Cointegration and Causality among Foreign Direct Investment in Tourism Sector, GDP, and Exchange Rate Volatility in Turkey

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Cointegration and Causality among Defense Expenditures, Economic Growth and Level of Exchange Rate in Turkey

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Abstract: This paper investigates cointegration and causality among exchange rate, military expenditures, and economic growth for Turkish economy. For this purpose, this study applied the Granger-causality (GC) and error correction (EC) techniques on 1974-2005 data for Turkey. The results show that military expenditures negatively affect economic growth, but this effect is not significant. This conclusion is meaningful for Turkey since she has problems with neighboring countries. Therefore, reducing military expenditures increase security problems. On the other hand, this study found bi-directional causality between level of exchange rate and economic growth (GDP).

Keywords: Defense expenditures, economic growth, exchange rate, cointegration, causality

1. Introduction

Military expenditures have an impact on economic growth, but the nature of this effect is uncertain. The ambiguity arises because some studies find military expenditures have positive effect, and some others find negative effect. At current state, therefore, we are unable to design and implement policy prescription. More studies are needed to clarify the issue further.

By exploring the existence of possible long-run relationship between military expenditures and economic growth in the case of Turkey, we endeavor to contribute to this literature. In addition to this, a relationship between level of exchange rate and GDP will also be studied. The paper is organized as follows: The next section reviews the previous literature; the section three outlines and describes the methodology and the data; section 4 demonstrates empirical findings, and the final section concludes.

2. Previous Literature

A line of argument finds positive relationships between military expenditures and economic growth, and explains the root causes behind the phenomenon. In his papers based on cross section data over 44 less-developed countries during the 1950-1965 period, Benoit (1973, 1978) argues that military expenditures positively affects economic growth because military spending may produce positive externalities on human capital formation through vocational training, which have a spillover effects on the entire economy. Ram (1986) states that growth can be influenced by the government by way of government's settling conflict between private and social interests, the government's prevention of foreign economic exploitation, and the encouragement of productive investment. Diamond (1990) also argues that defense expenditures may provide healthy investment environment by maintaining security and public order. However, Arora and Boyoumi (1994) emphasize the crowding-out effect of military expenditures. According to these authors reduction in military spending would offer significant long-term benefits for private investment and consumption, especially for developing countries.

A recent article supporting the view that increasing military burden accelerates economic growth has been written by Halıcıoğlu (2004). Halıcıoğlu presents new empirical evidence on the relationship between the level of economic growth and military expenditures in Turkey over the period of 1950-2002. Halıcıoğlu concludes that in the long-run there is a positive association between aggregate defense spending and aggregate output for Turkey.

Yildirim *at al.* (2005) empirically examines the effects of military expenditures on economic growth for Middle Eastern countries and Turkey over the period 1989-1999. Authors state that military expenditures may enhance economic growth through Keynesian aggregate demand effects. Yildirim *at al.* emphasize that if countries are experiencing unemployment, defense expenditures may have a stimulative effect on employment and production.

Another line argument demonstrates that government defense expenditures negatively affect economic growth. Russet (1969) was one of the early scholars who find negative relationship. Russet showed that for the U.S., Canada, England, and France, there is a significant negative impact of high defense spending on long term investment and economic growth. Russet pointed out that the defense burden deteriorates civilian consumption.

Ault and Hollenhorst (1971) modified and reexamined the Russet's (1969) analysis for the U.S. from 1939 to 1968. They claimed that Russet's investigation did not allow the detection of possible sub-period effects. According to these authors, when the World War II and Korean War periods are taken out from the entire period, a strong trade-off between high defense expenditures and other types of government spending such as government expenses on education and health can be found.

Deger and Smith (1983) analyzed the relationship in less developed countries using cross-sectional evidence within a macro statistical framework. They have found that military expenditure has a negative effect on economic growth and retards development.

Deger (1986) finds that when direct and indirect effects of military spending are considered in general, military spending will reduce growth rate and retard development. According to Deger, military establishments may have a modernizing role especially in less-developed countries, and they contribute a growth increase. But, this stimulating effect discontinues after a while. Deger compares the benefits and costs of the burden of military expenditures, and concludes that military expenditure does not increase growth rates in less-developed countries.

Mintz and Huang (1990) have endeavored to examine the timing and magnitude of potential defense spending cuts on economic growth in the United States over the period 1953-1987 by studying the direct effects and indirect impact of military spending on growth. Mintz and Huang have found that in the long-run lower military spending encourages economic growth. Scheetz (1991) considers the impact of military expenditures in Argentina, Chile, Paraguay, and Peru. Scheetz's conclusion supports the view that military expenditures negatively affect economic growth for all four countries.

Dunne *at al.* (2001) have empirically examined the hypothesis of a causal relationship between defense spending and economic growth in Greece and Turkey during the 1960-1996 periods by using standard pre-cointegration Granger causality techniques. Their results show that there is a positive association between a change in military burden and economic growth for Greece, but this result is not sustained when the cointegration between military burden and output is taken into account. The only evidence of significant Granger causality is in Turkey, in which a negative impact of military burden on growth has been found. Another variable examined in this paper is level of exchange rate (EX).

Previous studies have generally investigated the relationship between exchange rate volatility and trade volume but they have not reached an agreement among themselves. Therefore, the impact of exchange rate volatility on trade volume is ambiguous from a theoretical point of view (Sekmen, 2006). This paper will use level of exchange rate instead of exchange rate volatility and will analyze cointegration and causality among defense expenditures, GDP, and level of exchange rate for Turkey. This study will consider exchange rates since all payments for military equipments are made in terms of U.S. dollar (USD) or Euro. If domestic currency deteriorates against USD (or Euro), it has to pay more domestic currency to buy the same amount of foreign currency. Thus, the value of domestic currency against the USD or Euro which are the standard unit of currency in commodity markets across the globe determines country's payments for military expenditures.

3. Methodology and Data

The original cointegration regression is specified as follows:

$$Y_t = a_0 + a_1 X_t + e_t \tag{1}$$

Where Y_t represents the dependent variable, X_t stands for the independent variable, and e_t is the random error term. a_0 and a_1 are the intercept and slope coefficients, respectively. Since Turkish military expenditures are persistent, an intercept term is included as above. The time trend is not included here because a time stationary process is not known *a priori* (Perman 1991). In order to determine the nonstationarity property of the data, a univariate analysis of each of the three time series (military expenditures, real exchange rate, and real GDP) will be carried out by testing for the presence of a unit root. The Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) tests are used for this purpose.

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta y i + e_t \tag{2}$$

Where Δ is the first difference operator, n is the optimum number of lags on the dependent variable, and e is random error term. The null hypothesis for testing nonstationarity is $H_0 : \alpha_1 = 0$, meaning economic series are nonstationary. That is y_t is a random walk and it has a unit root. If the t-statistic associated with estimated coefficient, here α_1, is less than the critical values fort the test, the null hypothesis of no-cointegration cannot be rejected at 1 or 5 or 10 % level of significance.

As stated by Howard (2002) the potential presence of structural breaks makes the ADF test unreliable for testing stationary since structural breaks will tend to bias the ADF test towards non rejection-of the null hypothesis of a unit root. Perron (1989) suggests a test in order to investigate a stationarity in the presence of structural breaks. Therefore, this paper has used both Phillips-Perron test (PP) (Phillips and Perron, 1988) and the ADF test to examine the stationarity of the data, while other studies have used either ADF or PP test.

If defense expenditures (MEX) and economic growth (GDP) are cointegrated, this means that there is a long-term, or equilibrium, relationship between the two, then the question of which variable affects the other one must be important. Error correction (ECM) model and Granger-causality (GC) techniques is applied on 1974-2005 data to examine cointegration and causality among defense expenditures, economic growth, and exchange rate volatility.

According to Engle and Granger (1987), the ECM technique may take the following form:

$$\Delta GDP_t = \gamma_0 e_{t-1} \sum_{i=1}^{m} \gamma_1 \Delta GDP_{t-i} + \sum_{i=1}^{m} \Phi_i \Delta MEX_{t-i} + V_t \qquad (3)$$

where Δ denotes first difference operator, e_{t-1} is the error correction term, m is the number of lags to obtain white noise and V_t is another random disturbance term. If the coefficient of the error correction term is significantly different from zero[1], then, this will suggest that both series, GDP_t and MEX_t, exert a long-run relationship. As stated by Afzal (2006), if series are not cointegrated, the standard Granger bivariate causality test can be applied. One variable X is said to Granger cause another variable, Y, if Y is explained by using past values of Y. For example, MEX is said to Granger cause GDP, if GDP is explained by using past values of GDP. If it is believed that X causes Y, then it seems quite natural to expect that the regression:

$$Y = \alpha_0 + \sum \alpha_i Y_{t-i} + \sum \beta_i X_{t-i} + \mu_t \qquad (4)$$

$$X = \delta_0 + \sum \varphi X_{t-i} + \sum \delta_1 Y_{t-i} + e_t \qquad (5)$$

where X and Y are two different time series, for example GDP and military expenditures. μ_t and e_t are uncorrelated random errors. Causality can be found by testing the null

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[1] The absolute value of the error correction term is taken into account.

hypothesis H_0: $\beta_i = \delta_i = 0$. There is bi-directional causality if both β_i and δ_i are significant. X Granger causes Y if β_i is statistically significant but δ_i is not; and Y Granger causes X if δ_i is statically significant and β_i is not. This is called unidirectional causality.

In summary, we endeavor to examine cointegration and causality among defense expenditures, economic growth and level of exchange rate using Turkish data for 1974-2005 period published by Turkish Treasury and Turkish Central Bank. This study analyzes the cointegration and causality between level of exchange rate and defense expenditures, while other studies have just focused on defense expenditures and economic growth.[2]

4. Results and Discussions

4.1. Unit Root Tests

The results of the ADF and PP tests for stationary properties of the variables are presented in Table 1. It shows that the τ *(tau)* statistics for all the variables (ME, EXC, and GDP) are not significantly negative since they are positive and hence greater than the critical values at, respectively, 1%, 5%, and 10% levels from both ADF and PP tests, therefore, it is not possible to reject the null hypothesis of a unit root in the Turkish military expenditures, exchange rates, and GDP. However, the results of the first differenced variables indicate that the ADF test statistics for all the variables are significantly negative, therefore, the null hypothesis of unit root can be rejected in all variables at 1%, 5%, and 10% levels. The PP test statistics for all the variables are not significantly negative at 1%, 5%, and 10%. The PP test also shows that after differencing all the variables are stationary, meaning that all the variables are integrated of order I(1).

Table 1: **Results of the ADF and PP unit roots tests**

Variable	Augmented Dickey-Fuller test-(ADF)		Philips-Perron test (PP test)	
	Level form	First differences	Level form	First differences
ME	-2.0218	-5.9676	2.2731	-6.908
EXC	0.4171	-3.7915	0.4171	-3.8201
GDP	0.1039	-6.136	0.2461	-6.1241

Note: Critical values of 1, 5 and 10% level of significance are -3.66, -2.96 and -2.62 respectively for both ADF and PP tests.

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[2] The level of exchange rate is calculated as trade of one U.S dollar for Turkish Liras (TL), which has been changed as New Turkish Liras (YTL) after 2005.

4.2. Results of Johansen Cointegration Test

Johansen (1988) and Johansen and Juselius (1990) developed co integration methods in order to obtain long-run relationship among the series. According to Johansen cointegration test, non-stationary series, which are obtained from table 1, are tested whether these series reach to long-run equilibrium.

Table 2 shows Johansen cointegration test results. In the table 2, the null hypotehesis of $r = 0$, there is no one cointegrating vector, is tested against the alternative $r = 1$. For the test based on the trace statistic, it is 35.2 so that the null is rejected at 5% level, since the trace statistic is calculated as 44.55. In the case of maximum eigenvalue statistic, the critical value is 22.3 so that the null hypothesis cannot be rejected at the 5% level, since the maximum eigenvalue statistic is calculated as 21.2.

The next step is to test the null hypothesis of $r = 1$ against the alternative hypothesis of $r \geq 2$, meaning there might be two cointegrating vectors. In this case, the null is rejected using trace statistic (the 5% critical value is 20.3 while trace statistic is 23.4) but the maximum eigenvalue statistic (the 5% critical value is 15.9 while the calculated value is 15.4), and the null cannot be rejected using maximum eigen value statistic.

Another step is to test the null of $r = 2$ against the alternative of $r \geq 3$. Here, the null cannot be rejected using either the trace statistic (the five percent critical value is 9.2 while the calculated value is 7.96) or the maximum eigen value statistic (the 5% value is 9.2 while the calculated value is 7.96).

The normalized cointegrating vector is estimated as (including the constant term):

$$\hat{\beta} = (1 \quad 682.46 \quad \text{-0.00047} \quad \text{-5487.6})$$

The corresponding co integrating regression deduced from normalization which includes the constant term:

$$e_t = GDP_t + 682.46 MEX_t - 0.00047 EX_t - 5487.6 \tag{6}$$

Equation 6 can be written in the following format:

$$GDP_t = 5487.6 - 682.46 MEX_t + 0.00047 EX_t + e_t \tag{7}$$

Equation 7 is somewhat different from OLS estimation. The direct OLS estimation is

$$GDP_t = 3433 - 248.68MEX_t + 0.00049EX_t \qquad (8)$$

According to normalized cointegrating relationship, the coefficients of GDP variable is given by equation 8. All coefficients have expected sign; for instance, military expenditures are generally expected to cause GDP to decrease. Also, exchange rate is expected not to affect Turkish GDP and it is found that exchange rate insignificantly affect GDP.

Table 2: Johansen Cointegration Test Results - Sample: 1974-2005

H_0	H_1	Eigenvalue	Trace Statistic	5%	Eigenvalue	5%
$r=0$	$r=1$	0.507	44.55	35.193	21.202	22.3
$r=1$	$r \geq 2$	0.401	23.35	20.262	15.397	15.892
$r=2$	$r \geq 3$	0.233	7.96	9.165	7.956	9.165

Note: Trend Assumption: No deterministic trend.   Lags interval (in first differences): 1 to 1.

4.3. Results of the Error Correction Models

Table 3 presents the estimation of the ECM which contains three equations and each coefficient has an adjustment parameter. The adjustment coefficient associated with each variable must be different from zero. According to table 3, these adjustment parameters are different from zero; for example, the adjustment coefficient associated with the ΔGDP_t equation is negative (-0.17) and this negative sign means that there is a tendency toward short term fluctuations to equilibrium, but it is not significant (t-statistic=1.24), meaning "no cointegration" hypothesis cannot be rejected. However, the adjustment factor of ΔEX_t equation is different zero and it is also significant (t-statistic= 3.54). This is sufficient to reject any "no co integration" hypothesis.

Table 3: Error Correction Estimates

D(GDP)	D(MEX)	D(EX)
-0.17 (-1.24)	-0.000153 (-0.28)	463.69 (3.54)

Note: Figures in parentheses are t-statistics.

4.4. Results from the Granger Causality (GC) Test

The results of the GC test show that the null hypothesis of exchange rate volatility does not Granger cause GDP is rejected at 5% level. Also, the null hypothesis of GDP does not

Granger cause exchange rate is rejected. So it can be said that there is a bi-directional causality between GDP and exchange rate. However, the GC test shows that the Granger causality runs from exchange rate to military expenditures (the null hypothesis of exchange rate does not Granger cause military expenditure is rejected at the 5 % level).

Bidirectional causality between GDP and the EX supports the view that exchange rate volatility does not negatively affect Turkish trade volume, and so does GDP. Equation 8 represents that the coefficient of the EX is positive and this means that exchange rate volatility is regarded as an option and through exchange rate mechanism GDP will increase (when there is an increasing in the EX, it causes net exports to increase, and so does GDP).

The equation 8 shows that the coefficient of military expenditures (MEX) has a negative sign as expected. However, the result of the Granger causality test shows that the MEX is insignificant in affecting GDP. It is generally recognized that increasing military expenditures causes reduction in GDP, but the idea of reducing military expenditures increase GDP may not be true since reducing military expenditures needs some requirements, such as no terrorist threats and no any problem with neighbor countries.

Table 4: Granger Causality Test

Direction of Causality			F-Statistic	Probability
MEX	$\Rightarrow$	GDP	1.054	0.364
GDP	$\Rightarrow$	MEX	1.18	0.324
EX	$\Rightarrow$	GDP	2.11	0.143
GDP	$\Rightarrow$	EX	2.72	0.09
EX	$\Rightarrow$	MEX	2.41	0.11
MEX	$\Rightarrow$	EX	0.104	0.901

5. Summary and Conclusion

This paper examined cointegration and causality among defense expenditures, economic growth, and level of exchange rate. The results show that military expenditures negatively affect economic growth, but this effect is not significant. This conclusion can be interpreted as reducing military expenditures may increase security problems, which in turn reduce private investments and overall GDP. Therefore, military expenditures play an important role to have a good environment for investors increasing GDP.

An important conclusion of this study is that there is bi-directional causality between level of exchange rate and GDP for Turkish economy. As it is known, if GDP increases because of the increasing level of exchange rate, this means that investors do not take account of exchange rate risk, contrary to common idea, they consider other factors; for example, political stability and market structure.

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