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Defense spending and economic growth in Turkey: an empirical application of new macroeconomic theory

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This study presents new empirical evidence on the relationship between the level of economic growth and defense expenditures in the case of Turkey for the period of 1950–2002. On using new macroeconomic theory and multivariate cointegration procedure, this study demonstrates empirically that there exists a positive long-run relationship between aggregate defense spending and aggregate output in Turkey. In addition, the CUSUM and CUSUMSQ tests confirm the stability of the aggregate output function. The results obtained from this study are, by and large, in line with the previous studies concerning Turkey.

Keywords: aggregate defense spending; aggregate output; cointegration; stability tests; Turkey
JEL Classification: E69, E60, H50

1. Introduction

The relationship between military expenditure and economic growth has frequently been explored empirically in the defense economics literature since the seminal empirical research of Benoit (1973, 1978), which suggested that military spending had a positive impact on economic development. The results of Benoit's *ad hoc* studies are derived from the existence of a series of spin-offs, spill-overs and positive externalities which led to a significant number of empirical studies.

There are broadly two strands of empirical research into this topic in the defense literature. The first group uses single regression equations in order to test the impact of military expenditure on growth via Neoclassical or Keynesian approaches. The Neoclassical single supply-side model of growth and defense is based on the work of Feder (1982), Ram (1986) and Biswas and Ram (1986), which is referred to as the Feder–Ram model. The Keynesian single demand-side models are derived from the Keynesian representation of aggregate demand and are based on the initial work of Smith (1980).

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The second group consists of simultaneous equation models which incorporate the demand and supply sides to measure the impact of the military expenditure on growth and is based on the work of Deger and Smith (1983) and Deger (1986) and is known, by and large, as the Deger type model. It appears, however, that no clear agreement has emerged about the nature and extent of the growth effects of military expenditure from these empirical studies. For example, using the Feder–Ram models, Ram (1986), Atesoglu and Mueller (1990) and Ward *et al.* (1991) found a positive impact, while Biswas and Ram (1986), Alexander (1990) and Huang and Mintz (1991) concluded that there exists no relationship at all. With regard to the single demand-side equations, Smith (1980), Faini *et al.* (1984) and Rasler and Thomson (1988) showed a negative impact of military spending on growth. Finally, apart from a few countries, evidence from most of the simultaneous equation models indicates a negative impact of military expenditures on economic growth (Deger, 1986; Antonakis, 1997).

There are a few empirical studies relating to the defense expenditure and economic growth in the case of Turkey. The findings, however, are mixed. Sezgin (1997), employing a Feder–Ram model, found a positive effect, while a later study by Ozsoy (2000), using the same method, found no impact. These findings, however, are considered to be dubious by Brauer (2002), following the critique of Sandler and Hartley (1995, pp. 206–209) which states that the Feder-Ram type model is inherently structured to find a positive impact of military expenditure on economic growth. Moreover, using the Granger–Causality analysis, Sezgin (2000) showed that there exists a negative impact of military expenditure on economic growth. Sezgin (1999, 2001), on the other hand, using a Deger type model showed a positive effect of military expenditures on growth in Turkey. Yildirim and Sezgin (2002) also showed a positive impact of military expenditures on economic growth by using *a non-theoretical* VAR model, which included real income, real savings, real military expenditure, labor force, and real balance of trade variables.

More importantly, the findings of previous studies were limited to fiscal policies, ignoring the impact of monetary policy. To this end, Atesoglu (2002) differed from previous empirical studies by employing the new macroeconomic model of Romer (2000) and Taylor (2000) to measure the impact of military spending on economic growth. The new macroeconomic model replaces the standard IS-LM and AD-AS models and it also provides a more detailed account of fiscal and monetary policies on the national income.

This study adopts the approach of Atesoglu (2002) and analyzes the effect of military expenditure on Turkey's growth levels. This study departs from the previous studies concerning the impact of defense expenditures on Turkey's growth levels as follows: first, it utilizes the new macroeconomic theory along with the multivariate cointegration technique of Johansen (1991) that is found to be superior to other cointegration techniques as proposed by Gonzalo (1994); secondly, the stability of the estimated model is tested via CUSUM and CUSUMSQ tests so that it can be evaluated for an effective policy analysis.

This paper is designed as follows: section 2 introduces the new macroeconomic model that provides the new rationale of estimating the relationship between the defense sector and growth. Section 3 presents the empirical results with their economic implications. Finally, section 4 is devoted to the concluding remarks.

2. A brief outline of the new macroeconomic model with defense expenditure

Atesoglu (2002, pp. 56–57) outlined a simpler version of the new macroeconomic model of Romer (2000) and Taylor (2000) with an extension for defense expenditure. The empirical equation is derived from the augmented Keynesian cross model that also includes defense expenditures as a separate variable:

$$Y_t = C_t + I_t + X_t + GE_t + ME_t \tag{1}$$

where Y_t is real aggregate output, C_t is real consumption, I_t is real investment, X_t is real net exports, GE_t is real non-defense government expenditures and ME_t is real defense expenditures. Then the right-hand side variables in equation (1) are determined by:

$$C_t = a + b(Y_t - T_t) \tag{2}$$

$$T_t = c + dY_t \tag{3}$$

$$I_t = e - fR_t \tag{4}$$

$$X_t = g - hY_t - iR_t \tag{5}$$

where T_t is real taxes, R_t is real interest rate and a, b, c, d, e, f, g, h are positive parameters.

This paper also adopts the same approach of Atesoglu (2002) in treating R_t as an exogenous variable. Solving equations (1–5) for a reduced form of Y_t, the resulting equation augmented with a stochastic disturbance term (u_t) is:

$$Y_t = a_1 + a_2GE_t + a_3ME_t + a_4R_t + u_t \tag{6}$$

where $a_1 = [(a - bc + e + g)/(1 - b(1 - d) + h)]$, $a_2 = a_3 = 1/[(1 - b(1 - d) + h)]$, $a_4 = -(f + i)/[(1 - b(1 - d) + h)]$ and $a_2, a_3 > 0, a_4 < 0$.

Equation (6) is a reduced form of the new macroeconomic model in which the military and government expenditure and real interest rates form the determinants of output.

3. Empirical results

Traditional econometric techniques using time-series data implicitly assume that the data used in estimation are stationary. If stationarity is violated, this could lead to spurious results. In analyzing the time-series data properties, the Augmented Dickey–Fuller (ADF) (Dickey and Fuller, 1979, 1981) unit root test is most commonly applied. Pesaran and Pesaran (1997) argued that the ADF unit root testing procedure is not very powerful in finite samples. Therefore, the Phillips–Peron (PP) (Phillips and Peron, 1988) unit root test is used as one alternative. Cointegration analysis, on the other hand, provides an estimation of the relationship between the variables. The pioneering cointegrating study of Engle and Granger (1987), which is based on only a single long-run relationship between the variables, was developed further and extended into the multivariate cointegration technique by Johansen (1988, 1991) and Johansen and Juselius (1992).

All the series in equation (6), apart from the real interest rate, are evaluated in logarithmic form. Full definitions and sources of the time series of this study are included in Appendix A. The ADF and PP unit root tests for the variables are implemented and table 1 displays the results. All the series in equation (6) appear to contain a unit root in their levels, indicating that they are integrated at order one and, thus, that they are difference stationary.

Next, the Johansen–Juselius cointegration technique is applied. The results of the eigenvalue and trace statistics to identify the number of cointegrating vectors are reported for equation (6) and summarized in table 2, panel A. Eigenvalue and trace test statistics suggest one possible long-run relationship at the 95% level of significance in the VAR under consideration. The estimate of this vector is normalized on LRY by setting its coefficient at −1. It is clear that all variables are significant and carry their expected signs.

According to the results revealed in table 2, panel B, there is a positive long-run relationship between the real output and real defense spending. A 10% rise in real defense expenditure would lead to around 1.1% increase in real output. The impact of real non-defense government spending on the real output is substantially higher than that of real defense spending. However, the impact of monetary policy, represented by the real interest rate, is rather small in comparison to the fiscal policies. Compared to the results of Atesoglu (2002), this study also has similar signs on the estimated coefficients but magnitudes are different, especially in regard to the coefficient of military expenditure. For example, Atesoglu (2002) presented an estimate for that coefficient around 0.23, which is almost twice as high as the estimate here.

Equation (6) is evaluated further in order to examine its short-run dynamics. To this end, a vector error correction model (VECM) for each variable is

Table 1. Tests for integration.

ADF test statistic					Phillips–Peron test statistic				
Variable					Variable				
Levels		k lag	Differences	k lag	Levels		t lag	Differences	t lag
LRY	−2.43	1	−4.25*	2	LRY	−2.89	5	−15.24*	5
LRGE	−1.70	1	−3.89*	1	LRGE	−2.25	5	−6.60*	5
LRME	−1.88	1	−3.75*	1	LRME	−2.35	5	−6.93*	5
RR	−2.11	2	−3.21*	5	RR	−3.13	5	−10.94*	5

Notes: Sample levels 1956–2002 and differences 1957–2002. ADF tests include an intercept and a 1 to 5 lagged difference variable and k stands for the lag level that maximizes the AIC (Akaike Information Criteria). Phillips–Peron tests have also an intercept and t stands for the selected truncation lag level.
* Rejection of unit root hypothesis, according to McKinnon's critical value at 5%.

Table 2. Johansen and Juselius cointegration tests and results.

Panel A: the results of λ-max and trace tests					
Variables: *LRY*, *LRGE*, *LRME*, *RR*					
Null	Alternative	λ-max statistic	95% critical value	Trace statistic	95% critical value
$r = 0$	$r = 1$	33.20	31.79	67.28	63.00
Panel B: estimate of cointegrating vector					
LRY		constant	*LRGE*	*LRME*	*RR*
−1.000		0.2336	1.0084	0.1148	−0.0208
(none)		(0.1859)	(0.2761)	(0.0387)	(0.0048)
Panel C: vector error correction model					
Dependent variable		ΔLRY_t	$\Delta LRGE_t$	$\Delta LRME_t$	ΔRR_t
Error-correction term		−0.038	0.072	0.109	−0.001
		(2.788)*	(2.976)*	(2.172)*	(1.739)
R^2		0.567	0.513	0.402	0.371

Notes: The VAR structure is based on the AIC and SBC values, which sets the value of lag length to 1 but they are not reported due to space considerations. In panel A: r = number of cointegrating vectors. In panel B: values in parentheses are standard errors. In panel C: values in parentheses are absolute values of t-statistics. * indicates statistical significance at 5%.

formed. (See Enders (2004) for a detailed account of the VECM and its interpretation.) The VECMs, which include the lagged values of changes in all variables in equation (6), in addition to the lagged value of the estimated residual from equation (6), are estimated. The summary results of VECMs are presented in table 2, panel C. The error-correction terms for the output, the defense and non-defense spending error-correction equations are statistically significant, but this is not the case for the interest rate error-correction equation. The VECM results demonstrate that output, non-defense and defense expenditures adjust to sustain the long-run equilibrium of equation (6). These results also reveal that there is a bi-directional relationship between real national income and real defense spending. There is also a uni-directional causal relationship between non-defense government expenditure and real interest and the real interest to real output and real defense spending. The revealed VECM results are similar to those of Atesoglu (2002), except for the interest rate error-correction equation.

Next, testing for the stability of the long-run coefficients obtained in estimating equation (6) is carried out by using the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests (Brown *et al.*, 1975). These tests utilize the CUSUM and CUSUMSQ, respectively, which are updated recursively and are plotted against the break points in the broken sample points to test the null hypothesis that all the coefficients in the selected VECM are stable. Implementation of the CUSUM and CUSUMSQ tests in the form of the VECM for the real output is carried out by the *Microfit 4* routine suggested in Peseran and Peseran (1997). The graphical representations of the tests are presented in figure 1.

According to figure 1, neither CUSUM nor CUSUMSQ plots cross the 5% critical bounds, indicating no evidence of any structural instability in the

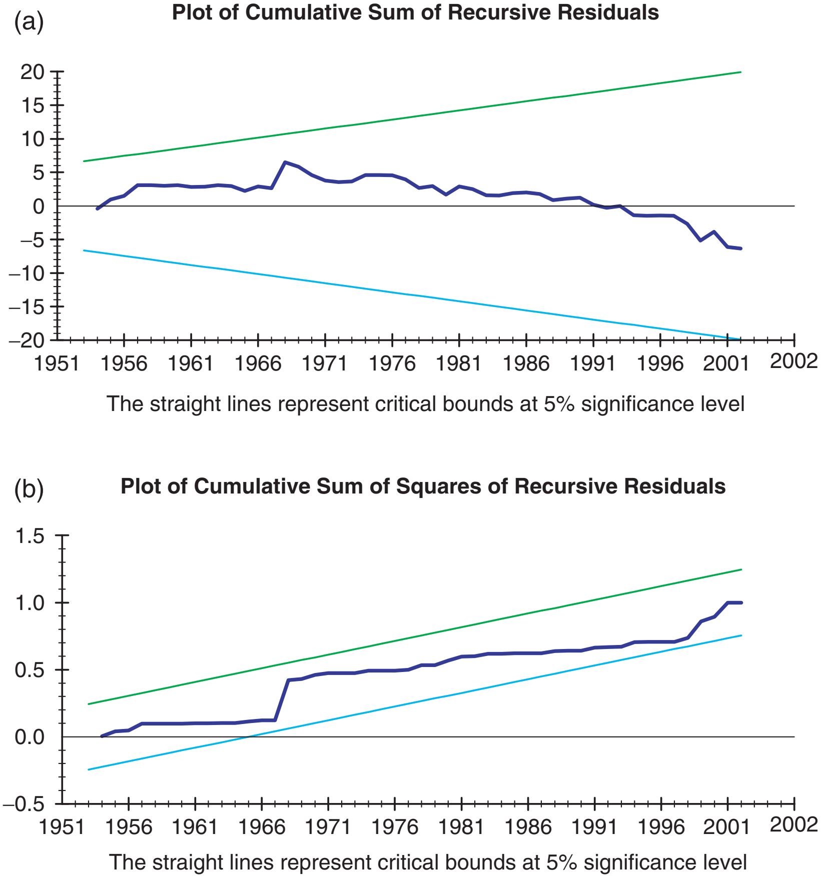

Figure 1. Plot of (a) cumulative sum of recursive residuals (CUSUM) and (b) cumulative sum of squares of recursive residuals (CUSUMSQ) statistics for coefficient stability.

real income equation and its determinants. Hence, any economic policy targeting determinants of the real income equation should yield stable results in the long run.

4. Conclusions

This study provides an empirical relationship between the real Turkish defense spending and the real Turkish output by employing the new macroeconomic theory (Taylor, 2000) and the multivariate cointegration technique. The findings of this study are in line with those of Atesoglu (2002). It is clear that a rise or fall in Turkish military spending will cause changes in the macroeconomic equilibrium in the long-run. The impact of military expenditure on the real output level is positive and about one tenth of the size of the real non-military defense expenditures. Nevertheless, the effect of the monetary policy on the real output is negligible. Both the CUSUM and CUSUMSQ tests also confirm the stability of long-run coefficients of the aggregate output function augmented with the non-defense and defense expenditures and real interest rates.

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Appendix A

A.1. *Data*

Data used in the econometric estimations are collected from SIPRI yearbooks, State Institute of Statistics (SIS) of Turkey and Ministry of Finance of Turkey. Although the Turkish data set for Turkish military expenditure goes as far back as before 1950, the data are inconsistent with other international data sets. The reliability and compatibility of Turkish military defense spending is also discussed in Gunluk-Senesen (2002).

A.2. *Data definitions and sources*

LRY is the natural logarithm of the real Turkish GNP in billions of Turkish Liras (TL) at 1990 prices. The nominal GNP is deflated by the Turkish consumer price index of $1990 = 100$. Source: SIS.

LRGE is the natural logarithm of the real non-defense government expenditure in billions of TL at 1990 prices. The real non-defense government spending is calculated by subtracting the real military spending from the real government expenditure and adding them to the real total public fixed investments. Sources: SIS, Ministry of Finance of Turkey and SIPRI.

LRME is the natural logarithm of the real defense spending in billions of TL at 1990 prices, which also includes the real total public fixed investments. Sources: SIS, SIPRI and the Turkish Ministry of Finance.

RR is the real average interest rate for bank deposits. Before 1970, the discount rate of the central bank of Turkey is used as a proxy for the average interest rate since there are no data available for those years. *RR* is calculated as follows: $((((1+R/100)/(1+P/100))-1)\times 100)$ where R is the annual nominal interest rates and P is the annual consumer price inflation rates. Source: SIS.

The econometric estimations are implemented by using *Microfit 4.0* interactive econometric software developed by Pesaran and Pesaran (1997).