A CAUSAL ANALYSIS OF TURKISH DEFENCE-GROWTH RELATIONSHIPS

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Türk Savunma-Büyüme İlişkisinin Nedensellik Analizi

Özet

Bu çalışmanın amacı Türkiye'nin savunma harcamaları ve ekonomik büyüme arasındaki nedensellik ilişkisini araştırmaktır. Bu çalışma 1924-1994 yılları kapsayacak şekilde Granger causality testi kullanılarak yapılmıştır. Bulunan sonuçlar göstermektedir ki, Türkiye'nin savunma harcamaları ile ekonomik büyümesi arasında bir ilişki vardır ve ilişki savunma harcamalarının ekonomik büyümeyi etkilemesi şeklindedir.

Abstract

The purpose of this paper is to investigate the causal relationships between defence expenditure and economic growth in the case of Turkey. The study employs the Granger causality test using annual time series data for the period 1924-1994. The results indicate that the relation between defence spending and economic growth does exist, and the direction of causality is running from defence spending to economic growth.

A Causal Analysis of Turkish Defence-Growth Relationships

1. INTRODUCTION

The aim of this paper is to analyse the presence and direction of causality between Turkish defence spending and economic growth over the period 1924-1994. Turkish defence expenditure has been around 4.8% of GNP (gross domestic product) over the last four decades and an average of 21.7% of central government budget outlay goes to defence spending. Turkey consistently allocates substantially high budgets to its defence sector compared with other NATO (North Atlantic Treaty Organisation) countries (SEZGİN, 1997).

It is mostly assumed that defence spending is causally prior to economic growth. Studies of the defence-growth relationships also assume that defence spending is an exogenous variable relative to economic growth. However, the literature in this area has shown that this relationship is not certain (JOERDING, 1986; CHOWDHURY, 1991; KUSI, 1994). Turkey provides a particularly useful case study for investigation of the causal relationship between defence spending and economic growth because of its high defence burden and considerably higher economic growth.

The remainder of this paper is organised as follows. Previous empirical evidence is critically analysed in section 2. The methodology is explained in section 3 and section 4 provides the empirical test results and their implications. Finally, the conclusions are presented in section 5.

2. PREVIOUS EMPIRICAL EVIDENCE

This section provides a brief review of the defence growth literature which has used Granger causality tests to analyse defence-growth relationships and exogenity of these two variables. An earlier study by Jeording (1986) analysed exogenity of defence and growth variables with a sample of 57 LDCs

(less developed countries) and concluded that defence spending is not strong exogenous variable relative to economic growth. Chowdhury (1991) applied this procedure to a sample of 55 LDCs. His test results showed a lack of consistency across different countries. While there were no causal relationships for 30 countries, a causal relationship was evident for the remaining 25 countries. These 25 countries had relatively high defence burdens and many of them had experienced a war or conflict during the term[1]. However, in no case was it found that defence spending helps economic growth (CHOWDHURY, 1991). Although Kusi (1994) found no causal relationships for 62 countries out of 77, the remaining 15 countries showed a causal relationships. In seven countries, defence spending Granger causes economic growth. However, in contrast to Chowdhury (1991), in no case was it found that defence spending helps economic growth. These 15 countries had similarities with those discussed by Chowdhury. They had high defence burdens and had experienced war[2]. Furthermore, Frederikson's (1991) study of the causal relationship between defence spending and economic growth showed a feedback relationship. This implies that neither economic growth nor defence spending can be considered exogenous.

On the other hand, in recent years, other studies have used a single country rather than bulk to analyse defence-growth relationships by the Granger causality test. Chen (1993), using Chinese data between 1950-1991, Madden and Haslehurst (1995), using Australian quarterly data between 1959-3 and 1993-2 and Kollias and Makrydakis, (1997) using Turkish data between 1954 and 1993, found no causal relationship between defence expenditure and economic growth for these countries. In contrast to the above three studies, Assery (1996) found that defence spending by the Granger test caused economic growth for Iraq between 1950 and 1980.

The results so far suggests that exogenity of the defence variable is not a clear issue. The Granger causality test should be analysed with caution, because the test is very sensitive to the sample period, number of observations, data frequency, lag length choice, structural changes over the period, stationary of variables and cointegration across the variables (RAM, 1995).

1 Causal relationships of 25 countries in Chowdhury (1991), which showed that defence spending causes economic growth: Argentina, Iran, Israel, Jordan, South Korea, Panama, Paraguay, Peru, Philippines, Sudan, Syria, Tanzania, Thailand, Uruguay, Venezuela. Those showing that economic growth causes defence spending were: Chilli, Ghana, Haiti, Libya, Saudi Arabia, Tunisia, Uganda. Feedback: Kenya, Indonesia, Egypt.

2 Causal relationships of 15 countries in Kusi (1994) which showed that defence spending causes economic growth: Pakistan, Indonesia, Malaysia, Malawi, Brazil. Those showing that economic growth causes defence spending: Israel, Jordan, Oman, Saudi Arabia, Bangladesh, Burundi, Congo. Feedback: Kuwait.

3. THE METHODOLOGY

A question that frequently arises in time series analysis is whether or not economic variables can help to forecast another economic variable. For instance, does defence spending cause economic growth. This question was proposed by Granger (1969). Testing causality in the Granger sense involves using F tests to test whether lagged information on available Y provides any statistically significant information about variable X in the presence of lagged X. If not, then ĀY does not Granger cause X@.

The procedure assumes a long-run relationship between the series. The test for Granger causality consists of the equations:

$$X_t = a_0 + \sum_{i=1}^{m} b_i X_{t-i} + \sum_{j=1}^{n} c_j Y_{t-j} + u_t \qquad (1)$$

where u_t is a serially independent random vector with mean zero and finite covariance matrix.

The testing of the Granger causality requires that the data series must be stationary. Models containing non-stationary variables will often lead to a problem of spurious regression (Engle and Granger, 1987). To test stationary of the variables, unit root tests are commonly used as developed by Dickey and Fuller (1979). If the data series contains a non-stationary variable, it should be differenced to result in a stationary series. In this study, the following augmented Dickey Fuller (ADF) regression is employed to test the unit root hypothesis:

$$\Delta X_t = \alpha_0 + TIME + a_2 X_{t-1} + a_3 \sum_{i=1}^{k} \Delta X_{t-1} + \varepsilon \qquad (2)$$

where X_t stands for economic growth or defence spending variables.

Granger causality tests are very sensitive to choice of lag length. Therefore, choice of lag length needs careful attention. This study uses Akaike's final prediction error (FPE) to determine appropriate lag length.

4. EMPIRICAL RESULTS

In this part, the causal relationship between Turkish defence spending and economic growth is tested. The trend of the Turkish defence burden and economic growth is shown in Figure 1 and Appendix Table A1. It can be seen from the figure that the Turkish defence burden has large fluctuations,

especially in the early years of the republic era, while economic growth is relatively stable.

In the light of recent developments in time series econometrics, stationary of variables must be tested. Table 2 reports the ADF test results for the level as well as for the first differences variables. As can be seen from the Table, the calculated ADF statistic is less than its critical value for economic growth. This means the series is said to be stationary or integrated order zero (i.e. I (0)). On the other hand, the defence spending variable seems non-stationary and it became stationary after differencing once.

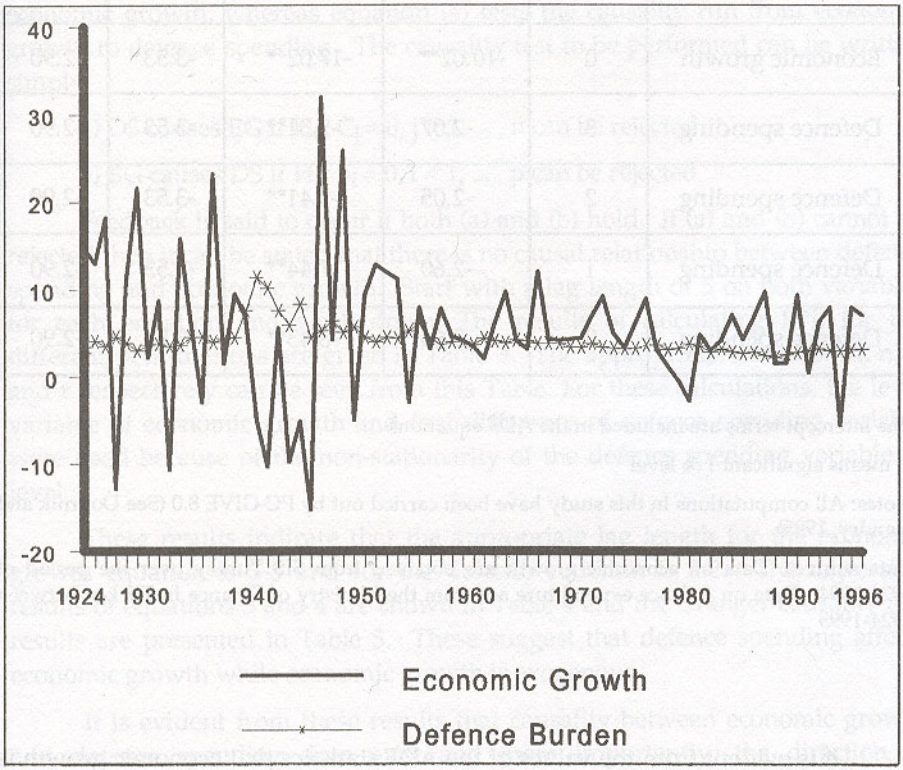

Table 1. ADF Tests for Unit Roots.

Variabes	Lag	Test statistic		Critical values	
		Level	First difference	1 %	5 %
Economic growth	3	-3.97**	-7.55**	-3.53	-2.90
Economic growth	2	-4.59**	-7.93**	-3.53	-2.90
Economic growth	1	-5.49**	-9.75**	-3.53	-2.90
Economic growth	0	-10.02**	-17.02**	-3.53	-2.90
Defence spending	3	-2.07	-5.31**	-3.53	-2.90
Defence spending	2	-2.05	-5.41**	-3.53	-2.90
Defence spending	1	-2.60	-7.44**	-3.53	-2.90
Defence spending	0	-2.64	-8.43**	-3.53	-2.90

The intercept terms are included in the ADF equations

** means significant 1 % level

Notes: All computations in this study have been carried out by PC-GIVE 8.0 (See Doornik and Hendry, 1995)

Data sources: Data on economic growth are obtained from SIS Turkey over the period of 1924-1994. Data on defence expenditure are from the Ministry of Finance in Turkey between 1924-1995

It is evident from the values of the ADF statistics that economic growth is I (0) and defence spending is I (1). The variables are not in the same order of integration, therefore, cointegrating regression is not applicable. It means that the economic growth and defence spending time series do not cointegrate. Although the economic growth and the defence spending variables do not cointegrate, the Granger causality test can still be applied on the variables.

The procedure assumes a long-run relationship between the series. The test for Granger causality consists of the equations:

$$EG_t = a_0 + \sum_{i=1}^{m} b_i EG_{t-i} + \sum_{j=1}^{n} c_j DS_{t-j} + u_t \quad (3)$$

$$DS_t = \alpha_0 + \sum_{i=1}^{p} \beta_i EG_{t-i} + \sum_{j=1}^{r} \gamma_j DS_{t-j} + \varepsilon_t \quad (4)$$

where u_t and ε_t are a serially independent random vector with mean zero and finite covariance matrix. EG refers to economic growth and DS to defence spending.

Equation (3) is used to test causality runs from defence spending to economic growth, whereas equation (4) tests the causality run from economic growth to defence spending. The causality test to be performed can be written simply:

a) DS causes EG if H_0: $C_j = 0, j = 1, \ldots, n$ can be rejected

a) EG causes DS if H_0: $\beta_i = 0, i = 1, \ldots, p$ can be rejected

Feedback is said to occur if both (a) and (b) hold. If (a) and (b) cannot be rejected then it can be stated that there is no causal relationship between defence spending and economic growth. Start with a lag length of 5 on both variables for each equation and work down. The results of calculating FPE for the different permutations are given in Table 3. The appropriate values of m, n, p and r respectively can be seen from this Table. For these calculations, the level variable of economic growth and first difference of defence spending variable were used because of the non-stationarity of the defence spending variable in level

These results indicate that the appropriate lag length for the economic growth equation is 5-5 and for the defence equation is 2-2. The regression results of equations 3 and 4 are shown in Table 4 and the Granger causality test results are presented in Table 5. These suggest that defence spending affects economic growth while economic growth is exogenous.

It is evident from these results that causality between economic growth and defence spending does exist and more importantly, the direction of causality running from defence spending to economic growth cannot be rejected at the 1% level of significance. These results, coupled with the existence of a long-run relationship between economic growth and defence spending, confirm that economic growth over the period of estimation was dependent on defence spending.

Table 2 Akaike Information Criterion.

Dependent variable economic growth (EG)			Dependent variable defence spending (DS)		
ΔEG_{t-i}	ΔDS_{t-i}	FPE	ΔEG_{t-i}	ΔDS_{t-i}	FPE
5	5	43.81	5	5	1.39
5	4	63.50	5	4	1.35
5	3	63.05	5	3	1.31
5	2	67.57	5	2	1.27
4	5	44.40	4	5	1.35
4	4	64.47	4	4	1.29
4	3	63.16	4	3	1.25
4	2	69.49	4	2	1.21
3	5	54.56	3	5	1.33
3	4	72.55	3	4	1.29
3	3	70.21	3	3	1.24
3	2	73.84	3	2	1.20
2	5	56.00	2	5	1.29
2	4	75.70	2	4	1.25
2	3	73.52	2	3	1.20
2	2	88.17	2	2	1.17

Notes: All computations in this study have been carried out by PC-GIVE 8.0 (See Doornik and Hendry, 1995).

Table 3. Regression Results of Equations (3) and (4).

Explantory Variables	Dependent Variable	
	ΔEG_t	ΔDS_t
Constant	-0.602 (-0.79)	-0.004 (-0.03)
ΔEG_{t-1}	-0.99 (-9.03)	0.014 (1.03)
ΔEG_{t-2}	-0.71 (-5.02)	0.013 (0.99)
ΔEG_{t-3}	-0.61 (-4.42)	-
ΔEG_{t-4}	-0.50 (-3.76)	-
ΔEG_{t-5}	-0.15 (-1.57)	-
ΔDS_{t-1}	-4.23 (-5.57)	-0.064 (-1.07)
ΔDS_{t-2}	0.19 (0.22)	-0.16 (-1.24)
ΔDS_{t-3}	-3.62 (-4.22)	-
ΔDS_{t-4}	-1.69 (-1.97)	-
ΔDS_{t-5}	-4.26 (-5.17)	-
R^2	0.78	0.07
DW	1.89	1.98

Notes: Numbers in brackets are t-ratios: DW is Durbin-Watson statistics. Notes: All computations in this study have been carried out by PC-GIVE 8.0 (See Doornik and Hendry, 1995).

Table 4. Granger Causality Tests (1924-1994)

Null hypothesis	F statistics
$\sum_{i=1}^{5} b_j = 0$ Defence causes economic growth	F (5, 54) = 11.672 probability: 0.0000
$\sum_{i=1}^{2} \gamma_i = 0$ Economic growth causes defence	F (2, 63) = 0.61028 probability: 0.5464

Notes: All computations in this study have been carried out by PC-GIVE 8.0 (See Doornik and Hendry, 1995).

5. CONCLUSION

This paper has analysed the causal relationships between Turkish defence spending and economic growth over the period 1924-1996. The analysis demonstrates that Turkish defence spending Granger causes economic growth, while economic growth does not Granger causes defence spending. It suggests that there is bidirectional causality between the two variables and it makes the defence variable exogenous while the economic growth variable seems endogenous.

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Appendix: Table A1. Turkey's Economic Growth and Defence Burden (1924-1994)

Year	Economic Growth %	Defence Burden %	Year	Economic Growth %	Defence Burden %	Year	Economic Growth %	Defence Burden %
1924	14.8	2.7	1948	25.8	5.1	1972	9.2	3.4
1925	12.9	4.1	1949	-5.0	5.7	1973	4.9	3.3
1926	18.2	3.5	1950	9.4	4.5	1974	3.3	3.2
1927	-12.8	4.6	1951	12.8	4.0	1975	6.1	3.3
1928	11.0	3.9	1952	11.9	4.5	1976	9.0	3.6
1929	21.6	3.0	1953	11.2	4.4	1977	3.0	3.7
1930	2.2	3.7	1954	-3.0	5.2	1978	1.2	3.1
1931	8.7	3.8	1955	7.9	6.1	1979	-0.5	3.3
1932	-10.7	3.5	1956	3.2	4.4	1980	-2.8	3.8
1933	15.8	3.7	1957	7.8	3.6	1981	4.8	3.5
1934	6.0	4.6	1958	4.5	4.0	1982	3.1	2.8
1935	-3.0	4.6	1959	4.1	4.0	1983	4.2	3.2
1936	23.2	4.0	1960	3.4	3.7	1984	7.1	2.9
1937	1.5	4.4	1961	2.0	4.4	1985	4.3	2.7
1938	9.5	4.5	1962	6.2	4.1	1986	6.8	2.8
1939	6.9	7.6	1963	9.7	3.9	1987	9.8	2.5
1940	-4.9	11.4	1964	4.1	4.2	1988	1.5	2.2
1941	-10.3	10.2	1965	3.1	4.1	1989	1.6	2.6
1942	5.6	7.6	1966	12.0	3.8	1990	9.4	2.8
1943	-9.8	5.9	1967	4.2	3.8	1991	0.4	3.0
1944	-5.1	8.3	1968	4.1	3.8	1992	6.4	3.3
1945	-15.3	4.5	1969	4.3	3.4	1993	8.0	3.0
1946	31.9	5.3	1970	4.4	3.4	1994	-5.5	3.0
1947	4.2	6.4	1971	7.0	3.8			

Sources: SIS Turkey (1994; 1996), Ministry of Finance (1993; 1995)