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Modelling beef consumption in Turkey: the ARDL/bounds test approach

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Abstract: The study aimed to examine the short-run and long-run relationship between beef consumption and beef prices, chicken meat prices, and per capita income for the period of 1994–2014 in Turkey by employing the ARDL/bounds test approach. After deciding on the presence of cointegration between the related variables, a parsimonious VECM model was estimated to conduct the structural analyses of the impulse response function and variance decomposition. The results of the bounds test suggest a long-run equilibrium relationship between beef consumption and its selected determinants. In addition, the empirical findings indicate that chicken meat prices and per capita income level have a positive effect on beef consumption. The results of variance decomposition reveal that the portion of beef prices in explaining beef consumption is large, whereas chicken meat prices have decreasing impact and income level has increasing impact on beef consumption in the long run. The results of the impulse response function are also consistent with the theory. The findings suggest that beef consumption is sensitive to beef prices and responds negatively to a shock in beef prices.

Key words: Beef consumption, cointegration analysis, impulse response function, variance decomposition, Turkey

1. Introduction

The total meat production in Turkey is about 3.1 million tons, 32.6% beef and 67.4% poultry meat, based on the data for 2014. Beef accounts for 87.5% of total red meat production and chicken meat accounts for 93.0% of total poultry production. Turkey is the world's 16th biggest beef producer while it ranks 8th in the production of chicken meat. Turkey exports 18.2% of its total chicken meat production; however, a significant amount of beef has to be imported due to the lack of production in recent years (1,2).

A steady increase in chicken meat production has significantly contributed to consumption. The annual average consumption of chicken meat per year per person increased from 3.65 kg to 19.8 kg (442% increase) in the period of 1994–2014. During the same period, the annual average consumption of beef per year per person rose from 5.38 kg to 11.4 kg (112% increase). Per capita consumption of chicken meat in Turkey exceeds that of the EU average (18.1 kg), whereas per capita consumption of beef is below the EU level. The annual per capita beef consumption is between 35.4 and 55.7 kg in countries such as the US, Brazil, Argentina, and Australia, the leading beef producers (2,3).

The most important factor affecting the level of beef consumption is the structure of beef demand. Beef prices and average income of consumers are the two main determinants of beef demand. Akbay et al. (4) found the beef price and income elasticities to be –1.89 and 0.32, respectively. Bilgic and Yen (5) and Armağan and Akbay (6) reported that the price elasticities of demand for beef are –1.59 and –1.22, respectively.

The preferences of chicken meat affect the choices of meat consumption since it is the closest substitute for red meat. In Turkey, chicken meat price and income elasticities, –0.32 and 0.08, respectively, are lower than beef price and income elasticities (4). The most important reason for this is that chicken meat prices (3.32 $/kg) are lower than beef prices (12.96 $/kg). In 2014, Turkish people consumed beef approximately four times more expensive than chicken meat (3). In recent years, the increase in beef prices has lead Turkish consumers to shift from beef to chicken meat. However, people cannot give up consuming beef in the long term due to the effect of eating habits. The dynamic nature of consumer preferences and changes in the socio-economic structure affect food consumption, including beef consumption. Therefore, measuring the level of food consumption in different time periods provides important

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findings for developing efficient and sustainable production and consumption policies. To analyze the animal food and meat consumption by performing different econometric methods, there are various studies that used time series data in the literature (7–12).

Besides the multiple regression approach, there are studies using different approaches to examine the animal food and meat consumption in Turkey. Some of these methods are ARIMA, Bayesian Markov chain Monte Carlo (MCMC), and linear approximation of almost ideal demand system (LA/AIDS), studied by Dağdemir et al. (13), Hatırlı et al. (14), Armağan and Akbay (6), Yavuz et al. (15), and Bilgic and Yen (5). However, none of these studies used the cointegration approach in modeling beef consumption. In the present study, the relationship between beef consumption and beef prices, chicken meat prices, and per capita income for the period of 1994–2014 in Turkey was investigated by performing the ARDL/bounds test method. Further, analyses of variance decomposition and impulse responses were conducted to measure the relative importance of random shocks.

2. Materials and methods

The theoretical framework of the model used in the current study is based on microeconomic theory (16). The linear functional form of the model is

$$BC = f(PB, PC, INC)\,, \tag{A}$$

where *BC* is the beef consumption (tons); *PB*, *PC*, and *INC* represent, respectively, the retail price for beef ($/kg), the retail price for chicken meat ($/kg), and per capita income ($). Specifying the consumption function in log-linear form, the following equation is obtained:

$$LBC_t = \beta_0 + \beta_1 LPB_t + \beta_2 LPC_t + \beta_3 LINC_t + u_t \tag{B}$$

It is expected that the signs of the elasticity parameters are $\beta_1 < 0$ and $\beta_2, \beta_3 > 0$. The annual data used in the study consist of time series from 1994 to 2014. The data set is restricted to this period due to the availability of official data. Data were collected from the sources of TÜİK (3). All the variables used in the study are presented in Figure 1.

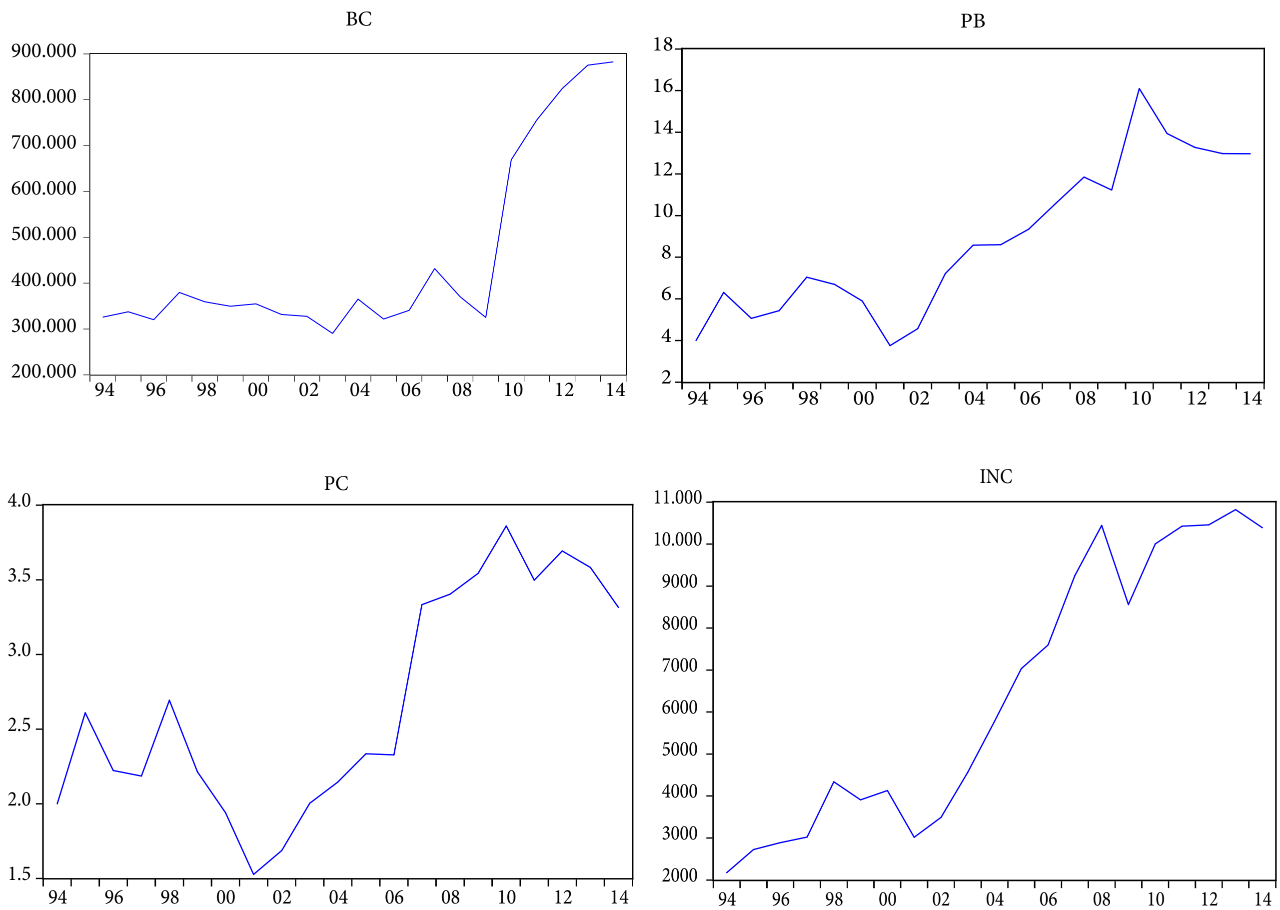

Figure 1. The variables used in the study, 1994–2014.

2.1. The ARDL/bounds testing methodology

The autoregressive distributed lag (ARDL) models are the standard ordinary least squares regressions, which include the lags of both the dependent variable and independent variables as regressors. The basic form of an *ARDL*(*p, q*) regression model is

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + ... + \beta_k Y_{t-p} + \alpha_0 X_t + \alpha_1 X_{t-1} + ... + \alpha_q X_{t-q} + \varepsilon_t , \quad \text{(C)}$$

where ε_t is a disturbance term.

The bounds testing procedure, developed by Pesaran et al. (17), requires the estimation of the following equation, which derives the relationship between beef consumption and its determinants, beef prices, chicken meat prices, and income level, as a conditional autoregressive distributed lag (ARDL):

$$\Delta LBC_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} \Delta LBC_{t-i} + \sum_{i=1}^{p_1} \alpha_{2i} \Delta LPB_{t-i} + \sum_{i=1}^{p_2} \alpha_{3i} \Delta LPC_{t-i} + \sum_{i=1}^{p_3} \alpha_{4i} \Delta LINC_{t-i} + \beta_1 LBC_{t-1} + \beta_2 LPB_{t-1} + \beta_3 LPC_{t-1} + \beta_4 LINC_{t-1} + u_t , \quad \text{(D)}$$

where *LBC* is the natural log of beef consumption, *LPB* is the natural log of beef price, *LPC* is the natural log of the price for chicken meat, and *LINC* is the natural log of per capita income. Δ is the first difference operator. q, p_1, p_2, and p_3 are the lag lengths.

The null hypothesis of "no cointegration" in the long-run is H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$. The computed *F*-statistic is compared with critical values obtained from Pesaran et al. (17). If the *F* test statistic falls below the lower bound, there is no cointegration. If the *F* test statistic is greater than the upper bound, we assume cointegration. On the other hand, if the *F*-statistic lies between both critical values, the test is inconclusive.

If a long-run relationship among the variables is confirmed, the long-run and short-run elasticity coefficients are estimated by using ARDL restricted error correction models. The long-run relationship model is given in the following equation:

$$LBC_t = \alpha_0^* + \sum_{i=1}^{q} \alpha_{1i}^* LBC_{t-i} + \sum_{i=1}^{p_1} \alpha_{2i}^* LPB_{t-i} + \sum_{i=1}^{p_2} \alpha_{3i}^* LPC_{t-i} + \sum_{i=1}^{p_3} \alpha_{4i}^* LINC_{t-i} + u_t^* \quad \text{(E)}$$

When there is cointegration among the variables, then there exists an error correction representation. The short-run relationship model is given in Eq. (F):

$$\Delta LBC_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} \Delta LBC_{t-i} + \sum_{i=1}^{p_1} \alpha_{2i} \Delta LPB_{t-i} + \sum_{i=1}^{p_2} \alpha_{3i} \Delta LPC_{t-i} + \sum_{i=1}^{p_3} \alpha_{4i} \Delta LINC_{t-i} + \alpha_5 ECT_{t-1} + u_t , \quad \text{(F)}$$

where α_5 is the coefficient of the error (or equilibrium) correction term (*ECT*). The error correction term indicates the speed of adjustment due to any short-run disequilibrium after a shock. A negative and statistically significant error correction term ensures convergence of the dynamics to the long-run equilibrium.

2.2. Vector error correction methodology (VECM)

The presence of cointegration between the variables suggests modelling the data by using a VECM, a set of multivariate linear models. The details of the VECM to model beef consumption and related variables are as follows:

$$\Delta LBC_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} \Delta LBC_{t-i} + \sum_{i=1}^{p_1} \alpha_{2i} \Delta LPB_{t-i} + \sum_{i=1}^{p_2} \alpha_{3i} \Delta LPC_{t-i} + \sum_{i=1}^{p_3} \alpha_{4i} \Delta LINC_{t-i} + \alpha_5 ECT_{t-1} + u_{1t} \quad \text{(G)}$$

$$\Delta LPB_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} \Delta LPB_{t-i} + \sum_{i=1}^{p_1} \beta_{2i} \Delta LBC_{t-i} + \sum_{i=1}^{p_2} \beta_{3i} \Delta LPC_{t-i} + \sum_{i=1}^{p_3} \beta_{4i} \Delta LINC_{t-i} + \beta_5 ECT_{t-1} + u_{2t} \quad \text{(H)}$$

$$\Delta LPC_t = \delta_0 + \sum_{i=1}^{q} \delta_{1i} \Delta LPC_{t-i} + \sum_{i=1}^{p_1} \delta_{2i} \Delta LBC_{t-i} + \sum_{i=1}^{p_2} \delta_{3i} \Delta LPB_{t-i} + \sum_{i=1}^{p_3} \delta_{4i} \Delta LINC_{t-i} + \delta_5 ECT_{t-1} + u_{3t} \quad \text{(J)}$$

$$\Delta LINC_t = \gamma_0 + \sum_{i=1}^{q} \gamma_{1i} \Delta LINC_{t-i} + \sum_{i=1}^{p_1} \gamma_{2i} \Delta LBC_{t-i} + \sum_{i=1}^{p_2} \gamma_{3i} \Delta LPB_{t-i} + \sum_{i=1}^{p_3} \gamma_{4i} \Delta LPC_{t-i} + \gamma_5 ECT_{t-1} + u_{4t} \quad \text{(K)}$$

Often, the dynamic features of a VECM are examined by conducting two types of structural analysis, variance decomposition and impulse response function. The variance decomposition analysis describes the proportional contribution in a variable's variance explained by all the variables after a shock given to the system. The impulse response function measures the effect of an impulse in one variable on the other variable in later periods (18).

3. Results and discussion

3.1. The results of unit root tests

The first step of the analysis is to find the order of integration of time-series variables especially to check that none of the series is $I(2)$. The results of augmented Dickey–Fuller (ADF) and Philips and Perron (PP) unit root tests are given in Table 1.

The results of the reported unit root tests show that all series are nonstationary in levels and the null hypothesis of the presence of a unit root at 5% significance level cannot be rejected. The first differences of all series are stationary at 1% significance level except beef consumption (*BC*), which is nonstationary based on the ADF test but also stationary based on the PP test. Thus, we conclude that all the series are integrated of the same order $I(1)$.

3.2. The results of the ARDL/bounds test

The approach ARDL/bounds test is applied in the study. This approach has advantages over the other alternatives, Engle and Granger (19) and Johansen (20,21). First, it produces more reliable estimates for small samples than other approaches (22). Second, it does not require all variables used in the analysis have the same order of integration. It can be used with variables purely $I(0)$ or $I(1)$, or a mixture of both. The only condition is none of the variables are $I(2)$. Third, integrating the dynamics of short-run and long-run equilibrium an error correction model (ECM) can be derived from the ARDL model (23). Fourth, it allows variables to assign different lag lengths in the model.

Therefore, the ARDL/bounds test approach is applied to investigate the existence of a long-run relationship as well as to estimate the long-run and short-run coefficients. As previously mentioned, the main advantage of preferring the ARDL method over others is reliability of the estimates for small samples. Several studies applied the ARDL/bounds test methodology with relatively small samples. Pattichis (24) performed the method to model the demand for butter, maize, rice, and milk powder imports in Cyprus using data for the period 1975–1994, 20 annual observations. Mah (25) applied the bounds test to derive the price and income elasticities of import demand in the long run for certain technology products in Korea for the period 1980–1997, 18 annual observations. Tang and Nair (26) employed the bounds test to analyze whether there is a long-run relationship between import demand and relative prices and income using annual data from 1970 to 1998, 19 observations. We applied the ARDL/bounds test with 21 annual observations in the current study.

The second step was the estimation of a basic ARDL model that explains beef consumption in terms of past values of beef consumption as well as the current and past values of the retail price for beef, the retail price for chicken meat, and per capita income level. To determine the lag structure for the regressors in the model, the ARDL (3,3,3,1) model is chosen that minimizes the Schwarz criterion (SC). Table 2 shows the estimates of the selected parsimonious ARDL model specification.

It is important to have statistically desirable parameter estimates for the further steps of the analysis. For this purpose, a number of diagnostic tests were performed for the model. The diagnostic tests results are provided in the bottom panel of Table 2. The selected ARDL (3,3,3,1) model passes the reported diagnostic tests (autocorrelation, heteroscedasticity, normality and functional form).

In the third step, the estimated ARDL (3,3,3,1) model was used as the basis for applying the bounds test to examine the long-run cointegration relationship among

Table 1. The results of unit root tests.

Variables	ADF test statistic	P-value	PP test statistic	P-value
BC	−2.7799	0.2202	−2.5349	0.3097
ΔBC	−3.0699	0.0510	−4.3028**	0.0037
PB	−2.3208	0.4051	−2.3208	0.4051
ΔPB	−5.2236**	0.0005	−5.2697**	0.0005
PC	−1.6999	0.7132	−1.6987	0.7137
ΔPC	−4.8121**	0.0013	−4.7896**	0.0014
INC	−1.9956	0.5684	−2.0106	0.5607
ΔINC	−4.6831**	0.0017	−4.6831**	0.0017

Note: Δ is the first difference operator
** , * indicate level of significance at 1% and 5%, respectively.

Table 2. The estimates of the ARDL (3,3,3,1) model.

Regressor	Coefficient	Standard error	t-statistic	P-value
LBC (−1)	0.755577	0.123091	6.138343	0.0036
LBC (−2)	−0.365215	0.199033	−1.834942	0.1404
LBC (−3)	0.347182	0.131348	2.643213	0.0574
LPB	0.445777	0.172700	2.581224	0.0612
LPB (−1)	−1.195589	0.231803	−5.157778	0.0067
LPB (−2)	−0.559211	0.213648	−2.617444	0.0590
LPB (−3)	−0.688642	0.235505	−2.924102	0.0431
LPC	−0.607864	0.209589	−2.900265	0.0441
LPC (−1)	−0.049229	0.223416	−0.220345	0.8364
LPC (−2)	0.781987	0.242118	3.229770	0.0320
LPC (−3)	0.985294	0.263807	3.734903	0.0202
LINC	0.451737	0.295472	1.528868	0.2010
LINC (−1)	0.868963	0.291498	2.981025	0.0407
C	−3.886006	2.949486	−1.317520	0.2581
R^2 = 0.9997	AdjR^2 = 0.9988	DW = 2.4091	SC = −3.192 F-statistic = 1165.61	
Test statistics of the diagnostic tests				
Breusch–Godfrey serial correlation LM = 3.3365 (0.2306)				
ARCH test = 0.0798 (0.7814)				
JB normality test = 0.3269 (0.8492)				
Ramsey RESET test = 4.3732 (0.1276)				

Note: For the diagnostic tests the P-values are given in parentheses.

beef and its determinants, the retail price for beef, the retail price for chicken meat, and per capita income. The results of the bounds test are presented in Table 3.

The F-statistic for the ARDL/bounds test is 26.8319, which exceeds all the critical values for the upper bounds. This result leads to rejection of the hypothesis of no long-run relationship. This indicates that there is a long-run equilibrium relationship between beef consumption and other regressors.

In the fourth step, the long-run coefficients of the ARDL model were estimated and are given in Table 4.

The results indicate that the signs of the elasticity parameters are consistent with economic theory. $\hat{\beta}_1 = -7.6114 < 0$; a rise in the price of beef decreases beef consumption. $\hat{\beta}_2 = 4.2299 > 0$; a decrease in the retail price of chicken meat leads to people consuming more chicken meat and less beef and so the consumption of beef decreases. $\hat{\beta}_3 = 5.0320 > 0$; as people get richer they

Table 3. The results of the ARDL/bounds test.

k	F-statistic	Significance level	$I(0)$	$I(1)$
3	26.8319	10%	2.37	3.2
		5%	2.79	3.67
		1%	3.65	4.66

*k denotes the number of regressors. The critical value bounds are from Pesaran et al. (2001).

Table 4. The estimated long-run coefficients.

Regressor	Coefficient	Standard error	t-statistic	P-value
C	–14.8062	9.7869	–1.5128	0.2049
LPB	–7.6114	2.3421	–3.2498	0.0314
LPC	4.2299	1.5911	2.6584	0.0565
LINC	5.0320	1.4913	3.3741	0.0279

can afford to buy expensive beef products. The coefficients of beef prices and per capita income are statistically significant at 5% significance level whereas the coefficient of chicken meat prices is significant at 10% significance level. A 1% increase in the beef price would decrease beef consumption by approximately 7.6% in the long run. A 1% change in the price of chicken meat will result in a long-run change of approximately 4.2% in beef consumption. A 1% change in per capita income level will result in a long-run change of approximately 5% in beef consumption. These results are similar to those reported by Armağan and Akbay (6), Akbay et al. (4), and Bilgic and Yen (5).

The results of the error-correction estimation are displayed in Table 5. The error-correction term, ECT_{t-1}, is negative (–0.26) and statistically significant at 1% level. Specifically, this term implies that nearly 26% of any disequilibrium level of beef consumption during the previous period will be adjusted in the current period. In other words, it takes about 4 years to attain the long-run equilibrium level. Finally, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) of the standardized recursive residuals are used to check the stability of the ARDL error-correction model as proposed by Brown et al. (27). The plots of both CUSUM and CUSUMSQ statistics are provided in Figures 2a and 2b. The results of the CUSUM and CUSUMSQ tests suggest that the residual variance is somewhat stable since the cumulative sum and cumulative sum of squares are generally within the 5% significance lines.

After examining a cointegrating relationship between beef consumption and beef prices, chicken meat prices, and per capita income level, the analyses of variance decomposition and impulse responses were conducted to measure the relative importance of random shocks (or innovations) by fitting a parsimonious vector error correction model (VECM).

3.3. The results of structural analyses

The results of variance decomposition over the 10-year horizons are reported in Table 6. The variance decomposition of beef consumption indicates that in the initial period beef consumption explains 100% of its own variation. In the second year of the period, a 66.92%

Table 5. The estimated short-run coefficients.

Variable	Coefficient	Standard error	t-statistic	P-value
ΔLBC_{t-1}	0.0180	0.0734	0.2454	0.8182
ΔLBC_{t-2}	–0.3471	0.0708	–4.9036	0.0080
ΔLPB_{1}	0.4457	0.0635	7.0186	0.0022
ΔLPB_{t-1}	1.2478	0.1385	9.0061	0.0008
ΔLPC_{t-2}	0.6886	0.0935	7.3576	0.0018
ΔLPC_{1}	–0.6078	0.0925	–6.5680	0.0028
ΔLPC_{t-1}	–1.7672	0.1504	–11.7496	0.0003
ΔLPC_{t-2}	–0.9852	0.1100	–8.9492	0.0009
ΔINC_{1}	0.4517	0.0921	4.9030	0.0080
ECT_{t-1}	–0.2624	0.0160	–16.3804	0.0001

ECT denotes the error-correction term.

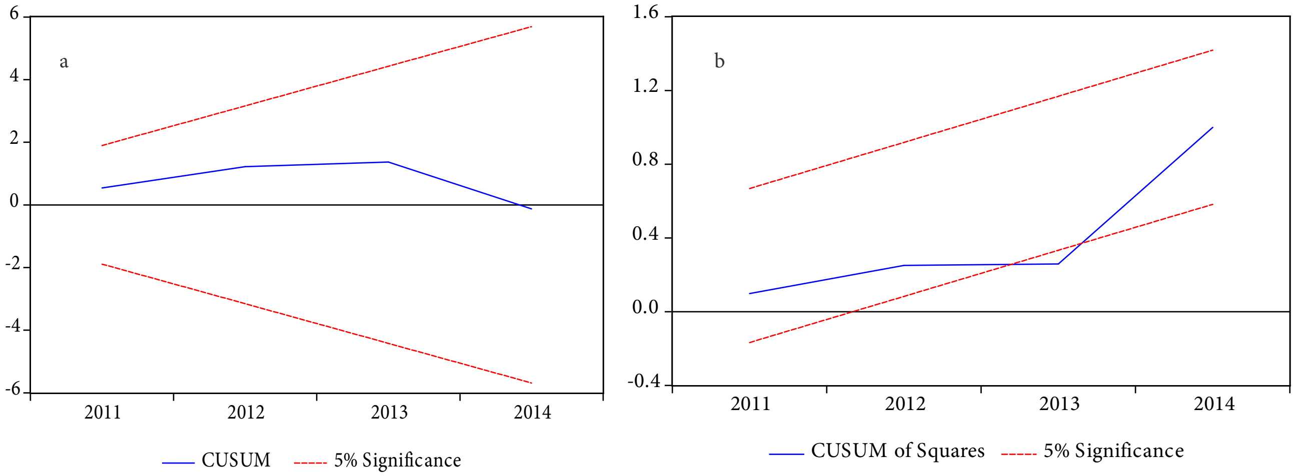

Figure 2a and 2b. Plots of CUSUM and CUSUMSQ.

portion of beef consumption is explained by its own innovations, whereas beef prices, chicken meat prices, and per capita income contribute to 24.03%, 6.85%, and 2.15%, respectively. In the long run, in the 10-year period, beef prices solely contribute to over 66% of beef consumption error variance for Turkey followed by 4.90% of per capita income and 3.91% of chicken meat prices. In the initial period, a 51.39% portion of beef prices is explained by its own innovations in addition to the contribution of beef consumption, which is 48.60%. In the long run, beef consumption, chicken meat prices, and income level contribute to beef prices by 18.95%, 13%, and 0.19%, respectively. The results also indicate that a 30.5% portion of chicken meat prices is explained by its own innovations whereas the contributions of beef consumption, beef prices, and the per capita income level are 4.17%, 64.44%, and 0.87%, respectively.

The results of the impulse response function are illustrated in Figure 3. Beef consumption responds negatively to a shock in beef prices with the impact increasing over the years. In contrast, beef consumption responds positively due to a shock in the prices of chicken meat, increasing from the first to the second year and then remaining almost the same for other periods. Additionally, beef consumption responds positively to a shock in the per capita income level.

4. Conclusion

This study aimed to examine the effect of the retail prices of beef, the retail prices of chicken meat, and per capita income on beef consumption for the short run and long run in Turkey over the period of 1994–2014. The ARDL/bounds test methodology was performed to determine whether there is a cointegration relationship between the selected variables. Moreover, the error correction model was estimated to seek the short-run relationship among the related variables. Additionally, the analyses of variance decomposition and impulse response were conducted to examine the short-term and long-term impacts of the beef prices, chicken meat prices, and income level on beef consumption.

The results of the bounds test indicate that there exists a long-run equilibrium relationship between beef consumption and its determinants. The signs of all the long-run coefficients are consistent with economic theory and they are all statistically significant. Chicken meat prices and the income level of people have a positive effect on beef consumption, whereas beef prices have a negative effect. Having a statistically negative error correction term is another piece of evidence of a certain return to the long-run equilibrium of the variables. The results of variance decomposition reveal that the share of beef prices in explaining beef consumption is large. Beef prices have short-term and long-term impacts on beef consumption. It is also argued that beef prices are the most important variable in explaining beef consumption in the short run and long run among the selected variables. While chicken prices have decreasing impact, income level has increasing impact on beef consumption in the long run. The results of the impulse response function are also consistent with the theory. The findings suggest that beef consumption is sensitive to beef prices and responds negatively to a shock in beef prices. However, the shocks of chicken meat prices and income lead to positive responses following a pattern that continues over the years.

There has been a long ongoing debate about the high price of beef for consumers in Turkey lasting years. The empirical findings of the current study will assist policymakers in dealing with this issue. Since it is detected that beef prices have the greatest effect on beef

Table 6. Variance decomposition of the four series.

Period	LBC	LBP	LCP	LINC
Variance decomposition of LBC				
1	100.0000	0.0000	0.0000	0.0000
2	66.9216	24.0631	6.8599	2.1552
3	42.3522	43.2749	10.0493	4.3235
4	34.1682	52.2651	8.8179	4.7486
5	31.0583	57.0013	7.1033	4.8368
6	29.1445	60.0156	5.9856	4.8541
7	27.6345	62.2465	5.2339	4.8849
8	26.5031	63.9078	4.6872	4.9017
9	25.6701	65.1658	4.2559	4.9080
10	25.0348	66.1415	3.9151	4.9084
Variance decomposition of LBP				
1	48.6085	51.3914	0.0000	0.0000
2	41.2646	54.4604	3.93767	0.3371
3	35.7938	55.0209	8.80669	0.3785
4	31.1467	56.0690	12.4901	0.2940
5	28.3023	58.6446	12.8118	0.2411
6	25.8206	60.9711	12.9889	0.2191
7	23.7144	63.0163	13.0678	0.2013
8	21.8740	64.7769	13.1550	0.1940
9	20.3078	66.3922	13.1066	0.1932
10	18.9522	67.8455	13.0036	0.1986
Variance decomposition of LCP				
1	23.037	39.3688	37.5938	0.0000
2	17.789	43.9830	37.8453	0.3825
3	13.799	46.5437	39.3714	0.2850
4	10.915	49.3182	39.4088	0.3569
5	9.0332	52.8183	37.7231	0.4252
6	7.5630	55.8654	36.0376	0.5338
7	6.4159	58.5115	34.4493	0.6231
8	5.4989	60.7552	33.0334	0.7124
9	4.7669	62.7277	31.7101	0.7952
10	4.1734	64.4464	30.5061	0.8739
Variance decomposition of LINC				
1	51.9716	33.9684	4.8004	9.2594
2	51.4582	40.6607	3.5456	4.3354
3	51.8964	41.9692	2.5591	3.5750
4	50.6359	42.8905	3.6288	2.8447
5	50.2002	43.6857	3.5374	2.5766
6	49.6413	44.4873	3.6014	2.2697
7	49.2176	45.1995	3.5132	2.0694
8	48.7597	45.8233	3.5133	1.9035
9	48.3468	46.3799	3.4953	1.7778
10	47.9572	46.8863	3.4852	1.6712

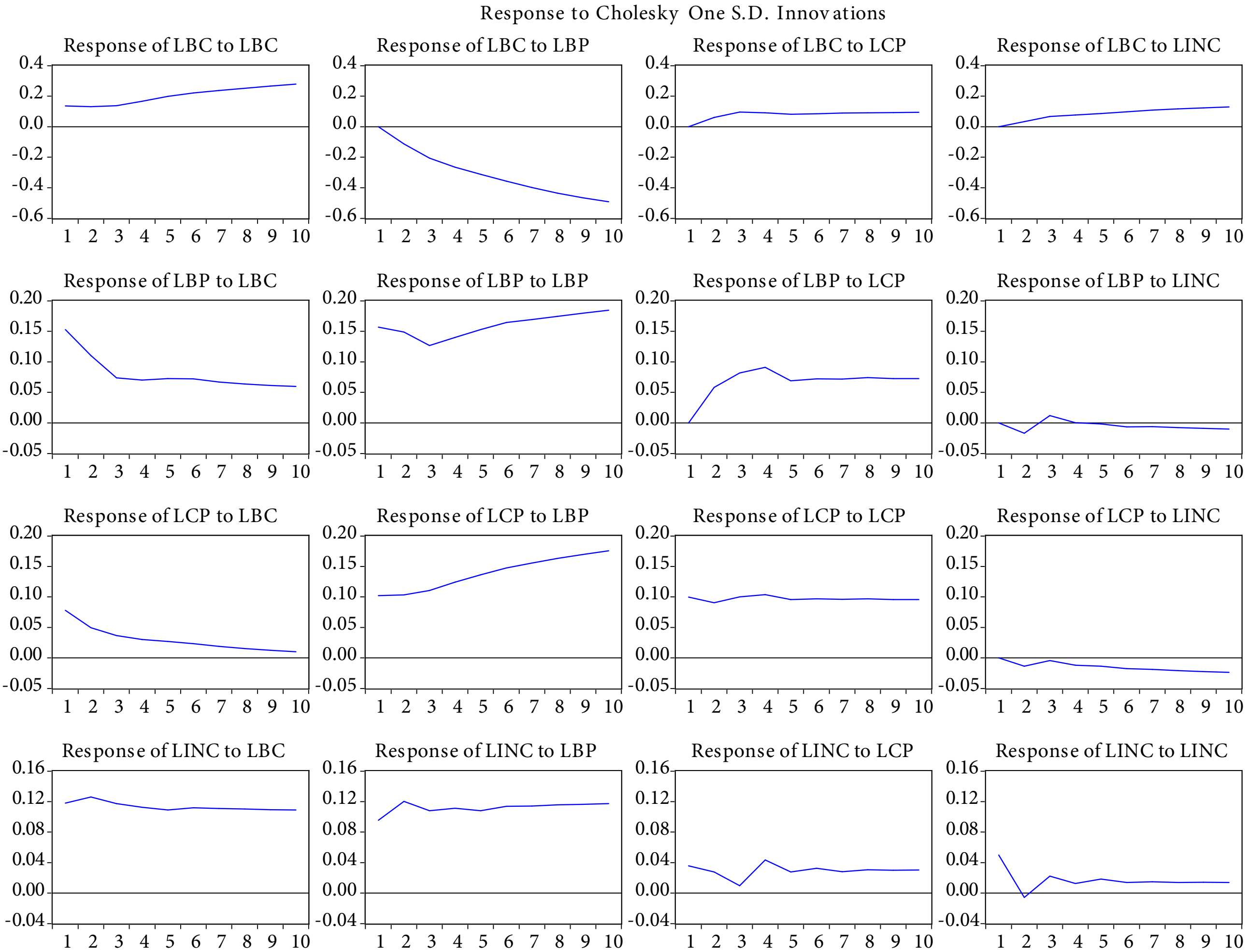

Figure 3. Responses of series to one S.D. innovations.

consumption, the main goal should be to improve the supply chain linkages within the country. In recent years, importing live animals and beef in order to prevent an increase in beef prices can be expected to provide a solution in the short term. However, this will lead to a decrease in domestic production in the long term and increased dependence on foreign red meat. Therefore, policies should be implemented to increase domestic production. To do so, incentives given to livestock producers should be increased. Always at a disadvantage compared with the large-scale producers in terms of higher costs, the small-scale livestock producers should be supported with efficient and sustainable programs. Additionally, forage crop production should also be promoted and subsidized to ensure low costs for producers.

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