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Agricultural Trade and its Determinants: Evidence from Bounds Testing Approach for Turkey

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ABSTRACT

This paper empirically analyses the long run relationship between agricultural trade performance and real exchange rate in Turkey by using quarterly data covering 1994:Q1-2012:Q3. The other factors that are expected to effect agricultural trade balance such as ratio of export and import prices of agricultural goods, producer prices, real income of the country are also added to the model. For this purpose, bounds test approach for co-integration and autoregressive distributed lag method are used to show the existence of long-term relationship between agricultural trade balance and its determinants in Turkey. The results show that real exchange rate, real gross domestic product, and agricultural producer prices are highly significant and have negative impact on determining agricultural trade balances in Turkey. Consequently, findings suggest that the policies or reforms that reducing producer prices and using new technologies to increase productivity may help to create trade surplus in agricultural trade of Turkey.

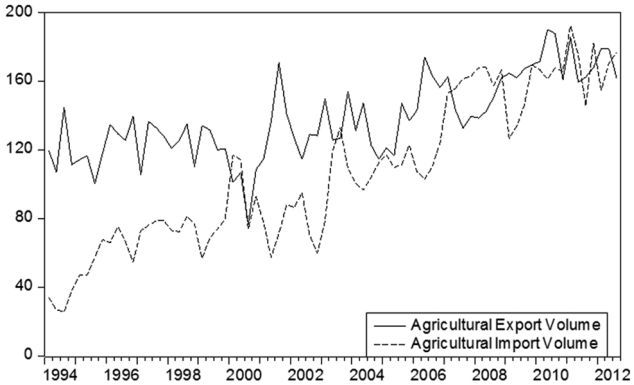
Keywords: Agricultural Trade, Turkey, Bound Test Approach
JEL Classifications: Q17, Q18, F14

1. INTRODUCTION

Agriculture sector and its development are very important for both developed and developing countries, like seen in Turkey with its climate, ecological and geographical conditions. According to the Ministry of Food Agriculture and Livestock of Turkey (2013), Turkey is in top five with 30 products in world agricultural product and with 20 products in exports in 2012, and the government defined the agriculture as a competitive and strategic economic sector rather than a social sector. Another report written by Organization for Economics Cooperation and Development (OECD) (2011) defined Turkey's agriculture as 7th biggest agricultural power of the World and mentioned that the recent reforms made by the government have been affected the sector positively in terms of agricultural exports. However, too see the big picture, it would be better to look at both agricultural export and agricultural import together.

As it can be seen from Figure 1, Turkey was a net exporter from 1994:Q1 to 2000:Q1 period. Especially until 2001, the government has supported agricultural sector with direct intervention on agricultural input and output prices such as providing subsidies or lower cost bank credits to prevent the farmers from unexpected climate and natural effects and buyers of agricultural goods from fluctuations in the market as well. However, after 2001 Turkey's

Figure 1: Agricultural Trade Volume of Turkey



agricultural exports and imports increased together, and the gap between exports and imports has started to narrow in last years. The position of Turkey changes from net exporter to net importer nowadays. The rapid increase in agricultural imports of Turkey may be associated with changes in some macroeconomic variables such as economic growth, real exchange rate, export and import prices, and producer prices. In this study, instead of using price indices, volume indices are preferred to use to consider demand changes rather than changes in price. Because, the reason of increased import may be explained not only by cheaper import prices but also increased in domestic demand as well. In addition to changes in these variables, another reason of increasing imports can be explained by Turkey's agricultural import policy options on agreements of World Trade Organization and integration to the European Union (EU) with two chapters (Chapter 11-12) directly related to agriculture in negotiations with EU; agriculture and rural development, food safety, veterinary and plant health.

In this paper, determinants of Turkish agricultural trade will be estimated. In next section literature about agricultural trade studies will be presented, then data and methodology will be discussed and in last part empirical results and conclusion will be discussed and finalized.

2. LITERATURE REVIEW

In the literature, most of the studies use the elasticity approach to explain trade balance of countries. In these studies, the results may vary depending on the different period of time, variables, and countries used in the studies.

Elasticity approach focuses on changes in real exchange rate of countries. This can be explained by using Marshall-Lerner (ML) condition. According to ML condition, when absolute value of summation of domestic demand elasticity of imports and foreign demand elasticity of exports is >1, a rise in exchange rate (depreciation of domestic currency) improves the trade balance of countries in long run. However, in this study it was aimed that were determine the factors effecting Turkish agricultural trade. Therefore, this part includes some examples from Turkish agricultural market. Yazici and Islam (2012) investigated the short run and long run impact of exchange rate on agricultural trade balance of Turkey with European Union based on the data 1988:Q1 - 2008:Q4 period and concludes that depreciation of domestic currency (rise in exchange rate) has significant negative impact on agricultural trade of Turkey. Yazici (2008) studied the effect of exchange rate on three sector of Turkey, including agriculture, by using the Almon lag technique and found that a rise in exchange rate first improves the agricultural trade, then worsens, then improves, and finally in the long run it has negative effect on agricultural trade balance. Yanikkaya et al. (2013) analyzed the selected agricultural commodities export flow of Turkey by using panel data set for the years from 1971 to 2010 and found that depreciation in Turkish Lira leads higher exports for grape and hazelnut. Another study by Fidan (2006) concluded that real effective exchange rate (REER) does not have significant effect on agricultural exports and imports of Turkey. On the other hand, Erdem et al. (2010) examined the impact of exchange rate uncertainty on agricultural trade in Turkey by using panel cointegration method for the years 1980-2005, and found that import trade volumes are more sensitive than export volumes to the negative impacts of exchange rate uncertainty. Erdal et al. (2012) used the data from 1995 to 2007 and claimed that exchange rate volatility has positive significant impact on agricultural exports of Turkey, but negative significant impact on agricultural imports of Turkey. Another study conducted by Uzunoz and Akcay (2009), analyzed the import demand for wheat during the period 1984-2006 for Turkey by using double log-linear function and they found that Turkey's import demand for wheat negatively affected by amount of production and positively affected by exchange rate, domestic price, and income per capita. In Turkey, the studies about the international trade generally concerned general economic sector rather focusing on sub sectors such as agriculture or mining etc.

Table 1 shows some examples from the literature regarding studies Turkey's trade balance, exports, and imports in different time periods and their conclusions. As it can be understood from this Table 1, there is not much study regarding agricultural trade more specifically. The studies about the agricultural sector were mentioned above and their number is very limited and mainly focusing on exchange rate as a variable. However, this paper considers more than one variable including country specific and sector specific factors such as agricultural export and import price ratio and agricultural producer prices rather than using only exchange rate as a determinant of Turkey's agricultural trade. And also, it uses the recent dataset and agricultural trade balance volume to consider demand changes rather than focusing on only import or export side and their prices. And finally, this study tries to look at general picture of Turkish agricultural trade instead of focusing on only one product as did in previous studies. It will provide to see big picture and recent trends in agricultural trade of Turkey.

3. DATA AND METHODOLOGY

In this paper, quarterly data covering 1994:Q1 - 2012:Q3 is used and agricultural trade volume balance (BALANCE), REER, the ratio of agricultural export price to import price (PR), real GDP per capita of Turkey (RGDP), and agricultural goods producer price index (PPI) for Turkey are the variables used in the study. BALANCE, REER and PR data were obtained from Statistics of International Trade of OECD, and also, RGDP and PPI data were obtained from Turkish Statistical Institute. The logarithmic forms of the variables were used in the analyses. Series that have significant seasonality are also corrected by using X-12 method in the E-views 8-software package.

To investigate the long run relationship between the variables, bound test for co-integration with autoregressive distributed lag (ARDL) modeling approach was adopted in this study. This model is recently developed by Pesaran et al. (2001) and provides some advantages in application; first, it can be applied even if the variables have different order of integration; second, it is good to prefer in small samples; and finally, it gives both short run estimation with error correction model (ECM) and long run estimations simultaneously. However,

Table 1: Some studies in the literature about turkey's trade balance, export, and import

Authors (date of study)	Covered period of time	Findings of studies
Berberoğlu and Oktay (1987)	1980-1987	Significant relationship between trade balance of Turkey and exchange rate
Abuşoğlu (1990)	1980-1988	Insignificant relationship between real effective exchange rate and Turkey's export
Egeli (1992)	After 1980	Conclude that the export credits are better as a policy instrument rather than exchange rate policies
Ulusoy and Zengin (1995)	1970-1992	Insignificant relationship between real exchange rate and export
Zengin and Terzi (1995)	1950-1994	No long run relationship and causality between exchange rate, trade balance, export and import
Terzi and Zengin (1999)	1989-1996	Insignificant relationship between exchange rate and trade balance
Zengin (2000)	1993:01-2000:08	Found that the exchange rate is ineffective tool to improve trade balance
Sivri and Usta (2001)	1994:01-2000:06	No causality from real exchange rate to import and export
Akbostancı (2002)	1987:01-2000:04	Positive shock in real exchange rate first improves the trade balance, then decreases, then improves again
Gürbüz and Çekerol (2002)	1995:01-2002:01	No long run relationship between exchange rate and trade balance
Yamak and Korkmaz (2005)	1995:01-2004:04	In the short run, the relationship between real exchange rate and trade balance is determined by capital goods
Barışık and Demircioğlu (2006)		By using only exchange rate as a policy tool to improve trade balance will not give effective results
Doğanlar (2002)	1980-1996	Negative relationship between exchange rate uncertainty and export
Bügük et al. (2003)		No relationship between exchange rate uncertainty and agricultural export
Demirel and Erdem (2004)	1990:01-2001:04	Significant impact of exchange rate uncertainty on exports to Germany, England, Italy, and USA
İrhan et al., (2011)	1990:Q1-2007:Q3	Real exchange rate depreciation improves the trade balance and no significant effect of crude oil prices
Azgun (2011)	1989:Q1-2009:Q3	Exchange rate shocks explain 21%, public and private consumption expenditure explain 30%, and interest rates explain 10% of the estimation error variance of the foreign trade balance
Yazici and Islam (2012)	1988:Q1-2008:Q4	Depreciation of Turkish Lira improves the trade balance in short run, but has negative impact on trade balance in long run

Source: Adopted from Hepaktan et al.(2011)

the main focus in this paper is to analyze the long run estimates for Turkish agricultural trade balance.

ARDL approach has two stages. Fist of all, long run relationship among variables should be determined by using bound test developed by Pesaran and Shin (1999). In the case of having any information on direction of relationship between variables, unrestricted conditional RCM (UECM) is estimated in the bound test approach. While doing this, each variable is taken as dependent variable and UECM is defined as:

$$\Delta Y_t = \mu_0 + \mu_1 t + \lambda_1 Y_{t-1} + \sum_{i=1}^{4} \theta_i V_{it-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \sum_{i=1}^{4} \sum_{j=0}^{p} \omega_{ij} \Delta V_{it-j} + \psi' D_t + \varepsilon_t$$

In this equation, V_t is the vector defined as V_t=*(LPR, LREER, LRGDP, LPPI)*, D_t is the vector including exogenous variables such as structural break dummies. Here, according to the Wald test, null hypothesis asserts that there is no co-integration *(H_0: $\lambda_1 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$)*, while the alternative hypothesis asserts long run relationship between variables (H_0: $\lambda_1 \neq \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$). While testing the null hypothesis, critical values provided by Pesaran et al. (2001) is used. They provide three different scenarios in their paper about the conclusions of test results. When calculated F statistics exceeds the upper bound critical value in given significance, null hypothesis is rejected and we can conclude that variables have long run relationship (cointegrated). In the light of the results, ARDL approach to the estimation of level relations is adopted as below.

$$Y_t = \mu_0 + \sum_{j=1}^{p_i} \beta_j Y_{t-j} + \sum_{i=1}^{4} \sum_{j=0}^{q_i} \phi_{ij} V_{it-j} + \psi' D_t + u_t$$

Here, all variables are defines as above. Then, the next step in ARDL procedure, conditional ECM is defined as;

$$\Delta Y_t = \mu + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \sum_{i=1}^{4} \sum_{j=0}^{p} \omega_{ij} \Delta V_{it-j} + \vartheta ECM_{t-1} + \psi' D_t + \varepsilon_t$$

In this equation, whilst γ_j and ω_{ij} are short-term parameters, shows the speed of adjustment through the long run equilibrium. Error correction term (ECM_t) is defined in following format;

$$ECM_t = Y_t - \hat{\beta}_0 - \hat{\beta}_1 LPR - \hat{\beta}_2 LREER - \hat{\beta}_3 LRGDP - \hat{\beta}_4 LPPI$$

4. EMPIRICAL RESULTS

Correlations among the variables are given in Table 2. According to the results, highest correlation among variables is between BALANCE and LPPI with 78%. It simply means that there

is almost 80% negative correlation between trade balances in agricultural goods with the PPI as an indicator of cost of production in agricultural goods.

The Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Unit roots tests are also employed and the results are given in Table 3. According to the unit root test results, all variables are stationary at their first differences, which means integrated of order 1. Agricultural trade balance (BALANCE) is non-stationary in ADF, and PP test suggest that BALANCE is integrated of order zero only at 10% significant level. However, some can conclude that ADF can be taken into consideration as an alternative to PP.

Now, considering the stationary of variables in first differences for Turkey, Table 4 gives the bound test results for co-integration between LPR, LRGDP, LREER, LPPI and BALANCE under three different scenarios suggested by Pesaran et al. (2001). Maximum lag order (P) is determined as 2 according to both Akaike Information Criteria results and Schwartz Information Criteria results. Therefore, maximum lag length is set to 2. Since k=4 (number of independent variables), the 0.05 critical value bounds are (2.86, 4.01), (–2.86, –3.99), (3.05, 3.97), (3.47, 4.57) (–3.41, –4.36) for F_{iii}, t_{iii}, F_{iv}, F_{v}, and t_{v}, respectively. For P=2, tests lie outside the 0.05 critical value bounds and reject the null hypothesis that there exists no level equation in both cases without or with deterministic trend. Overall, the test results supports the existence of level equation (long run relationship) when a sufficiently high lag order is selected.

Table 5 shows the results of level equation (long run estimation) results for Turkish agricultural trade balance. Coefficients of all variables in the equation, except LPR even though it has the expected sign, are highly significant. According to the price theory, we are expecting higher quantity of supply, which is agricultural exports of Turkey in this study, in the case of increasing in price. Therefore, LPR has the correct sign but seems insignificant in the long run.

Another important determinant of the Turkish agricultural trade balance is the real exchange rate, which is defined as the price of domestic currency in terms of foreign currency. Any increase in real exchange rates (depreciation of domestic currency) is expected to increase trade balance through making the exports cheaper for foreigners and imports more expensive for domestic consumers, which lead positive coefficient in the model. However, for the agricultural trade of Turkey, although it is highly significant, it negatively affects agricultural trade balance of Turkey interestingly. On the other hand, this result shouldn't be surprise for agricultural goods. The coefficient of REER (–0.610) shows us that Turkish agricultural trade balance is inelastic with respect to REER, exactly similar with inelastic demand of agricultural goods in general. And also, in the literature, there are some studies shows that exchange rate rises is known to have negative effects on exports for developing countries (Hall et al., 2010). Similar findings are observed for Turkey as well (Rey, 2006; Balcilar et al., 2013). According to the Arndt and Huemer (2004) and Freund et al. (2012), although the sign of the REER is expected to be positive under normal conditions, increase in the share of imported inputs in exports and assembly can be eliminated the positive effect of REER on supply of exports and the its estimated parameter may be negative or insignificant.

Other important variable that determines the agricultural trade balance is real income per capita (RGDP) of Turkey. As far as the expected, it shows a negative impact on agricultural trade balances. It means that increase in real domestic income in Turkey will lead higher demand for goods and services including foreign agricultural goods as well. Therefore, it will affect agricultural trade balance of Turkey as negatively through increasing the imports from abroad even if keeping the exports constant.

Finally, LPPI, as an indicator of cost of agricultural production including fuel oil, fertilizer, machinery, seed, labor etc., has

Table 2: Pearson correlation coefficients

Variables	BALANCE	LPR	LREER16	LRGDP	LPPI
BALANCE	1.000000				
LPR	–0.362275	1.000000			
LREER16	–0.011387	0.324258	1.000000		
LRGDP	–0.769904	0.290381	–0.270362	1.000000	
LPPI	–0.785039	0.486418	–0.154358	0.841046	1.000000

Table 3: Unit root test results

Tests & Variables	Level		First differences	
	Intercept	Intercept and trend	Intercept	Intercept and trend
ADF				
BALANCE	–1.616451 (9)	–4.338385*** (0)	–9.190612*** (0)	–9.168434** *(5)
LPR	–2.606185*(1)	–2.664800 (1)	–6.721317*** (1)	–4.907961*** (0)
LREER16	–2.662229* (1)	–3.066627 (1)	–10.67072*** (0)	–10.59971*** (0)
LRGDP	–0.536196 (0)	–2.325624 (0)	–9.280125*** (0)	–9.203514*** (0)
LPPI	–2.568524 (4)	–1.912647 (4)	–1.590427 (7)	–2.563372 (3)
PP				
BALANCE	–3.099295*	–4.411564***	–9.190612***	–9.168434***
LPR	–2.363764	–2.518332	–6.640386***	–6.580352***
LREER13	–3.831026***	—3.849697**	–11.93171***	–12.81643***
LRGDP	–0.536196	–2.531930	–9.150631***	–9.081660***
LPPI	–2.519750	–2.460247	–9.602171***	–15.14926***

*.**.***: ???

Table 4: Bound test results

Bound test and results	I (0)	I (1)
Without determintic trends (k=4)		
F_{iii} 20.64326	2.86	4.01
t_{iii} –8.173299	–2.86	–3.99
With determintic trends (k=4)		
F_{iv} 16.90931	3.05	3.97
F_{v} 13.86907	3.47	4.57
t_{v} –8.101818	–3.41	–4.36

Table 5: ARDL level equation with constant

Dependent variable: BALANCE				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
LPR	0.118031	0.161968	0.728733	0.4686
LREER16	–0.610284	0.197607	–3.088375	0.0029
LRGDP	–1.159820	0.274323	–4.227938	0.0001
LPPI	–0.100609	0.033259	–3.024972	0.0035
C	12.06858	2.353903	5.127050	0.0000

ARDL: Autoregressive distributed lag

negative sign and highly significant as expected for Turkey. This result indicates that in the long run, increased in the agricultural producer prices affects Turkish agricultural trade balance negatively.

5. CONCLUSION AND POLICY IMPLICATIONS

This paper has empirically analyzed the long run relationship between Turkish agricultural trade balance, real exchange rate, real income, agricultural goods trade prices, and producer prices by using the bound test and ARDL approach based on the quarterly data covering 1994:Q1 - 2012:Q3 period. The result of bound test confirm the co-integration between the variables.

The main contribution of the paper is to analyze the Turkish agricultural sector by using the up to date sectorial data rather than focusing on only one variable related to international trade in general such as real exchange rate. The focus of this paper is to see the main country specific reason of worsen agricultural trade balance in recent years.

Results indicate that in long run real an increase in exchange rate, real income and producer prices effects Turkish agricultural trade balance negatively. This finding suggests that to improve the Turkish agricultural trade balance through exchange rate policy, domestic currency should be appreciated with respect to other currencies. And last and may be the most important finding is to improve Turkish agricultural trade balance by decreasing producer prices (cost of production) through supporting farmers (producers) via different channels such as using new technologies to lower production costs. Government has a central role especially in developing countries in this respect. Government can provide some lower cost credits to the farmers and financial incentives for supporting them as well. When we consider the fuel oil prices in Turkey as an input (cost) of agricultural production like other sectors of economy, developing countries like Turkey can try to use some other technologies rather that fuel oil due to its highest cost. If government wants to increase agricultural goods production in Turkey, they may reduce the taxes and duties of imported agricultural machinery to decrease the cost of production. Especially after the process in EU integration new policy environment is required to increase the agricultural production, and in turn, it is expected to improve agricultural trade balance. In this respect decision makers can describe some additional domestic policy tools such as infrastructural development, using R&D approach, insurance and credit markets etc.

It should be reminded that the results obtained from this study recommends to decrease cost of production in agriculture to have comparative advantage among other countries and it depends on using new technologies in this sector to get more efficient allocation of resources and more production. Primarily, the structure of the agricultural sector should be competitive. This is provided by diversification of rural economy and development in human resources to improve the capacity. We can also define the agricultural sector priorities as strengthening of agricultural marketing infrastructure and agro industries integration. In this context, establishment of market information systems, dissemination of licensed warehousing system, establishment of commodity exchanges and provision of liquidity to the agricultural sector should be provided. On the other hand, some of the farmers have been confronted with new technology but have not been informed in use of these tools and machines to overcome the problems encountered in reducing production costs and achieve more gain. Therefore, agricultural extension activities should be expanded by creating relevant units to support and assist to farmers at the stage of transition to controlled and equipped production. And finally, supports for production should be well planned to reach an adequate level in Turkey.

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