The Effect of Exchange Rates on the International Trade in Turkey

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Abstract

This study analyzes the impact of exchange rates on Turkey's international trade pattern. Cointegration and vector error correction model (VECM) procedures are applied on monthly data set covering the period 2003:01-2012:08. One of the main finding of the paper is that exchange rates, exports and imports are cointegrated and, thus, cannot drift too far apart in Turkey. Furthermore, the VECM analysis shows that long run causality runs from exports and imports to exchange rates, and vice versa.

Key Words: *Exchange Rates, Trade, Cointegration, VECM, Turkey*

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Introduction

As it is well known, economic theory constructs a positive relationship between higher, measured as direct quatation, i.e. ₺/per$, exchange rates and exports and a negative relationship between it and imports. However, empirical studies have provided conflicting results about the relationship between exchange rates and international trade flows. Yet, in Turkey, there are only a few numbers of studies that covers this issue. This paper aims to contribute to the related literature by applying times series techniques on the Turkish data set.

Huchet-Bourdon and Korinek (2011) study relationship between exchange rate volatility and trade in China, Europe and the United States in agricultural, manufacturing and mining sectors. They find that both Europe's and the U.S's trade flows statistically significantly related to China's exchange value of the Yuan. Further, they conclude that in the long run exports are more sensitive to the real exchange rates than imports in China. Alam (2010) investigates the issue and finds that in Bangladesh there is no Granger-causality relationship between real depreciation of Taka and exports. Harri et. al. (2009) use cointegration analysis to determine changes in the strength of the linkage between agricultural commodities, oil prices, and exchange rates. They find that exchange rates are effective in regulating trade flows in the United States. Altintas et. al. (2012) study the relationship between Turkish exports, foreign income, relative prices, and exchange rates by employing quarterly data covering 1993Q3-2009Q4. Their findings reveal that nominal exchange rate volatility positively and statistically significantly affects exports. In another study in Turkey, Vergil (2002) investigates the effect of real exchange rates on the export flows to the United States, Germany, France, and Italy. He finds that the real exchange rates have a significant negative impact on real exports.

The following section provides theoretical explanation of the subject. Section three introduces the data set. Section four presents the methodology and reports the estimated results. Finally, section five concludes the paper.

Theoretical Literature

There are two main theoretical explanations in determining the impact of exchange rates on international trade. These are the J-Curve term and the Marshall-Lerner condition.

The J-Curve term indicates that a country's trade balance experiences a pattern that looks like the letter-J if its currency becomes devalued. At first imports exceed exports causing a trade deficit. Then, as the export prices decrease, the country's level of exports increases leading to a trade surplus. Immediately following the devaluation of the currency the volume of trade stays relatively unchanged due to the recognition and reaction time lags that exist in the process of consumers' market search for cheaper alternatives. Furthermore, there may be effective pre-existing trade contracts that must be carried out. In the longer term, the depreciation of the currency can favorably affect the current account balance as imported goods become more expensive for domestic consumers and exported goods become cheaper for foreign consumers, resulting an increase in net exports (Bahmani-Oskooee, 1985).

In technical term, when does a real depreciation of the currency can improve the current account balance of a country? The Marshall-Lerner condition tries to find an answer to this question. The condition states that a real depreciation of the currency can improve trade balance if the sum of the elasticities of the demand for exports and imports with respect to the real exchange rate is, in absolute values, greater than one. So, if exported goods are price elastic, the total export revenue will increase (Ison and Wall, 2007: 335).

In macroeconomic theory, the impact of currency appreciation, or depreciation, is explained through some well-known channels. If a country's currency appreciates, imported goods will become cheaper for domestic consumers, causing an increase in imports. Imported raw materials also will be cheaper lowering cost of domestic production. Cheaper imported goods will force domestic producers to decrease their prices, and thus, inflation will be lower. Together with the lower inflation, interest rates will also fall and subsequently consumer spending and capital spending will be higher. Nevertheless, as exporters lose their international price competitiveness, due to strong domestic currency, the country's trade deficit will increase. When exports fall, business confidence and capital investment will also fall and consequently slower economic growth and higher unemployment will be experienced (Froyen, 1993: 587-606). A depreciation of the currency would mostly cause opposite of these effects.

Balance of Payments (BOP) measures can be used in order to explore the impact of international trade on a country's foreign exchange rates. The relationship between the exchange rates and the BOP can be illustrated as;

BOP = (X-M) + (CI-CO) + (FI-FO) + FXB

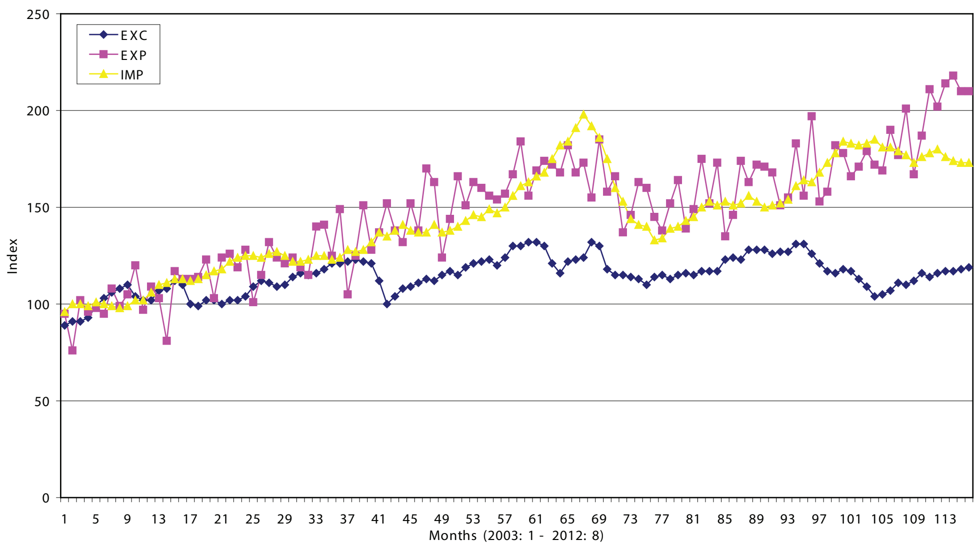
where, X is exports, M is imports, CI is capital inflows, CO is capital outflows, FI is financial inflows, FO is financial outflows. The term (X-M) is as called Current Account Balance, (CI-CO) is called as Capital Account Balance, (FI-FO) is called as Financial Account Balance and FXB is the official monetary reserves.

A country's BOP can have an important effect on the level of its exchange rates. Under a fixed exchange rate system, the government tries to ensure that the BOP as a whole is around zero. Under a floating exchange rate system, however, surpluses or deficits can influence exchange rates. For example, if a country's imports sizably exceed its exports, then the country will have a net BOP deficit. This will cause an excess supply of the domestic currency on markets. Consequently, the domestic currency will depreciate. On the other hand, a net surplus occurring in the BOP due to excessive exports, relative to imports, will cause an appreciation of the domestic currency (Froyen, 1993: 584-592).

Data

The monthly data covering the period 2003:1-2012:8 comes from Central Bank of the Republic of Turkey (CBRT) electronic data delivery system. The exchange rate data is an indexed (2003=100) real effective exchange rate values and is based on CPI. The export and import data sets are indexed (2003=100) real values and are based on Broad Economic Categories (BEC) classification. In this paper we will be labeling exchange rates as EXC, exports as EXP, and imports as IMP.

Figure 1: Exchange Nates (EXC), Exports (EXP) and Imports (IMP)



Above, Figure 1 is supplied in order to get a priory idea about the three different variables that will be unanalyzed in the paper. From the figure, interestingly enough, we can see that exports and imports move quite together.

Econometric Tests and Specifications

In this section first we will conduct unit root test to see if the series are stationary. Then cointegration test will be done to see possible long run relationship among the variables. Following the test, if the series are cointegrated, a Vector Error Correction Model (VECM) will be constructed in order to further check on the behavior of the series. Model descriptions of the section to some extent rely on Gunes (2007).

Unit root and cointegration tests

First, we need to check for the stationarity of the series, because most of the macroeconomic series appear to be nonstationary, as discussed in Nelson and Plosser (1982). Among the several unit root tests that exist to check for stationarity, we apply Augmented Dickey-Fuller (ADF) test to examine the stationarity of the series. Table 1 reports results from the ADF unit-root tests below:

Table 1: Augmented Dickey-Fuller (ADF) test results

Variables	Form	Constant, No Trend	Constant, Trend
EXC	Level	-2.6959 (4)	-2.6864 (4)
	First Difference	-4.2062* (6)	-4.1499* (6)
EXP	Level	-0.1733 (9)	-1.6162 (9)
	First Difference	-4.0013* (10)	-3.9514** (10)
IMP	Level	-2.1130 (3)	-3.4172 (3)
	First Difference	-3.3061** (10)	-3.3670** (10)

All variables are in log forms. The optimal lag lengths are determinedby Shazam default, according to AIC and SC, and are given in parenthesis.

The output presented in Table 1 shows significance levels w.r.t. 1% and 5% and represented as one asterisk and two asterisks, respectively. Critical values are from Davidson and MacKinnon (1993). The results show that the existence of unit root (i.e., nonstationarity) can't be rejected when the series EXC, EXP, and IMP are in levels. This means that none of the variables are stationary in levels. However, when the variables are converted to their first differences, they become stationary and can be considered as integrated of order one, I(1).

Cointegration Test

In order to proceed for the cointegration analysis, we must be sure that the series possess same order of integration. If a variable has to be differenced *d* times to become stationary, then the variable is called integrated order of *d*, *I(d)*, (Kennedy, 1996: 253). The results above show that our variables are *I(1)*. A finding of cointegration indicates that there is a long run equilibrium relationship between the variables. To test for cointegration, we utilize Johansen-Juselius (1990) testing procedure.

The Johansen-Juselius, (JJ), cointegration testing procedure provides two test statistics to detect the number of cointegrating vectors. They are called *trace* and *maximum eigenvalue* test statistics. In using $\lambda_{trace} = T \sum_{j=r+1,n} \ln(1-\lambda_j)$ equation the trace test statistic, for the null hypothesis, state that there are at most *r* number of cointegrating vectors. In the equation *T* gives the number of observations, and λ_js show the estimated values of the characteristic roots, by assuming that the variables are *I(1)*. By using the relationship $\lambda_{max} = -T \ln(1-\lambda_{r+1})$, the maximum eigenvalue test statistic builds the null hypothesis as there are at most *r* cointegrating vectors, and the alternative hypothesis as there are *r+1* cointegrating vectors.

Table 2 provides the results of Johansen-Juselius cointegration tests for the series. The necessary critical values for the test statistics are provided by Johansen and Juselius (1990).

Table 2: Johansen-Juselius cointegration test results

	r = 0	C. Values	r ≤ 1	C. Values	r ≤ 2	C. Values
λ_{trace}	39.637	31.3 (5%)	13.424	15.6 (10%)	0.027	6.7 (%10)
λ_{max}	26.213	21.3 (5%)	13.397	12.8 (10%)	0.027	6.7 (%10)

According to the AIC and SC criteria optimum lag length is selected to be 12. The model includes three seasonal dummies. No restrictions on the constant term are imposed.

In Table 2 results obtained from trace, λ_{trace}, and maximum eigenvalue, λ_{max}, test statistics are presented. The trace test results indicate that there is only one cointegrating vector in the model. However, maximum eigenvalue test shows that there are more than one cointegrating vectors in the model. Since this outcome in the λ_{max} test is true with only 10% significance level, we may assume that solely a single vector defines the cointegration space. As Enders (2004: 372) expresses, cointegrated series share the same stochastic trends, and thus, tend to move together. This means that there is a long run relationship between the variables.

Error Correction Model

As Granger (1983) and Engle and Granger (1987) state cointegrated series have an error correction representation, and also if the variables are cointegrated, then the possibility of the estimated regression being spurious is ruled out. Since our series are cointegrated, we can proceed to determine the short-run properties of the series and the direction of causality, in Granger sense, among the variables by utilizing a number of vector error correction equations. The related vector error correction model (VECM) can be written as below:

$$\Delta \ln EXC_t = \theta_1 + \sum^a \Phi_1(i)\Delta \ln EXP_{t-i} + \sum^a \Omega_1(i)\Delta \ln IMP_{t-i} + \sum^a g_1(i)\Delta \ln EXC_{t-i} + \psi_1 E_{t-1} + e_{1t} \quad (1)$$

$$\Delta \ln EXP_t = \theta_2 + \sum^b \Phi_2(i)\Delta \ln EXC_{t-i} + \sum^b \Omega_2(i)\Delta \ln IMP_{t-i} + \sum^b g_2(i)\Delta \ln EXP_{t-i} + \psi_2 E_{t-1} + e_{2t} \quad (2)$$

$$\Delta \ln IMP_t = \theta_3 + \sum^c \Phi_3(i)\Delta \ln EXC_{t-i} + \sum^c \Omega_3(i)\Delta \ln EXP_{t-i} + \sum^c g_3(i)\Delta \ln IMP_{t-i} + \psi_3 E_{t-1} + e_{3t} \quad (3)$$

where Δ is the first-difference operator, *E* is the error correction term, θ, Φ, Ω, g, ψ are parameters to be estimated, and the terms *a, b, c,* are lag lengths. The coefficients of E_{t-1} capture the speed of adjustments of $\Delta \ln EXC_t$, $\Delta \ln EXP_t$, and $\Delta \ln IMP_t$ towards long-run equilibrium levels. Since E_{t-1} is derived from the long run cointegrating relationship, the error correction terms provide long run causal relationships in the equations.

In equations (1), (2) and (3), various types of Granger-causality relationships can be obtained. As Acaravcı and Ozturk (2012) discuss, these relationships can exhibit three different forms. Taking equation (1) as an illustration we can explain these three situations as following:

i) If $H_0:\Omega_1=0$ and $H_0:\Phi_1=0$ for all (i) are tested, then this shows short run or weak Granger causality relationship.

ii) If $H_0:\psi_1=0$ is tested, then this indicates presence of long run causality among the variables. If $\psi_1=0$, this means that EXC does not respond to the deviations from the long run equilibrium in the previous period.

iii) If $H_0:\Omega_1=\psi_1=0$ and $H_0:\Phi_1=\psi_1=0$ for all (i) are tested, then this gives strong Granger causality relationship among the variables.

The vector error correction model (VECM) estimation results obtained from Equations (1), (2), and (3) are given in Table 3. Some standard diagnostic tests, for structural change and regression specification, were conducted during the process of estimation.

Table 3: Results from the vector error correction model (VECM)

Regressors	Coefficients (Eq. 1)	Coefficients (Eq. 2)	Coefficients (Eq. 3)
E_{t-1}	-0.2423*	-0.2871**	-0.1203*
$\Delta lnEXC_{t-1}$	0.2161**	0.1796	-0.0156
$\Delta lnEXP_{t-1}$	-0.0297	-0.3902*	-0.0651*
$\Delta lnIMP_{t-1}$	0.0177	0.3940	0.5529*
$\Delta lnEXC_{t-2}$	-0.0190**	0.2163	-0.1337**
$\Delta lnEXP_{t-2}$	-0.0542***	-0.3521*	-0.0962*
$\Delta lnIMP_{t-2}$	0.0258**	0.1582	0.1172
$\Delta lnEXC_{t-3}$	0.1386***	0.7874***	-0.0550
$\Delta lnEXP_{t-3}$	-0.0445***	-0.0216	-0.0656*
$\Delta lnIMP_{t-3}$	-0.0991	-0.4610***	0.1162**
Constant	0.0031	0.0106	0.0033**
* = 1% ; ** = 5% *** = 10%	R^2 : 0.2818 DW:1.97	R^2 : 0.4948 DW: 2.05	R^2 : 0.4318 DW: 2.06

In estimating equations (1), (2), and (3), the use of three lags were best-fitting VEC regression specification. The results presented in Table 3 show that the estimated error correction terms in all three cases are significant and have negative signs indicating that the convergence to the equilibrium state is achieved in the long run. In the other words, each error correction term coefficient points out that a deviation from the long-run equilibrium value in one period is corrected within the next period by the size of that estimated coefficient. For the three equations, the estimated error corrections are around 24%, 29%, and 12% per period, month, respectively. These numbers indicate that, even though deviations occur in the short run, in the long run each variable returns back to its long-run equilibrium state. For example, exchange rates return back to their long-run equilibrium state within about four months, as the estimated error correction coefficient is 24%.

In general, as presented in Table 3, estimated results show that the short run relationships among the three variables theoretically meaningful and seem to provide Granger causality, though they are not tested for this purpose. Also, almost all short run effects occur within relatively short time, i.e., at most three months. The Wald-tests of the differenced independent variables provide possible presence of the short run causal relationship. However, as Masih and Masih (1996) describe, non-significance of the explanatory variables does not indicate a violation of the theory that explains various relationships among the variables, because theory does not primarily deal with the short term relationships. This paper also does not concern about or try to test the short run causality relationships.

Conclusion

In this study we have investigated the relationship between exchange rate volatility, exports and imports by applying cointegration and vector error correction model (VECM). Unit root test results show that these series were non-stationary in levels, but were stationary after differencing once. The cointegration test results reveal that exchange rates, exports and imports are cointegrated, implying that these variables cannot drift too far apart in the long run. The vector error correction model (VECM) estimates coming from Equations (1), (2) and (3) further indicate that most of the explanatory variables' estimated coefficients, showing short run dynamics, are statistically significant.

If we compare our findings with a few other studies conducted for Turkey, our results contradict with Altintas et. al. (2012)'s study as they find that nominal exchange rate volatility positively affects exports. Our results for Turkey support Vergil (2002) who also found that Turkish real exports tend to decrease when the real exchange rates increase.

In the long run, why exchange rates affect exports and imports is understandable and the theoretical explanations about the issue were discussed in Section 2. However, the effects of exports and imports on exchange rates need some closer consideration, as the estimated results show presence of such a relationship. For this, we need to focus on a country's current account balances, or, more specifically, on trade balance. A country's trade balance can be considered one of the important determinants of exchange rates. If a country's trade balance is greatly in deficit, then in international markets this will be viewed as a risk factor in terms of the debt balances and consequently the country's currency will depreciate. Trade surplus will cause an opposite effect on the country's value of currency.

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