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THE IMPACT OF EXCHANGE RATE VOLATILITY ON TURKEY'S LIVESTOCK IMPORTS

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Abstract

Turkey is a country with high young population rate. Also, after the internal conflicts that arose in neighboring countries, flocks of people have immigrated to Turkey. High population growth caused high food demand. Also, most of the population in Turkey is Muslim, and it is creating extra demand in the feast of sacrifice. During recent years, because of these reasons, the supply of meat could not meet the demand, and high demand increased the meat prices with high costs. The government of Turkey, therefore, started to import live animals to reduce meat prices. In this study, for the period 2005M01- 2018M01, the relationship between real effective exchange rate, real effective exchange rate volatility and Turkey's livestock imports was examined using bounds test, symmetric and time-varying symmetric causality tests.

In this study, unit root analysis was performed using ADF and PP tests. The results of ADF and PP unit root tests indicated that the parameters were stationary at different levels and that none of the parameters was stationary at the 2nd level. According to bounds test, the F-statistic value calculated at a significant level of 5% and 10% was found less than bottom limits, the cointegration relation between the variables was not determined. As a result of the bounds test, it was concluded that there was no long-term relationship between the variables. According to the results of a Hacker-Hatemi-J causality test, a causality relationship was not found from volatility, reel effective exchange rate and industrial production index to Turkey's livestock exports. Timer varying causality analysis confirmed this result for a significant part of the time interval. However, a causality relationship was determined for some periods from volatility, reel effective exchange rate and industrial production index to Turkey's livestock exports.

In this study,for the period 2005M01- 2018M01, the relationship between real effective exchange rate, real effective exchange rate volatility and Turkey's livestock imports was examined using bounds test, symmetric and time-varying symmetric causality tests.

Keywords: Foreign Trade, Real Exchange Rate, Time Series, Bounds Test, Causality Tests
Related Field: B-5

1. Introduction

Turkey is a country with high young population rate. Also, after the internal conflicts that arose in neighboring countries, flocks of people have immigrated to Turkey. High population growth caused high food demand. Also, most of the population in Turkey is Muslim, and it is creating extra demand in the feast of sacrifice. During recent years, because of these reasons, the supply of meat could not meet the demand, and high demand increased the meat prices. The government of Turkey, therefore, started to import live animals to reduce meat prices.

Due to the changes in supply and demand conditions, from the second half of the 2000s, food prices have been a significant increase in the world. The period 2007-2008 was the period of high food prices and instability in the markets and a period known as the food crisis period. The prices, which started to decline after 2008, started to rise again in 2010 (Bayramoğlu and Yurtkur 2015).

In recent days, Turkey's agricultural and animal products prices are on the agenda of the country. Policymakers are applying different solutions to under control the prices. Understand the reasons of high agricultural and animal products prices is necessary to find and apply logical solutions.

Turkey also faced with the high exchange rate fluctuations and reveals a higher risk countries for food suppliers. Turkey has limited studies on the determinants of food prices. In some of the studies, the effect of exchange rate on Turkish food prices was also examined. Çıplak and Yücel (2004) and Bayramoğlu and Yurtkur (2015) are some of these studies. The foreign exchange rates found in the works of Çıplak and Yücel (2004) are the determining factors of food prices. Bayramoğlu and Yurtkur (2015) analyzed the relationship between exchange rates and agricultural producer prices with the VAR approach between 1999: 2-2014: 4. According to empirical results, exchange rates have a lagged effect on prices.

The main aim of this study is to determine the effects of volatility in real effective exchange rates on Turkey's livestock imports.

The accomplishment of this objective is expected to answer the following research questions:

1. What effect does the exchange rate volatility have on Turkey's livestock imports?
2. How does the exchange rate affect livestock traders and farm policy?
3. What measures do governmental policy planners need to implement to minimize the impact of exchange rate volatility?

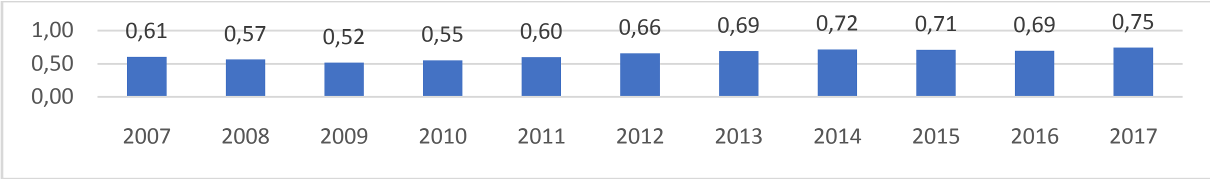
2. Turkey's Livestock Production and Imports

The annual meat consumption per person in Turkey has increased by 95 per cent in the last 20 years. In 1998, 16.6 kilograms of meat per capita was consumed per year. This figure increased to 32.3 kilograms in 2017. While the highest increase was experienced in cattle consumption with 149 per cent, sheep consumption decreased by 20 per cent in the same period. On the other hand, chicken meat consumption increased by 107 per cent.

Table 1. Turkey's Number of Livestock and Livestock Products

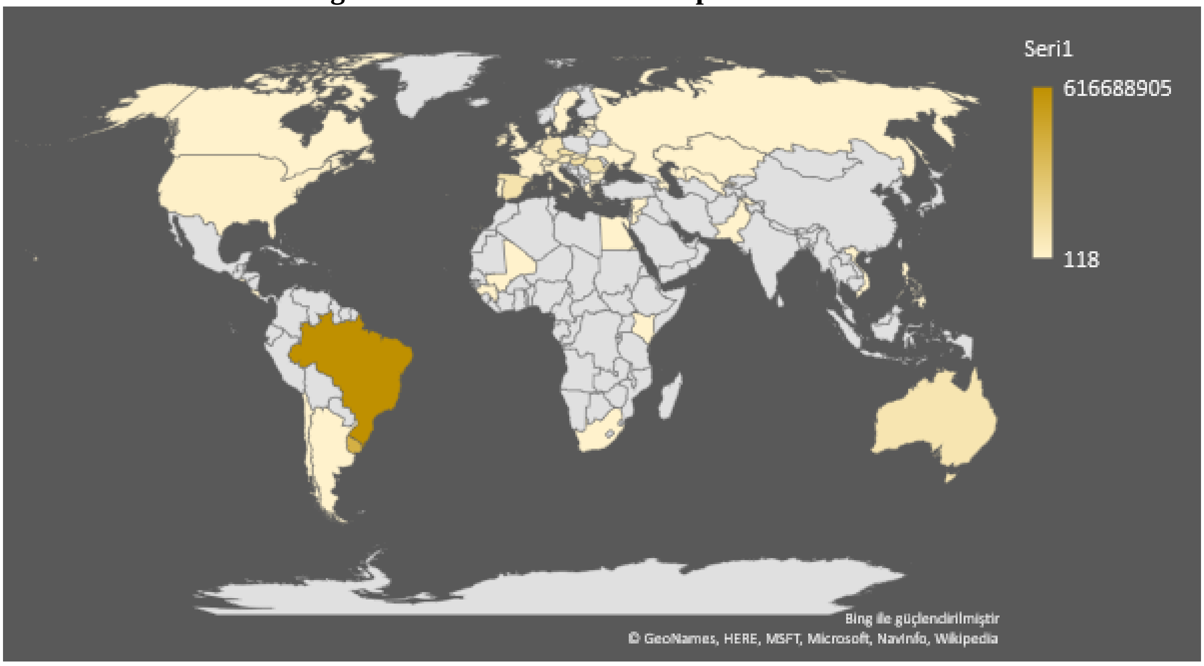
	Cattle	Sheep	Goats	Total(Head)
2001	10 548 000	26 972 000	7 022 000	44 542 000
2002	9 803 498	25 173 706	6 780 094	41 757 298
2003	9 788 102	25 431 539	6 771 675	41 991 316
2004	10 069 346	25 201 155	6 609 937	41 880 438
2005	10 526 440	25 304 325	6 517 464	42 348 229
2006	10 871 364	25 616 912	6 643 294	43 131 570
2007	11 036 753	25 462 293	6 286 358	42 785 404
2008	10 859 942	23 974 591	5 593 561	40 428 094
2009	10 723 958	21 749 508	5 128 285	37 601 751
2010	11 369 800	23 089 691	6 293 233	40 752 724
2011	12 386 337	25 031 565	7 277 953	44 695 855
2012	13 914 912	27 425 233	8 357 286	49 697 431
2013	14 415 257	29 284 247	9 225 548	52 925 052
2014	14 223 109	31 140 244	10 344 936	55 708 289
2015	13 994 071	31 507 934	10 416 166	55 918 171
2016	14 080 155	30 983 933	10 345 299	55 409 387
2017	15 943 586	33 677 636	10 634 672	60 255 894

Source: Turkish Statistical Institute, 2019.



Source: Turkish Statistical Institute, 2019.

Figure 1. Number of Livestock per Person



Source: Turkish Statistical Institute, 2019.

Figure 2. Turkey's Livestock Import Destinations– 2018

Table 2. Livestock Products T

	Meat (Tons)	Milk (Tons)	Chicken meat (Tons)
2001	435 778	9 495 550	614 745
2002	420 595	8 408 568	696 187
2003	366 962	10 611 011	872 419
2004	447 154	10 679 406	876 774
2005	409 423	11 107 897	936 697
2006	438 530	11 952 099	917 659
2007	575 622	12 329 789	1 068 454
2008	482 458	12 243 040	1 087 682
2009	412 621	12 542 186	1 293 315
2010	780 718	13 543 674	1 444 059
2011	776 915	15 056 211	1 613 309
2012	915 844	17 401 262	1 723 919
2013	996 125	18 223 712	1 758 363
2014	1 008 272	18 630 859	1 894 669
2015	1 149 262	18 654 682	1 909 276
2016	1 173 042	18 489 161	1 879 018
2017	1 126 403	20 699 894	2 136 734

Source: Turkish Statistical Institute, 2019.

The percentage of the livestock in Turkey rose by 29% from 2007 to 2017. In this period, Turkey's population also increased by 13%. However, we should also keep in mind that illegal immigrants entered in Turkey in this period.

Table 3. Livestock Import Destinations Table (2018)

Country	Livestock Import	Percentage of Total Livestock Import
Brazil	616688905	34.88%
Uruguay	412486313	23.33%
Hungary	120387970	6.81%
Czechia	111447112	6.30%
Spain	92625884	5.24%
Romania	83272421	4.71%
Australia	81862800	4.63%
Germany	62060422	3.51%
Austria	44764976	2.53%
Slovakia	41517708	2.35%
Total		94.30%

Source: Turkish Statistical Institute, 2019.

Turkey mostly imported livestock from Latin American countries such as Brazil and Uruguay in 2018. The share of these two countries in total livestock imports of Turkey is 58.21%. With a share of 31.45%, European countries (Hungary, Czechia, Spain, Romania, Germany, Austria and Slovakia) are in the list of top ten countries supplying Turkey's livestock imports after Latin American countries.

3. Empirical Analyses

In the study, the model developed by Bahmani-Oskooee and Goswami (2004) was used to examine the relationship between the real effective exchange rate and volatility and exports. Model (1) is given below:

$$LNLA = LNREER + VOL + LNIPE$$

Table 4. Variables Used in Present Study

Abbreviation of Variable	Definition	Period	Source
LNLA	Turkey's Livestock Imports	2005M01-2018M01	Turkish Statistical Institute Database
LNREER	Real Effective Exchange Rates		
LNIPE	Industrial Production Index		
VOL	Volatility		EGARCH (1.1)

3.1 GARCH Model

Bollerslev (1986) extended the ARCH model to the Generalized Autoregressive Conditionally Heteroscedastic (GARCH) model, which assumes that the conditional variance depends on its own p past values, and q past values of the squared error terms. The variance equation of the GARCH (p,q) model can be expressed as

$$a_t = \sigma_t \varepsilon_t \; where \; \varepsilon_t \sim f_v(0,1)$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i a_{t-i}^2 + \sum_{i=1}^{q} \beta_i \sigma_{t-i}^2$$

$$\sigma_t^2 = \alpha_0 + \alpha(B)a_{t-1}^2 + \beta(B)\sigma_{t-1}^2$$

where α_0 is a constant and the innovations or residuals follow the probability density function $f_v(0,1)$ with zero mean and unit variance. In non-normal case, $v$are used as additional distributional parameters for the scale and the shape of the distribution. $\alpha(B)$is a polynomial of degree p and $\beta(B)$ is a polynomial of degree q where B is the backward shift operator.

Bollerslev (1986) has shown that the GARCH(p,q) process is covariance stationary with E(a_t) = 0, var(a_t) = α_0 / $(1 - \alpha(1) - \beta(1))$ and cov(a_t, a_s) = 0 for t ≠ s if and only if $\alpha(1) + \beta(1)$< 1.

In this study, Standart GARCH (Bollerslev,1986), Integrated GARCH (Engle and Bollerslev, 1986, Nelson, 1990), Exponential GARCH (Nelson, 1991), Threshold GARCH (Zakoian, 1994), GJR-GARCH of Glosten, Jagannathan and Runkle (1993) and Absolute Value GARCH (Taylor, 1986) models are applied for modeling the volatility of foreign exchange rates. Moreover, the innovation process is allowed to follow the normal distribution, skewed normal distribution, Student-t distribution, skewed Student-t distribution, Generalised Error Distribution (GED), skewed GED, normal inverse Gaussian (NIG) distribution and Johnson's SU distribution which are assumed conditional distributions for mentioned models. For details, one can read the article by Chu et al. (2017).

3.2 EGARCH Model

Nelson (1991) proposed the exponential GARCH (EGARCH) model to handle with some weakness of the GARCH model. The positive and negative error terms have a symmetric effect on the volatility is an assumption of an ordinary GARCH model. In fact, the negative shocks on asset price have a greater influence on volatility than positive shocks if negative and positive shocks have the same magnitude. In particular, the weighted innovations are considered in the EGARCH model to allow for asymmetric effects between positive and negative asset returns. The weighted innovations can be written as follows

$$g(\varepsilon_t) = \theta\varepsilon_t + \gamma[|\varepsilon_t| - E(|\varepsilon_t|)]$$

where $,\gamma \in \mathbb{R}$. $\varepsilon_t$and$|\varepsilon_t| - E(|\varepsilon_t|)$ are iid sequences with zero mean and both follows continuous distributions. Thus, $E[g(\varepsilon_t)] = 0$. $g(\varepsilon_t)$is an asymmetric function since

$$g(\varepsilon_t) = \begin{cases} (\theta+\gamma)\varepsilon_t - \gamma E(|\varepsilon_t|), if \varepsilon_t \geq 0 \\ (\theta-\gamma)\varepsilon_t - \gamma E(|\varepsilon_t|), if \varepsilon_t < 0 \end{cases}$$

The general form of the EGARCH(p,q) model is

$$a_t = \sigma_t\varepsilon_t, \qquad \ln(\sigma_t^2) = \alpha_0 + \left[\frac{1 + \beta_1 B + \cdots + \beta_{q-1}B^{q-1}}{1 - \alpha_1 B + \cdots + \alpha_{p-1}B^{p-1}}\right] g(\varepsilon_{t-1})$$

where$1 + \beta_1 B + \cdots + \beta_{q-1}B^{q-1}$ and $1 - \alpha_1 B + \cdots + \alpha_{p-1}B^{p-1}$ are polynomials with zeros outside the unit circle and have no common factors (Tsay, 2012). The natural logarithm of the conditional variance enables the coefficients of the model can have negative values and $g(\varepsilon_t)$ function satisfies that the model can respond asymmetrically to positive and negative lagged values of a_t.

The normal distributed EGARCH(1,1) model is

$$a_t = \sigma_t\varepsilon_t, \qquad (1 - \alpha_1 \mathrm{B})\ln(\sigma_t^2) = (1 - \alpha_1)\alpha_0 + g(\varepsilon_{t-1})$$

where the ε_t are iid standart normal. In the case of normal distiributed EGARCH(1,1) model, $E(|\varepsilon_t|) = \sqrt{2/\pi}$ and by rewritting the $g(\varepsilon_{t-1})$ the model becomes

$$(1 - \alpha_1 \mathrm{B})\ln(\sigma_t^2) = \begin{cases} \alpha_* + (\theta+\gamma)\varepsilon_{t-1}, if \varepsilon_{t-1} \geq 0 \\ \alpha_* + (\gamma - \theta)(-\varepsilon_{t-1}), if \varepsilon_{t-1} < 0 \end{cases}$$

where$\alpha_* = (1 - \alpha_1 \mathrm{B})\alpha_0 - \left(\sqrt{2/\pi}\right)\gamma$ and the coefficients $(\theta + \gamma)$ and $(\gamma - \theta)$ show the symmetry in response to positive and negative a_{t-1} (Tsay, 2012). If the conditional distribution for the innovations is standardized Sudent-t distribution the expected mean of ε_t is

$$E(|\varepsilon_t|) = \frac{2\sqrt{v-2}\,\Gamma((v+1)/2)}{(v-1)\Gamma(v/2)\sqrt{\pi}}$$

So;

$$\alpha_* = (1 - \alpha_1 \mathrm{B})\alpha_0 - \left(\frac{2\sqrt{v-2}\,\Gamma((v+1)/2)}{(v-1)\Gamma(v/2)\sqrt{\pi}}\right)\gamma$$

The effective foreign exchange rate of the US Dollar (USD) and the Turkish Lira (TRY) monthly data in the period of years 2005-2018 were used to determine the volatility. The logarithm of the FOREX had a unit root according to ADF and KPSS test. By taking the first difference of log of USD/TRY data, it became stationary. ARCH-LM and Ljung-Box tests show that there was an ARCH effect on the data. So, GARCH type models can be applied to the data. GARCH, IGARCH, SGARCH, EGARCH, TGARCH, AVGARCH and GJR-GARCH were fitted to data and normal distribution, skewed normal distribution, Student-t distribution, skewed Student-t distribution, Generalised Error Distribution (GED), skewed GED, normal inverse Gaussian (NIG) distribution and Johnson's SU distribution were assumed as the conditional distributions for the innovations. The fitted models were compared according to information criteria which are given at the following table. In conclusion, the Student-t EGARCH (1,1) model was found as the best convenient model for the volatility of USD/TRY FOREX data and the parameter estimations are given in Table 2. The diagnostics test are given in Appendix A.

Table 5. Model Comparison

	Information Criteria				
Model	**Akaike**	**Bayes**	**Shibata**	**Hannan-Quinn**	**Likelihood**
sgedgarch	-4.459436	-4.342133	-4.462251	-4.411793	353.836
stdtgarch	-4.518344	-4.420593	-4.520315	-4.478642	357.4309
gedavgarch	-4.513916	-4.377064	-4.517717	-4.458332	359.0855
stdgjrgarch	-4.51862	-4.381768	-4.522422	-4.463037	359.4524
stdegarch*	-4.565199	-4.467448	-4.56717	-4.525497	361.0856
sgedigarch	-4.456271	-4.378069	-4.457542	-4.424509	351.5891
nigsgarch	-4.433666	-4.335915	-4.435637	-4.393964	350.826

Table 6. Student-t EGARCH(1,1)

Optimal Parameters for Student-t EGARCH(1,1)				
	Estimate	**Std. Error**	**t value**	**Pr(>|t|)**
alpha0	-4.954573	1.07923	-4.59086	0.000004
alpha1	-0.727058	0.14775	-4.9209	0.000001
beta1	0.335505	0.14516	2.31135	0.020813
gamma1	0.071535	0.20225	0.35369	0.723572
shape	10.592908	8.79518	1.2044	0.228435

3.3 Unit Root Tests

In this study, unit root analysis was performed using ADF and PP tests. The results of tests are presented in Table 3. The null hypotheses of ADF and PP test equations were established based on the assumption that the series includes unit root.

The results of ADF and PP unit root tests indicated that the parameters were stationary at different levels and that none of the parameters was stationary at the 2nd level. According to the data in Table, the results are as follows; LNLAI(I), LNIPE I(I), VOL(0), and LNREER I(I) at the significance level of 5%.

Table 7. Stationary Test Results Table

UNIT ROOT TEST TABLE (PP)											
	At Level					At First Difference					
		LNLA	**LNIPE**	**LNREER**	**VOL**			**d(LNLA)**	**d(LNIPE)**	**d(LNREER)**	**d(VOL)**
With Constant	t-Statistic	-2.7	0.1	-1.4	-8.8	With Constant	t-Statistic	-33.1	-15.0	-9.7	-62.9
	Prob.	0.1	1.0	0.6	0.0		Prob.	0.0	0.0	0.0	0.0
		*	n0	n0	***			***	***	***	***
With Constant & Trend	t-Statistic	-6.6	-2.3	-3.2	-8.7	With Constant & Trend	t-Statistic	-32.9	-15.0	-9.7	-62.8
	Prob.	0.0	0.4	0.1	0.0		Prob.	0.0	0.0	0.0	0.0
		***	n0	*	***			***	***	***	***
Without Constant & Trend	t-Statistic	0.9	2.6	-0.6	-6.1	Without Constant & Trend	t-Statistic	-29.0	-14.5	-9.7	-62.9
	Prob.	0.9	1.0	0.4	0.0		Prob.	0.0	0.0	0.0	0.0
		n0	n0	n0	***			***	***	***	***
UNIT ROOT TEST TABLE (ADF)											
	At Level					At First Difference					
		LNLA	**LNIPE**	**LNREER**	**VOL**			**d(LNLA)**	**d(LNIPE)**	**d(LNREER)**	**d(VOL)**
With Constant	t-Statistic	-1.2	0.1	-1.1	-9.1	With Constant	t-Statistic	-11.6	-15.4	-9.7	-9.6
	Prob.	0.7	1.0	0.7	0.0		Prob.	0.0	0.0	0.0	0.0
		n0	n0	n0	***			***	***	***	***
With Constant & Trend	t-Statistic	-3.5	-1.7	-3.6	-9.0	With Constant & Trend	t-Statistic	-11.5	-15.3	-9.7	-9.6
	Prob.	0.0	0.8	0.0	0.0		Prob.	0.0	0.0	0.0	0.0
		**	n0	**	***			***	***	***	***
Without Constant & Trend	t-Statistic	1.0	3.2	-0.7	-6.2	Without Constant & Trend	t-Statistic	-11.5	-14.6	-9.6	-9.6
	Prob.	0.9	1.0	0.4	0.0		Prob.	0.0	0.0	0.0	0.0
		n0	n0	n0	***			***	***	***	***

Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant
*MacKinnon (1996)
onesided p-values.

For cointegration analysis, there are cointegration tests in literature used by Engel and Granger (1987), Johansen (1988), Johansen and Juselius (1990). These tests cannot be used in cases of various levels of stationarity of variables. The bounds test developed by Paseran et al. (2001) allows the cointegrationanalysis in case of various levels of stationarity of variables. According to variables stationary levels, we used the bounds test for cointegration analyses.

3.4 Bounds Test and Hacker – Hatemi-J Causality Test

After determining the optimal length of lag regarding the unlimited error correction model, the cointegration relationship between the variables was examined using the bounds test. The results of the bounds test are presented in the table.

Table 8. Bounds Test Results

F-Bound Test	**H0: No cointegration relationship**			
Test Statistic	**Test Value**	**Significance Level**	**I(0)**	**I(1)**
F-Test Value	1.507	%10	3.588	4.605
k	3	%5	4.203	5.320
ARDL (4,0,2,1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNCH(-1)	0.300	0.081	3.688	0.000
LNCH(-2)	0.243	0.084	2.900	0.004
LNCH(-3)	0.085	0.084	1.014	0.312
LNCH(-4)	0.211	0.081	2.610	0.010
LNRER	1.628	1.491	1.092	0.277
VOL	4.195	90.172	0.047	0.963
VOL(-1)	-46.544	88.381	-0.527	0.599
VOL(-2)	117.172	87.724	1.336	0.184
LNIPE	-5.759	3.725	-1.546	0.124
LNIPE(-1)	6.448	3.666	1.759	0.081
C	-8.470	9.834	-0.861	0.391
@TREND	0.005	0.006	0.901	0.369
Diagnostic Tests				
X^2_{BG}		9,155 [0,057]		
X^2_{NORM}		4,575 [0,032]		
X^2_{WHITE}		5,444 [0,063]		
X^2_{RAMSEY}		0,347 [0,555]		

According to Table, the F-statistic value calculated at a significant level of 5% and 10% was found less than bottom limits, the cointegration relation between the variables was not determined. As a result of the bounds test, it was concluded that there was no long-term relationship between the variables. To determine the number of lags in the ARDL model, the Schwarz information criteria were utilized. As seen in Table, ARDL (4,0,2,1) model was chosen as the suitable ARDL model.

After the bounds test, the "Hacker and Hatemi-J (2006) test" was used for causality analyses. Examination of the stationarity processes of series is not required. However, to determine the lag lengths required for a VAR model, it is necessary to perform stationarity analysis of series and determine the level of maximum stationarity.

When the normality assumption is met, the aforementioned Wald Test statistics have asymptotic X2 distribution that has an equal degree of freedom when compared to the limitations to be tested

(Hacker and Hatemi-J, 2006). In their study, Hacker-Hatemi-J (2006) applied the Toda-Yamamato test but achieved the critical values via bootstrap simulation even though the error terms were not normally distributed (Yılancı 2012).

Table 9. Hacker ve Hatemi-J Causality Test Results

Causality Direction	Test Value	Critical Values		
		%1	%5	%10
VOL->LNLA	0.176	4.737	6.473	10.860
LNREER->LNLA	1.892	4.826	6.205	9.723
LNIPE->LNLA	2.830	4.662	6.139	10.043

According to the results of a Hacker-Hatemi-J causality test, a causality relationship was not found from volatility, reel effective exchange rate and industrial production index to Turkey's live animal exports.

3.5 A Time-Varying Symmetric Causality Analysis

According to the results of the Hacker Hatemi-J causality test, there was no causality relationship determined from volatility to livestock imports, from real effective exchange rate to livestock imports and from industrial production index to livestock imports. Timer varying causality analysis confirmed this result for a significant part of the time interval. However, a causality relationship was determined for some periods from VOL, LNREER and LNIPE to LNLA.

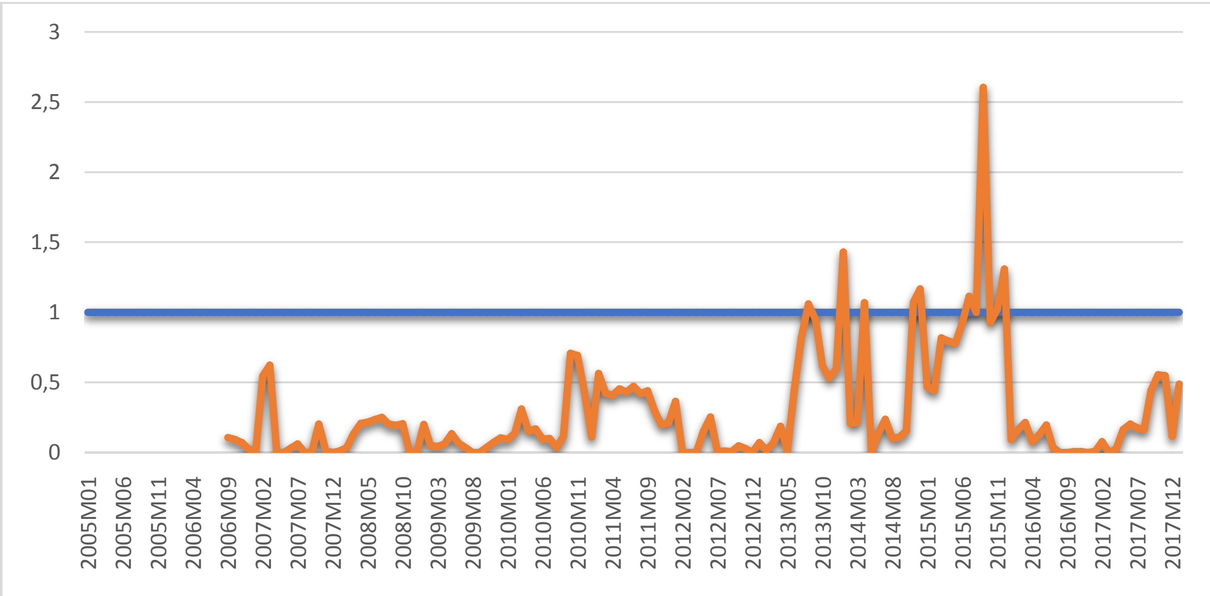


Figure 4. Time-Varying Symmetric Causality Test Results from VOL to LNLA

Two general elections were held in Turkey in 2015. The first elections were held in June and the second in November. The second elections were held because a coalition government was not formed after the first elections. This election process increased the uncertainty in the country. During the Feast of Sacrifice (2015M09), causality relation from VOL to LNLA was revealed.

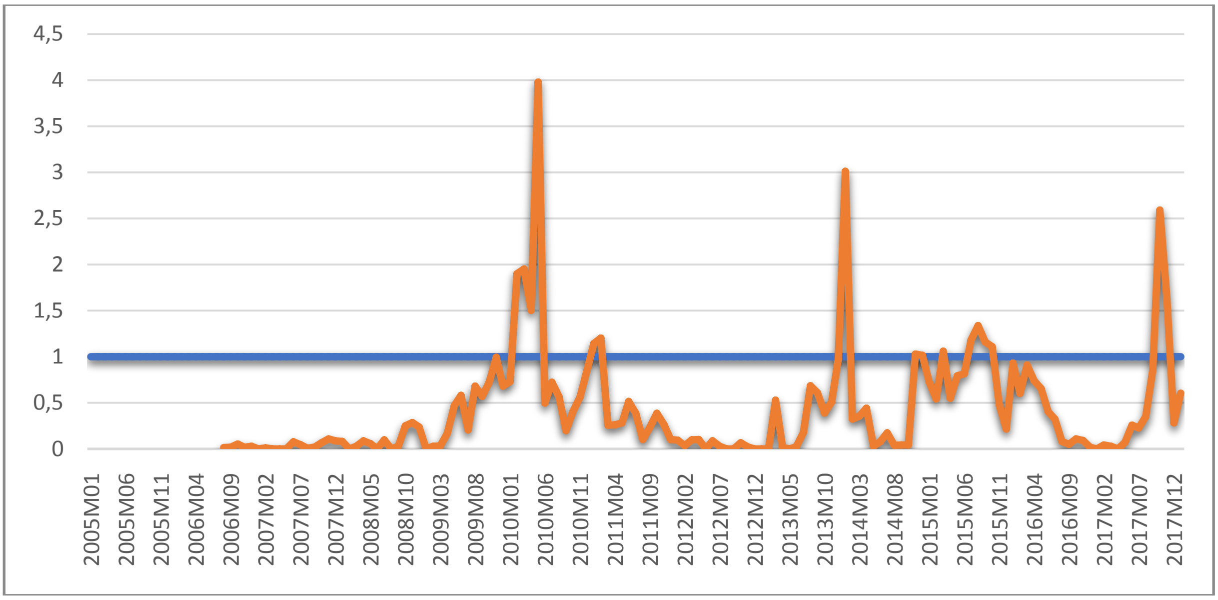


Figure 5. Time-Varying Symmetric Causality Test Results from LNREER to LNLA

In April 2010, the General Directorate of Meat and Fish Authority opened the tariff quota for live cattle and beef meat imports to reduce meat prices.

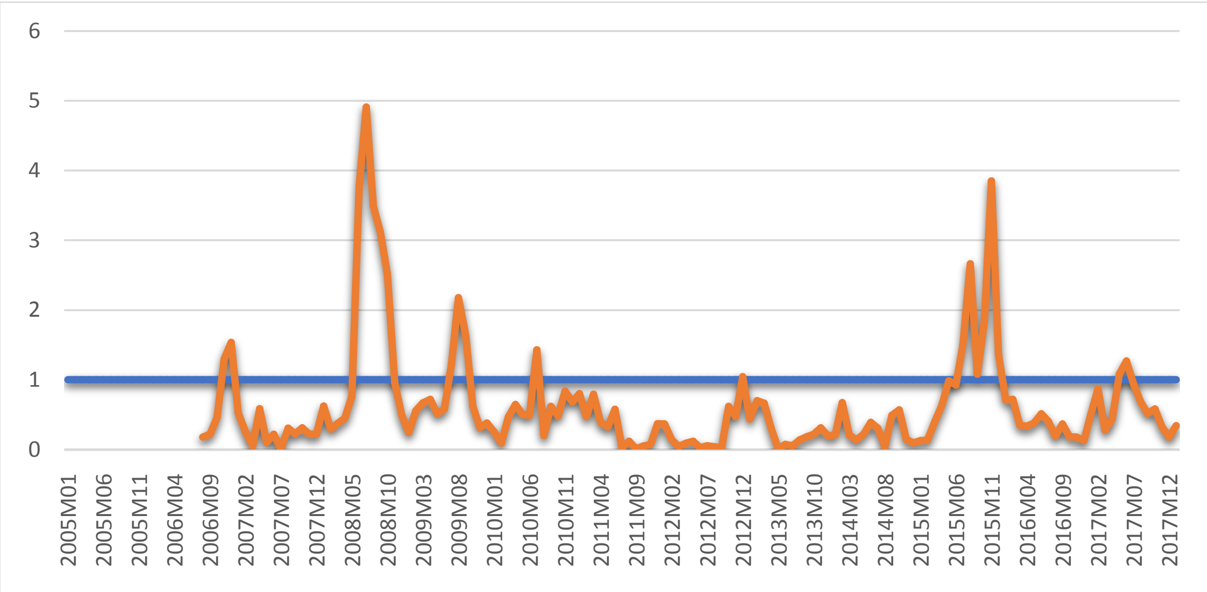


Figure 6. Time-Varying Symmetric Causality Test Results from LNIPE to LNLA

Timer varying causality analysis result confirmed there is no causality relationship as a result of symmetric causality test from LNIPE to LNLA for a significant part of the time interval. However, a causality relationship was determined from LNIPE to LNLA for the year 2008 when there was an economic crisis and for the year 2015 when two general elections were held in Turkey.

4. Conclusion

Turkey is experiencing an issue with high meat prices, and also Turkey's per capita meat consumption is below the world average. According to the empirical results, Turkey's exchange rate volatility does not have a long term impact on Turkey's livestock imports. However, for some years in the study period, we determined a causality relationship from exchange rate volatility to livestock imports. For this reason, we can conclude that the economic and political situations are determining the impact of exchange rate volatility.

Turkish farmers were held responsible for high meat prices for a long time. However, Turkey's farmers are faced with high costs of various inputs such as animal feed and petroleum. Turkey is a net livestock importer. According to the test results, exchange rate and volatility do not have a direct impact on livestock (live animal) imports. But exchange rates have an impact on the costs of livestock (live animal) producers.

Turkey has a meat supply deficit and the Turkish Government has been trying to solve the meat supply deficit by imports. However, I believe it should support Turkey's livestock sector because Turkey's exchange rate on the imports of livestock has achieved no effect in the long term. The relationship between the two variables has been determined for some periods. Therefore, the reasons for this should be determined.

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Appendix A.

```
*---------------------------------*
*          GARCH Model Fit        *
*---------------------------------*

Conditional Variance Dynamics
-----------------------------------
GARCH Model      : eGARCH(1,1)
Mean Model       : ARFIMA(0,0,0)
Distribution     : std

Optimal Parameters
------------------------------------
        Estimate  Std. Error  t value Pr(>|t|)
omega  -4.954573     1.07923 -4.59086 0.000004
alpha1 -0.727058     0.14775 -4.92090 0.000001
beta1   0.335505     0.14516  2.31135 0.020813
gamma1  0.071535     0.20225  0.35369 0.723572
shape  10.592908     8.79518  1.20440 0.228435

Robust Standard Errors:
        Estimate  Std. Error  t value Pr(>|t|)
omega  -4.954573     1.78940  -2.7689 0.005625
alpha1 -0.727058     0.16572  -4.3874 0.000011
beta1   0.335505     0.24472   1.3710 0.170386
gamma1  0.071535     0.14466   0.4945 0.620957
shape  10.592908     6.85351   1.5456 0.122197

LogLikelihood : 361.0856

Information Criteria
------------------------------------

Akaike       -4.5652
Bayes        -4.4674
Shibata      -4.5672
Hannan-Quinn -4.5255

Nyblom stability test
------------------------------------
Joint Statistic:  1.0953
Individual Statistics:
omega  0.04974
alpha1 0.62495
beta1  0.05487
gamma1 0.06576
shape  0.05462

Asymptotic Critical Values (10% 5% 1%)
Joint Statistic:         1.28 1.47 1.88
Individual Statistic:    0.35 0.47 0.75
```

```
Weighted Ljung-Box Test on Standardized Residuals
------------------------------------
                        statistic p-value
Lag[1]                      2.924 0.08725
Lag[2*(p+q)+(p+q)-1][2]     4.714 0.04850
Lag[4*(p+q)+(p+q)-1][5]     6.334 0.07500
d.o.f=0
H0 : No serial correlation

Weighted Ljung-Box Test on Standardized Squared Residuals
------------------------------------
                        statistic p-value
Lag[1]                     0.3174  0.5732
Lag[2*(p+q)+(p+q)-1][5]    2.4979  0.5063
Lag[4*(p+q)+(p+q)-1][9]    4.2094  0.5537
d.o.f=2

Weighted ARCH LM Tests
------------------------------------
            Statistic Shape Scale P-Value
ARCH Lag[3]   0.06971 0.500 2.000  0.7918
ARCH Lag[5]   3.19693 1.440 1.667  0.2625
ARCH Lag[7]   3.90184 2.315 1.543  0.3609


Sign Bias Test
------------------------------------
                   t-value   prob sig
Sign Bias           0.5636 0.5739
Negative Sign Bias  0.8746 0.3832
Positive Sign Bias  0.8944 0.3726
Joint Effect        1.8994 0.5935


Adjusted Pearson Goodness-of-Fit Test:
------------------------------------
  group statistic p-value(g-1)
1    20    18.62       0.4817
2    30    25.54       0.6500
3    40    47.59       0.1627
4    50    52.33       0.3459


Elapsed time : 0.4338379
```