

**ODTÜ
GELİŞME
DERGİSİ**

**METU
STUDIES IN
DEVELOPMENT**

ISSN 1010-9935

Cilt
Volume **21**

Sayı
Number **1**

Yıl
Year **1994**

MAKALELER / ARTICLES

- Said M. ALKHATIB** The Dynamic Dependence Pattern of Inflation in Jordan
- Mahmut Bali AYKAN** Türkiye'nin Basra Körfezi Güvenliği Politikası: 1979-1988
- E. Fuat KEYMAN** How Critical is Critical International Relations Theory? Modernity Versus Postmodernity as a False Antithesis
- Robert E. LOONEY** The Economic Consequences of Defense Expenditures in the Middle East
- M. Fatih TAYFUR** Main Approaches to the Study of Foreign Policy: A Review
- A. Nuri YURDUSEV** The Concept of International System as a Unit of Analysis

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
İKTİSADİ VE İDARİ BİLİMLER
FAKÜLTESİ



MIDDLE EAST TECHNICAL UNIVERSITY
FACULTY OF ECONOMIC AND
ADMINISTRATIVE SCIENCES

The economic consequences of defense expenditures in the Middle East

Robert E. Looney

National Security Affairs, Naval Postgraduate School, Monterey, California 93943 USA

Abstract

Since the Middle East has the highest defense burden (defense expenditures as a share of gross domestic product) in the developing world, it is of some interest to assess the extent military expenditures have influenced national efforts at expanding investment. The purpose of this paper, therefore, is to assess whether military expenditures in five of the major defense spenders, namely Algeria, Egypt, Syria, Israel, and Saudi Arabia, have been at the expense of physical capital accumulation as well as other macroeconomic aggregates.

After finding series free of unit roots, the methodology used consisted of a series of Granger Causality tests modified by a Hsiao procedure to identify the optimal timing of impact. While there is little evidence supporting the position that investment or growth causes defense, many countries have developed fairly elaborate feedback mechanisms whereby defense impacts on investment and growth and in turn is affected by that growth. In addition, while there is little evidence that defense hurts investment or growth, there is ample support for the position that: (a) the relationship between defense and investment or growth varies considerably among countries, and (b) the lag structures also differ greatly.

1. Introduction

One can easily argue (Cummings *et al.*, 1980) that the post-1973/74 expansion in military expenditures undertaken over the last several decades

in the Middle East has pre-empted resources capable of contributing to physical capital formation. As a result, military expenditures have tended to frustrate national development programs, especially those of the non-oil exporting countries (Hewitt, 1993).

While this view makes intuitive sense, it is conceivable that military expenditures do not necessarily reduce economic growth in developing countries. Defense expenditures may act as an economic stimulus in such ways as financing heavy industry and the acquisition of advanced technologies, providing employment, and attracting investment.

Since the Middle East has the highest defense burden (defense expenditure as a share of gross domestic product) in the developing world, it is of some interest to assess the extent military expenditures have influenced national efforts at expanding investment. The purpose of this paper, therefore, is to assess whether military expenditures in five of the major defense spenders, namely Algeria, Egypt, Syria, Israel, and Saudi Arabia, have been at the expense of physical capital accumulation as well as other macroeconomic aggregates. As a basis of comparison, we undertook a similar analysis using other categories of public expenditures.

2. Literature survey: the impact of defense expenditures

A body of conventional wisdom has amassed over the years concerning the causes and consequences of Third World militarisation. More often than not in the early literature this wisdom has been anecdotal and biased towards the standard "guns versus butter" analogies. Since the modern defense establishment is a heavy consumer of technical and managerial manpower and foreign exchange, resources that are especially scarce in the Third World, the conventional argument is that increased defense burdens should reduce the overall rate of growth (Chan, 1987; Deger and West 1987).

To test this theory, a rapidly growing body of empirical research has attempted to identify the impact of defense spending on various aspects of economic development and growth. Numerous studies have grown out of the debate. Unfortunately, no consensus has emerged. In the original study, Benoit (1978) found strong evidence to suggest that defense spending encouraged the growth of civilian output per capita in less developed countries.

On the other hand, Rothschild (1977) concluded that increased military expenditures lowered economic growth by reducing exports in fourteen OECD countries during 1956-69. In his examination of 54 developing

countries for the sample period 1965–73, Lim (1983) found defense spending to be detrimental to economic growth. Deger and Sen (1983), Leontief and Duchin (1983), and Faini *et al.* (1984), Biswas and Ram (1986), and Grobar and Porter (1989) also found evidence refuting the claim that defense spending stimulates economic growth.

In contrast, research that examines the economic impact of Third World military expenditure by utilising various sub-groupings of countries tended to contradict these findings. Much of this research implicitly argues that in certain economic situations it is possible by creating a stable environment that added defense expenditures may stimulate higher rates of investment, technological progress, technology transfer and hence increased overall growth (Wolf, 1981).

This research has gone through various stages and levels of sophistication, with the initial studies largely based on ordinary least squares regression techniques using Benoit's data set for the 1950–65 period. The original study (Frederiksen and Looney, 1982) using this methodology grouped countries on the basis of discriminant analysis with savings and investment used as discriminating variables and found that countries with relatively high levels of savings and investment experienced positive impacts on growth, while the impact was statistically insignificant for countries experiencing low levels of savings and investment.

A second study (Frederiksen and Looney, 1983) also used Benoit's sample countries. However, it grouped countries largely on the basis of foreign exchange earnings, import elasticity, and productivity of investment. Again, relatively unconstrained countries experienced positive impacts on growth stemming from defense expenditures, while the relatively foreign exchange constrained countries showed a statistically insignificant but negative impact.

Using a later time period, 1965–73, and again grouping developing countries on the basis of their relative savings and investment, Frederiksen and Looney (1985) found that the relatively unconstrained countries enjoyed a positive impact from defense expenditures.

These initial studies examined only the impact of defense expenditures on growth. More recent analysis in the area has been more sophisticated, employing more elaborate statistical devices and/or more subtle country groupings. For example, Third World military producers (defined in Neuman, 1984) experienced positive impacts from military expenditures on growth, investment, savings, but declines in productivity in the 1970–82 period (Looney, 1989a). Non-producers experienced declines in growth and

investment.

In recent years, analysis has branched into more complex issues, and utilised both time series (Looney, 1986; 1987; 1988) and simultaneous equation models estimated by two and three stage least squares regression techniques. These studies introduce the demand for military expenditures into the analysis to allow for feedbacks from the macro-economy to defense (Giyamah-Brempong, 1989). Interestingly enough, the results (Looney and Frederiksen, 1986; Mohammed 1993a; 1993b) produced by these techniques tend to confirm the results obtained from simpler, more naive models.

In short, the research summarised above demonstrates a consistent pattern whereby certain groups of Third World countries –usually the more successful economically, the more stable politically, or those engaged in military production– derive positive impacts on investment and growth from military spending (Looney 1989b; 1991). Those countries less successful economically, more politically unstable or lacking a domestic arms industry fail to derive any positive economic impacts from defense expenditures.

Having said this, it is important to note that a number of adverse effects stem from defense expenditures. This is true even in those countries experiencing higher overall rates of growth from increased allocations to defense. In particular, countries with an indigenous arms industry may suffer a deterioration in the distribution of income from added defense expenditures (Looney, 1989a). The same may also occur in military regimes as the authorities shift income from urban consumers to industrial groups (Looney, 1989c).

A major limitation of the studies cited above is that, by their nature cross-sectional studies are very aggregative, so that applying them to specific countries is hazardous at best. Obviously they are also incapable of capturing the dynamics (Federiksen and Looney, 1994) associated with time. Lebovic and Ishaq's (1987) study of defense spending in the Middle East attempts to overcome these deficiencies. Using a pooled time-series, cross-sectional analysis on various groupings of Middle Eastern States, they found that higher military spending tended to suppress economic growth in the non-oil states of the Middle East during the 1973–84 period.

However, while Lebovic and Ishaq drew on time series data, they were not able to incorporate the potential effects of lags between the time defense expenditures occur and the period of maximum economic impact. In this regard, Babin (1989) has noted that incorporating the time variable into analysis can be critical because some relationships that may exist over time disappear in the short-run and vice versa. Clearly at the national level,

development usually requires a series of changes that occur through systems, which involve organisations, agencies, economic structures and technological change (Babin, 1989: 249). Consequently (as Babin concludes), it is unjustifiable to assume that a country's defense spending will have an immediate, or even short-term, effect on national economic performance.

Babin's main finding was that while short-run economic impacts of defense expenditure may be nil or even negative, the longer term effect on growth is likely to be positive. Along these lines, Kick and Sharda's (1986) analysis suggests that an increase in the military manpower ratio has a significant positive effect on infrastructure and social welfare. This impact occurs with a long (twelve year) lag. Kick and Sharda also found that the relationship over a twelve year period is positive. Militarisation, whether measured by expenditures or size of the military, does contribute to development.

3. The issue of causation

Nearly all of the studies noted above have implicitly accepted Benoit's (1978: 276) original assertion that "...the direct interaction between growth and defense burdens seems to run primarily from defense burdens to growth rather than vice versa. It seems clear that in the sample countries higher defense burdens simulate growth." While this may well be true, it is simply an assertion and not based on empirical evidence. In fact, there is a high likelihood that defense expenditures may simply reflect economic conditions and not be an initiator of economic change. As an extreme case, it is obvious that increased defense expenditures in Saudi Arabia largely reflect improvements in the international oil markets and hence the country's expanded gross domestic product (GDP). While defense expenditures might feed back to affect GDP, this impact would be minimal by comparison.

It follows that before drawing any definitive conclusions as to the impact of defense expenditures, one must satisfactorily address the issue of causation. Fortunately several statistical tests are gaining wider acceptance for this purpose. To date, the original and most widely used causality test is one developed by Granger (1969; 1988).

3.1. Granger test

Granger (1969) defines causality such that X Granger causes (G-C) Y if Y can be predicted more accurately in the sense of mean square error, with

the use of past values of X than without using past X. Based upon the definition of Granger causality, a simple bivariate autoregressive (AR) model for defense and GDP can be specified as follows:

$$GDP_t = c + \sum_{i=1}^p a_i GDP_{t-i} + \sum_{j=1}^q b_j DEF_{t-j} + u_t \quad (1)$$

$$DEF_t = f + \sum_{i=1}^r d_i DEF_{t-i} + \sum_{j=1}^s e_j GDP_{t-j} + v_t \quad (2)$$

where GDP is the gross domestic product and DEF refers to defense expenditures; p, q, r and s are lag lengths for each variable in the equation; and u and v are serially uncorrelated white noise residuals. By assuming that error terms (u, v) are "nice", ordinary least squares (OLS) becomes the appropriate estimation method.¹

Within the framework of unrestricted and restricted models, a joint F-test is appropriate for causal detection:

$$F = \{ [RSS_r - RSS_u] / [df_r - df_u] \} / [RSS_u / df_u] \quad (3)$$

where RSS_r and RSS_u are the residual sum of squares of restricted and unrestricted models, respectively; and df_r and df_u are, respectively, the degrees of freedom in restricted and unrestricted models.

The Granger test detects causal directions in the following manner. First, unidirectional causality from DEF to GDP if the F-test rejects the null hypothesis that past values of DEF in equation (1) are insignificantly different from zero and if the F-Test cannot reject the null hypothesis that past values of GDP in equation (2) are insignificantly different from zero. That is, DEF causes GDP but GDP does not cause DEF. Unidirectional causality runs from GDP to DEF if the reverse is true. Second, bidirectional causality runs

¹ If the disturbances of the model were serially correlated, the OLS estimates would be inefficient, although still unbiased, and would distort the causal relations. The existence of serial correlation was checked by using a maximum likelihood correlation for the first-order autocorrelation of the residuals [AR(1)]. The comparison of both OLS and AR(1) results indicated that no significant changes appeared in causal directions. Therefore, we can conclude "roughly" that serial correlation was not serious in this model.

between DEF and GDP if both F-test statistics reject the null hypotheses in equations (1) and (2). Finally, no causality exists between DEF and GDP if we cannot reject both null hypotheses at the conventional significance level.

Joerding (1986) has tested the defense growth hypothesis using Granger causality methods. That is, he tested for the assumed exogeneity of defense budgets. Using a pooled sample containing 15 observations from each of 57 countries, Joerding employed a multivariate model which also included investment and government spending and concluded that defense expenditures are not strongly exogenous and that previous studies were flawed.

While Joerding's work provides insight into the nature of the relationship between defense and growth, there are three issues that merit further attention (LaCivita and Frederiksen, 1991):

1. Joerding lumps all countries into one sample. This suggests a commonality of causal relationships across diverse economic environments. As was shown by Frederiksen and Looney (1983; 1985), splitting a pooled sample into separate groups (in their case based on the level of relative resource constraints) can lead to quite different results.

2. By aggregating the sample, Joerding assumed a common lag structure for all of the countries in the sample (in his study, four years on the defense and growth variables). If a causal relationship does exist (either defense to growth or growth to defense) we could expect the time lags to differ from country to country.

3. Joerding's method for choosing lag length was *ad hoc*.

The results of Granger causality tests depend critically on the choice of lag length (Chowdhury, 1991). If the chosen lag length is less than the true lag length, the omission of relevant lags can cause bias. If the chosen lag is greater than the true lag length, the inclusion of irrelevant lags causes estimates to be inefficient.

While Joerding chose his lag lengths based on preliminary partial autocorrelation methods, there is no *a priori* reason to assume lag lengths equal for all of our sample countries. For example, in a study of the Philippines, Frederiksen and LaCivita (1987) found no statistical relationship between growth and defense when both variables had a lag equal to four. With a lag length of two periods, however, growth caused defense. Since both lag lengths are arbitrary, one cannot form an objective conclusion as to the direction of causation.

3.2. The Hsiao procedure

To overcome the difficulties noted above, Hsiao (1981) developed a systematic method for assigning lags. This method combines Granger Causality and Akaike's final prediction error (FPE), the (asymptotic) mean square prediction error, to determine the optimum lag for each variable. In a paper examining the problems encountered in choosing lag lengths, Thornton and Batten (1985) found Hsiao's method to be superior to both arbitrary lag length selection and several other systematic procedures for determining lag length.

The first step in Hsiao procedure is to perform a series of autoregressive regressions on the dependent variable. In the first regression, the dependent variable has a lag of one. This increases by one in each succeeding regression. Here, we estimate M regressions of the form:

$$G_t = a + \sum_{i=1}^m b_i G_{t-i} + e_t \quad (4)$$

where the values of m range from 1 to M . For each regression, we compute the FPE in the following manner:

$$FPE_m = [(T+m+1) ESS_m/T] / (T-m-1) \quad (5)$$

where T is the sample size, and FPE_m and ESS_m are the final prediction error and the sum of squared errors, respectively. The optimal lag length, m^* , is the lag length which produces the lowest FPE. Having determined m^* , additional regressions expand the equation with the lags on the other variable added sequentially in the same manner used to determine m^* . Thus we estimate four regressions of the form:

$$G_t = a + \sum_{i=1}^{m^*} b_i G_{t-i} + \sum_{j=1}^n c_j D_{t-j} + e_t \quad (6)$$

with n ranging from one to four. Computing the final prediction error for each regression as:

$$FPE_{m^*,n} = [(T + m^* + n + 1) ESS_{m^*,n}/T]/(T - m^* - n - 1) \quad (7)$$

we choose the optimal lag length, n^* , as the lag length which produces the lowest FPE. Using the final prediction error to determine lag length is equivalent to using a series of F-tests with variable levels of significance.²

The first term measures the estimation error and the second term measures the modeling error. The FPE criterion has a certain optimality property (Hsiao, 1979: 326) that "balances the risk due to bias when a lower order is selected and the risk due to increases in the variance when a higher order is selected". As noted by Judge *et al.* (1982), an intuitive reason for using the FPE criterion is that longer lags increase the first term but decrease the RSS of the second term, and thus the two opposing forces are optimally balanced when their product reaches its minimum.

Depending on the value of the final prediction errors, four cases are possible: (a) *Defense causes Growth* –occurring when the prediction error for growth falls when the equation includes defense. In addition, when growth is added to the defense equation, the final prediction error increases; (b) *Growth causes Defense* –occurring when the prediction error of growth increases when defense is added to the regression equation for growth, and is reduced when growth is added to the regression equation for defense; (c) *Feedback* –occurring when the final prediction error decreases when defense is added to the growth equation, and the final prediction error decreases when growth is added to the defense equation; and (d) *No Relationship* –occurs when the final prediction error increases when defense is added to the growth equation, and also increases when growth is added to the defense equation.

4. Methodology

The data for military expenditures used to carry out the Hsiao tests are from the Stockholm International Peace Research Institute, *SIPRI Yearbook, World Armaments and Disarmament*. Annual data on Gross Domestic Product is from various issues of the International Monetary Fund, *International Financial Statistics Yearbook*. When consistent price deflators were not available, we introduced the growth of the defense burden (the share of defense in GDP) into the regression equations.

Several conceptual problems remain. First, most economic time series are

² Since the F-statistic is redundant in this instance they are not reported here. They are, however, available from the author upon request.

non-stationary. As indicated by Judge *et al.* (1982) "stationarity is an important property as it guarantees that there are no fundamental changes in the structure of the process that would render prediction difficult or impossible". To overcome this problem, we used the rates of growth of each variable in the estimated equations³. Regressing these transformed series on a constant and time produced coefficients that were different from zero for all countries. Similar regressions of the untransformed levels indicated the presence of a trend.

Second, military expenditures may affect the macro-economy in a way similar to that associated with other types of public expenditure. If this is the case any adverse effects identified may not be due to military expenditures *per se*, but government expenditures in general. To test for this possibility, we undertook additional regressions using (when available) figures on government consumption and/or public sector capital formation in place of defense expenditures. If the results were significantly different using these other forms of public spending, we concluded that the defense/growth relationship was unique and not simply a reflection of the general nature of public expenditures.

Finally, investment is only one of many macro variables capable of providing insights as to the implications for longer run development. As a basis of comparison, we substituted other macro aggregates such as GDP, inflation, and imports for capital formation⁴.

5. Results

The results (Table 1) for our five countries indicate the direction of causation, together with the optimal lag for each macro aggregate.

Algeria

In terms of the defense impact/causality issue, the main findings (Table

³ The Dickey-Fuller (1979) method was used to address the issue of non-stationarity and cointegration aspects of the time series used. See the Appendix for a full discussion of the method and main findings. I am indebted to an anonymous referee for suggesting the desirability of including these tests.

⁴ These variables are only reported here when a causal relationship was found.

1) suggest that:

1. No statistically significant relationships occur between defense and investment.

2. With regard to other macroeconomic aggregates, causation is from defense to growth. This relationship is positive, with the lag between defense and growth relatively short (one year). However, the final prediction error for growth to defense was only slightly lower than that obtained from the growth to defense regression.

3. Perhaps because of their rapid increase in the mid- to late 1970s, Algerian defense expenditures have created inflationary pressures. These pressures occur over time with a lag period of around four years, making budgetary control of inflation difficult.

4. While exogenous in terms of their impact on GDP growth and the rate of inflation, defense expenditures themselves also seem to lead to a general expansion in government consumption. That is, defense expenditures appear more flexible than other types of government expenditures, expanding and contracting before budgetary changes in other public allocations. This finding suggests that defense is a semi-luxury good, expanding rapidly when extra revenues are available, but cut back during periods of austerity.

5. Defense expenditures also follow general expansions in imports, suggesting that they are largely responsive to the relaxation of foreign exchange constraints.

Defense burdens are relatively low in Algeria. If defense does have an impact on the economy, it is probably slight albeit positive. Excessive defense expenditures may have an inflationary impact, perhaps because they occur largely in the domestic market, rather than manifesting themselves in increased imports.

Egypt

Egyptian defense expenditures fluctuated widely, resulting in a corresponding differential impact on the country's leading economic aggregates (Table 1):

1. The major difference between defense expenditures and general government current expenditure lies in their respective impacts on real gross capital formation: (a) Increases in the defense burden (the share of defense in GDP) have a strong impact on investment. This impact occurs over a four year period, not only for the period as a whole, but for each of the sub-periods as well. (b) In contrast, changes in government consumption

Table 1
Middle East: Summary of Country Expenditure Patterns
Statistically Significant Directions of Causation

Causal Relationship	Time Period	Direction of Causation	Optimal Lag (Years) Strength
<i>Algeria</i>			
Defense/Investment	1967-88	No-Relationship	
Defense/GDP	1967-88	Def → GDP(+)	(1) Weak
Defense/Inflation	1967-88	Def → Inf(+)	(4) Strong
Defense/Imports	1967-87	Import → Def(+)	(3) Moderate
<i>Egypt</i>			
Defense/Investment	1965-88	Def → Invest(+)	(4) Strong
Gov Cons/Investment	1970-87	Gov Cons → Inv(-)	(1) Moderate
Defense/GDP	1965-80	Def → GDP(-)	(1) Moderate
Gov Consumption/GDP	1965-80	Feedback(-)	(1) Moderate
Defense/Imports	1965-87	Def → Imp(+)	(4) Strong
Gov Cons/Imports	1965-87	Def → Imp(+)	(4) Weak
<i>Syria</i>			
Defense/Investment	1962-87	Feedback(+)	(4) Strong
Defense/GDP	1962-87	Feedback(+)	(4) Strong
Defense/Imports	1962-87	Feedback(+)	(4) Strong
<i>Israel</i>			
Defense/Investment	1955-87	Def → Invest(+)	(4) Strong
Defense/GDP	1955-87	GDP → Def(+)	(3) Moderate
Gov Cons/GDP	1955-87	GDP → Gov Cons(+)	(1) Moderate
<i>Saudi Arabia</i>			
Defense/Investment	1965-88	No Relationship	
Defense/GDP	1965-88	GDP → Defense	(3) Strong
Defense/Non-Oil GDP	1965-88	Feedback(-)	(1) Strong
Gov Invest/Non-Oil GDP	1965-88	GDP → Gov Inv(+)	(1) Strong
Gov Cons/Non-Oil GDP	1965-88	GDP → Gov Cons(+)	(2) Weak
Defense/Non-Oil GDP	1970-88	Defense → GDP(+)	(1) Weak
Gov Cons/Non-Oil GDP	1970-88	GDP → Gov Cons(+)	(1) Weak
Gov Invest/Non-Oil GDP	1970-88	Feedback(+)	(1) Strong

Note: Summary of results obtained from Granger Causality Tests using a Hsiao Procedure to determine the optimal lag, i.e., a four year lag indicates that most of the impact from the expenditures or GDP in any one year tends to be distributed over four successive years. See the Appendix for a discussion of the tests used to determine stationarity and cointegration aspects of the time series used.

impacted negatively (with a one year lag) on gross capital formation.

2. If one considers the 1965-87 period as a whole, no statistical pattern occurs between the growth of the defense burden and overall gross domestic product. However, over the earlier 1975-80 period, defense expenditures had

a negative impact on real GDP. Finally, the second sub-period, 1970–87, experienced little or no interrelation between defense and the economy as a whole.

3. To determine if the economic impact of defense expenditures was unique to that category of government allocations, we undertook similar tests using the growth in the share of government consumption in GDP. The main finding here was that government consumption also showed little relationship to GDP over the period as a whole.

4. On the other hand, the impact of government consumption expenditures in the two sub-periods was somewhat different than that of defense: (a) for the 1965–80 period, government consumption interacted with GDP, tending as with defense to reduce GDP with a one year lag, and (b) government consumption was determined by GDP over the 1970–87 period. From this we can conclude that defense allocations respond to factors other than pure internal economic conditions, while other types of government expenditure are more responsive to changes in the country's underlying economic base.

5. Both defense and general government consumption expenditures are fairly import intensive with increases in each leading to a follow-on expansion in imports. However, there is one major difference between the two types of expenditures in that in the 1970–87 period increased imports also facilitated increases in government consumption (but not in defense expenditures). Again, this finding demonstrates the relative reliance of government consumption on the country's underlying resource base.

From these patterns, a general picture emerges whereby defense expenditures in Egypt have a number of positive linkages with the economy as a whole. In particular, increased defense expenditures appear to increase the profitability of investment over time, with the ultimate effect of higher rates of investment than would have otherwise been the case. On the other hand, the fairly strong import effect associated with defense expenditures may at times have compounded the country's foreign exchange problems, thus causing a general contraction of the economy. This phenomenon appears to have been present before 1980, but was not a factor in the preceding years, perhaps as a result of United States military aid.

These results are suggestive of a Military Keynesianism (Looney, 1989b; 1991) effect (the use of procurement from local arms industries to stabilise the economy) associated with Egyptian defense expenditures. In fact, similar patterns occur in other Third World arms producers (Looney and Frederiksen, 1990).

In situations where governments have used defense expenditures to stabilise the economy, a characteristic pattern is one where fluctuations in defense allocations offset deviations (positive or negative) in the expansion of the overall economy. That is, when the economy is growing faster than its trend (and overheating occurs) defense expenditures decline to reduce overall demand. Similarly, during recessionary periods, defense expenditures expand to increase aggregate demand and thus employment.

Apparently, because of direct links to indigenous arms industries, the multiplier effect associated with defense expenditures is greater than that with other types of government procurement. The resulting income and employment multiplier is higher and therefore defense expenditures are the preferred way of fine tuning the economy.

Syria

In a comprehensive survey of the Syrian economy, the World Bank (1986), noting that the economy averaged around 10 percent real growth rate over the 1970–82 period, argued that the main sources of this growth were government expenditures, including military expenditures. In addition, the Bank contends that rapid increases in investment also contributed to this period's rapid economic expansion. From this the Bank concludes that there has been an increasing dependence of the Syrian economy on government expenditures in general and defense expenditures in particular.

This interdependence, whereby expenditures positively affect growth, with growth in turn delineating the amount of resources available for future expenditures, is apparent from the causality tests undertaken for the 1962–87 period (Table 1):

1. Increases in the defense burden impacted strongly on investment. This impact occurs over time, averaging four years. In turn, increases in investment provided a short-run (one year) stimulus to the defense budget. The same patterns held for defense and gross domestic product.
2. A fairly strong set of interrelationships occurs between defense and imports, with defense contributing to the country's import burden. In turn, additional imports facilitate an expansion of the country's expenditures on defense.
3. The same pattern occurs between defense and two other main macroeconomic aggregates, namely gross fixed capital formation and private consumption (with private consumption probably simply mirroring the movements in overall gross domestic product).

From these findings, it is apparent that defense expenditures in Syria have aided the country's economic expansion. However, given the relatively large import effect associated with defense expenditures, other types of public allocations may have been (or at least were potentially) more effective in this regard.

Israel

While Israel's military burden is one of the highest in the world, there is little evidence to indicate any negative impacts on the growth of gross domestic product associated with expanded allocations to the military (Table 1):

1. Defense expenditures appear to have had a generally positive impact on fixed capital formation. That is, increases in defense expenditure have, with a one year lag, stimulated increased rates of investment.

2. As a basis of comparison, tests using increases in the government consumption/GDP ratio indicated a similar pattern with the exception of the 1967–87 period. During this time increases in GDP (in contrast to the situation with defense) maintained their positive impact on government consumption. On the other hand, there is little evidence that government consumption was (in contrast to defense) able to stimulate increases in gross capital formation.

3. For the period as a whole (1955–87) there is a fairly strong positive relationship from GDP leading to increased defense expenditures (with an average lag structure of three years).

4. While this same relationship held for the twenty year period of 1955–75, it appears to have broken down in recent years; during the 1967–87 period there was no statistically significant relationship between the growth in defense expenditures and that of the overall economy.

A similar contrasting pattern with respect to imports exists between defense expenditures and general government consumption. While both categories of expenditures show no relationship with imports over the 1955–75 period, increases in defense expenditures cause increases in imports over the 1967–87 period. During this time frame, increases in imports permit government consumption to expand.

These import patterns suggest that the impact of defense expenditures on the economy is fundamentally different from that of other types of government allocation. In addition, this differentiation appears to be increasing with time. In recent years, defense expenditures received a high

priority, with non-defense expenditures allowed to expand only when excess resources are available.

The ability of defense expenditures (as opposed to government consumption) to stimulate gross capital formation is consistent with a model of foreign aid recently developed by McGuire (1987). According to McGuire, foreign aid creates several price and income movements in the recipient country. For Israel, United States aid has created an indirect stimulus to investment via the complementarity between investment and defense. In addition, aid provides significant resources (via tax relief) to the private sector. Subsequently, these resources flow into capital formation. "It appears in summary, that a significant fraction of United States aid goes to support capital formation in Israel via this diversion of resources" (McGuire, 1987: 867). In short, United States military grants to Israel have not only allowed the country to increase military expenditures rapidly in the short-run, but perhaps more importantly, to increase them in a way that was not detrimental to investment and economic growth.

Saudi Arabia

While defense expenditures have in a general sense mirrored the developments in the oil sector, the pattern is complex and has altered over time (Looney, 1987). There appears to be a structural shift associated with the oil price increases in the early 1970s that sets the 1960-73 period somewhat apart from the latter years. The impact (on a dollar per dollar basis) of the oil sector on defense was stronger in the earlier period.

Specifically, for the 1960-85 period as a whole, the short-run marginal propensity of the government to spend on defense was 0.03, with a longer run propensity to spend of 0.20. That is, a one billion riyal increase in oil revenues would result in an expansion of allocations to defense of 0.03 billion in the same year (in constant prices). Over time (three to five years), the government tended to expand its allocations to defense by 0.20 billion riyals. In contrast, the short and long run propensities to spend oil revenues on defense were respectively: 0.87 and 0.34 for the 1960-73 sub-period, and 0.16 and 0.03 for the 1973-85 sub-period.

In terms of causality, since oil revenues make up a significant portion of gross domestic product, the results were of no great surprise:

1. For the period as a whole (1965-88), movements in total gross domestic product (at constant prices) tended to induce changes in the Kingdom's allocations to the military. In this sense, defense expenditures in Saudi Arabia

are endogenous, affected by economic growth and not vice versa. The average lag was three years—that is, the past three years growth in GDP was the best predictor of the growth in defense expenditure for any one year.

2. Interestingly enough, except for government consumption, none of the other standard macroeconomic aggregates seem affected by past movements in the country's gross domestic product.

While the relationship between total GDP and defense is fairly intuitive and straightforward, that between defense and non-oil GDP is more complex:

1. For the period as a whole (Table 1), defense and non-oil economic activity appear closely interrelated, with neither variable being completely exogenous with respect to the other. That is, past movements (an optimal lag of four years) in defense tended to reduce somewhat increases in real non-oil output. On the other hand, increases in non-oil GDP tended (with an optimal lag of one year) to stimulate additional increases in defense expenditures.

2. Over the last eighteen years, however, a clear pattern has emerged whereby defense expenditures have become intertwined with non-oil GDP. This new relationship has involved defense expenditures increasing non-oil GDP with an average lag of two years. In turn, increases in non-oil GDP facilitate (with a one year lag) expanded allocations for defense.

3. Also during this period, the relationship between non-oil GDP and government consumption seems to have changed so that causation began to run largely from GDP to government consumption. One implication of this pattern is that defense expenditures have taken on a stronger role relative to government consumption in stimulating non-oil income.

These findings suggest that at least on the aggregate level, the Saudi Arabian economy has not suffered from the relatively large defense burden assumed by the government. Based on an earlier study (Looney, 1987), however, several caveats are in order.

That study found that in general defense expenditures have not had a neutral impact on the pattern of development in Saudi Arabia. In addition, the study concluded that, as with oil revenues, the impacts associated with defense expenditure occur over time. The net effect has been to retard growth in several key sectors, while stimulating expansion of others. Those sectors penalized by defense expenditures include: (a) agriculture, (b) manufacturing (other than oil refining), (c) electricity, water and power, and (d) services. It appears that substituting non-defense expenditures for allocations to the military on a riyal for riyal basis would have resulted in rates of growth higher than those actually observed.

On the other hand, several sectors are likely to have benefited from

defense expenditures. These include (a) mining, (b) construction, (c) wholesale and retail trade, and (d) the ownership of dwellings. Shifting public sector allocations from defense to non-defense would have reduced the expansion of these sectors relative to the rates of growth actually achieved.

6. Conclusions

For the most part, cross-sectional studies have implicitly assumed that causation runs from defense to investment and/or growth. The five-country case studies examined above provide evidence that is somewhat at odds with this view. While there is little evidence supporting the alternative position that investment or growth causes defense, many countries have developed fairly elaborate feedback mechanisms whereby defense impacts on investment and growth and in turn is affected by that growth. In addition, while there is little evidence that defense hurts investment or growth, there is ample support for the position that: (a) the relationship between defense and investment or growth varies considerably among countries, and (b) the lag structures also differ greatly.

Areas for future research should include a more rigorous examination of the manner in which defense affects growth – Keynesian linkages, investment stimulation and the like. Are defense expenditures fundamentally different from other types of government allocations in affecting growth and, if so, why?

.....

Appendix

Testing for Unit Roots and Cointegration

The time series must be stationary to yield valid Granger Tests (Granger, 1988). In this regard the finding of a unit root in a time series indicates non-stationarity. In a well known paper, Dickey and Fuller (1981) suggested a method for computing a test for a unit root in a time series and presented critical values for their proposed tests with and without the trend variable included. Dickey-Fuller (DF) tests were performed using *PC Give Version 7*.

Table A1
Unit Root Tests

Country Variable	Time Interval	Dickey-Fuller	Augmented DF
<i>Algeria:</i>			
GDP	1967-88	-0.448	-0.7536
$\Delta(\text{GDP})$	1967-88	-4.727*	-3.648*
Defense	1967-88	-1.503	-1.659
$\Delta(\text{Defense})$	1967-88	-4.273	-4.139*
<i>Egypt:</i>			
GDP	1965-87	-0.362	-1.319
$\Delta(\text{GDP})$	1965-87	-3.197*	-3.426*
Defense	1965-87	-0.737	-0.792
$\Delta(\text{Defense})$	1965-87	-4.642**	-4.578**
<i>Syria:</i>			
GDP	1962-87	-0.904	-0.905
$\Delta(\text{GDP})$	1962-87	-5.237**	-5.229**
Defense	1962-87	-2.876	-2.347
$\Delta(\text{Defense})$	1962-87	-4.501**	-4.629**
<i>Israel:</i>			
GDP	1955-87	-0.499	-1.364
$\Delta(\text{GDP})$	1955-87	-3.297*	-3.865*
Defense	1955-87	-0.548	-0.893
$\Delta(\text{Defense})$	1955-87	-4.861**	-4.544**
<i>Saudi Arabia:</i>			
GDP	1965-88	-0.231	-1.687
$\Delta(\text{GDP})$	1965-88	-3.247*	-3.999*
Defense	1965-88	-0.777	-0.781
$\Delta(\text{Defense})$	1965-88	-4.842**	-4.785**

* means significant at the 95% level.

** means significant at the 99% level.

In a simple case where:

$$x_t = a + bx_{t-1} + e_t$$

where $b = 1$ which generates a random walk (with drift if a not equal to 0). Here, the autoregressive coefficient is unitary and stationarity is violated. A process with no unit or explosive roots is said to be $I(0)$; a process is $I(d)$ if it needs to be differenced d times to become $I(0)$. The Durbin-Watson (DW) statistic for the level of a variable offers one simple characterisation of this integrated property. For example, if x_t is a random walk, DW will be very small. If x_t is white noise, DW will be around 2. Very low DW values thus indicate that a transformed model may be desirable perhaps including a mixture of differenced and disequilibrium variables.

The tests⁵ consisted of first performing the DF procedure on the logs of all variables: Here, the t -test on the lagged value is the relevant statistic (with critical values provided in MacKinnon, 1991, and Davidson and MacKinnon, 1993). As noted above, these tests indicated non-stationarity. Next tests were performed on the first differences of the log values. In all cases these were significant at the 95% level (and often at the 99% level, see Table A1).

References

- BABIN, N. (1989), "Military Spending, Economic Growth and the Time Factor", *Armed Forces and Society*, 15, 249-62.
- BENOIT, E. (1978), "Growth and Defense in Developing Countries", *Economic Development and Cultural Change*, 26, 271-80.
- BISWAS, B. and RAM, R. (1986), "Military Expenditures and Economic Growth in Less Developed Countries: An Augmented Model and Further Evidence", *Economic Development and Cultural Change*, 35, 361-72.
- CHAN, S. (1987), "Military Expenditures and Economic Performance", in United States Arms Control and Disarmament Agency, *World Military Expenditures and*

⁵ For a full description of the tests, the selection of lags and the process of differencing see Dornik and Hendry (1992: 111-2).

- Arms Transfers, 1986*, Washington: ACDA, 29-38.
- CHOWDHURY, A.R. (1991), "A Causal Analysis of Defense Spending and Economic Growth", *Journal of Conflict Resolution*, 35, 80-97.
- CUMMINGS, J., ASKARI, H. and SKINNER, M. (1980), "Military Expenditures and Manpower Requirements in the Arabian Peninsula", *Arab Studies Quarterly*, 2, 38-49.
- DAVIDSON, R. and MACKINNON, J.G. (1993), *Estimation and Inference in Econometrics*, Oxford: Oxford University Press.
- DEGER, S. and SEN, S. (1983), "Military Expenditure, Spin-off and Economic Development", *Journal of Development Economics*, 13, 67-83.
- DEGER, S. and WEST, R. (1987), "Introduction: Defense Expenditure, National Security and Economic Development in the Third World", in S. Deger and R. West, *Defense, Security and Development*, London: Francis Pinter, 1-16.
- DICKEY, D. A. and FULLER, W. A. (1979), "Distribution of the Estimators for Autoregressive Time Series With a Unit Root", *Journal of the American Statistical Association*, 74, 427-31.
- (1981), "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", *Econometrics*, 49, 1057-72.
- DORNIK, J. A. and HENDRY, D. F. (1992), *PC GIVE Version 7: An Interactive Econometric Modelling System*, Oxford: University of Oxford.
- FAINI, R., ANNEZ, P. and TAYLOR, L. (1984), "Defense Spending, Economic Structure and Growth: Evidence Among Countries and Over Time", *Economic Development and Cultural Change*, 32, 487-98.
- FREDERIKSEN, P. C. and LACIVITA, C.J. (1987), "Defense Spending and Economic Growth: Time Series Evidence on Causality for the Philippines, 1956-1982", *Journal of Philippine Development*, 26, 354-60.
- FREDERIKSEN, P. C. and LOONEY, R. E. (1982), "Defense Expenditures and Growth in Developing Countries", *Journal of Economic Development*, 7, 113-26.
- (1983), "Defense Expenditures and Economic Growth in Developing Countries", *Armed Forces and Society*, 10, 633-46.
- (1985), "Another Look at the Defense Spending and Development Hypothesis", *Defense Analysis*, 1, 205-10.
- (1994), "Budgetary Consequences of Defense Expenditures in Pakistan: Short-Run Impacts and Longer-Run Adjustments", *Journal of Peace Research*, 31, 11-8.
- GIYMAH-BREMPOG, K. (1989), "Defense Spending and Economic Growth in Sub-Saharan Africa: An Econometric Investigation", *Journal of Peace Research*, 30, 79-90.
- GRANGER, C.W.J. (1969), "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods", *Econometrics*, 37, 424-38.
-

- (1988), "Some Recent Developments in a Concept of Causality", *Journal of Econometrics*, 39, 199-211.
- GROBAR, L. M. and PORTER, R. C. (1989), "Benoit Revisited: Defense Spending and Economic Growth in LDCs", *Journal of Conflict Resolution*, 33, 318-45.
- HEWITT, D. (1993), "Military Expenditures World Wide: Determinants and Trends, 1972-1988", *Journal of Public Policy*, 12, 105-52
- HSIAO, C. (1979), "Causality Tests in Econometrics", *Journal of Economic Dynamics and Control*, 7, 326-35.
- (1981), "Autoregressive Modeling and Money-Income Causality Detection", *Journal of Monetary Economics*, 6, 85-106.
- JOERDING, W. (1986), "Economic Growth and Defense Spending: Granger Causality", *Journal of Development*, 21, 35-40.
- JUDGE, R.C., HILL, W., GRIFFITHS, H., LUTKEPOHL, H. and LEE, T.C. (1982), *Introduction to the Theory and Practice of Econometrics*, New York: John Wiley and Sons.
- KICK, E. and SHARDA, B. D. (1986), "Third World Militarization and Development", *Journal of Developing Societies*, 2, 49-67.
- LACIVITA, C. J. and FREDERIKSEN, P. C. (1991), "Defense Spending and Economic Growth: An Alternative Approach to the Causality Issue", *Journal of Development Economics*, 35, 117-26.
- LEBOVIC, J. and ISHAQ, A. (1987), "Military Burden, Security Needs, and Economic Growth in the Middle East", *Journal of Conflict Resolution*, 31, 106-38.
- LEONTIEF, W. and DUCHIN, F. (1983), *Military Spending: Facts and Figures*, New York: Oxford University Press.
- LIM, D. (1983), "Another Look at Growth and Defense in Less Developed Countries", *Economic Development and Cultural Change*, 31, 377-84.
- LOONEY, R. E. (1986), "Factors Underlying Venezuelan Defense Expenditures, 1950-83: A Research Note", *Arms Control*, May 1986, 74-108.
- (1987), "The Impact of Defense Expenditures on the Saudi Arabian Private Sector", *Journal of Arab Affairs*, 6, 198-229.
- (1988), "The Role of Defense Expenditures in Iran's Economic Decline", *Iranian Studies*, 21, 52-83.
- (1989a), "Impact of Arms Production on Third World Distribution and Growth", *Economic Development and Cultural Change*, 38, 145-54.
- (1989b), "Military Keynesianism in the Third World: An Assessment of Non-Military Motivations for Arms Production", *Journal of Political and Military Sociology*, 17, 43-64.
- (1989c), "The Economic Impact of Rent Seeking and Military Expenditures in the Third World", *The American Journal of Economics and Sociology*, 48, 11-30.

- (1989d), "Internal and External Factors in Effecting Third World Military Expenditures", *Journal of Peace Research*, 26, 33-46.
- (1991), "A Post-Keynesian Analysis of Third World Military Expenditures", *Rivista Internazionale di Scienze Economiche e Commerciali*, 38, 779-98.
- LOONEY, R. E. and FREDERIKSEN, P. C. (1986), "Defense Expenditures, External Public Debt and Growth in Developing Countries", *Journal of Peace Research*, 23, 329-38.
- (1990), "The Economic Determinants of Military Expenditure in Selected East Asian Countries", *Contemporary Southeast Asia*, 12, 265-77.
- MACKINNON, J. G. (1991), "Critical Values for Cointegration Tests", in R. F. Engle and C.W.J Granger (eds.), *Long Run Economic Relationships*, Oxford: Oxford University Press, 267-76.
- MCGUIRE, M. C. (1987), "Foreign Assistance, Investment, and Defense: A Methodological Study with an Application to Israel, 1960-1979", *Economic Development and Cultural Change*, 35, 847-73.
- MOHAMMED, N. (1993a), "Defense Spending and Economic Growth in Subsaharan Africa: Comment on Giymah-Brempong", *Journal of Peace Research*, 30, 95-6.
- (1993b), "Economic Growth and Defense Spending in Sub-Saharan Africa: Benoit and Joerding Revisited", *Journal of African Economies*, 2, 145-56.
- NEUMAN, S. (1984), "International Stratification and Third World Military Industries", *International Organization*, 38, 172-3.
- ROTHSCHILD, K.W. (1977), "Military Expenditure, Exports and Growth", *Kyklos*, 30, 804-13.
- THORNTON, D. L. and BATTEN, D.S. (1985), "Lag-length Selection and Tests of Granger Causality Between Money and Income", *Journal of Money, Credit and Banking*, 17, 164-78.
- WOLF, C. (1981), "Economic Success, Stability and the 'Old' International Order", *International Security*, 6, 75-92.
- WORLD BANK (1986), *Syria: Recent Economic Developments and Prospects*, Washington: IBRD.
-