Is the Fluid Milk Subsector Competitive in Turkey?

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Abstract: The significant increase in the concentration ratio in Turkey's fluid milk market has heightened concern about the exercise of market power. During 1980-98, the 4-firm concentration ratio and Herfindahl index increased by 11% and 33%, respectively. In this study, we estimated the degree of imperfection in the fluid milk market at retail level using the New Empirical Industrial Organization approach during the period 1980-98. For this purpose, the demand equation and first-order-profit maximization condition, which allow the degree of market power to be determined, were estimated. Using 2-stage-least-square estimation, market power was found to be 0.11. This parameter shows that the fluid milk market is not perfectly competitive, but the behavior of firms is much closer to price taking than to collusion.

Key Words: Turkey's milk market, market power, competition, oligopoly

Türkiye'de Süt Sektörü Rekabetçimidir?

Özet: Türkiye süt sektöründe dört firma yoğunluğundaki önemli artış bu sektörde pazar gücü ile ilgili endişelerin artmasına neden olmuştur. 1980-1998 döneminde, dört firma yoğunluğu ve Herfindahl indeksi sırasıyla % 11 ve % 33 artış göstermiştir. Bu çalışmada 'Yeni Endüstriyel Organizasyon' yaklaşımı ile Türkiye'de süt sektörünün pazar gücü perakende seviyesinde 1980-98 dönemi için tahmin edilmiştir. Pazar gücünü ortaya koyabilmek için talep denklemi ve kar maksimizasyonuna ait birinci seviyeden türev denklemleri elde edilmiştir. İki aşamalı en küçük kareler yöntemi kullanılarak pazar gücü katsayısı 0,11 bulunmuştur. Bu pazar gücü katsayısı, Türkiye'de süt sektörünün tam rekabet şartlarında olmadığını fakat bu sektördeki işletmelerin ortak hareketle fiyatları belirlemediğini ve fiyat oluşumunun tam rekabet koşullarına yakın olduğunu ortaya koymaktadır.

Anahtar Sözcükler: Türkiye süt piyasası, pazar gücü, rekabet, oligopol

Introduction

Over the last 2 decades, major changes have occurred in the field of industrial organization. Due to dissatisfaction with structure-conduct-performance (SCP) studies, the "New Empirical Industrial Organization" (NEIO) method has become more popular (1-3). In contrast to the SCP approach, NEIO studies use aggregate or firm level data in a single industry, and integrate microeconomic theory and advanced structural econometric models based on the price and quantity decisions of firms to measure market power and other market structure relationships. There have been numerous applications of the NEIO approach in the food and tobacco sectors (4-9).

Today, the food-processing sector consists of a relatively small number of large firms. Food-processing companies buy raw products from many farmers, transform them into multiproduct form, and then market the products to consumers through wholesalers or middlemen. The industrial structure often allows food-processing companies to affect both the purchasing of inputs and the selling of products. In essence, they can exercise market power in the food-processing sector as a result of imperfect competition.

The objective of this study was to estimate the degree of imperfect competition in the fluid milk market at retail level of Turkey. The major contribution of this study is to highlight the concern about the fluid milk market, which has been recently scrutinized by the Turkish competition authority. Moreover, this is one of the first studies to use the NEIO approach to measure market power in the Turkish food sector. Given this objective, the institutional background of the fluid milk market in Turkey is presented in the first section. The methodology for estimating market power is given in the second section. Data sources and results of the econometric model are given in the third section and a discussion is provided in the final section.

Institutional Background

Fluid milk production has significant value among animal products in Turkey, accounting for 44.3% in 1999 (10). The organizational structure of the fluid milk subsector is somewhat mixed in that some firms (7%) use advanced technology. On the other hand, most firms (93%) are small, and these firms process milk and milk products under primitive conditions. Modern and primitive firms produce 56 and 44% of the fluid milk in Turkey, respectively (11).

Several important legal and institutional changes have occurred in the fluid milk subsector of Turkey over the last 2 decades. In 1963, the government established the 'Milk Industry Organization of Turkey' (MIOT). The main purposes of the MIOT were to establish and assure fair market prices for both milk producers and consumers, stimulate and lead the private sector, purchase milk from producers and process milk and milk products at MIOT plants. The MIOT used several policy tools to achieve these goals. For example, a milk support program was introduced for the first time and the MIOT started paying premiums to dairy farmers depending on the quality of milk. Moreover, it tried to establish milk cooperatives among milk producers. Due to the inefficiency of the MIOT, it was privatized in 1996.

The dairy industry in Turkey is confronted with a number of structural and institutional problems. One significant problem is mainly due to the marketing structure of fluid milk. Around 47% of fluid milk in Turkey is consumed unpacked, which is often unhygienic and possibly dangerous for human consumption (12). A recent study on consumption behavior in the fluid milk showed that low milk prices and ease of purchase were major factors affecting the purchasing of unpacked fluid milk (13). Several researchers indicated that unpacked fluid milk contained pathogenic organisms above tolerable limits in Turkey (14-17). In addition a recent study indicated that about 80% of raw milk was processed or marketed by various suppliers such as small backyard operators and individual milk sellers without safety controls or any financial records (18). In the same study it was also indicated that as these suppliers operate without financial records, they have around 20% cost advantage over modern dairy firms. Hence, this structure creates unfair competition between small backyard and modern dairy firms that, in turn, prevents the development of modern fluid milk processing companies,

which have only a 20% market share (12,18). Several researchers indicated that the unstable price of fluid milk, high prices of roughage and concentrate, insufficient cold chain and unfair price setting for dairy farmers are other major problems in the dairy sector (18-22).

Over the last decade, there has been an increase in the number of private companies entering the fluid milk market. Pınar and Mis milk are 2 major private companies that process fluid milk and milk products in Turkey (23). During 1980-98, the fluid milk subsector became more concentrated, mainly because of the growth of the largest manufacturers.

The concentration ratio of an industry is used as an indicator of the relative size of firms in relation to the industry as a whole. This ratio assists in determining the market structure of the industry. The most commonly used measures of market concentration are the 4-firm concentration ratio (CR_4) and the Herfindahl-Hirschman index (HHI). CR_4 is defined as the market share of the 4 largest firms in the industry. This ratio ranges from almost 0 for perfect competition to 1 for a monopoly. An alternative to CR_4 that attempts to reflect all the information in the concentration curve is the HHI. For an industry with N firms, this is defined as,

$$HHI = \sum_{i=1}^{n} S_i^2 ,$$

where S_i is the market share of the ith firm. In other words, the HHI is the sum of squares of the market shares of all firms in the industry. The HHI takes into account the relative size and distribution of the firms in a market. The value of HHI approaches zero implying close to perfect competition when a market consists of a relatively large number of firms of equal size (24).

The CR_4 and HHI values in the fluid milk subsector of Turkey are given in the Figure. CR_4 showed a rapid increase from the 40s to 50s during 1980-98. The HHI ranged from 0.04 to 0.14 during the same period. McCorriston and Sheldon (25) indicated that a higher concentration ratio, economies of scale, and product differentiation are the most important factors enabling market power and any one of these could indicate the existence of market power. Given the organizational structure and increasing concentration ratio, we suspect market power might be exercised in this subsector.
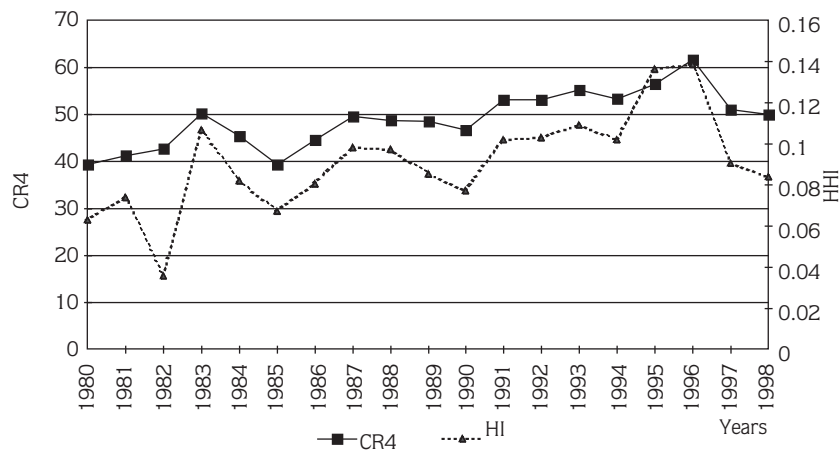
Figure. The four-firm concentration ratio (CR4) and Herfindahl Hirschman index (HHI).

Materials and Methods

Suppose that an industry is considered one in which n firms produce a homogeneous product, $(q_1, q_2, ... q_n)$, and industry output is

$$Q = \sum_{i=1}^{n} q_i.$$

Let the market demand in an industry be given by the implicit function

$$Q_t = Q(P_t, Z_t) \tag{1}$$

where Q_t is the total quantity demanded, P_t is the price of output, Z_t is a vector of exogenous variables that affect demand such as income and the prices of substitute products, and t is a time subscript. Suppose also that aggregate marginal cost (MC) facing the industry is given by the following equation:

$$MC_t = MC(Q_t, W_t) \tag{2}$$

where W_t is a vector of exogenous variables such as factor prices. Assuming that firms are price takers in a given industry, equilibrium price and quantity will be determined by

$$P_t = P(Q_t, Z_t) = MC_t = MC(Q_t, W_t) \tag{3}$$

Equation 3 indicates that the industry is perfectly competitive if perceived industry marginal revenue (MR) equals MC. Defining industry revenue as, $R_t = P_t Q_t = P(Q_t, Z_t)Q_t$, the equilibrium condition is given by the expression

$$MR_t(\lambda) = P_t + \lambda Q_t \left[\frac{dP_t}{dQ_t} \right] = MC(Q_t, W_t) \tag{4}$$

where λ is defined as an index of the degree of market power, that is, the gap between market price and industry MC (26). Bresnahan (26) argues that λ will range from 0 for a competitive industry to 1 for a monopoly. Values between 0 and 1 measure the degree of oligopoly power in an industry. Alternatively, λ can be interpreted as conjectural variation. Using a simple duopoly model, we can illustrate this connection between λ and conjectural variations. Suppose that firm 1 produces q_1 units of output and expect firm 2 to produce q_2^e units of output. Then the total output it expects to be sold is $Q_t = q_1 + q_2^e$.

The profit maximization problem for firm 1 then is expressed as

$$Max_{q1} = P(Q)q_1 - C_1(q_1) \tag{5}$$

where P(Q) is the inverse demand function, and $C_1(q_1)$ is total cost function for firm 1. Differentiating equation [5] with respect to q_1 and after some manipulations, the first order condition can be expressed as

$$P(Q) + \frac{dP}{dQ}\left[1 + \frac{dq_2}{dq_1} \right]q_1 = MC_1(q_1) \tag{6}$$

where $MC_1(q_1)$ is the marginal cost of firm 1, q_2 is the equilibrium output level of q_2^e and

$$\frac{dq_2}{dq_1}$$

is the conjectural variation term. It describes how firm 1 conjectures firm 2 will vary its output when firm 1 makes a small change in output Δq_1. If we assume symmetry between all n firms in an industry, that is, they have the same cost function and produce the same amount of

output, equation [6] can be written for n firms as follows:

$$P(Q) + \frac{dP}{dQ}\left[\frac{1+(n-1)v}{n}\right] = MC \qquad [7]$$

where v is its conjectural variation about each of its rivals. Since, from [4], we know that

$$P_t + Q_t\left[\frac{dP_t}{dQ_t}\right]\lambda = MC,$$

it follows that equations [4] and [7] are identical, where market power index is defined as

$$\lambda = \left[\frac{1+(n-1)v}{n}\right]. \qquad [8]$$

It is clear that if firms behave as in perfect competition, that is, v = -1 and λ = 0, in Cournot-Nash fashion, the values of v and λ are 0 and 1/n, respectively.

This study uses annual data for 1980 to 1998. These data were collected from numerous governmental sources. Data related to the retail prices of milk (P_t), producer price of milk (W_t) and per-capita domestic product (Z_t) were collected from various publications of the State Institute of Statistics of Turkey (27). All prices and per-capita gross domestic product data were deflated by the wholesale price index and GNP deflator, respectively. The wholesale price index and GNP deflator were collected from the State Institute of Statistics of Turkey. Data on the retail quantity of fluid milk were collected from the State Planning Organization of Turkey (28).

Regression Analysis and Results

In order to evaluate the degree of imperfection in the fluid milk market, we need to select functional forms for industry demand and aggregate MC. The industry demand function in [1] is expressed in the following form:

$$Q_t = \beta_0 + \beta_1 P_t + \beta_2 Z_{1t} + \beta_3 Z_{2t} + \varepsilon_t \qquad [9]$$

where Q_t is the quantity of fluid milk sold at retail level, P_t is the real fluid milk price at retail level, Z_{nt}(n=1,2) are exogenous variables that are defined explicitly in the next section, and ε_t is the error term that is normally distributed with mean μ and variance σ^2.

The aggregate MC function was considered a function of the fluid milk price received by farmers since it is the main input for milk processors. A time trend is also included in the MC function to take account of technological changes in the industry. Based on these factors, the MC function is specified in the following form:

$$MC_t = \alpha_0 + \alpha_1 W_t + \alpha_2 T \qquad [10]$$

where W_t is the fluid milk price received by farmers, T is the trend and t is a time subscript. Substituting equation [10] into profit maximizing condition [4] and rearranging the terms, the following linear equation is derived:

$$P_t = \alpha_0 + \alpha_1 W_t + \alpha_2 T + \alpha_3 Q_t + U_t \qquad [11]$$

where W_t, Q_t and T are as previously defined,

$$\alpha_3 = -\lambda \frac{dP_t}{dQ_t} \text{ and } U_t \text{ is N } (\mu. \sigma^2).$$

Taking the first derivative of equation [9] with respect to Q_t, it can be seen that

$$\left[\frac{dP_t}{dQ_t}\right] = \frac{1}{\beta_1},$$

and the market power parameter is the product of 2 regression parameters with a negative sign, $\lambda = -\beta_1\alpha_3$ (26). In order to identify the degree of market power, Bresnahan (26) adds one more variable to the demand equation, namely $P_t Z_t$. In this paper, it is assumed that MCs are constant, and therefore, there is no identification problem in the model. Deodhar and Sheldon (29) also used this special case of the Bresnahan methodology to estimate the degree of imperfection in the German market for banana imports.

In order to measure the degree of imperfection, equations [9] and [11] need to be estimated. To empirically implement the described equations, the demand equation is expressed as

$$Q_t = \beta_0 + \beta_1 P_t + \beta_2 Z_t + \beta_3 T_t^2 + \varepsilon_t \qquad [12]$$

where Q_t is the retail quantity of fluid milk, P_t is the retail price of fluid milk, Z_t is per-capita GNP and T_t^2 is the squared time trend. It is apparent that equations [11] and [12] are a simultaneous system for the fluid milk market and P_t and Q_t are endogenous variables. The demand [12] and first-order condition [11] equations are over-identified. For estimation, we used the 2-stage-least-squares (2SLS) estimation procedure, in which the instruments were per-capita GNP, the producer price of fluid milk, time and squared time trend. We also employed 3-stage-least-squares estimation but there was no significant improvement over the 2SLS results. Estimated

parameters and asymptotic standard errors of the simultaneous model are shown in the Table. All estimations were carried out using the Shazam 7.0 software.

In general, the results for both equations are plausible in terms of the statistical significance of individual parameters and goodness of fit. The R^2 values of demand and the first-order condition are 0.97 and 0.98, respectively. As indicated by Durbin-Watson statistics at 1% significance, there is no autocorrelation problem in the demand equation or first-order condition. In the demand regression, the real fluid milk price and income variables comply with economic theory and are statistically significant at the 5% level. In the first-order condition regression, all variables are statistically significant at the 5% level. The positive and significant coefficient for the producer price of fluid milk is consistent with its expected effect on MC. The negative and significant time trend implies that MC declined in the fluid milk market over this period mainly because of technological changes.

The primary interest of this study was to estimate the degree of imperfection and its implications for the industry. In the simultaneous system, the related parameters for calculating marker power are $\beta_1 = -0.342$ and $\alpha_3 = 0.317$, and both of these parameters are statistically significant. Therefore, the market power parameter for this industry is $\lambda = -(-0.342)(0.317) = 0.11$. This parameter suggests that the fluid milk subsector is not perfectly competitive, but the behavior of the firms is much closer to competition than to collusion. Stated differently, the increasing concentration ratio within the fluid milk subsector has not resulted in excessive monopoly power being exercised by the firms. Of course, the large share of fluid milk that is marketed through milkmen and by direct sales from producers to consumers could be a limiting factors on firms' exercise of market power. In fact, a significant amount of fluid milk (47%) in Turkey is marketed by milkmen and through direct sales to consumers from producers (12).

Discussion

The main objective of this study was to measure the degree of market imperfection in the fluid milk market in Turkey, a market that the Turkish competition authority recently received complaints about because of a suspicion of market imperfection. In this study, we used a structural econometric model, based on a method originally proposed by Bresnahan (26). The results show that the price behavior of firms in this industry is neither perfectly competitive nor collusive, but their behavior is much closer to competition than to collusion. Stated differently, the increasing CR_4 has not resulted excessive market power being exercised in the fluid milk market in Turkey. The results presented in this article are consistent with the conclusion of the Turkish competition authority.

The results of this study have some implications for policy makers, firms and consumers. Policy makers

Table. Two-stage-least–squares estimation results.

Demand Equation	Coefficient	t-Ratio
Intercept	-274.760	-3.428*
Retail price of fluid milk, P_t	-0.342	-5.268*
Per-capita gross national product, Z_t	0.251 E-03	4.171*
Squared time trend, T^2	0.583	4.478*
R^2	0.970	
Durbin-Watson Statistic	1.601	
First-Order-Condition		
Intercept	-2.395	-0.397
Producer price of fluid milk, W_t	2.675	21.040*
Retail quantity of fluid milk, Q_t	0.317	2.161*
Time trend, T	-5.345	-1.961**
R^2	0.980	
Durbin-Watson Statistic	1.710	

Note: * Indicates significance at 5% level using 2-tail test.
        ** Indicates significance at 5% level using 1-tail test.

should note that this moderate market power might stem from product differentiation, the image of firms and scale economies. Moreover, the results imply that there is no severe price collusion among the firms in this sector. On the other hand, firms intending to enter this market face relatively high competition. Regarding consumers, the results indicate that they enjoy relatively low prices compared to monopoly prices resulting from rigid competition in this sector.

Acknowledgements

References

1. Bresnahan, T.F., Schmalensee, R.: The Empirical Renaissance in Industrial Economics An Overview. J. Indus. Econ. 1987; 35: 371-378.

2. Bresnahan, T.F.: Empirical Studies of Industries with Market Power; Handbook of Industrial Organization. Elsevier Science Publishing Company, Inc., New York, USA. 1989.

3. Perloff, J.M.: Econometric Analysis of Imperfect Competition and Implications for Trade Research; The Workshop on Industrial Organization and International Trade: NC-194. 1991; USA.

4. Just, R.E., Chern, W.S.: Tomatoes, Technology and Oligopsony. Bell J. Econ. 1980; 16: 189-211.

5. Lopez, R.E.: Measuring Oligopoly Power and Production Responses of the Canadian Food Processing Industry. J. Agricul. Econ. 1984; 5: 219-230.

6. French, B.C., King, G.A.: Dynamic Relationships in the California Cling Peach Industry. Gianni Foundation Research Report No: 338. 1986.

7. Azzam, A.M., Pagoulatos, E.: Testing Oligopolistic and Oligopsonistic Behavior: An Application to the US Meat-Packing Industry. J. Agricul. Econ. 1990; 41: 362-370.

8. Deodhar, S.Y., Sheldon, I.M.: Market Power in the World Market for Soymeal Exports. J. Agricul. Res.-Econ. 1997; 22: 78-86.

9. Hatırlı, S.A.: A Measurement of Market Power and/or Cost Efficiency in the U.S. Frozen and Potato Chips Subsectors. PhD Dissertation. The Ohio State University, Colombus, Ohio, USA. 2000.

10. State Institute of Statistics, Agricultural Structure: Production, Price, Value. State Institute of Statistics Prime Ministry Republic of Turkey, Ankara, Turkey.

11. Büyükkılıç, D., Arpacıoğlu, H.: The Productivity of Milk and Milk Products Industry and Comparison of Firms. The National Productivity Center. Report No: 406. 1990. Turkey.

12. SETBİR, Dairy Sector Reports. The Association of Dairy Beef and Food Manufacturers and Producers in Turkey. 2001.

13. Erdem, Y.K., Ergin, G.: Sokak Sütçülüğünün İçme Sütü Endüstrisine Etkisi. İçme Sütü, Editör: Demirci, M., s: 138-141, 1998, Tekirdağ. (In Turkish)

14. Altun B., Besler T., Unal, S.: Evaluation of Fluid Milk Sold in Ankara. Sür. Tıp Eğit. Derg. 2002; 11: 51-55.

15. Çağlarırmak N.: Total Count and Types of Bacteria, Staphylococcal for Fluid Milk Sold Different Streets of İzmir. MSc Dissertation. University of Dokuz Eylül, İzmir. 1987.

16. Aytur E.: A Research on Some Physical, Chemical and Microbiologic Characteristics of Unpacked Fluid Milk Sold in Adana. MSc Dissertation.University of Çukurova, Adana. 1990.

17. Kavas G.: Researches on Physical, Chemical and Microbiologic Characteristics of Unpacked Fluid Milk Sold in İzmir Province, MSc Dissertation, University of Ege, İzmir. 1991.

18. Açıkgöz, M.: Süt Sanayiinin Hammadde Sorunları. Türkiye II. Besi ve Süt Hayvancılığı Sempozyumu. 11-12 Haziran 2001, Ankara.

19. Yavuz, F., Aksoy, Ş., Tan, S., Dağdemir, V., Keskin, A.: Türkiye'de Sütçülük Politikaları ve Sektörün Yapılanması Üzerine Bir Araştırma. Türkiye II. Besi ve Süt Hayvancılığı Sempozyumu. 11-12 Haziran 2001, Ankara.

20. İnan, İ.H., Aksoy, Ş., Kubaş, A., Gaytancıoğlu, O.: Türkiye'de Süt Sanayinin Durumu, Sorunları ve Çözüm Önerileri. III. Milli Süt ve Süt Ürünleri Sempozyumu, 2-3 Haziran 1994, İstanbul.

21. Akman, N.: Hayvancılığın Yapısı, Sorunları ve Çözüm Önerileri. Türkiye II. Besi ve Süt Hayvancılığı Sempozyumu. 11-12 Haziran 2001, Ankara.

22. Dağdemir, V., Keskin, A., Tan, S., Aksoy, Ş., Yavuz, F.: Türkiye Sütçülük Sektöründeki Değişik Kesimlerin Sektörle İlgili Görüşlerinin Analizi. Türkiye V. Tarım Ekonomisi Kongresi. 18-20 Eylül, 2002, Erzurum.

23. IFC (International Financial Center): Pinar Süt Mamülleri Sanayii Dairy-Turkey. Project No: 9367, prepared by Lawrence Bouton, 1999, USA.

24. Pepall, L., Richards, D.J., Norman, G.: Industrial Organization: Contemporary Theory and Practice. South-Western College Publishing, 1999, USA.

25. McCorriston, S., Sheldon, I.M.: Imperfect Competition, Trade Policy, and Processed Agricultural Products. Organization and Performance of World Food Systems: NC-194. 1989; USA.

26. Bresnahan, T.F.: The Oligopoly Solution Concept is Identified. Econ. Lett. 1982; 10: 87-92.

27. State Institute of Statistics, Statistical Yearbook of Turkey, various years. State Institute of Statistics Prime Ministry Republic of Turkey.

28. State Planning Organization, Annual Development Plans, various years. State Planning Organization of Prime Ministry Republic of Turkey.

29. Deodhar, S.Y., Sheldon, I.M.: Is Foreign Trade (Im)Perfectly Competitive? An Analysis of the German Market for Banana Imports. J. Agricul. Econ. 1995; 46: 336-348.