Dynamics of Price Transmission and Market Power in the Turkish Beef Sector

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ABSTRACT

This article addresses the recent beef price increases in Turkey. Spikes occurred due to the impact of low milk prices, which led to the liquidation of dairy herds, and retailers' oligopolistic behavior. In this research, we investigate these issues by first concentrating on the mechanism of price transmission along the beef marketing channel, and then testing the possibility of market power. The empirical results reveal a differential impact on producers and retailers along the supply chain, consistent with imperfect competition. Price transmission is asymmetric and price margins widen. The results also reject the null hypothesis of perfect competition at the retail level, and show retail beef price behavior is consistent with the presence of oligopolistic market structure. Consolidation and dominance of downstream industries raise public concerns and has policy implications.

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Key words: dairy herd liquidation, beef price spike, asymmetric price adjustment, oligopolistic market structure, Turkey

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1. INTRODUCTION

Beef prices have increased significantly in Turkey in recent years. There are two strands of thought among the press and policy makers to explain the recent beef price spikes. One references the low milk prices leading to liquidation and excessive culling of dairy cows back in 2007-2008. They argue dairy farmers were faced with production cost problems that led to excessive liquidation of more than 400,000 dairy animals (Akman, 2010). Dairy animals were slaughtered by almost twice the annual average in 2007, according to the Turkish Statistical Institute (hereafter TurkStat).

The other strand of thought on the price spikes points to the role of market concentration and market power in the meat supply chain, especially at the retail level. Erdoğan *et al*. (2012) argue that big retailers have increased their market share for food all through recent years. The share of national chains in fast-moving consumer goods increased from 31 percent to 51 percent between 2005 and 2011, and concentration ratio for the eight largest firms increased from 9 to 15 percent (Erdoğan *et al*., 2012). Retail price increases were more prominent during this period compared to the wholesale prices, suggesting downstream oligopolistic behavior.

This research concentrates on those two themes to explore and explain the mechanisms of beef price spikes experienced in Turkey. First, we investigate the price adjustments along the beef marketing channel. We would like to discover whether price transmission was asymmetric along the vertically linked chain. We use the vector error correction (VEC) framework and analyze the vertical beef price relationships between farm, wholesale, and retail prices. The emphasis is on the dynamics of speed of price adjustment. Asymmetric prices transmission

(APT) affects price spreads between retail and producer levels and is an indication of inefficiency and imperfect competition along the supply chain. Analysis of price transmission could explain why consumers paid significantly higher prices.

There is an extensive literature addressing price transmission along vertically linked markets. Meyer and von Cramon-Taubadel (2004) and Frey and Manera (2007) provide a comprehensive review of this literature. Dynamics of price transmission is commonly used as an empirical methodology to study price policies of producers and retailers. Meyer and von Cramon-Taubadel (2004) argue that APT is theoretically consistent with price gauging by intermediaries when there is concentration or other practices that distort competition. In the case of price gauging, intermediaries with market power can pass on price increases, but withhold price declines to final consumers. Second, we investigate the allegations of market power behavior by the big retailers, accused of exploiting the dairy herd liquidation. The lack of credible quantity data does not allow for a direct measure of buyer power. However, we follow a new methodology devised by Lloyd, *et al.* (2009), to directly test for the null hypothesis of perfect competition by using price data only. They suggest incorporating marketing costs and exogenous supply and demand shifters to the time-series analysis. Using the NEIO conjectural variation model, they provide a quasi-reduced form of retailer-producer price framework. They argue that in a perfectly competitive market, demand and supply shocks have no lasting effect on the farm-retail price margins. As a 'first-pass test,' if it is revealed that supply and demand shifters have statistically significant coefficients, there is the possibility of imperfect competition.

The problem of concentration and presence of market power in food markets have been addressed extensively in the literature (e.g., Bakucs and Ferto, 2005; Cotterill, 2005). However, whether price transmission and market structure are related or uncompetitive market structure

leads to asymmetric price transmission, especially in emerging and developing countries have not been investigated except for a few studies (e.g., Falkowski, 2010 for the Polish milk sector). The recent beef price spikes in the Turkish beef marketing channel call for an investigation of both price adjustment mechanism and market structure.

This study verifies the presence of a long-term relationship between producer and retail prices. The empirical results reveal asymmetric price transmission along the supply chain, and a differential impact on the producer-retail prices. The results of the test for the presence of market power also reject the null hypothesis of perfect competition. The rejection of the null is an indication of imperfect competition and market power at the retail level. This study concludes retail price behavior is consistent with an oligopolistic market structure in Turkey.

The rest of the paper is organized as follows: In the next section, we describe the red meat market in Turkey. This is followed by the empirical model development and summary statistics for the dataset used in this analysis. Next, we briefly present a structural equation formulation for testing imperfect competition developed by Lloyd *et al*., (2009). In the following section, the empirical results are presented. The last section concludes the paper and discusses policy implications.

2. RED MEAT MARKET IN TURKEY

Livestock breeding in Turkey contributes to about a quarter of the country's agricultural output (Akbay and Boz, 2005). Dairy and dual purpose cattle is the major source of red meat in the country (Akman, 2010). Cattle are primarily raised for their milk, and the share of cattle raised just for meat is low. Feed accounts for around 70 to 85 percent of the total cost of meat production (Koç et al., 2001, Çiçek et al., 2010). Imports are a significant amount of animal feed;

in 2009, Turkey imported 96 percent of soybeans and 10 percent of maize consumed in the country (FAOSTAT, 2012), mostly for animal feed.

Dairy and dual purpose cattle are the source of roughly 86 percent of red meat produced in the last decade. From 2005 to 2012, annual beef production ranged between 610,000 to 800,000 tons, corresponding to slaughter of 3.5 to 5.3 million cattle. Beef production initially peaked in 2007 and 2008, reaching 797,000 tons. However, in 2009, beef and mutton production cumulatively declined to the lowest amounting to a bit more that 700,000 tons. Red meat production increased to 2007-2008 levels only in 2012, but 2012 production totals also included a significant amount of live cattle imports that were slaughtered domestically.

Red meat prices have increased significantly in Turkey in the last ten years. During the 2005-2012 period, retail beef prices rose by 106 percent. At the same time retail sheep-meat prices increased by 145 percent and animal feed index by 78 percent (TurkStat, 2013). Overall, meat price increases were higher than the increase in the CPI food index, which was 78 percent during the same period. Bilgiç and Yen (2013) report that the rapid increase in prices around 2009 led to almost 30 percent decrease in per capita red meat consumption. These sharp price increases have attracted the interest of both the Turkish press and policy makers.

One view argues that the premature culling of dairy herds around 2007, led to increased supply of slaughtered animals initially, and depressed wholesale beef prices temporarily, due to the sudden increase in beef supply. The premature slaughter of cows led to a drop in the supply of heifers and bullocks for the next few years; fewer cows in the current period meant fewer calves in the subsequent periods. Beef prices responded to the shortage of cow and calf stocks, and the initial changes in milk markets had a significant bearing on the subsequent beef price increases. By 2009, that premature slaughter caused a significant decline in the beef supply, and

that coupled with almost no imports, increased beef prices at every level. Wholesale beef prices increased rapidly after May 2009 and retail prices followed with a higher rate. Retail beef prices increased in 2009-2010 by 40 percent (Figure 1).

<Insert Figure 1 about here>

Another view on the red meat price spikes focuses on the role of market concentration and market power in the supply chain in Turkey. Consumer groups and non-governmental organizations have claimed that the price increases were the result of oligopolistic behavior by major buyers and organized food retailers that buy in large quantities. The share of supermarkets in total consumer food expenditures has increased rapidly, similar to many other emerging/developing countries, and with the increasing role of supermarkets, the role of processed food has increased. Erdoğan *et al*. (2012) argues that big retailers have increased their market share for food all through recent years.

The share of national chains in fast-moving consumer goods increased from 31 percent to 51 percent between 2005 and 2011, and concentration ratio for the eight largest firms in all retailing has increased from 9 to 16 percent (Erdoğan *et al*., 2012: 30). The concentration ratios may not seem very high but another sign of buying power by retailers is that top retailers are exercising their buyer power via at least 10 different non-price channels, such as shelf space charges and retrospective discounts (Erdoğan *et al.*, (2012). Similar trends were observed in the late 1990s in the United Kingdom as well (Competition Commission, 2000). Erdoğan *et al.*, (2012) estimate that the share of these extras in total revenues accounts for 13 percent of all sales by 2009 for national retailers in Turkey. The fact that retail price increases were more prominent than wholesale also suggests downstream market concentration, and oligopolistic practices by

the retailers. The price increases caused uproar among local media and civil society organizations, and raised suspicion of market power behavior, especially by retailers.

3. DATA DESCRIPTION AND ECONOMETRIC MODEL DEVELOPMENT

3.1. Beef Data Description

To investigate price transmission along the beef supply chain, monthly time series beef price spreads were assembled from the Turkish Statistical Institute (TurkStat) for farm prices $\{P_{ft}\}$, wholesale prices $\{P_{wt}\}$, and retail prices $\{P_{rt}\}$. For the analysis, we use prices from January 2005 to December 2012. The data used in this study was collected officially and announced publicly by the TurkStat. Monthly price data is available at all levels along the supply chain and has been collected using the same methodology since 2005. All prices are in Turkish Lira per kilogram for beef. Also, all prices are deflated with the consumer price index (CPI). All variables are seasonally adjusted by using the Census X12 method. Table 1 shows the summary statistics for the price series. Beef prices have experienced significant increases at every level, especially between May 2009 and the November 2010. Gross margins between producer and retail prices have widened in this period (Figure 1).

< Insert table 1 about here >

3.2. Econometric Model Development

Given the nature of the underlying data series, we follow closely the contemporary time series modeling paradigm. First, the temporal properties of the price series are analyzed using augmented Dickey-Fuller tests. The tests involve running a regression of the first difference of each series against the series lagged one period, lag difference terms, and a constant. The null

hypothesis is that the series are nonstationary in their levels, I(1), and their first differences are stationary, or I(0). We also test for seasonality and structure breaks in the data.

Traditionally, definition of price asymmetry refers to a situation in which producers' price increases are passed along more quickly and more completely to consumers than are price reductions (Pelzman, 2000; Bakucs and Ferto, 2005). In such cases, the standard Dickey-Fuller unit root tests are improperly specified and inefficient in detecting a cointegration relationship (Enders and Granger, 1998).

Second, Johansen's cointegration tests are employed to determine whether a long-run relationship exists among the price series. Next, we estimate a VEC model and conduct hypothesis testing within this framework. Whenever the series are integrated and cointegrated, a VEC Model is an appropriate means of characterizing the multivariate relationships among the variables (Engle and Granger, 1987). The VEC model uses both short-term dynamics as well as long-term information. The short-run speeds of price adjustment from the VEC model show whether price transmission is asymmetric.

Finally, in the context of cointegration framework, we use a quasi-reduced form conceptualization proposed by Lloyd *et al*., (2009) to directly test imperfect competition and presence of buyer power. Evolving market structure means a straightforward cointegration analysis will not be enough to deduce causal relationships. Also, simple concentration ratios have limited value in empirical analysis of market power (Clarke *et al*., 2002). Following Lloyd *et al*., (2009) and Falkowski (2010), we incorporate meat processing sector labor cost index as a proxy for marketing costs. Feed cost is also used as a proxy for supply shifters, and consumer price index is employed as a proxy for demand shifters.

3.3. Theoretical Market Power Formulation

Lloyd, et al., (2009) theoretical framework is based on the equation of price spread between retail and producer levels. Their approach starts from the premise that under competitive conditions, the spread is solely due to marketing costs (Equation 1). In a perfectly competitive market, retail prices are influenced only by producer prices and marketing costs including processing-related costs. However, when the parameter for 'conjectural elasticity' is different from zero, there is buyer power and market shocks have a differential impact in addition to marketing costs at each level in the marketing chain. They assume fixed-proportion production technology, constant returns to scale, linear marketing cost function, and linear functional form for the exogenous demand and supply shifters to obtain Equation 2 in reduced form:

$$P_R = P_F + M \text{ or } M = P_R - P_F \quad (1)$$

$$P_R = \gamma_0 + \gamma_1 P_F + \gamma_2 M + \gamma_3 D + \gamma_4 S, \quad (2)$$

where P_R is retail beef prices, P_F producer beef prices, M is marketing costs, and D and S are exogenous demand and supply shifters. The expected signs for the coefficients are: $\gamma_1 > 0$, $\gamma_2 > 0$, $\gamma_3 > 0$, and $\gamma_4 < 0$. The expected signs for γ_1 and γ_2 are positive because under any condition they contribute to the retail beef prices. The null hypothesis of perfect competition is $H_0 : \gamma_3 = \gamma_4 = 0$. That is, if the estimated coefficients for the supply and demand shifters are statistically different from zero, then the null hypothesis of perfect competition will be rejected. Under imperfectly competitive conditions, γ_3 and γ_4 are not equal to zero because, for example, demand shifters shift the demand curve to the right, widen the margins, and mark price up above marginal cost.

4. EMPIRICAL RESULTS

4.1. Temporal Properties of Beef Price Series

Consistent with the literature, we use an augmented Dickey-Fuller (ADF) test to determine the order of integration of each series. Following Enders (1995) and Hendry's (1986) "General to Specific" procedure, we started with an over-specified ADF regression where *n*, the number of lags, was relatively large (n = 10) and then employed a battery of lag length diagnostic tests to refine the specification for each series. The upper portion of Table 2 summarizes the ADF test results for the beef variable, while the lower portion catalogues the results for the first difference of each price series. Given a MacKinnon 10 percent critical value, we failed to reject the null hypothesis of a unit root for these variables with two terms, a constant, and a trend. Each series was then first differenced and the ADF regressions were re-estimated with a constant but no trend. In each case, we rejected the null hypothesis of a unit root at the one percent level of significance.

< Insert Table 2 about here >

We also used seasonal unit root test with both seasonal Dickey Fuller and more general HEGY test (Hylleberg, Engle, Granger, Yoo (1993)). The results were consistent indicating the series to be I(1) in level. Hence, we have enough evidence to assume unit roots even after controlling for seasonality. Also, ADF test can under-reject when there are structural breaks in series with deterministic trends, and prior to ADF, test for structure breaks are recommended. We ran the Zivot and Andrews (1992) tests allowing for breaks with both intercept and trend. Both tests showed the series were I(1) in levels, again consistent with the ADF test results (these results are available upon request). We then checked for long-run equilibrium or cointegration.

Following Enders (1995), when the series are I(1) processes, the possibility of equilibrium is examined using Johansen's cointegration test. These results are reported in Table 3. Each cointegrating equation contains an intercept and a slope coefficient. At the five percent level of significance for the trace test (Johansen and Juselius, 1992), we reject the null hypotheses that $r = 0$ or $r = 1$. Hence, the cointegrating rank of the system is at most two at the five percent level. These results suggest there are two long-run equilibrium relationships between the three price series. The cointegrating vectors provide the foundation to empirically address short-run economic reactions like speeds of adjustment, and long-run relations.

< Insert Table 3 about here >

4.2. Vector Error Correction and Dynamic Speeds of Adjustment

A more contemporary approach to quantifying the relationship between I(1) series is to construct a VEC model. The ADF and cointegration test results suggest that a VEC model is appropriate to characterize the multivariate relationships among the three price series (Engle and Granger, 1987). A VEC model incorporates cointegration to capture the information contained in each series' long-run stochastic trend, and reflects the fact that the variables are I(1) and must be differenced. In this model, the first-difference in each series is represented as a function of its own lagged values, the lagged values of the other variables, and cointegrating equations. The specification of the VEC model is as follows:

$$\Delta P_t = a_0 + \sum_{i=1}^{k-1} \Gamma_i \Delta P_{t-i} + \prod P_{t-k} + e_t,$$

where ΔP_t is a (3x1) matrix (ΔP_{1t}, ΔP_{2t} and ΔP_{3t} represent the three price series); α_0 is a (3x1) vector of intercept terms; the $\Gamma_i \Delta P_{t-i}$ terms reflect the short-run relationships among elements of the P_t matrix, and the $\prod$ matrix captures the long-run relationships among the variables. The

$\prod$ matrix can be decomposed into two $p' \times r$ matrices, α and β, where $\prod = \alpha\beta'$. The matrix β contains the co-integrating vectors that represent the underlying long-run relationship and the α matrix describes the speeds of the adjustment in which each variable returns to its long-term equilibrium after a temporary shock or departure from it (Johansen and Juselius, 1992; Schmidt, 2000).

The diagnostics of the VEC model are summarized in Table 4. The usual loss functions, AIC and Schwarz criterion, were minimized and the log likelihood function of the system approached its maximum near the final specification. As expected, we found no evidence of first-order autocorrelation at the five percent level of significance using the Durbin-Watson bounds test. The adjusted R^2 values indicate that between 33 to 58 percent of the variation in the price series are explained by the model.

< Insert Table 4 about here >

The VEC model analysis of dynamic adjustments provides a precise measure of the speeds of price transmission. The empirical estimates are summarized in the top portion of Table 4. The speeds of adjustment for retail and wholesale prices were statistically significant at the five percent level with estimated values of 0.38 and -0.58, respectively. The speed of adjustment for farm prices was -0.06, but statistically insignificant. The positive sign of the retail and negative sign of the wholesale price coefficients imply that when the cointegration equation is out of equilibrium, retail prices tend to rise whereas wholesale prices tend to fall, widening the price margins.

The speed of adjustment of wholesale prices, in absolute value, is higher than the one for retail, which indicates wholesale prices to be relatively more 'flexible,' or retail beef prices are relatively 'sticky' and adjust more slowly. That is an indication of asymmetric price transmission

and a possible sign of growing concentration and inefficiency, especially at the retail level. If we assume a perfectly competitive market, such as an auction market, with perfect information and no adjustment costs or explicit contracts, then prices adjust quickly and fully in response to market changes. However, the results indicate this is not the case in the Turkish beef sector, and the pace of price adjustment differs in vertically linked markets. This is an important insight for policy makers, and has clear implications for the retail-producer price spread, and efficiency and equity of the Turkish beef marketing system.

4.3. Market Power

Previous results confirmed retail and producer prices behaved differently along the beef marketing channel, and widened the retail-producer price spread. In this section, we determine whether imperfect competition could be considered as the cause. The approach to test for presence of market power is to estimate the quasi-reduced form in Equation 2. The procedure is first to check the series for stationarity the same as before, to see if they are I(1). Then, apply cointegration analysis, and finally, test the null of perfect competition using the estimated coefficients of exogenous demand and supply shifters.

Same as before, first the ADF unit-root tests were applied. The results failed to reject the null hypothesis of a unit root, indicating all the series in Equation 2 to be non-stationary in levels, except the demand shifter, food price index. After first-differencing and re-estimating, the results rejected the null hypothesis of a unit root at the one percent level of significance for all the model variables, showing the series to be stationary. We again considered seasonality and structural breaks in the dataset, but the results did not change. Then, we employed the cointegration analysis. It revealed the existence of three cointegrated vectors for the variables in Equation 2 (the results are available upon request). Finally in the context of the cointegration

model, we estimated the coefficients in Equation 2 to test the null hypothesis of perfect competition.

Lloyd *et al*., (2009) argue that in Equation 2, income is an ideal demand shifter, but monthly income data is not available. Instead, they recommend using retail food index as a proxy for the demand shifter. We followed their strategy and used Consumer Food Price Index as a proxy for the demand shifter (2003=100). Also, we used feed costs for the supply shifter to explicitly address the special case in Turkey. Cows are viewed as live inventory for red meat. Feed costs constitute majority of costs of milk production and cattle fattening. Any increase in feed costs impacts cost of inventory, leading to liquidation of cows.

Lloyd *et al*., (2009) used an index of average earnings in retail sector as a proxy for marketing costs, and Falkowski (2010) used wages in the agri-food processing. Those series are available only quarterly for Turkey. We chose the index of gross wages in the meat-processing sector (2005=100) as a proxy for marketing costs, and interpolated the quarterly data linearly to transform it into monthly (use of cubic spline interpolation resulted in almost identical values). The behavior of marketing cost, demand and supply shifter are presented in Figure 2.

<Insert Figure 2 about here>

The estimation results of coefficients in Equation 2 are summarized in Table 5. All the coefficients are statistically significant and the signs are all consistent with the theoretical predictions. For the existence of market power, we specifically focus on the estimation results of coefficients of demand and supply shifters. Those coefficients are both statistically significant at the five percent level, and the null hypothesis of perfect competition, $H_0 : \gamma_3 = \gamma_4 = 0$ is rejected.

< Insert Table 5 about here >

As expected, the sign of coefficient of the demand shifter is positive, and the one for supply shifter is negative. That is, the demand shifter shifts the demand curve to the right, and the supply shifter shifts the supply curve to the left; consequently the margins widen. These results are consistent with the price transmission results earlier. The rejection of the null hypothesis suggests the behavior of the spread between producer and retail prices in the Turkish beef marketing chain is consistent with the existence of market power and oligopolistic behavior.

5. CONCLUSIONS AND POLICY IMPLICATIONS

There are various arguments about the root causes of recent price spikes in the Turkish beef sector. The press and policy makers have paid plenty attention to the rapid price increases and their impacts on the long-term sustainability of Turkish beef sector. To study the price increases, we first analyzed the relationships between farm, wholesale, and retail beef prices, and examined dynamics of price adjustment along the Turkish marketing channel. We found price transmission to be asymmetric along the supply chain. Wholesale prices adjusted more quickly than retail prices, revealing relative price stickiness at the retail level, with price margins widening. While the presence of asymmetric price transmission could be a sign of imperfect competition and oligopolistic market behavior, Azzam (1999) argues asymmetric price transmission could also happen in a competitive environment.

Therefore, we further analyzed the widening of the retail-producer price spread to investigate whether imperfect competition and oligopolistic behavior could be the source of the imperfection. We tested the presence of market power by estimating a quasi-reduced form of the producer-retail spread, employing exogenous demand and supply shifters. The results pointed to

the presence of market concentration and oligopolistic behavior in the retail end of the beef marketing chain, where supermarket chains have some market power (Erdoğan et al., 2012).

One reason for the differential price dynamics along the Turkish beef marketing channel is the existence of noncompetitive market conditions. In an efficient market condition, prices are transmitted fully and completely. However, the beef price analysis revealed differential speeds of adjustment, and the existence of an imperfectly competitive market structure in the Turkish beef sector. There is increasing concentration in the consumer goods sector, and retailers have gained bargaining power over meat processors. There are no sizable corporate farms or farmer cooperatives that can generate any supplier power. The increasing concentration in the fast moving consumer goods sector, and retailers' bargaining power could explain the stickiness of prices at the retail level. Other explanations for the existence of price asymmetry and differential speeds of adjustment could be product heterogeneity, long-term contracts, and adjustment or menu costs (e.g., Zachariasse and Bunte, 2003).

The results of this study have policy and welfare implications and raise public concerns. On the one hand, those implications points to the crucial role of policy makers and supply chain managers in charge of the nation's food security. Such policy goals are to support producers and provide a sustainable supply of red meats in the country. On the other hand, they are also important to consumers, regarding the products they purchase and the prices they face. They demand access to affordable dairy and beef products that take a sizable share of their consumption budget.

Dairy and dual purpose cattle will continue to be the primary source of red meat in Turkey for the foreseeable future. However, dairy farmers are facing an uncertain environment characterized by small scale operations, volatile milk prices, and degraded grazing areas. This

situation calls for strategic policy actions to better manage beef and milk operations, construct appropriate oversight institutions that could help increase the efficiency of operations, and provide assurances to consumers of a sustainable stream of beef supply.

REFERENCES

Akbay, C., and I. Boz. (2005) "Turkey's Livestock sector: Production, consumption and policies." Livestock Research for Rural Development, 17: Article No.105.

Akman, N. (2010) "İthalatın Gerekçesi Et Fiyatları Mıdır? (Are Meat Prices The Cause of Imports?)" Ankara Zootekni Derneği. Available online at: http://anzoder.org.tr/et-fiyat.pdf.

Azzam, A.M. (1999). Asymmetry in rigidity in farm–retail price transmission. American Journal of Agricultural Economics, 81, 525–533.

Bakucs, L.Z. and I. Ferto. (2005) "Marketing Margins and Price Transmission on the Hungarian Pork Meat Market." Agribusiness 21(2), 273–286.

Bilgic, A., and S.T. Yen. (2013) "Demand for Meat and Dairy Products by Turkish Households: a Bayesian Censored System Approach." Agricultural Economics (forthcoming).

Clarke, R., Davies, S., Dobson, P. and Waterson, M. (2002). Buyer Power and Concentration in European Food Retailing, Edward Elgar, Cheltenham

Competition Commission. (2000). Report on the Supply of Groceries from Multiple Stores in the United Kingdom. London HMSO.

Cotterill, R.W. (2005). The impact of the Northeast Dairy Compact on New England consumers: a report from the milk policy wars. Agribusiness, 21(4), 455-471.

Çiçek, H., Cevger, Y., Tandoğan, M., and Şahin, E. H. (2010). "Estimation of Optimum Fattening

Period by Cattles of Brown Swiss Hybrid (F1) Fattening." Kafkas Universitesi Veterinerlik Fakultesi Dergisi 16(1), 63-67.

Enders, W. (1995) Applied Econometric Time Series, John Wiley & Sons, Inc, New York, NY.

Enders, W., and C.W.J. Granger. (1998). "Unit-root tests and asymmetric adjustment with an example using the term structure of interest rates." Journal of Business & Economic Statistics 16(3), 304-311.

Engle, R.E., and C.W.J. Granger. (1987) "Cointegration and Error Correction: Representation, Estimation, and Testing." Econometrica 55, 251–276.

Erdoğan, T., M. B. Akkaya, N. Ünübol, E. İnce, and S. Işık. (2012) Türkiye Hızlı Tüketim Malları Perakendeciliği Sektör İncelemesi Nihai Raporu (Fast Moving Consumer Goods Retailing in Turkey: Final Report). Ankara: Rekabet Kurumu. Available online at: http://www.rekabet.gov.tr/dosyalar/sektorraporlari/sektorrapor7.pdf.

FAOSTAT. 2012. Available online at: http://faostat.fao.org/

Fakowski, J. (2010) Price transmission and market power in a transition context: evidence from the Polish fluid milk sector, Post-Communist Economies, 22(4), 513-529

Frey, G., and Manera, M. (2007). Econometric models of asymmetric price transmission. Journal of Economic Surveys, 21(2), 349–415.

Hendry, D.F. (1986) "Econometric modeling with cointegrated variables: An overview." Oxford Bulletin of Economics and Statistics 48, 48201-48212.

Hylleberg, S., Engle, R. F., Granger, C. W. J., and Yoo, B. S. (1990) "Seasonal integration and cointegration," Journal of Econometrics 44(1-2), 215-238.

Johansen, S., and K. Juselius. (1992) "Testing Structural Hypothesis in a Multivariate Cointegration Analysis of the PPP and UIP for the UK." Journal of Econometrics 53,

211–244.

Koç, A., A. Bayaner, S. Tan, Y. E. Ertürk, and F. Fuller. (2001) Analysis of the Impact of Support Policies and Programs on Animal Resources Development in Turkey. TEAE.

Lloyd, T., McCorriston, D., Morgan, W., Rayner, A., Weldegebriel, H. (2009) "Buyer Power in U.K. Food Retailing: A 'First-Pass' Test." Journal of Agricultural & Food Industrial Organization, 7, Article 5.

MacKinnon, J.G., A.A. Haug, and L. Michelis. (1999) "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration." Journal of Applied Econometrics 14, 563–577.

Meyer, J., and von Cramon-Taubadel, S. (2004). Asymmetric price transmission: a survey. Journal of Agricultural Economics, 55(3), 581–611.

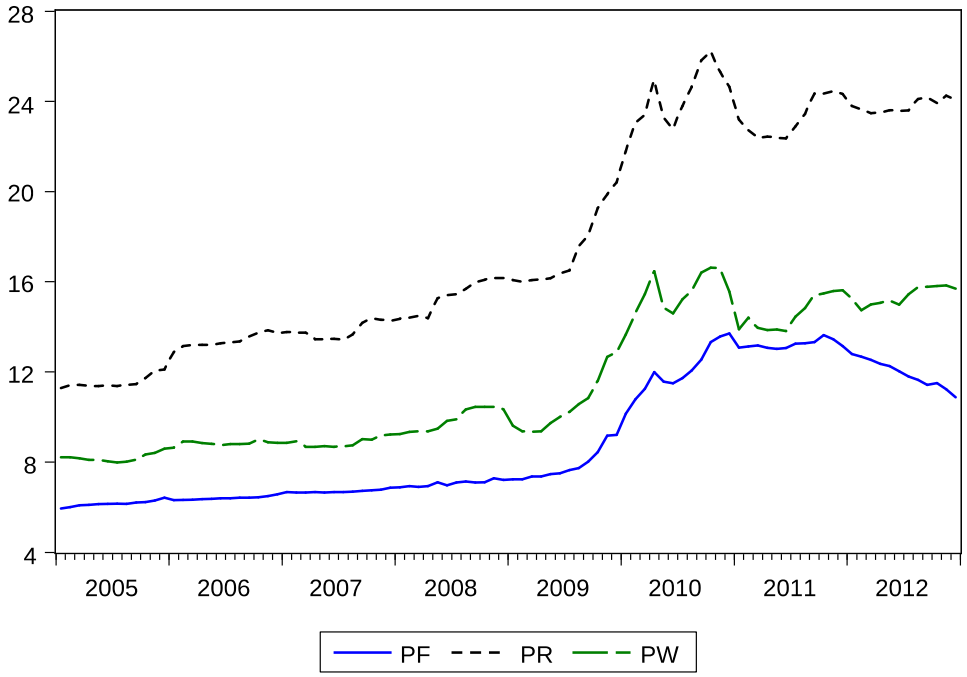
Pelzman, S. (2000) "Prices Rise Faster Than They Fall." Journal of Political Economy 108, 3, 446–502.

Schmidt, M. B. (2000) "The Dynamic Behavior of Wages and Prices: Cointegration Tests Within a Large Macroeconomic System." Southern Economic Journal, 67, 123–138.

TurkStat. Turkish Statistical Institute Agricultural Prices Website. (2013). Available online at: http://tuik.gov.tr/VeriBilgi.do?alt_id=50

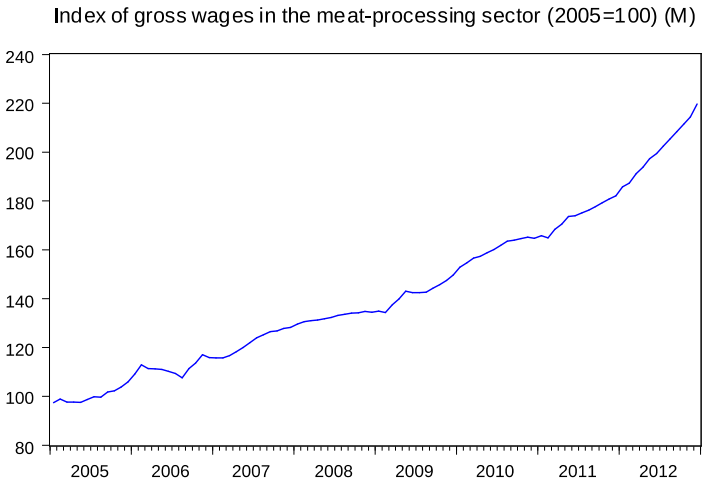
Zachariasse, L.C., and F.H.J. Bunte. (2003) "How Are Farmers Faring in the Changing Balance Dimensions of the Food Economy." Paper presented at the OECD–Conference on Changing Dimensions of the Food Economy: Exploring the Policy Issues, Den Haag, February 6–7, 2003.

Zivot, E., and D.W.K. Andrews. (1992) "Further Evidence on the Great Crash, Oil Price Shock and the Unit Root Hypothesis" Journal of Business and Economic Statistics 10, 251-270.



PF: farm level beef prices; PR: retail beef prices; PW: wholesale beef prices.

Figure 1: Monthly Farm, Wholesale, and Retail Beef Prices (Turkish Lira per Kilogram)



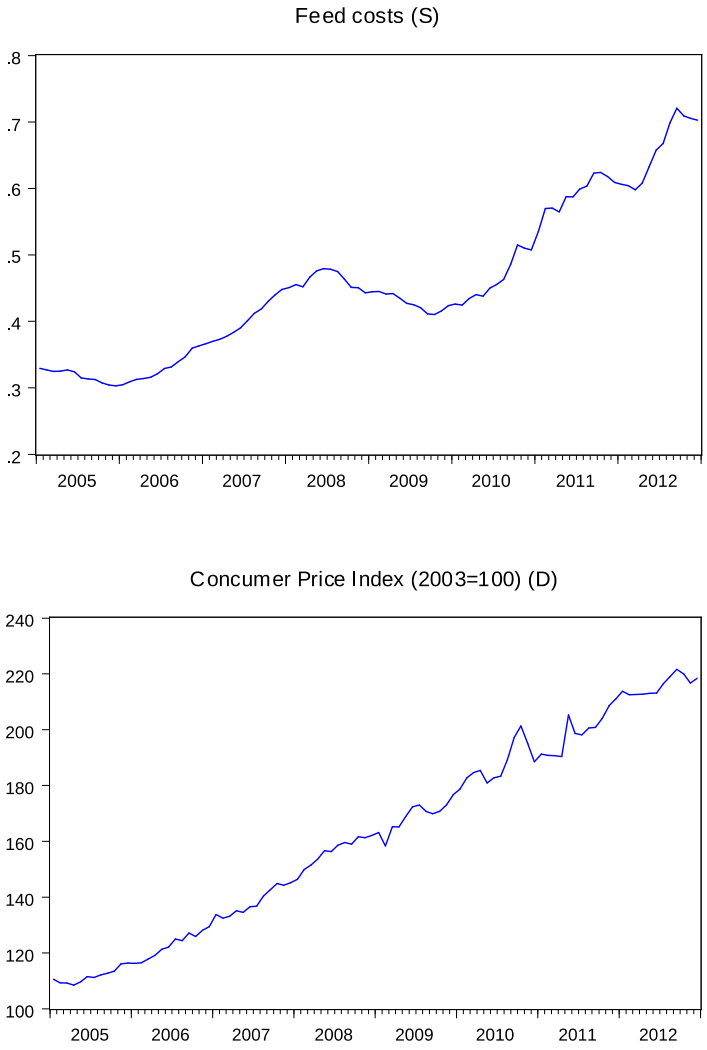


Figure 2: Marketing costs, demand and supply shifters

TABLE 1: Descriptive Statistics for Farm, Wholesale, and Retail Beef Prices

	PF	PW	PR
Mean	8.92	11.46	17.81
Median	7.1898	10.0955	15.93
Maximum	13.57	16.83	25.42
Minimum	5.92	8.076	11.12
Std. Dev.	2.80	2.99	4.908
Skewness	0.53	0.40	0.24
Kurtosis	1.51	1.40	1.39
Jarque-Bera	13.38	12.86	11.30
Probability	0.0012	0.0016	0.0035
Sum	856.01	1099.73	1709.79
Sum Sq. Dev.	748.89	851.01	2288.25
Observations	96	96	96

TABLE 2: Augmented Dickey-Fuller (ADF) Test Results

Statistic/Diagnostic	Test Results for Variables in Levels		
	P_{ft}	P_{wt}	P_{rt}
ADF Test[a]	2.11	1.52	1.23
F *Test*	12.89*	3.67*	4.81*
Durbin Watson	1.58	2.04	2.07
	Test Results after First-Differencing Variables		
	P_{ft}	P_{wt}	P_{rt}
ADF Test[a]	4.59*	6.99*	6.54*
F *Test*	21.44*	48.88*	42.71*
Durbin Watson	2.13	2.02	2.50

Note. * denotes 1% significance level.

[a] In absolute value and compared to MacKinnon (1999) critical values.

TABLE 3: Unrestricted Cointegration Rank (Trace) Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob. **
None *	0.22	36.52	29.80	0.01
At most 1 *	0.14	15.74	15.49	0.05
At most 2	0.03	2.97	3.84	0.08

Note. Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

TABLE 4: The Empirical Estimates of Speeds of Adjustment and Diagnostics

Variable	ΔP_{ft}	ΔP_{wt}	ΔP_{rt}
Speeds of Adjustment	-0.06	-0.58**	0.38**
Model Diagnostics			
Adj. R^2	0.58	0.47	0.33
AIC	-0.51	-0.84	1.41
Schwarz Criterion	-0.43	1.79	2.35

Note. ** denotes 5% significance level.

TABLE 5: Point Estimation Results for Equation 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PF	1.34	0.13	10.41***	0.00
M	0.04	0.01	2.73***	0.01
S	-0.15	3.13	-1.96**	0.05
D	0.02	0.01	2.15**	0.03
C	-1.04	2.25	-0.46	0.65

Note. *** denotes 1% significance level. ** denotes 5% significance level.