3.18) (-0.12) (-9.32)	0.84	1.29	43.50
LWP	0.8732 + 0.7687 Ln (p _t ^r /WPI) (3.25) (6.50)	0.71	1.35	42.26

Note: Ln = natural log, LWP = Ln (live weight producer price/WPI) (WPI = 1968)

respectively, from 2003 to 2007. During the same period, inflation is expected to increase by 5% using the market equilibrium price as the clearing condition in the model (Table 4). Estimated simulation results are presented in Table 5. Chicken prices paid by the consumer will rise by 8% on average over the baseline figure during the simulation periods. This price change will increase stocks by 8% and production by 3%, annually.

Simulation II: the effect of a 2% increase in beef price

The simulation is tested using the assumptions in Table 4 (expected beef price). Beef price is assumed to be rising by 2%. The increase in chicken meat demand is greater than that in simulation I. In 2001, demand will increase by 7% according to the apparent demand model in simulation I. At the same time, production has also increased by 4% from simulation I. This means that production has risen to cover demand as dictated by the equilibrium condition. Simulation results are presented in Table 6. Chicken consumer prices will rise by 9% on average from the baseline beginning from 2002 and during the simulation periods. This price change will

increase the stock by 8%, production by 2% and demand by 3% for the same period.

Simulation III: the effect of tax

With the assumption given in Table 4, the simulation was tested for the effect of value added tax and it seemed rather apparent that demand would rise. According to simulation I, demand will rise by 17% in 2001. At the same time, the change in stock is 35%, the change in production is 9%, and change in net trade is 0%. As seen in Table 7, chicken consumer prices will rise by 8% on average from the baseline in 2002 and during the simulation periods. These price changes will increase the stock by 7%, production by 2% and demand by 3% over the base values in the same period (Table 7).

Discussion

The results of this study show that an increase in beef prices will raise chicken meat consumption. The implementation of a tax will decrease the consumption of chicken meat. With any tax hike, the demand for chicken meat will increase considerably.

Table 4. Beef price and macroeconomic variable assumptions.

Macroeconomic data	1999	2000	2001	2002	2003	2004	2005	2006	2007
Population (1000 head)	64,385	65,311	66,029	66,756	67,490	68,232	68,983	69,742	70,508
Percentage change from the previous year	0.73	1.44	1.10	1.10	1.10	0.10	1.10	1.10	1.10
GDP at current prices (trillion TL)	83,124	108,061	124,270	136,697	150,367	165,404	181,944	200,139	220,153
Percentage change from the previous year	55	30	15	10	10	10	10	10	10
Wholesale price index (1968 = 100,1000 TL)	10,610	13,262	14,589	15,318	16,084	16,888	17,733	18,619	19,550
Percentage change from the previous year	63	25	10	5	5	5	5	5	5
Beef consumer price (Current price TL/kg,1000 TL)	2,415	3,019	3,320	3,486	3,661	3,844	4,036	4,238	4,450
Percentage change from the previous year	63	25	10	5	5	5	5	5	5
World chicken meat price (Current price TL/kg,1000 TL)	492	615	677	711	746	784	823	864	907
Percentage change from the previous year	63	25	10	5	5	5	5	5	5

Note: (1 US \$ = 540,098 TL in 1999; 671,765 TL in 2000; 1,439,567 TL in 2001; 1,575, 027 in 2002; 1,655,642 in 2003).

Koç et al. (14), using a multi-commodity partial equilibrium simulation model for the Turkish soybean market, estimated the income elasticity as 0.88, and price elasticity as -1.23 from their chicken meat demand model. They also estimated the cross-price elasticity of chicken meat demand to beef as 0.60. The Turkish Ministry of Agriculture (15) estimated demand income elasticity as 0.7 from their study of chicken meat consumption in Turkey. Beghin (16) estimated the price elasticity of chicken meat demand as -0.65 , demand income elasticity as 0.9, and supply own-price elasticity as 0.35; Kasnakoğlu (17) estimated the own-price elasticity of chicken meat demand as -0.44 ; and Koç (18) estimated the own-price elasticity of chicken meat demand as -0.44 . Turkey's SPO makes demand estimates based on an income elasticity of chicken meat of 1.2 (19).

According to this analysis, the price elasticity of chicken meat (for slaughtered chickens) is 0.37, whereas

the income elasticity is 0.95. The elasticity of the chicken meat/beef ratio is -0.81 . Finally, tax elasticity was -0.23 . Price elasticity for the number of the slaughtered chickens supplied was 0.37, which is consistent with the figure of 0.35 estimated by Beghin (16). The income elasticity of demand was 0.95, which is close to what Koç (18) and Beghin (16) estimated for chicken meat. The tax elasticity of chicken meat consumption was -0.23 .

According to the macroeconomic assumptions made in this study, changing beef prices (without applying tax) seem to lead to an increase in chicken meat consumption during the simulation periods.

In simulation I, chicken meat consumption will increase from 657 thousand metric tons to 894 thousand metric tons. In simulation II, chicken meat consumption will grow by 39% from the beginning to the end of the simulation period. In simulation III, growth of consumption is 37% during the simulation periods.

Table 5. Equilibrium price and the impact of price on demand, stock, production and net trade.

Years	1999	2000	2001	2002	2003	2004	2005	2006	2007
Variables	Thousand metric tons								
Chicken meat demand	657	690	715	742	770	799	829	861	894
Change from baseline (per cent)	7	4	2	3	3	3	3	3	3
Chicken meat stocks	209	191	206	222	240	258	278	299	321
Change from baseline (per cent)	15	-8	8	8	8	8	8	8	8
Chicken meat production	453	505	516	528	539	550	561	571	582
Change from baseline (per cent)	3	11	2	2	2	2	2	2	2
Net trade	6	7	7	8	9	9	9	10	10
Change from baseline (per cent)	-1	13	12	9	6	5	4	3	2
Chicken meat supply	663	697	722	750	778	808	838	870	904
	Thousand turkish liras per kg								
Chicken meat consumer price	951	1,328	1,504	1,629	1,763	1,907	2,062	2,228	2,407
Change from baseline (per cent)	23	20	13	8	8	8	8	8	8

Note: (1 US \$ = 540,098 TL in 1999; 671,765 TL in 2000; 1,439, 567 TL in 2001; 1,575,027 in 2002; 1,655,642 in 2003).

Table 6. Effect of changing beef price on demand, stock, production and net trade.

Years	1999	2000	2001	2002	2003	2004	2005	2006	2007
Variables	Thousand metric tons								
Chicken meat demand	658	693	720	749	779	811	844	879	915
Change from baseline (per cent)	7	4	3	3	3	3	3	3	3
Chicken meat stocks	210	193	209	226	245	265	287	311	336
Change from baseline (per cent)	16	-8	8	8	8	8	8	8	8
Chicken meat production	454	506	518	530	542	554	566	578	589
Change from baseline (per cent)	3	12	2	2	2	2	2	2	2
Net trade	6	7	7	8	8	9	9	9	10
Change from baseline (per cent)	-1	15	11	9	6	5	4	3	2
Chicken meat supply	664	699	727	757	787	820	853	888	925
	Thousand turkish liras per kg								
Chicken meat consumer price	954	1,338	1,523	1,658	1,803	1,960	2,130	2,313	2,510
Change from baseline (per cent)	27	16	14	9	9	9	9	9	9
	Assumption (change in real beef price paid by consumer)								
Beef meat consumer price	2,445	3,105	3,477	3,720	3,981	4,260	4,558	4,877	5,218
Percentage change from the previous year (per cent)	65	27	12	7	7	7	7	7	7

Note: (1 US \$ = 540,098 TL in 1999; 671,765 TL in 2000; 1,439,567 TL in 2001; 1,575,027 in 2002; 1,655,642 in 2003).

Table 7. Effect of tax on demand, stock, production and net trade.

Years	1999	2000	2001	2002	2003	2004	2005	2006	2007
Variables Thousand metric tons									
Chicken meat demand	768	804	834	866	899	934	970	1,008	1,048
Change from baseline(per cent)	12	3	3	3	3	3	3	3	3
Chicken meat stocks	281	261	279	300	323	347	372	399	428
Change from baseline(per cent)	35	-7	7	7	7	7	7	7	7
Chicken meat production	492	550	561	573	585	596	607	619	629
Change from baseline(per cent)	11	12	2	2	2	2	2	2	2
Net trade	5	6	7	8	8	9	9	9	9
Change from baseline(per cent)	-9	16	13	10	7	5	4	3	3
Chicken meat supply	773	810	841	874	907	943	979	1,017	1,057
Thousand Turkish liras per kg									
Chicken meat consumer price	1,264	1,786	2,016	2,177	2,349	2,533	2,730	2,941	3,167
Change from baseline(per cent)	36	17	13	8	8	8	8	8	8

Note: (1 US \$ = 540,098 TL in 1999; 671,765 TL in 2000, 1,439,567 TL in 2001; 1,575,027 in 2002; 1,655,642 in 2003).

From the simulation results, it is concluded that the sector will grow within the framework of the assumptions made earlier. However, other variables such as product diversity, transaction costs and consumer health considerations also have an effect on the sector. Yet the unavailability of data on these variables necessitated their exclusion from the analysis.

From the beginning of the 1980s to 1998, chicken meat supply increased by 73.08% and chicken meat demand by 88.8% in Turkey. According to policies adopted in Turkey (simulation I), chicken meat supply will increase by 36.34% and chicken meat demand by 36.07% from 1999 to 2007. With a 2% increase in beef prices (from 1999 to 2007) there will be increases in chicken meat supply and demand (by 39.34% and 39.05%, respectively). If value added tax is removed, the corresponding rates of increase in supply and demand will be 36.73% and 36.45%, respectively. In the same period (1999-2007) consumer prices of chicken meat will increase by 153%.

Because of recent economic crises in Turkey, some large firms have gone bankrupt. Yet there was no decrease in the chicken meat supply. Looking at figures

on actual meat supply for 2001, it can be concluded that the actual case will be close to what is envisaged by the model.

Under the existing policy (simulation I) there is a beef deficit in Turkey and the gap is filled by imports. With chicken meat, on the other hand, domestic supply covers domestic demand and the government is seeking means to export chicken meat. While value added tax on beef is 1%, it is 8% on chicken meat. This policy affects chicken meat demand negatively.

While the prices of imported beef are lower than domestic prices, the domestic prices of chicken meat are far above world prices, which leads to insufficient increases in demand. In Turkey, it is a matter of a short time to increase the supply of chicken meat. Yet, if supply exceeds demand, it will be quite difficult to export the surplus since domestic prices are higher than world prices. Despite the fact that the Turkish government pays 56 US dollars per metric ton export subsidies, total payment is limited to 350,000 US dollars. Given this, it is very difficult for Turkey to increase its exports of chicken meat.

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