IBAD journal
ULUSLARARASI BİLİMSEL ARAŞTIRMALAR DERGİSİ
JOURNAL OF THE INTERNATIONAL SCIENTIFIC RESEARCHES

Cilt-Volume: 3 | Sayı-Issue: 1 | Sayfa-Page: 55-78 | Bahar-Spring | Yıl-Year: 2018

IBAD, 2018; 3(1):55-78 Geliş tarihi/First received: 20.10.2017 Kabul tarihi/Accepted: 24.11.2017

TÜRKİYE TİCARET AÇIĞININ AMPİRİK OLARAK İNCELENMESİ

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Özet

Bu çalışmamızda, reel döviz kurunun kısa ve uzun vadede ticaret dengesi üzerindeki etkisi, Türkiye için 1992'den 2011'e üçer aylık veri seti kullanılarak incelenmiştir. Ayrıca, petrol fiyatları, reel dış ve iç gelir gibi Türkiye'nin ticaret dengesi belirleyicileri, bu değişkenlerin ticaret açığına neden olup olmadığını gözlemlemek için model içine dahil edilmiştir. Vektör Hata Düzeltme Modeli (VECM), Johansen eş-bütünleşme analizi, Granger nedensellik testi ve genelleştirilmiş impuls cevap analizi ile uygulanmıştır. VECM bulguları, J eğrisinden ziyade S eğrisi desenini üreten, reel döviz kuru ile ticaret dengesi arasındaki uzun dönemli ilişkinin varlığını önermektedir. Wald testi altında reel döviz kuru ile ticaret dengesi arasında kısa vadeli ilişkinin varlığını buluyoruz ancak sonuçlar Granger nedensellik analizi kapsamıyor.

Anahtar Kelimeler: Ticaret açığı, VECM, Johansen eş entegrasyon analizi, J eğrisi, döviz kuru

EMPIRICAL EXAMINATION OF THE TURKISH TRADE DEFICIT

Abstract

In this study, we examine real exchange rate effect on trade balance both in the short run and long run by using quarterly data set from 1992 to 2011 for Turkey. Also other determinants of trade balance of Turkey such as oil prices, real foreign and domestic income are taken into the model in order to observe whether these variables cause trade deficit or not. Vector Error Correction Model (VECM) is applied with Johansen cointegration analysis, Granger causality test and generalized impulse response analysis. VECM findings suggest existence of long run relationship between real exchange rate and trade balance which generates S curve pattern rather than J curve. We find also existence of short run relationship between real exchange rate and trade balance under Wald test but not under Granger causality analysis.

Keywords: Trade deficit, VECM, Johansen co-integration analysis, J Curve, exchange rate

Özgün Araştırma / Original Article
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ISSN: 2536-4642

Doi Number :http://dx.doi.org/10.21733/ibad.2169

1. Prologue

The study examines the Turkey's chronicle trade deficit by means of observing the dynamics of trade balance in order to understand which of the variables deteriorate this deficit and also in what manner these variables affect trade balance. Also, current account deficit of Turkey has always been debated and be one of the most popular issue in Turkish Economy for many years. In the light of this idea, trade balance attracts researchers' attention due to being the most significant part of current account which helps them to understand reasons of current account deficit.

The world development indicators from World Bank data and calculate trade deficit to GDP ratio between 1992 and 2010 have been applied to see general appearance of trade deficit for Turkish economy. Results indicate that there is an upward trend in this ratio after 2001 when fixed exchange rate regime has been changed to "managed float". For example, trade deficit to GDP ratio was 5.13 percent in 2001 while it reached its last ten years peak in 2006 by 10.18 percent. By 2010 this ratio is calculated as 9.76 which is very close to its peak level for last ten years period. These results also attract our attention to investigate about effects of exchange rate regime on trade deficit of Turkey. The quarterly data set from 1992 to 2011 for Turkey's economy have been applied in order to examine chosen independent variables, such as real exchange rate, real foreign income, real domestic income and oil price per barrel, which influence on trade balance. Vector Error Correction Model (VECM) is applied where we use ordinary least squared (OLS) method with Johansen cointegration analysis, Granger causality test and generalized impulse response analysis.

2. Methodological Approach and Data

The quarterly time series data set has been applied for the period between 1992.Q1 and 2011.Q4 for Turkey. Related data sets that are used in our study are generated by using Central Bank of Republic of Turkey (CBRT) Electronic Data Delivery System (EDDS) and International Financial Statistics (IFS) of IMF. We use Economic and Social Data Service (ESDS) in order to access IFS. Trade balance (TB) is measured by considering ratio of export to import and the result of each year deflated by consumer price index (CPI). Nominal exchange rate is also deflated by CPI to get real effective exchange rate (REER) and 2005 is taken as base year for REER. GDP volume index of Turkey is deflated by using GDP deflator and we obtain real domestic GDP index (RDY) for Turkey and again 2005 is takes as base

ISSN: 2536-4642

year. GDP volume changes of seven countries (Germany, Italy, Spain, France, Netherlands, UK and US) are used to calculate real foreign income (RFY) variable. Firstly, we generate GDP volume index for each country, then GDP deflator of each country is used to calculate their real income. Finally, we took average of real GDP index of these countries according to 2012 trade volume with Turkey as percentage to calculate final version of RFY. Our final variable is spot oil price per barrel which is taken from Dow Jones.

a. Formulation of the Model

The model that has been applied in this study was developed before by Rose and Yellen (1989) who are taken TB as dependent variable while REER, RDY and RFY are independent variables. In the study a (0,1) dummy variable has been used which is not used in Rose and Yellen (1989) to examine shifts in the real exchange rate due to exchange rate regime change from fixed-but adjustable to managed floating[3] by the beginning of 2001. Also, we plan to extend the scope of our study by adding Oil price per barrel (OIL) variable which is absent for studies that we follow. The reason of taking OIL variable is that: majority of crude oil needs in Turkey is being provided by import. Peker and Hotunoğlu (2009) states that nearly 90 percent of crude oil need of Turkey is being imported which covers remarkable place in the current account deficit. They include oil price variable in their study which investigate the reasons of current account deficit in Turkey. Real OECD GDP was used in paper of Rose and Yellen; however we take average of seven trade partners of Turkey as our RFY. Akbostancı (2002) and Kimbugwe (2006) are also developed same model for Turkish data. The only difference for Kimbugwe's paper is that taking trade balance as a ratio between export and import. We will follow this way by taking TB as the ratio of export over import. Functional indication and equation form of our model can be shown as:

$$TB_t = f(REER_t\ RDY_t\ RFY_t\ OIL_t)$$

$$TB_t = \alpha_0 + \alpha_1 REER_t + \alpha_2 RFY_t + \alpha_3 RDY_t + \alpha_4 Oil_t + \alpha_5 D_R + e_t \quad (1)$$

Equation (1) indicates independent variables that may have significant effects on dependent variable that is stated trade balance in our model. According to Kimbugwe (2006) and many other studies we expect coefficients of independent variables of (1) as the following: real exchange rate coefficient "α1" is expected positive due to Marshall-Lerner condition that suggests real depreciation will lead to improve trade balance through increasing export. Growth of Turkey's GDP is generally increases import more than export, thus we expect to

[3] Exchange rate is permitted to float but Central Bank may intervene depending on the economic conditions.

ISSN: 2536-4642

see negative sign for "α3". Kimbugwe (2006) asserts that sign of coefficient of real foreign income is ambiguous for Turkey's trade balance due to uncertainty on domination of supply or demand side factors. Finally, we expect for "α4" to be negative due to crude oil has large proportion in Turkey's import where an increase in oil prices would deteriorate trade balance of Turkey.

We use logarithmic form of the model where *ln* represents natural logarithm, D R is dummy variable that have a value zero until 2000.Q4, after this period it takes value of 1 and et is the residual term of our model.

$$ln\text{TBt} = \alpha 0 + \alpha 1\ lnREERt + \alpha 2\ lnRDYt + \alpha 3\ ln\text{RFYt} + \alpha 4\ ln\text{Oil t} + \alpha 5\ \text{DR} + \text{et} \quad (2)$$

Equation (2) represents our model in logarithmic form where it gives more desirable results on residual tests. Part 4.2 states benefit of preferring logarithmic form and table 3 indicates residuals test results which convince us to use equation (2).

b. Model and Estimation

In this study, the ordinary least squared (OLS) method and restricted VAR model have been applied which is known as VECM with Unit Root Test, Cointegration analysis and impulse response functions in order to determine the effect of Exchange rate regime to trade balance of Turkey. VAR model is firstly developed by Sims in 1980. Sims (1980) refuses to differentiate variables as exogenous and endogenous and he suggests that in an econometric model each variable has an effect on another variable while this variable has also been affected by the other variables. Thus, each variable is considered as endogenous in VAR model. However, under restricted VAR model, we can take dummy variable as exogenous.

Gujarati (1995) states that if a VAR model has N number of variables, all of these variables need to be stationary. If variables have unit roots, suitable transformation needs to be done to convert non-stationary variables into stationary. In order to check whether variables are stationary or not, Augmented Dickey Fuller (ADF) unit root test will be applied as an initial step. First, unit root test will be checked at level by selecting intercept, choice in the equation. Then, if necessary, variables will be tested by taking first difference and selecting intercept choice again. The next step after completion of unit root test for variables is that selection of optimal number of lag order. Most common selection is being done by taking into consideration Akaike information criteria (AIC) and Schwarz information criteria (SC). We will also look at Hannan-Quinn information criterion (HQ), Final prediction error (FPE) and LR test statistic. Decision will be taken according to result of the majority of these criteria.

ISSN: 2536-4642

Johansen's Cointegration Test in VAR model is useful to understand whether non-stationary variables are cointegrated or not which means also whether variables have long run association or not. Onafowora (2003) states that if there is no long run association, then non-stationary variables are said to be not cointegrated, on the other hand, if they are cointegrated, this will lead to obtain long run association among variables. In other words, result of this test indicates that in the long run whether variables move together or not. In addition, variables must be integrated of same order (in our model all variables adjusted to I(1) by taking their first differences) in order to apply Johansen's cointegration test. Trace statistic, which detects number of cointegrated equations, and Maximum Eigenvalue statistic, which tests absence of cointegration and existence of number of cointegration, are most commonly used to detect cointegration between equations.

In our study we use Impulse Response Analysis to measure first response of trade balance then response of real exchange rate to one unit shock for endogenous variables *ln*tb, *ln*reer, *ln*rdy, *ln*rfy and *ln*oil under VECM. After that, we will apply Variance Decomposition analysis in order to check whether impulse responses results are corresponding with variance decomposition analysis or not. Briefly, empirical findings suggest existence of long run relationship between real exchange rate and trade balance which generates S curve pattern rather than J curve. We find also existence of short run relationship between real exchange rate and trade balance under Wald test but not under Granger causality analysis.

3. Unit Root Test

As a first step of our analysis we check whether variables are stationary or not. Thus, ADF Unit root test is applied for model (1) at level for intercept choice. All of variables have a unit root at level for intercept choice except TB. At first difference level, for all hypothesis we can reject null hypothesis at 5% level meaning that variables are stationary for intercept choice. Result for ADF unit root test for model (1) is presented in Table 1.

We apply again ADF Unit root test is applied for model (2) at level for intercept choice. All of variables have a unit root at level for intercept choice except *ln*TB. At first difference level, for all hypothesis except *ln*RFY we can reject null hypothesis at 5% level meaning that variables except *ln*RFY are stationary for intercept choice. For *ln*RFY we apply second

ISSN: 2536-4642

difference level and we could reject null hypothesis which suggests that there is no unit root at 5% level. Result for ADF unit root test for model (2) is presented in Table 2.

Table 1: Results of ADF Unit Root Test for Variables

Variables	Level		First Difference	
	ADF Test Statistics		ADF Test Statistics	
	Intercept	Lags	Intercept	Lags
Trade Balance (X/M)	-3.898*	0	-	
Real Exchange Rate	-1.652	0	-7.966*	0
Real Domestic Income	2.550	8	-3.983*	7
Real Foreign Income	-0.686	6	-3.381*	5
Oil Price	*-0.421*	*2*	*-9.199**	1

***Null hypothesis is rejected at 5 %level**
Note: Critical value for the ADF statistic is -3.5426.The order of the lag length is selected using the Schwarz Information Criterion (SC).

Table 2. Results of ADF Unit Root Test for Logarithm Version of Variables

Variables	Level		First Difference	
	ADF Test Statistics		ADF Test Statistics	
	Intercept	Lags	Intercept	Lags
lnTrade Balance (X/M)	-3.829*	0	-	-
lnReal Exchange Rate	-1.735	0	-7.631*	1
lnReal Domestic Income	0.180	4	-3.784*	7
lnReal Foreign Income	-2.035	5	-2.551	4
lnOil Price	*-0.647*	*0*	*-8.047**	

***Null hypothesis is rejected at 5 %level**
Note: Critical value for the ADF statistic is -3.5426.The order of the lag length is selected using the Schwarz Information Criterion (SC).

4. Residual Tests

In order to check whether our model is good enough to make estimation or not, firstly we should do some tests on residual. We test both normal and logarithmic form of our model in order to see benefit of using logarithmic form. For the normal form of the model, histogram

ISSN: 2536-4642

and normality test suggests that null hypothesis could not be rejected with the 0.0095 probability value, which means that residuals are not normally distributed. However, in the logarithmic form we can reject the null hypothesis by 0.4516 probability value which means residuals are now normally distributed. Second test which is serial correlation LM test (two lags) gives same results in terms of fail to reject null hypothesis which suggests that there is no serial correlation. Last test is heteroskedasticity test where we choose ARCH (two lags) as test type. By using normal form we can not reject null hypothesis which means that there is no heteroskedasticity by obtaining 0.0622 probability value of chi-square. Also, we can not reject null hypothesis when we take logarithmic form of our model by 0.1833 probability value which gives better result than normal form of the model which is also desirable.

Table 3: Residual Tests in Normal and Logarithmic Forms of the Model

	Normal Form		Logarithmic Form	
	Jarque-Bera	Probability	Jarque-Bera	Probability
Histogram and Normality Test	9.3057	0.0095	1.5895	0.4516
	Obs*R-squared	Prob. Chi-Square	Obs*R-squared	Prob. Chi-Square
Heteroskedasticity Test : ARCH (2 lags)	5.5546	0.0622	3.3935	0.1833
Serial Correlation LM Test (2 lags)	0.7465	0.6885	2.1569	0.3401

a. Optimal Lag selection

We apply lag length criteria by including seven lags to determine optimal lag for our estimation. AIC suggests seven lags where it tends to be higher if we choose more than seven as the lag selections. LR suggests five lags as optimal selection while by selecting FPE, it will offer us six lags. However, we make our final decision according to choose SC and HQ tests which indicate two lags as optimal lag selection and both of them are remaining same if we

ISSN: 2536-4642

expand the number of lags that we include. Table 4 indicates test result that is done for optimal lag selection.

Table 4: Optimal Lag Selection

VAR Lag Order Selection Criteria
Endogenous variables: LNTB LNREER LNRFY LNRDY LNOIL
Exogenous variables: C
Sample: 1 80
Included observations: 73

Lag	LogL	LR	FPE	AIC	SC	HQ
0	86.53343	NA	7.37e-08	-2.233792	-2.076912	-2.171273
1	475.2411	713.5183	3.47e-12	-12.19839	-11.25710	-11.82327
2	539.7327	109.5472	1.19e-12	-13.28035	-11.55466*	-12.59263*
3	563.9991	37.89562	1.24e-12	-13.26025	-10.75016	-12.25994
4	593.1915	41.58911	1.16e-12	-13.37511	-10.08061	-12.06220
5	629.6011	46.88360*	9.20e-13	-13.68770	-9.608801	-12.06219
6	662.1719	37.47870	8.47e-13*	-13.89512	-9.031816	-11.95701
7	693.7381	31.99864	8.50e-13	-14.07502*	-8.427308	-11.82431

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

b. Johansen Co-integration Test Results

We use data at level and also original data which has not already transformed in order to check whether there are cointegrated equations or not. Result of Johansen cointegration test suggests that under trace statistics, null hypothesis of there is no cointegration among variables can be rejected at 5 percent level. However, null hypothesis of there is at most 1 cointegrated equation and there are at most 2, 3 and 4 cointegrated equations can not be rejected which have bigger p-values than 5 percent level. Actually, we do not need to check cointegration for at most 2, 3 and 4 if we will detect at most 1 cointegrated equation. Table 5 indicates Johansen cointegration test results which detects cointegration among variables. Thus, the following interpretation can be done: there is one cointegrated equation which also means that all variables have long run association. In addition, under maximum eigenvalue statistic null hypothesis of there is at most 1 cointegrated equation can not be rejected which gives the same result corresponding with trace statistic.

ISSN: 2536-4642

Table 5 : Johansen Cointegration Test Result

Sample (adjusted): 4 80
Included observations: 77 after adjustments
Trend assumption: Linear deterministic trend
Series: LNTB LNREER LNRFY LNRDY LNOIL
Exogenous series: DUMMY
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.422145	79.06539	69.81889	0.0076
At most 1	0.262802	36.83605	47.85613	0.3553
At most 2	0.110801	13.35886	29.79707	0.8745
At most 3	0.046021	4.316402	15.49471	0.8764
At most 4	0.008904	0.688647	3.841466	0.4066

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.422145	42.22935	33.87687	0.0040
At most 1	0.262802	23.47719	27.58434	0.1540
At most 2	0.110801	9.042457	21.13162	0.8290
At most 3	0.046021	3.627755	14.26460	0.8964
At most 4	0.008904	0.688647	3.841466	0.4066

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

According to this result, as long as we find cointegration among variables, we can apply vector error correction model (VECM) that is also known as restricted VAR. At this stage Alptekin (2009) suggests that it is also possible to apply Granger Causality test within the VECM. This test produces causation relationship between two variables. It is important to bear in mind that Granger Causality test is being applied in order to analyse short run causality among variables. Gujarati (1995) uses two following equation in order to demonstrate causality between any two variables such as X and Y:

$$Xt = \alpha + \Sigma \beta j\ Yt\text{-}1 + \Sigma \gamma j\ Xt\text{-}1 + u1t \quad (3)$$

$$Yt = \theta + \Sigma \delta j\ Xt\text{-}1 + \Sigma \lambda j\ Yt\text{-}1 + u2t \quad (4)$$

In addition, stationary variables need to be used in Granger Causality test. If they are non-stationary, procedure of converting them into stationary needs to be applied to make them

ISSN: 2536-4642

stationary. Also u1t and u2t need to be uncorrelated. Table 6 indicates that the normalized cointegration coefficients result that is obtained from Johansen cointegration test. According to this result oil price has a negative effect on trade balance which is defined as the ratio between export over import. The oil price coefficient is -0.164 which can be interpreted as ten percent increase in oil prices while other variables are remained constant will deteriorate the ratio of export over import as 1.64 percent. Also, real foreign income and real effective exchange rate have negative influences on trade balance. Coefficients suggests that ten percent growth in real foreign income deteriorate trade balance by 2.4 percent while ten percent rise in real exchange rate result as a decline in trade balance by 3.85 percent. On the other hand, real domestic income has positive effect on trade balance. Ten percent increase growth of domestic income will improve trade balance by 2.85 percent.

Table 6: Johansen Cointegration Test: Normalized Cointegrating Coefficents

1 Cointegrating Equation(s): Log likelihood 571.7809

Normalized cointegrating coefficients (standard error in parentheses)

LNTB	LNREER	LNRFY	LNRDY	LNOIL
1.000000	-0.385042	-0.240115	0.285284	-0.163852
	(0.20481)	(0.18601)	(0.09939)	(0.08962)

c. Granger Causality Test Results

Lag selection is an important criterion for Granger Causality test which may cause to misleading change in results if it is not done properly. In the light of this idea, we use two different groups of lag selection criteria in our test. First we use SC and HQ test as lag selection criteria which suggest two lags as an optimal choice. Then we use five lags which is determined as optimal selection according to LR. In this test, stationary variables need to be used, thus we take first difference of our 5 variables which convert most of them from non-stationary to stationary. Results for Granger Causality test which indicates short run causality is presented in table 7 and in table 8.

ISSN: 2536-4642

Table 7: Granger Causality test results for two lags selection

Pairwise Granger Causality Tests
Sample: 1 80
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DLNREER does not Granger Cause DLNTB	77	2.76722	0.0695
DLNTB does not Granger Cause DLNREER		4.65717	0.0125
DLNRFY does not Granger Cause DLNTB	77	0.10295	0.9023
DLNTB does not Granger Cause DLNRFY		0.14325	0.8668
DLNRDY does not Granger Cause DLNTB	77	1.23613	0.2966
DLNTB does not Granger Cause DLNRDY		6.33324	0.0029
DLNOIL does not Granger Cause DLNTB	77	6.64569	0.0022
DLNTB does not Granger Cause DLNOIL		0.63852	0.5310
DLNRFY does not Granger Cause DLNREER	77	0.31456	0.7311
DLNREER does not Granger Cause DLNRFY		0.32587	0.7230
DLNRDY does not Granger Cause DLNREER	77	1.18837	0.3106
DLNREER does not Granger Cause DLNRDY		3.56461	0.0334
DLNOIL does not Granger Cause DLNREER	77	0.32618	0.7227
DLNREER does not Granger Cause DLNOIL		1.91751	0.1544
DLNRDY does not Granger Cause DLNRFY	77	0.21493	0.8071
DLNRFY does not Granger Cause DLNRDY		0.29384	0.7463
DLNOIL does not Granger Cause DLNRFY	77	4.22435	0.0184
DLNRFY does not Granger Cause DLNOIL		0.41769	0.6601
DLNOIL does not Granger Cause DLNRDY	77	0.76585	0.4687
DLNRDY does not Granger Cause DLNOIL		0.66501	0.5174

Table 7 indicates that under two lags selection the hypothesis of *dln*tb does not Granger Cause *dln*reer and *dln*rdy can be rejected under 5 percent level which means that trade balance cause real exchange rate and real domestic income in the short run while it does not cause real foreign income and oil price in the short run which make sense. Furthermore, oil price cause trade balance and real domestic income while does not cause other variables. Also, real exchange rate causes real domestic income while does not cause any other variables in the short run. All other combinations do not Granger cause each others.

ISSN: 2536-4642

Table 8: Granger Causality test results for five lags selection

Pairwise Granger Causality Tests
Sample: 1 80
Lags: 5

Null Hypothesis:	Obs	F-Statistic	Prob.
DLNREER does not Granger Cause DLNTB	74	1.36506	0.2495
DLNTB does not Granger Cause DLNREER		5.22349	0.0004
DLNRFY does not Granger Cause DLNTB	74	0.51138	0.7666
DLNTB does not Granger Cause DLNRFY		0.69770	0.6272
DLNRDY does not Granger Cause DLNTB	74	0.55340	0.7351
DLNTB does not Granger Cause DLNRDY		2.66366	0.0301
DLNOIL does not Granger Cause DLNTB	74	5.41674	0.0003
DLNTB does not Granger Cause DLNOIL		0.51177	0.7663
DLNRFY does not Granger Cause DLNREER	74	0.87831	0.5009
DLNREER does not Granger Cause DLNRFY		0.61459	0.6891
DLNRDY does not Granger Cause DLNREER	74	0.29513	0.9139
DLNREER does not Granger Cause DLNRDY		1.52212	0.1957
DLNOIL does not Granger Cause DLNREER	74	0.60533	0.6960
DLNREER does not Granger Cause DLNOIL		1.14956	0.3440
DLNRDY does not Granger Cause DLNRFY	74	1.87653	0.1111
DLNRFY does not Granger Cause DLNRDY		1.04976	0.3967
DLNOIL does not Granger Cause DLNRFY	74	3.60924	0.0062
DLNRFY does not Granger Cause DLNOIL		0.44408	0.8160
DLNOIL does not Granger Cause DLNRDY	74	1.49668	0.2036
DLNRDY does not Granger Cause DLNOIL		0.42911	0.8267

According to Granger Causality test results under five lags selection which is indicated in table 8, null hypothesis of *dln*tb does not Granger cause *dln*reer can be rejected at 5 percent level meaning that trade balance does cause real effective exchange rate in the short run. Also the following outcomes can be obtained for the short run period from the result: trade balance cause real domestic income while it does not cause to real foreign income and oil price. Moreover, real effective exchange rate does not cause trade balance, real foreign income, real domestic income and oil price. Oil price causes trade balance and real foreign income while it does not cause real effective exchange rate and real domestic income. Finally, real domestic income and real foreign income do not cause all other variables. To summarize Granger causality test, oil price cause trade balance and real foreign income and also trade balance causes real exchange rate and real domestic income for both lag selection in the short run. In addition, when we select two lags, we can observe that real exchange rate causes real

ISSN: 2536-4642

domestic income while this is not the case for five lags selection. Other causality results has been unchanged when lag selection criteria is taken differently.

d. Vector Error Correction Model (VECM) Results

Table 9 indicates VECM results in system form which give detailed evidences in order to evaluate variables influence on trade balance. Firstly, we look at the number of variables which are statically significant to explain trade balance. In order to see this, we check p-values of variables in our model. Real exchange rate is statically significant for lag one and lag two and have influence on trade balance. Real foreign income and oil price variables are statically significant for lag two while they are not for lag one by 8 percent and 63 percent of p-values respectively. On the other hand, real domestic income and trade balance itself are not significant for lag one and lag two which means they do not have influence on dependent variable which is trade balance in our model.

Secondly, our error correction term "C (1)" is significant and the coefficient is negative which is desirable. This means there is a validity of the long run equilibrium relationship among all variables which supports our Johansen cointegration test result. C (1) is equal to -0.407 which means that 40.7 percent of imbalance in our model has been eliminated in one quarter by error correction term. Also, our dummy variable is significant where it has positive sign in front of its coefficient and its p-value is less than 5 percent. Dummy variable has positive impact on trade balance in Turkey and the policy decision in 2001 which was made by converting fixed exchange rate regime into floating regime. This means that policy change can be evaluated as successful in terms of showing positive impact on trade balance.

Finally, we look at R-squared and F-statistic values to check their significance level. Although R-squared value is a bit low that is calculated as 0.47 which may cause a bit problem for us in terms of estimation quality, F-statistic has p-value less than 5 percent probability which means that it is statistically significant. This means that independent variables jointly have influence on dependent variable. In addition, we obtain desirable result by having R-square value is less than Durbin-Watson statistic value which also proves that our estimation is not spurious.

ISSN: 2536-4642

Table 9: Vector Error Correction Model Result in System Form

Dependent Variable: D(LNTB)
Method: Least Squares
Sample (adjusted): 4 80
Included observations: 77 after adjustments
D(LNTB) = C(1)*(LNTB(-1) - 0.385042226516*LNREER(-1) - 0.240115200848*LNRFY(-1) + 0.285284185515*LNRDY(-1) - 0.163851922342*LNOIL(-1) + 0.972178377441) + C(2)*D(LNTB(-1)) + C(3)*D(LNTB(-2)) + C(4)*D(LNREER(-1)) + C(5)*D(LNREER(-2)) + C(6)*D(LNRFY(-1)) + C(7)*D(LNRFY(-2)) + C(8)*D(LNRDY(-1)) + C(9)*D(LNRDY(-2)) + C(10)*D(LNOIL(-1)) + C(11)*D(LNOIL(-2)) + C(12) + C(13)*DUMMY

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.407926	0.105821	-3.854874	0.0003
C(2)	0.141784	0.113777	1.246157	0.2172
C(3)	0.042444	0.108712	0.390426	0.6975
C(4)	-0.366602	0.153637	-2.386160	0.0200
C(5)	-0.410417	0.157869	-2.599734	0.0116
C(6)	1.927447	1.089835	1.768568	0.0817
C(7)	-2.257876	1.069691	-2.110773	0.0387
C(8)	0.025213	0.099825	0.252576	0.8014
C(9)	0.111913	0.100211	1.116776	0.2683
C(10)	-0.028824	0.060025	-0.480197	0.6327
C(11)	-0.266062	0.060025	-4.432497	0.0000
C(12)	-0.038096	0.021304	-1.788184	0.0785
C(13)	0.078545	0.026442	2.970488	0.0042

R-squared	0.461979	Mean dependent var	-0.000669
Adjusted R-squared	0.361100	S.D. dependent var	0.107542
S.E. of regression	0.085960	Akaike info criterion	-1.917140
Sum squared resid	0.472899	Schwarz criterion	-1.521433
Log likelihood	86.80989	Hannan-Quinn criter.	-1.758861
F-statistic	4.579543	Durbin-Watson stat	1.840149
Prob(F-statistic)	0.000027		

We can also evaluate coefficients of independent variables one by one. Real exchange rate has negative sign in front of coefficients that are C (4) and C (5) which are also statically significant. Coefficients of real foreign income have two different signs, but we take into consideration C (7) due to being significant and it has negative sign. However, coefficient is not small enough to make significant interpretation by being bigger than one. Although real domestic income coefficients have positive sign, we can observe that they are not significant. Lastly, oil price coefficient C (11) has negative sign where c (10) is not significant but also has positive sign. To compare these results with our coefficient sign expectation part that is stated in part 3.1, we can say that, coefficient of oil price and has similar result with our expectation. However, VECM results suggest that real domestic income is not statically significant to check its effect on trade balance and an also real foreign income result does not

ISSN: 2536-4642

make sense to interpret. Moreover, results suggest that an increase in real exchange rate will deteriorate trade balance which is against to our expectation.

e. Wald Test Results

We use also Wald test in our VECM example in order to check whether our variables have short run causality on trade balance or not. First, we develop null hypothesis that suggests real exchange rate does not cause trade balance.

Table 10: Wald Test for Real Exchange Rate Coefficients

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	6.528353	(2, 64)	0.0026
Chi-square	13.05671	2	0.0015

Null Hypothesis: C(4)=C(5)=0

According to above Wald test result, real exchange rate coefficients C(4) and C(5) jointly causes trade balance in the short run which means the null hypothesis can be rejected at 5 percent level. Secondly, we test whether real foreign income has short run causality on trade balance or not.

Table 11: Wald Test for Real Foreign Income Coefficients

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.227777	(2, 64)	0.1161
Chi-square	4.455553	2	0.1078

Null Hypothesis: C(6)=C(7)=0

Test result suggests that coefficients of real foreign income, jointly does not cause trade balance in Turkey in the short run which means we fail to reject null hypothesis. Then, we check Wald test short run causality for real domestic income on trade balance.

ISSN: 2536-4642

Table 12: Wald Test for Real Domestic Income Coefficients

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	10.09842	(2, 64)	0.0002
Chi-square	20.19685	2	0.0000

Null Hypothesis: C(8)=C(9)=0

Wald test result indicates that real domestic income causes trade balance in the short run where null hypothesis can be rejected at 5 percent level which suggests real domestic income does not cause trade balance. Finally, we check same thing for oil price by developing null hypothesis that claims oil price does not cause trade balance.

Table 13: Wald Test for Oil Price Coefficients

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.674280	(2, 64)	0.5131
Chi-square	1.348560	2	0.5095

Null Hypothesis: C(10)=C(11)=0

We can not reject null hypothesis in this Wald test that is done to test short run causality of oil price on trade balance, because Chi-square value is more than 5 percent level meaning that oil price does not has short run causality on trade balance. To compare Wald test results with VECM result, we realize that there are some differences in terms of causality in the short and long runs. For example, although real domestic income does not have a long run effect on trade balance according to VECM results, it has short run causality on trade balance. Moreover, oil price and real foreign income variables (for their second lags) also statistically significant in the long run where they do not cause trade balance in the short run. On the other hand, real exchange rate has both short and long run causality on trade balance.

f. Impulse Response Analysis Results

Equations 4 and 5 can help us to explain Impulse Response Analysis. This analysis shows the response of endogenous variables in the VAR model when one unit of shock is added to

ISSN: 2536-4642

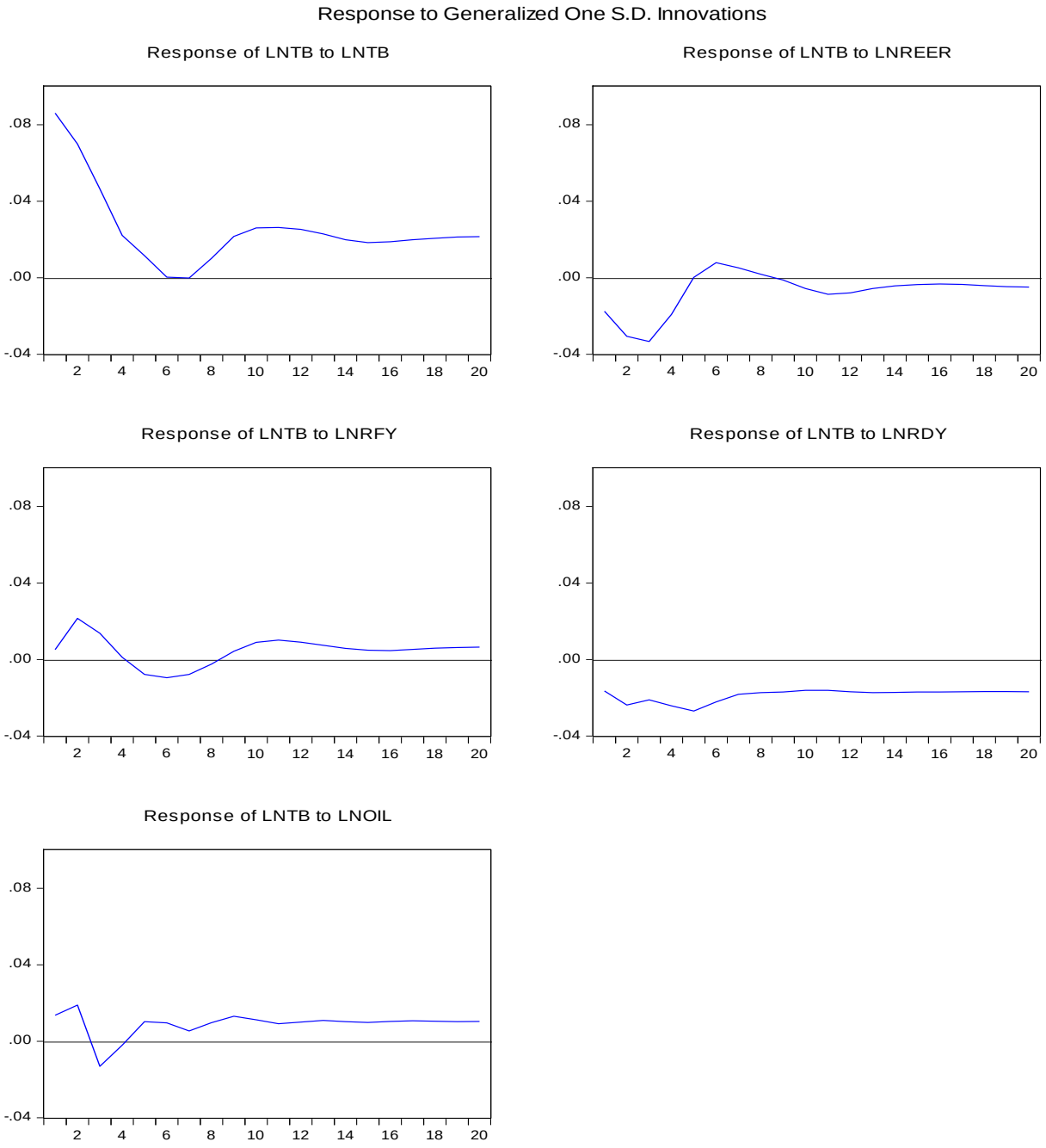
residual terms which are defined as U1 and U2 in equations 4 and 5. Thus, this analysis tells us for example, a change in U1 will generate a change in Xt. Also, it will generate a change next period for Xt and Yt. In Figure 1, impulse response of trade balance to itself, real exchange rate, real foreign income, real domestic income and oil prices are measured by using generalized impulses as decomposition method. Twenty periods has been chosen in this analysis.

Results indicate that response of trade balance to itself is initially positive up to six quarters. Then the effect touches zero line which means trade balance does not affect itself for the periods seven and eight. Finally the effect becomes again positive and remains in this manner until twentieth period. Secondly, results suggests that response of trade balance to real exchange rate shock is negative which lasts five quarters after shock was applied and then the effect turns to positive for two periods, finally it becomes again negative from the ninth period on and remain stable.

Thirdly, real foreign income shock initially positively affects trade balance for three quarters. Then it becomes negative between forth and eight quarters and finally turns to positive at 9 quarters. Then the effect remains stable after tenth quarter. Then, one unit shock that is applied to real domestic income negatively affects trade balance for all quarters that are chosen for future period. Finally, response of trade balance to one unit standard deviation shock for oil price affects trade balance positively for 2 quarters. For the third quarter, the effect turns to negative while after fifth quarters effect becomes again positive and remains constant from sixth quarter on.

ISSN: 2536-4642

Figure 1: Impulse Response Analysis: Response of Trade Balance to Variables



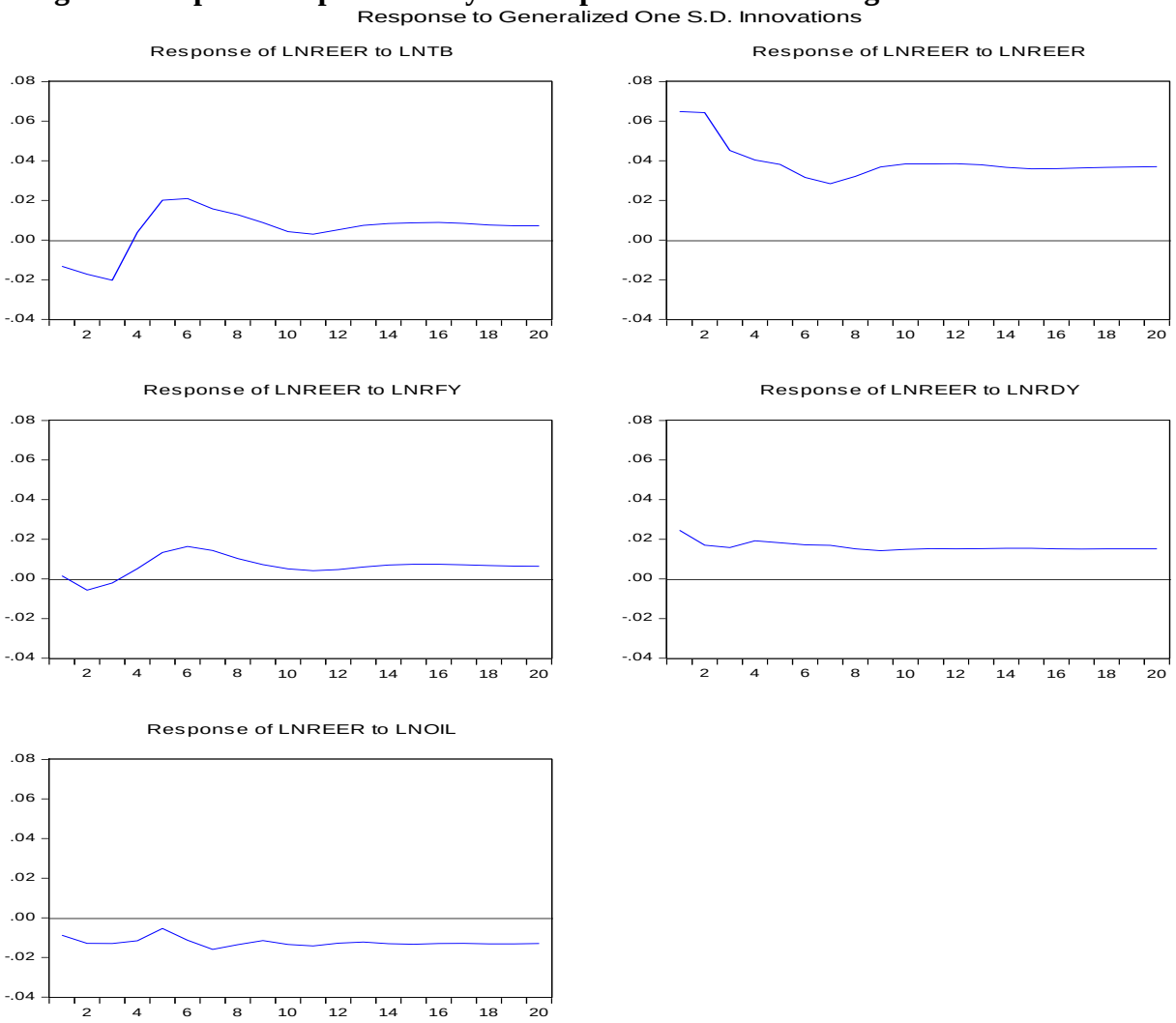
The Figure 2 indicates response of real exchange rate when one unit shock is given to residual of itself and other four variables. Firstly, one unit innovation of trade balance has negative effect on real exchange rate which last four quarters. Between fifth quarter and eighth quarter effect turn to positive and after tenth quarter it becomes stable until the end of selection future period.

ISSN: 2536-4642

Secondly, we check response of real exchange rate to one unit shock of itself. It is clear that shock has positive effect on real exchange rate and this effect remains positive until the end of selection period. The effect is initially higher for first two periods then it falls gradually until seventh period. Finally it increases again and remains stable after ninth period. Thirdly, one unit shock for real foreign income has positive effect for first quarter, then until the third period it becomes negative. Then it gradually increases and turns to positive again between forth and sixth quarters. Until the tenth quarter it falls a bit but still remains positive and stable until the end.

Then, response of real exchange rate to one unit shock of real domestic income is positive for twenty quarters which shows stable effect generally. Finally, one unit innovation of oil price has negative effects on real exchange rate which gradually affects better until fifth quarters than effect becomes stable but still negative from eight quarters on.

Figure 2: Impulse Response Analysis: Response of Real Exchange Rate to Variables



ISSN: 2536-4642

g. Variance Decomposition Analysis

Alptekin (2009) states that variance decomposition analysis has a significant role in order to detect which variables explain better to improvements on dependent variables in an econometric model estimation. In the light of this opinion, we calculate variance decomposition of trade balance for other endogenous variables.

Table 14: Variance Decomposition Analysis of LnTB

Period	S.E.	LNTB	LNREER	LNRFY	LNRDY	LNOIL
1	0.085960	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.113901	94.58889	2.147378	2.490550	0.501568	0.271618
3	0.128362	87.58130	5.280951	2.805103	0.623406	3.709240
4	0.132222	85.33626	6.256122	2.644654	2.127051	3.635914
5	0.136427	80.87018	5.912603	2.889351	5.883800	4.444071
6	0.140313	76.45233	5.922623	3.227214	8.970177	5.427657
7	0.142536	74.08727	5.873219	3.445671	10.83371	5.760125
8	0.144590	72.48678	5.782905	3.397880	12.06924	6.263191
9	0.147639	71.65458	5.594401	3.296796	12.73583	6.718391
10	0.150946	71.52028	5.352608	3.395659	12.97507	6.756383
11	0.154104	71.51826	5.183002	3.571754	13.09591	6.631069
12	0.157115	71.37512	5.018846	3.672999	13.33539	6.597649
13	0.159845	71.00355	4.853038	3.692608	13.75251	6.698298
14	0.162139	70.50765	4.716862	3.670540	14.27182	6.833124
15	0.164208	69.98748	4.598741	3.628862	14.80738	6.977536
16	0.166334	69.48308	4.483035	3.581316	15.30565	7.146913
17	0.168550	69.05284	4.367160	3.543929	15.73380	7.302271
18	0.170777	68.72428	4.253982	3.525099	16.08922	7.407411
19	0.173014	68.46052	4.145296	3.518216	16.39551	7.480460
20	0.175267	68.21458	4.040252	3.514038	16.68167	7.549459

Cholesky Ordering: LNTB LNREER LNRFY LNRDY LNOIL

Table 14 indicates variance decomposition of trade balance which states the following results: for the second period, 94.6 percent of variance of trade balance is explained by itself. This shows that the most significant endogeneity for trade balance is itself. However, after sixth period this ratio falls to 76 percent and this ratio fluctuates between 68.2 and 72 .5 percent for the periods between eight and twenty. From eight periods on variance fluctuations can be observed stable.

When we take the twentieth period into consideration, we can summarize decomposition of variance for other variables as the following: the explanatory effect of real domestic income to trade balance is realized as 16.7 percent share which is the highest among variables while oil price has 7.55 percent, real exchange rate has 4.04 percent and real foreign income has 3.51 percent shares. Especially, real domestic income effect is initially smaller but then it increases gradually and tends to increase if we select more periods. Oil price effect is also has an increasing trend and it has second big effect on trade balance. On the other hand, real

ISSN: 2536-4642

exchange rate and real foreign income effects seem more stable than oil price and real domestic income. Also, their effects are not more than these two variables. To evaluate these results, oil price and real domestic income has negative effect on trade balance through increasing import. This is the case for Turkish economy for years: economic growth leads to boost import growth and increasing oil prices deteriorate trade balance due to absence of crude oil reserves in Turkey. However, real foreign income growth has positive effect on trade balance of Turkey through demand increase on Turkish goods which improves export.

5. Resume

The study examines real exchange rate influence on trade balance for both short run and long run. By means of this study we have also studied real foreign income, real domestic income and oil prices effect on trade balance to understand determinants of trade deficit of Turkey.

Empirical findings suggest the following: According to Johansen cointegration analysis, under trace and maximum eigenvalue tests variables found cointegrated which means there is long run relationship among variables. This result enables us to apply VECM.

Our VECM findings indicate that error correction term is significant and 40.7 percent of imbalance in our model has been eliminated in one quarter by error correction term. Also, our dummy variable is significant and it shows that policy change in 2001 which made in exchange rate regime has positive impact on trade balance in Turkey. We can briefly mention other variables' effect under VECM analysis. Real exchange rate and oil price are statically significant and have negative effect on trade balance in the long run. However, we found real foreign income and real domestic income as not statically significant which means also they do not have meaningful influence on trade balance in the long run. Finally, we observe that independent variables jointly have an effect on trade balance according to F-statistic value while we obtain a bit low R-squared value as 0.47. This does not cause a problem since our model is found significant in terms of residual tests. Histogram and normality test, heteroscedasticity test and serial correlation LM test give desirable results in the logarithmic form of our model. We can compare these results with our expectation that is done in formulation of model part. We can say that, coefficient of oil price and has similar result with our expectation. Moreover, results suggest that an increase in real exchange rate will deteriorate trade balance which is against to our expectation.

For short run analysis we apply both Granger causality and Wald test. Thus, at 10 percent level real exchange rate influence trade balance in short run under Granger causality test. Also, according to this test results oil price causes trade balance while real foreign income and real domestic income does not cause trade balance in the short run. Moreover, Wald test results under VECM indicate that coefficients of real exchange rate jointly influence trade balance in the short run. Also, real domestic income coefficients' has short run effect on trade balance. On the other hand, the effects of coefficients of real foreign income and oil price jointly are not statically significant for trade balance which means that they do not have influence on trade balance in the short run.

Generalized impulse response analysis under VECM applied which gives following results: trade balance positively affects itself for twenty quarters. However, response of trade balance

ISSN: 2536-4642

to one-unit shock of exchange rate shows S curve pattern which is initially negative then turns to positive finally it becomes negative and stable until the end of twentieth period. This result supports findings of Onafowora (2003). Moreover, trade balance has been positively affected by real foreign income after nine quarters while the effect is fluctuated as being positive initially and turns to negative for 4 periods again becomes positive at eighth quarter. This pattern also followed by response of trade balance to one-unit shock of oil price but in different quarters.
Also, we checked response of real exchange rate to standard deviation shocks of other variables. We found that except oil price effect on real exchange rate, response of real exchange rate to itself and other variables is positive for twenty quarters.

Finally, we finish our empirical test by variance decomposition test. We calculated variance decomposition of trade balance and found that most of variance fluctuations can be explained by itself. Real domestic income, oil price, real exchange rate and real foreign income are ordered in terms of the power to explain rest of the fluctuations.

To conclude, some recommendations can be made for Turkey in order to improve her trade deficit for the following periods. Firstly, as we found oil price statically significant in our findings, oil and natural gas explorations should be accelerated and budget that is reserved for these activities should be increased. It is highly possible that Turkey could reach these resources due to located in Middle-east region which has many oil exporter countries. If Turkey could increase oil and natural gas productions, the rate of import on energy usage would be dramatically declined from 90 percent level. Of course, this would affect Turkey's trade deficit in a good aspect. In addition, according to Turkish Electricity Transmission Company (TEİAŞ), rate of natural gas that is used in Electricity Generation in Turkey is 44 percent which have significant negative effect on trade deficit, because 96 percent of natural gas that is used in Turkey was imported in 2010. In the light of this information, the rate of fuels that are imported should be reduced by establishing new sources in electricity generation in order to improve trade deficit in the following years. Nuclear energy is one of the ways to decrease imported fuels in energy needs of Turkey, but this is a controversial issue in terms of possible negative threats of this energy to the environment.
Secondly, as we found also the effect of real exchange rate significant on trade balance, we can say that "managed float" exchange rate regime should be continued to be implemented, because our findings suggest that dummy variable which represents policy change in 2001 which is done by converting fixed exchange rate regime into managed float, has positive impact on trade balance and it is statically significant to explain trade deficit. Moreover, CBRT's foreign exchange reserves should be continued to be strengthened in order to respond instantaneous capital outflows during crisis periods. Because, the reason of exchange rate regime change in 2001 was to fail to respond this kind of capital outflows which resulted to exhaustion of foreign exchange reserves of CBRT. Lastly, Turkey's export seems open to fluctuations due to having neighbours and partners which are struggling with economic and political crisis such as public debt crisis in Greece, civil war in Syria, political instability in Iraq and economic recession in EU. Because of this problematic environment, Turkey should diversify her trade to developing markets.

ISSN: 2536-4642

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ISSN: 2536-4642