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# Testing the relationship between military spending and private investments: Evidence from Turkey[1]

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**Abstract.** *This study aims to empirically test the relationship between military spending and private investments for the period 1975-2014. Throughout this aim, in order to test the stationarity of series and the co-integration relationship between them, unit root test of Carrioni-i-Silvestre et al. (2009) and co-integration test of Maki (2012) are used, respectively. Then, co-integration coefficients are estimated via Stock and Watson (1993)'s dynamic ordinary least squares (DOLS) method. Finally, causal relationships between the series are tested by Hacker and Hatemi-J (2012) bootstrap causality test. Empirical findings point out the positive relationship between military spending and private investment (crowding in effect) in long term. However, the results of the causality test indicate that there is no causality from military spending to private investments. This study is thought to make a contribution to the literature for being the first study analyzing the relationship between military spending and private investments in Turkey.*

**Keywords:** Military Spending, Investments, Carrion-i Silvestre Unit Root Test, Maki Cointegration, Bootstrap Granger Causality Test.

**JEL Classification:** C22, C32, E22, H56.

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## 1. Introduction

Military spending (*or* military budget), also known as a defense spending, is the amount of financial resources dedicated by a nation to raising and maintaining an armed forces or other methods essential for the defense purposes. The amount of military spending plays a very important role for the country in terms of continuing to exist, protect its power and unity. This amount may change depending on the countries' geopolitical, geographical, ethnical, economic and social structure, and political instability. Among a wide range of variables affecting the amount of military spending, war risk and state of war can be mentioned as the most influential ones. Some others are democracy level and political-regime type of the country. Any increase in political instability of a country triggers the rise of military spending. Besides, recent developments in weapon and defense industries have led countries worldwide to increase their military budgets.

After World War II, there was a state of political and military tension between powers in the Western Bloc (the United States of America, its NATO allies and others) and powers in the Eastern Bloc (the Soviet Union and its allies in the Warsaw Pact). This tension, known as the Cold War, lasted from about 1946 to 1991, beginning with the second Red Scare and ending with the August Coup that destabilized the Soviet Union and later contributed to its dissolution. Then, the post–Cold War era, that is the period from the dissolution of the Soviet Union in 1991 to the present, began. In this period, it is obviously seen that the United States of America become by far the most powerful country in the world and the rise of China from a relatively weak developing country to a fledgling superpower. After the Cold War's bipolarization, especially for the period 1980-2000, significant decreases were observed in the military spending, particularly in the Middle East and then South Asia, North Africa and the developing countries. This may be due to the financial limitations that forced governments to regulate their priorities of public expenditures (Looney, 1994: 17).

In the beginning of post-Cold War era, especially during the 1990s, similar to developing countries, USA also cut the defense budget. According to SIPRI (Stockholm International Peace Research Institute) Military Expenditure Database, military spending of USA began a decline, reaching below 6.0% in 1990, below 4.0% in 1996 and bottoming out at 3.5% of gross domestic product (GDP) in 2001, about half the level of 1985. But, the terrorist attack on the World Trade Center Complex in New York in 2001 (9/11 attacks) caused a substantial increase in USA military spending in two stages. In the 1$^{st}$ stage, it increased to 4.6% by 2005 for the invasion of Iraq, and then to 5.0% in 2008 for the "surge" in Iraq. Following, military spending increased further to 5.7 percent in 2011 with the stepped up effort in Afghanistan. Defense spending is expected to decline to 4.5 percent of GDP in 2015 and 3.8 percent GDP by 2020 in USA. For the period 2010-2014, SIPRI statistics show that USA is the world's biggest exporter of major arms, accounting for 31.0% of global shares.

The pattern of rise in military spending has largely continued in 2014, although spending in Latin America was essentially unchanged. Military spending in Central Europe has begun to rise again following the falls in previous years resulting from the global financial crisis that began in 2008. Africa, Asia, Eastern Europe and the Middle East

countries continued to see large increases. Among these countries; military spending of Saudi Arabia and Russia have increased by 17.0 and 8.1 percent respectively (Freeman et al., 2015: 2-6). In 2014, following USA, China has the most military spending in the world with its military budget of $216 billion. China's military spending has also led a rise in total military spending in the Asia-Pacific region.

Another cause of rise in military spending may be referred to the Arab Spring. The Arab Spring was a revolutionary wave of demonstrations and protests (both non-violent and violent), riots, and civil wars in the Arab world that began on 18 December 2010 in Tunisia with the Tunisian Revolution. It spread rapidly throughout the countries of the Arab League such as Libya, Yemen, Algeria, Bahrain, Jordan and Morocco. While the wave of initial revolutions and protests faded by mid-2012, some started to refer to the succeeding and still ongoing large-scale discourse conflicts in the Middle East and North Africa as the Arab Winter. The most radical discourse from Arab Spring into the still ongoing civil wars took place in Syria as early as the second half of 2011. Military spending in the Middle East amounted to $196 billion in 2014, an increase of 5.2% over 2013, and 57% since 2005. The largest increases since 2005 were by Iraq (286%), the United Arab Emirates (135%), Bahrain (126%) and Saudi Arabia (112%). Kuwait's military spending increased by 112% between 2005 and 2013.

According to SIPRI data of 2014, total amount of military spending in the world has increased by 13% in the last 10 years with a total of over $1,776 billion, representing 2.3% of global GDP or $245 per person.

**Table 1.** *World Military Spending (2015)*

| Region | Military Spending | Change (%) |
|---|---|---|
| Africa | 39.1 | +5.9 |
| North Africa | 18.4 | +7.6 |
| Sub-Saharan Africa | 20.7 | +4.8 |
| Americas | 689 | -5.7 |
| Central America and the Caribbean | 10.6 | +9.1 |
| North America | 613 | -6.4 |
| South America | 65.4 | -1.3 |
| Asia and Oceania | 450 | +5.0 |
| Central and South Asia | 67.8 | +2.0 |
| East Asia | 310 | +6.2 |
| Oceania | 30.4 | +6.9 |
| South East Asia | 42.2 | -0.4 |
| Europe | 397 | +0.6 |
| Eastern Europe | 101 | +8.4 |
| Western and Central Europe | 296.2 | -1.9 |
| Middle East | 185 | +5.2 |
| TOTAL | 1,760 | -0.4 |

**Source:** SIPRI Military Expenditure Database, 2015. Note: Figures are in $ b., at constant 2014 prices and exchange rates.

As one of the world's top 15 military spenders in 2013 and 2014, military spending and defense budget have always been a significant topic for Turkey. According to the data given in Table 2, it can be said that military spending has a tendency of decrease after year 2000. However, this decrease is somewhat fallacious. Diversification in GDP calculation method in Turkey may be the most important reason for this *unreal* proportional decrease in military spending. In real terms, it is obvious that the defense

budget is increasing every year in Turkey. According to SIPRI data, while the military spending of Turkey was $12.08 billion in 2005, it increased up to $17.13 billion in 2011 and $22.62 billion in 2014. Similarly, the amount of military spending per capita has increased from $158 to $298 in the last 15 years. Besides, of the total world military spending, Turkey's share is 1.3%. The underlying reasons of increase in total military spending may be related with the recent developments in the Middle East, the lunatic fringes showing up in the region after the developments in Syria and Iraq, the terrorist attacks carried in order to take the advantage of the political instability existing in the region recently by PKK terror organization.

**Table 2.** *Military Spending Indicators of Turkey*

| Indicator | 1995 | 2000 | 2005 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| Military Spending (% of GDP) | 3.9 | 3.7 | 2.5 | 2.4 | 2.2 | 2.3 | 2.2 | 2.2 |
| Military Spending (billion $) | 6.61 | 9.99 | 12.08 | 17.75 | 17.13 | 17.81 | 18.43 | 22.62 |
| Military Spending per Capita ($) | 113 | 158 | 178 | 246 | 234 | 241 | 246 | 298 |

**Source:** SIPRI Military Expenditure Database.

This study aims to shed light on the relationship between military spending and private investments in Turkey. Upon this aim, advanced econometric methods are performed to estimate the mentioned relationship on a sample of Turkey for the period 1975-2014. In the following sections of the study, theoretical background on the relationship between military spending and investments and the review of related literature are presented, respectively. Then model and data, and methodology and estimation results are given. Finally, in the Conclusion, findings of the study are discussed.

## 2. Theoretical Background of the Relationship between Military Spending and Investments

According to the Keynesian economic theory, government spending can be used to increase aggregate demand, thus increasing economic activity, reducing unemployment and deflation. Therefore, as related with the subject of this study, government's military spending can also be used to create positive effects on economic activities such as production (Şimşek, 2003: 7-8). The demand created by military spending increases capacity utilization, consequently maximizing the output level. As a result, investments and growth increase at the rate of capital gain (Looney, 1994). Therefore, according to this theory, it can be said that military spending has a crowd-in effect on private sector investments. The studies of Kaldor (1976) and Benoit (1978) are among the ones supporting Keynesian theory. However, military spending may sometimes affect private investments negatively. This is because of loan interest in cases where military spending is financed with loan. The negative effect of military spending on private investments is known as "crowding-out" effect (*see*, *for instance*, Smith (1980); Lim (1983) and Mintz and Huang (1990).

Military and defense spending may generate a number of positive externalities, such as human capital formation, technological spin-offs and security spillovers. In general, military technology is developed by scientists and engineers specifically for use in battles and many new technologies has come as a result of the military spending of science (Nadaroğlu, 1985: 184-185). For example, infrastructure of war technology created before and during the war has played a very essential role in the reconstruction of

Germany after World War II (Çınar, 2012: 27-30). Effects of military spending can also be observed in various manufacturing industries as a result of technologic feedbacks resulting from the production of developed arms (especially in the arms manufacturing countries) (Değer and Şen, 1995: 280).

Another positive effect of military spending is a safe environment for members of the society. In the developing countries such as Turkey, where majority of the private sector investments are directly financed through foreign capital investments, a safe environment encourages such investments, and therefore leads stronger economic growth. Finally, reductions in production may be observed in developed countries -especially in times of peace- due to effective demand shortages. In such periods military spending may boost the amount of production by encouraging economic activities (Eshay, 1983: 87).

In literature, there also exists a contrary view indicating that military spending has negative economic effects. The Classical school of thought argues that an increase in military spending is likely to retard economic growth. In this argument, higher military spending implies a lower level of private investment and domestic savings, and lower consumption due to lower aggregate demand. This can be specifically explained as follows. A higher level of military spending will lead to an increase in the interest rate, which will crowd out the private investment (Looney, 1994: 36). For instance, high interest rates of loans for military spending are considered among the main reasons for productivity slowdown in the US compared to Japan (Fontanel, 1995: 572).

In general, the military community are highly skilled. This may decrease the demand for human capital needed especially for the private sector. Moreover, the demand for high skilled labor in the area of defense may also decrease the marginal return of capital in other sectors (Peled, 2001: 11).

## 3. Literature Survey

There exists a vast literature on the effect of public expenditures on the private sector investments with mixed empirical findings. However, studies analyzing the relationship between the military spending and private investments are fewer with limited empirical findings.

Chester (1978) did not find any significant relationship between military spending and unemployment in his study in which he examined the effect of military spending on private sector investments in the United States. However, a positive relationship between military spending and economic growth has been found. Percebois (1986), analyzing the economic effects of military spending in France, has concluded that military spending has crowding-out effect on private sector investments. Another finding of the study was that the effect of military spending on economic growth was unclear and not significant.

Gold (1997) researched the effects of military spending on private sector investments for the period 1949-1988 in the United States. His findings indicated that there did not exist and trade-off between the total investment expenditures and military spending in the long term. However, for the period 1949-1971, the findings were different indicating that there was in a trade-off between military spending and investments. His empirical findings also

supported the crowding-out hypothesis, though he stated that military spending was in a trade-off with private consumption, rather than with private investments.

Saal (1998)'s study, consisting of the periods 1973-1979 and 1980-1986, concluded that manufacturing industries directly related to defence industry had higher total factor productivity, and the technological changes in the area of defence had important influences in the development of manufacturing industries in the United States. Scott (2001) tested defence-investment relationship in England by using 1974-1996 data. According to the results of the study, an increase in military spending leaded to a reduction in investment as a proportion of GDP. Furthermore, the results also showed that the crowding-out effect of investment by military expenditures was observed entirely in the private sector.

Smith and Dunne (2001) researched the inter-relationship between military spending, investments and growth through panel data models by using the data of 28 countries including Turkey. The countries included in the study are grouped in as OECD and other countries. While the first group is composed of 17 countries, the other group is composed of 9 countries. Findings indicated that in the period 1960-1997, no statistically significant relationship was found between military spending, investments and growth.

In another study, Şimşek (2003) examined the effects of different types of public expenditures such as military spending, public infrastructure expenditures, public consumption expenditures, general public services expenditures, and social security and welfare expenditures etc. on private sector investments. He found out that military spending, and social security and welfare expenditures in total had positive and significant effects on private sector investments. Ateşoğlu (2004) used a different model for the United States case in the period 1947-2001. He revealed that there existed a positive co-integration relationship between military spending and investments. Findings did not support a trade-off between military spending and private investments.

In a study analyzing the effects of military spending on private investments in France, different from other studies, Malizard (2014) divided military spending into two subgroups as equipment expenditures and non-equipment expenditures. He found out that while the non-equipment expenditures had crowding-out effect on private sector investments, the equipment investments has crowding-in effect on private sector investments.

Hou and Chen (2014) examined the effect of military spending on investments in 13 selected OECD countries over the period 1971-2012 by using different estimation methodologies including panel data, cross-section and time series estimation methods. Results of the study revealed that military spending had a crowding-out effect on investments.

## 4. Model and data

In order to examine the effect of military spending on private investment in Turkey, a function as follows is used:

$$lnPINV_t = \beta_0 + \beta_1 lnMS_t + \beta_2 lnINT_t + \varepsilon_t \quad (1)$$

In Equation 1; *lnPINV*, *lnMS and lnINT* denote natural logarithm of gross private sector fixed capital investment, natural logarithm of military spending and interest rate, respectively. Data of private sector fixed capital investment interest rate are obtained from Republic of Turkey Ministry of Development, and data of military spending is obtained from SIPRI Database. Military spending and private gross fixed capital data are computed in real terms, using GDP price deflator. The data covers the period 1975-2014.

## 5. Methodology and estimation results

### 5.1. Multiple Structural Breaks Unit Root Test of Carrion-i-Silvestre et al. (2009)

The multiple structural breaks unit root test developed by Carrioni-i-Silvestre et al. (2009) allows for the presence of multiple breaks affecting the individual effects and time trend under the endogenous structural break assumptions This test also offers improvements over commonly methods in even small samples, and is superior to other similar tests, especially about the total number (maximum up to five) of presence of multiple breaks. Carrioni-i-Silvestre et al. (2009)'s test is the extension of Kim and Perron (2009)'s test.

In their model, $y_t$ is the stochastic process generated according to:

$$y_t = d_t + u_t \tag{2}$$

$$u_t = \alpha u_{t-1} + v_t, \qquad t = 0, \dots, T \tag{3}$$

where $\{u_t\}$ is an unobserved mean-zero process.

Totally, five test statistics have been developed by Carrioni-i-Silvestre et al. (2009) as given below:

$$P_T^{GLS}(\lambda^0) = \{S(\overline{\alpha}, \lambda^0) - \overline{\alpha} S(1, \lambda^0)\}/s^2(\lambda^0) \tag{4}$$

$$MZ_\alpha^{GLS}(\lambda^0) = \left(T^{-1} - s(\lambda^0)^2\right)\left(2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1} \tag{5}$$

$$MSB^{GLS}(\lambda^0) = \left(s(\lambda^0)^{-2}T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{\frac{1}{2}} \tag{6}$$

$$MZ_t^{GLS}(\lambda^0) = \left(T^{-1}\tilde{y}_T^2 - s(\lambda^0)^2\right)\left(4s(\lambda^0)^2 T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-\frac{1}{2}} \tag{7}$$

with $\tilde{y}_t = y_t - \widehat{\Psi}' z_t(\lambda^0)$, where $\widehat{\Psi}$ minimizes the objective function.

Following Ng and Perron (2001), the fifth statistic in Carrioni-i-Silvestre et al. (2009) is a modified feasible point optimal test defined by:

$$MP_T^{GLS}(\lambda^0) = \frac{[c^{-2}T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2 + (1-\bar{c})T^{-1}\tilde{y}_T^2]}{s(\lambda^0)^2} \tag{8}$$

Asymptotic critical values are obtained by using the bootstrap. The null hypothesis of a unit root is rejected in case of calculated test statistics being smaller than critical values. Carrioni-i-Silvestre et al. (2009) unit root test results are given in Table 3.

**Table 3.** *Carrion-i-Silvestre et al. (2009) Unit Root Test Results*

| Variable | Critical Values | | | | | Break Dates |
|---|---|---|---|---|---|---|
| | $P_T^{GLS}$ | $MP_T^{GLS}$ | $MZ_\alpha^{GLS}$ | $MSB^{GLS}$ | $MZ_t^{GLS}$ | |
| *lnPINV* | 21.548 (8.869) | 21.288 (8.739) | -17.722 (-42.874) | 0.167 (0.107) | -2.966 (-4.618) | (1980;1997;2001;2005;2009 |
| *lnMS* | 23.166 (9.036) | 23.389 (9.036) | -18.598 (-47.397) | 0.163 (0.102) | -3.042 (-4.855) | (1978;1987;1993;1998;2003) |
| *lnINT* | 20.791 (8.706) | 21.410 (8.706) | -18.905 (-45.109) | 0.158 (0.104) | -2,993 (-4.746) | (1979;1983;1996;2004;2007) |
| *ΔlnPINV* | *5.110*** (5.543) | *5.010*** (5.543) | *-18.204*** (-18.325) | *0.165*** (0.168) | *-3.016*** (-2.896) | |
| *ΔlnMS* | *4.885*** (5.543) | *5.070*** (5.543) | *-17.981*** (-17.325) | *0.166*** (0.168) | *-2.997*** (-2.896) | |
| *ΔlnINT* | *5.057*** (5.543) | *5.064*** (5.543) | *-18.228*** (-17.325) | *0.165*** (0.168) | *-3.008*** (-2.896) | |

**Note:** Figures in parenthesis are critical values obtained by using the bootstrap at significance level of 5%. ** and *Δ* denote stationarity at significance level of 5%; and the first difference, respectively.

Accordingly, the test statistics for the first differences reject the null hypotheses and indicate that series are stationary in first differences. In other words, the series are integrated of order 1, [I(1)].

### 5.2. Maki (2012) Cointegration Test Under Multiple Structural Breaks

Co-integration tests suggested by Zivot and Andrews (1992), Gregory and Hansen (1996) and Westerlund and Edgerton (2007) allow only one structural break. However, Maki (2012) proposes a test performing better than its ancestors when the co-integration relationship has more than three (maximum up to five) breaks. Maki (2012) uses four different regression models in as given below:

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \beta' x_t + \mu_t \quad (9)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \beta' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + \mu_t \quad (10)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \beta' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + \mu_t \quad (11)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \sum_{i=1}^{k} \gamma_i t D_{i,t} + \beta_i' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + u_t \quad (12)$$

where $t = 1,2, \dots, T$. $y_t$ and $x_t = (x_t \dots x_{mt})'$ denote observable 1(1) variables, and $u_t$ is the equilibrium error. $y_t$ is a scalar and $x_t = (x_{1t}, \dots, x_{mt})'$ is an $(m \times 1)$ vector.

The asymptotic critical values of the tests for the maximum number of breaks (from 1 to 5) approximated by Monte Carlo simulations coded by GAUSS are given in Maki (2012).

The null hypothesis of non-existence of co-integration between series is rejected in case of calculated test statistics being smaller than these critical values. The results of multiple structural breaks co-integration test of Maki (2012) are given in Table 4.

**Table 4.** *Results of Maki (2012) Co-integration Tests*

| Models | Test Statistics | Critical Values* | | | Break Dates |
|---|---|---|---|---|---|
| | | 1% | 5% | 10% | |
| 0 | -5.228[a] | -6.075 | -5.550 | -5.297 | 1978;1983;1988;1991;2005 |
| 1 | -5.729[a] | -6.329 | -5.830 | -5.558 | 1978;1982;1987;1998;2008 |
| 2 | -6.711[a] | -7.470 | -6.872 | -6.563 | 1977;1981;1987;1990;2010 |
| 3 | -7.518[a] | -8.217 | -7.636 | -7.341 | 1982;1988;1992;2000;2005 |

**Note:** Critical values are obtained from Table 1 in Maki (2012). [a] denotes significance level of 10%.

According to the results, it can be claimed that there is a co-integration relationship between variables, and private investment converges to its long-run equilibrium by correcting any possible deviations from this equilibrium in the short run.

### 5.3. Estimation of Long-Term Coefficients

DOLS method of Stock and Watson (1993) is improved on ordinary least squares (OLS) and has some advantages such as coping with small sample and dynamic sources of bias. Using DOLS estimators requires existence of co-integration between dependent and explanatory series.

The DOLS estimator is obtained from the Equation (13):

$$y_t = \alpha_0 + \alpha_1 t + \alpha_2 x_t + \sum_{i=-q}^{q} \delta_i \Delta x_{t-i} + \varepsilon_t \qquad (13)$$

where q represents optimum leads and lags, and $\varepsilon_t$ error term, respectively.

The long-term coefficients that are estimated through the DOLS approach are denoted in Table 5.

**Table 5.** *DOLS Estimation Results*

| Variables | Coefficients | t-statistics | p value |
|---|---|---|---|
| lnMS | 1.474[a] | 1.380 | 0.000 |
| lnINT | -1.500[b] | 0.087 | 0.096 |
| D1 | -0.018 | 0.361 | 0.954 |
| D2 | -0.587 | 0.352 | 0.106 |
| D3 | -0.253 | 0.345 | 0.467 |
| D4 | -0.328 | -0.347 | 0.351 |
| D5 | 0.231 | 0.347 | 0.510 |
| Intercept | 7.595[a] | 0.465 | 0.000 |

Adj. $R^2$: 0.87; S. E. of reg.: 0.237; D-W test statistics: 1.013. [a] and [b] denote significance levels of 1% and 10%, respectively.

Dummy variables of breaking periods obtained from Maki (2012) co-integration test are included to the model to get long-term coefficient. As seen, the coefficient of military expenditure is positive and significance. In other words, military expenditure affects private investment positively.

Besides, the coefficient of the other independent variable of the model, the interest rate is statistically significant and negative as expected. It can be said that military spending in Turkey crowd in private sector investments in Turkey supporting Keynesian Theory.

However, the results of dummy variables representing the break dates of Maki (2012) test are not statistically significant.

### 5.4. Hacker and Hatemi-J (2012) Bootstrap Granger Causality Test

Co-integration analyses do not provide information on the direction of causality. So, to determine causal relationships between the series, the bootstrap causality test of Hacker and Hatemi-J (2012) is used in this study.

In the context of Granger causality, Hacker and Hatemi-J (2012) consider the vector autoregressive model of order$k$, $VAR(k)$;

$$\gamma_t = \beta_0 + \beta_1 \gamma_{t-1} + \cdots + \beta_k \gamma_{t-k} + \mu_t \qquad (14)$$

where $\gamma_t$, $\beta_0$ and $\mu_t$ are vectors with dimensions $n \times 1$ and $\beta_i, i \geq 1$ is a parameter matrix with $n \times n$ dimensions. The error vector, $\mu_t$, has a zero-expected value, assumed to be independent and identically distributed with a non-singular covariance matrix $\Omega$.

Hatemi-J Information Criterion (*HJC*) is as given below:

$$HJC = ln\left(\det\widehat{\Omega}_k\right) + k\left(\frac{n^2 lnT + 2n^2 \ln(lnT)}{2T}\right) \qquad k = 0, \ldots, K \qquad (15)$$

where $ln$ is the natural logarithm; $\det\widehat{\Omega}_k$ is the determinant of the estimated variance-covariance matrix of the residuals in the $VAR(k)$ model for lag order $k$; $n$ and $T$ are the number of variables and the sample size (number of observations), respectively.

In case of variables being integrated, standard asymptotical distributions cannot be used to test for restrictions in the $VAR$ model. To overcome this problem, Toda and Yamamoto (1995) uses an augmented $VAR(k+d)$ model, where $d$ denotes integration order of variables. This model can be written compactly as below:

$$Y = DZ + \delta \qquad (16)$$

To test the null hypothesis of non-Granger causality, the modified Wald (*MWALD*) test statistic is used. This test is as:

$$MWALD = \left(Q\hat{\beta}\right)' \left[Q\left(\left(Z'Z\right)^{-1} \Theta \Omega_U\right) Q'\right]^{-1} \left(Q\hat{\beta}\right) \sim \chi_k^2 \qquad (17)$$

where $Q$ is an $k \times n\left(1 + n(k+d)\right)$ indicator matrix used to identify restrictions implied by the null hypothesis; and $\Theta$ is the element by all element matrix multiplication operator (the Kronecker product). The null hypothesis non-Granger causality is rejected in case of calculated Wald statistic being higher than the bootstrap critical value.

**Table 6.** *Bootstrap Causality Test of Hacker and Hatemi-J (2012)*

| | | Critical Values* | | |
|---|---|---|---|---|
| The Null Hypothesis | MWALD Statistics | 1% | 5% | 10% |
| lnPINV → lnMS | 1.70 | 7.72 | 4.23 | 2.94 |
| lnMS → lnPINV | 1.45 | 8.11 | 4.37 | 3.19 |
| lnMS → lnINT | 0.48 | 7.79 | 4.33 | 2.96 |
| lnINT → lnMS | 0.53 | 7.77 | 4.34 | 2.94 |
| lnPINV → lnINT | 0.84 | 7.65 | 4.37 | 2.96 |
| lnINT → lnPINV | 5.08** | 8.09 | 4.44 | 3.03 |

**Note:** ** denotes significance level of 10%. *Critical values are calculated based on 10,000 replicates.

The outcome from Hacker and Hatemi-J (2012) bootstrap Granger causality test is illustrated in Table 6. According to the results of the test, there exists one-way causality only from interest rates to private investments in Turkey. However, there does not exist any causal relationship between military spending and private investments.

## 6. Conclusion

The proportion of military spending in national budget is gradually increasing as a result of recent developments threatening Turkey's security. This increase may also have tendency to affect the other dynamics of Turkish economy. The importance of this study is related with this fact. Also, any study analyzing the relationship between military spending and private investments in Turkey has not been done yet. So, this study also attempts to fill this gap.

In this study, the relationship between military spending and private investments in Turkey is analyzed. The analysis begins with employing the Carrion-I Silvestre et al. (2009) unit root test with multi structural breaks, and co-integration test of Maki (2012). Then, DOLS estimation method is used to find out the long-term coefficients, and finally Hacker and Hatemi-J (2010) bootstrap Granger causality test is performed. DOLS estimator shows that military spending is positively related to private investments. Though there exists no causal relationship between these variables, there is a causal relationship between interest rate and private expenditure according to Granger causality test.

In accordance with the findings of the DOLS estimator, this study concludes that military spending affects private investments positively in Turkey. Thus, it is possible to mention that military spending in Turkey crowds in private investments in Turkey. New technologies, especially emerging from research and development activities in defense industry will quickly disperse and affect other industries.

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