Defense Spending and Economic Development in Lebanon: A Co-integration and Vector Autoregression Analysis

Rock-Antoine Mehanna

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Abstract

The lack of statistical data on Lebanon, especially before the 1990s, limited the amount of empirical work on this country. Unlike standard defense - growth literature that focuses mainly on total military expenditures, this study attempts to underscore the human resources' aspect of defense spending in Lebanon as measured by the armed personnel. It also examines the temporal causality between defense spending (i.e. total defense resources) and economic development, and between armed personnel (i.e. human defense resources) and economic development. Results show that total defense resources, and perhaps more interestingly, human defense resources, retard Lebanon's economic development significantly. Findings also reveal that diverting human resources, relative to total resources including physical, away from the private sector may be at least three times more distorting than diverting physical resources (e.g., land, building, and materials).

الإنفاق الدفاعي والتنمية الاقتصادية في لبنان: تحليل التكامل المشترك ومتجه الانحدار الذاتي

روك أنطون مهنا

ملخص

إن نقص البيانات الإحصائية عن لبنان، وخصوصاً عن فترة ما قبل التسعينات، قد حد من كمية الأعمال الإمبريقية عن هذا البلد. وعلى خلاف أدبيات النمو الدفاعي التي تركز بشكل أساسي على مجموع الإنفاق الدفاعي، فإن هذه الدراسة تحاول التأكيد على جانب الموارد البشرية للإنفاق الدفاعي في لبنان مقاساً بعدد الأشخاص في القوات المسلحة. كما تشخص الورقة السببية المؤقتة بين الإنفاق الدفاعي (أي مجموع الموارد الدفاعية) والتنمية الاقتصادية، وكذلك بين عدد الأشخاص في القوات المسلحة (أي الموارد الدفاعية البشرية) والتنمية الاقتصادية. تبين النتائج أن الموارد الدفاعية وربما بشكل أكثر أ همية، الموارد الدفاعية البشرية، تعيق التنمية الاقتصادية في لبنان بشكل جو مري. كما تشير النتائج أيضاً إلى أن تحول الموارد البشرية، نسبة إلى مجموع الموارد بما فيها العينية، بعيداً عن القطاع الخاص، يمكن أن يكون مشو ماً ثلاث مرات على الأقل أكثر من تحول الموارد الطبيعية (مثل الأرض، المباني والمواد الأولية).

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Introduction

The lack of statistical data on Lebanon, especially before the 1990s, limited the amount of empirical work on this country. Unlike standard defense spending literature that focuses mainly on total military expenditures, this study attempts to underscore the human resources' aspect of defense spending in Lebanon as measured by the armed personnel. It borrows from the new growth theory to examine the relationship between defense spending (i.e. total defense resources) and economic development, and between armed personnel (i.e. human defense resources) and economic development.[1]

The relationship between defense spending and economic development is a controversial topic. There has been no sufficient empirical evidence on this relationship, while standard literature has synthesized few theoretical explanations. Defense spending may affect economic development either negatively through a crowding out of investment, positively through an expansion of aggregate demand, or positively through increased security. Past and contemporary work has examined the relationship between defense spending as measured mainly by total military expenditures—i.e. total physical and human resources—and economic development, and has reported mixed results (Sezing, 2000; Schiller, 1999; Kollias, 1994; Ward and Davis, 1992). These mixed findings are perhaps due to the methodology, sample period, sample countries, and/or the specificity of different countries.

Despite some recent attempts to investigate the relationship between defense spending and economic development in a panel set-up,[2] standard literature still shows a preference for examining the aforementioned relationship on a country basis time-series rather than panel data or cross-section (Kusi, 1994). The preference of country-specific studies is amplified by the dynamic existence of multi-layers of social, political, and economic factors embedded among different countries. Kusi (*op. cit.*) indicates that the link between defense spending and economic activity cannot be generalized across countries because it may depend on the sample period of study and the level of socio-economic development of the country concerned.

The puzzle between defense spending and economic development extends not only to their temporal causality, but also to the instrumentality and the endogeneity of pertinent variables. This is described by Gupta *et al.* (2001) and Mauro (1995) who argue that different channels linking defense spending to growth may exist in different countries, hence the preferable use of country-specific examination, rather than cross-country or panel data.

This study borrows from the new growth model of Barro and Sala-i Martin (1995) to address the physical, as well as the human capital aspects of defense spending, within a growth framework. The new growth model predicts the growth rate of economic development as a function of physical capital, human capital, a set of institutional determinants (e.g., rule of law), and some macroeconomic policies such as government spending, including defense spending, investment, trade openness and fertility rates.[3]

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(1) In this paper, the terms "economic development," "economic growth," and "growth" are used interchangeably and represent the growth rate in per capita real gross domestic product (GDP).

(2) See Dakurah *et al.*, 2001.

(3) Barro and Sala-i-Martin examine the link between defense spending and growth in cross-country regression and find inconclusive results. For further details on the role of defense spending within the new growth framework, see Barro and Sala-i-Martin (1995).

Following Mauro's (1995) and Kusi's (1994) rationales, this paper uses a time-series co-integration and vector autoregression (VAR) analysis. This would allow the focus on the distinct dynamics of a single country — Lebanon — as well as the isolation of the possible structural channels that could affect the link between defense spending and economic development. Additionally, the feature of the adopted econometric model would allow the accounting for major exogenous shocks over the years such as the Lebanese military build-up during the early 1990s post war period without necessarily following the Barro and Sala-i Martin approach (1995), which uses a dummy variable to control for war.

In addition to being the first empirical defense study in Lebanon, the author believes that no empirical work has yet explored the role of human defense resources within the defense-growth framework. Subsequently, the novelty of this paper is that it attempts to shed light on the role of human defense resources in economic development by separately examining the effects of total military expenditures and armed personnel as a percentage of labor force. This could be consistent with the globalization framework that argues in favor of the dominance of human resources over physical ones.

Therefore, it is hypothesized that: (1) an increase in defense spending, i.e. total resources; and (2) an increase in armed forces personnel, i.e. human defense resources, tend to burden the Lebanese economy and impede economic development.

Defense Spending and Armed Personnel in Lebanon

Lebanon's defense spending as a percentage of gross national income (GNI) in 1999 (4%) is way above the world average of 3.3%, averages for middle- and high-income countries of 2.7 and 2.3% respectively, and European average of 1.9%. Additionally, Lebanon's defense spending as a percentage of central government expenditures remained considerably high throughout the 1990s. In 1992, it was more than triple the share of Europe's and 55% larger than high income countries and world averages. However, it started to drop in the latter part of the decade as shown in Table 1.

Table 1. Defense Spending

	% of GNI		% of Government Expenditures	
	1992	1999	1992	1999
Lebanon	4	4	18.5	11
Middle East & N. Africa	14.5	7	49	28.5
Low Income	2.6	2.5	11.8	13.8
Middle Income	4	2.7	21.1	15.8
High Income	3.1	2.3	11.1	9.1
Europe EMU	2.3	1.9	5.7	5.2
World	3.2	2.3	12.2	10

Source: World Bank. 2002. World Development Indicators.

Ironically, while most of the world, including low, middle, and high-income countries; European countries; and the Middle East (especially the Gulf States after the 1990 Gulf war) and North Africa known for their recent high military spending, cut their armed forces personnel as a percentage of the labor force, Lebanon increased its already high percentage from 3.1 in 1992 to 3.9 in 1999 (see Table 2). Lebanon's large percentage of armed forces personnel is to be compared, for instance, with middle-income countries and the world average that went down from 1% in 1992 to 0.7% in 1999.

Table 2. Armed Forces Personnel

	Total in thousands		% of Labor Force	
	1992	1999	1992	1999
Lebanon	37	58	3.1	3.9
Middle East & N. Africa	2,631	2,529	3.3	2.6
Low Income	6,483	6,254	0.7	0.6
Middle Income	12,383	10,220	1	0.7
High Income	5,665	4,724	1.3	1
Europe EMU	2,181	1,768	1.6	1.3
World	24,533	21,198	0.9	0.7

Source: World Bank. 2002. World Development Indicators

Three other issues to wit: (a) national security, (b) foreign policy, and (c) the trade off between *guns and butter*, are also pertinent to the "broader" topic of defense spending but not examined in this empirical study because they deserve to be investigated in a separate analysis. Consequently, this study examines a timely topic of significant importance affecting a current public policy dilemma in Lebanon. The country is struggling to find ways to control its flagrant public debt which is 180% of GDP in 2002. In addition, until this writing, there exists no such empirical study of the impact of defense spending in Lebanon.

The Lebanese public debt dilemma is obviously exacerbated by the large interest payments (48% of the budget in 2002), the slow privatization process, the large public wage bill and the unstable regional political situation. Subsequently, this study attempts to shed more light on the under-addressed component of government defense spending. In the midst of fiscal austerity measure, it may be noted that defense spending as a percentage of total public expenditure has dropped from 9.96% in 2001 to just 9.63% in 2002, a mere 0.33 percentage point (Lebanese Ministry of Finance, 2002).

Literature

The literature on defense spending and economic development is at once rich and also inconclusive. Several studies report a positive link, while others report a negative one. Kollias (1994) and Dunne and Nikolaidou (2001) examine the effect of defense expenditure on economic growth in Greece between 1963-1990 and 1960-1996, respectively, and find a significant negative relationship between defense spending and the economic welfare of Greece. Similarly, Dunne and Vougas (1999) adopt a VAR model to estimate the effect of military spending on the South African economy and report a negative link. Alternatively, Sezing (2000) analyzes the link between defense spending and growth in Turkey using a disaggregated approach where he finds a

significant positive correlation between the two variables. However, none of these studies consider the human resources aspect of defense policy.

Several studies have investigated the US defense policies for a 45-year period, and have argued that US defense spending is negatively correlated with economic development due to either the added budget deficit or the reduction in investment (Lapidus, 1993; Mintz and Huang, 1990; Ward and Davis, 1992). Conversely, Mueller and Atesoglu (1993) argue that the instrumentality of research and development in technology tend to spur a significant positive relationship between defense spending and economic development in the US.

Baran and Sweezy (1966) analyzed the role of defense spending in a sample of eighteen of the wealthiest capitalist countries. Their findings, known as the Baran-Sweezy theory, indicate that the greater the role of defense spending is in a capitalist economy, the lower the level of unemployment and the faster the rate of growth should be. However, Szymanski (1973) disputes the Baran-Sweezy theory and finds that while the level of unemployment is associated with the level of defense spending as predicted by the theory, the rate of growth is negatively associated.

From the perspective of new growth models, Mehanna (2002) argues that among developing countries, internal political stability, rather than government defense spending, would provide an environment conducive to economic growth. Barro and Sala-i Martin (1995) explore defense spending across countries to determine if it really acts as a productive instrument. To control for war, they add a dummy variable for countries that participated in at least one external war over the period 1960-1985. They postulate that an exogenous increase in government expenditures on defense could generate better national security. However, if the increase in defense spending is due to greater military threats, then such an expenditure would be nonproductive. They also find that the estimated coefficient of defense spending has an insignificant effect on economic growth.

Mehanna and Hassan (2003) examine the increase in US defense expenditures during the Kosovo war and its impact on the US domestic economy. They argue that an increase in defense spending would act as a fiscal policy that could stimulate aggregate demand if a country faces a potential or current war under the following circumstances of: (1) a remote location (not with a bordering state); (2) a collective effort (the country is a member of an international or regional body like NATO, UN, etc.); and (3) against a relatively marginal military power that would not threaten national security.

Methodology

This study borrows from the new growth theory of Barro and Sala-i Martin (1995):

$$PCI = f(DEF\ ;\ PERS\ ;\ X_i) \qquad \text{(Equation 1)}$$

where *PCI* denotes growth in real GDP per capita; *DEF* denotes growth in defense spending per capita ; *PERS* denotes growth in the ratio of armed personnel to labor force; and X_i represents a set of institutional determinants (e.g., rule of law) and other macroeconomic policies, such as trade openness and investment. Within the new growth framework, *DEF* is a component of the traditional determinant government spending (with a net negative impact); while *PERS* is one aspect of the broader human capital, which is depicted in endogenous, as well as new growth models.

Defense spending can crowd out investment, spur aggregate demand, and/or improve security, affecting economic development negatively in the former or positively in the latter two.

It is hypothesized here that the negative impact through the crowding out of investment, as well as human resources, outweighs the other two positive forces, aggregate demand and national security. According to both the endogenous and new growth theories, the main productive component in defense spending is research and development (R&D), something that is mostly absent in Lebanon. Subsequently, the diversion of physical resources away from the private sector could thwart entrepreneurial activities, a prominent engine for growth, particularly in Lebanon.

Perhaps more importantly, the diversion of human resources (armed forces personnel) from the private towards the public sector could have an even greater negative impact on economic development than physical capital does. Additionally, the argument behind the positive effect of security from external threats (and not internal security, which is the job of police/internal forces, i.e., Ministry of the Interior and not the Defense Ministry) could be much challenged. In fact, Lebanon's small military prowess relative to the much larger two regional (border) countries, Israel and Syria, makes the outcome of security from external threats unfeasible and irrelevant.

Growth in defense spending per capita is used as a proxy for military spending (i.e., total defense resources) and is represented by the symbol DEF. The growth rate in real gross domestic product (GDP) per capita is used as a proxy for economic development (or per capita income) and is represented by the symbol PCI. This study also employs the armed forces personnel (referred to as PERS) as a percentage of labor force as a proxy for the human defense resources. DEF, PERS, and PCI quarterly data are from 1985-Q1 through 1999-Q4. The data sets are collected and disaggregated quarterly following the exponential smoothing approach to increase their frequencies. The data are borrowed from the World Bank's World Development Indicators, the Bureau of Verification and Compliance's World Military Expenditures and Arms, and Lebanon's Ministry of Finance.

Data on defense spending from governments are often incomplete and unreliable. Thus, most researchers supplement their data from various sources. Defense spending data cover expenditures of the Ministry of Defense. Excluded are expenditures on public order and safety, which are classified separately. Armed forces personnel refer to active duty military personnel but exclude civilian police.

As previously noted, casual observation suggests a plausible association between defense spending and economic development in Lebanon. It is also useful to note that the new growth model, as well as much of the literature which reports a significant link, both indicate that the contemporaneous change in defense spending tends to impact subsequent rates of economic development. The direction and the resource components, however, differ. In order to prove any significant existence and causality in this stylized relationship, a co-integration analysis is performed followed by a dynamic VAR model to estimate the link between PCI, DEF, and PERS.

This study follows the Johansen co-integration and error correction methodology supplemented by a VAR and Granger analysis to assess the endogeneity of and causality between pertinent variables.[4] Johansen methodology begins with the first-order vector autoregression (VAR) where one can generalize this model to allow for a higher-order VAR as follows:

[4] For further discussion of the Johansen co-integration and error correction methodology, see Enders, 1995.

$$\Delta X = \sum_{i=1}^{p-1} \pi \Delta X_{t-1} + \pi X_{t-p} + \varepsilon_t \qquad \text{(Equation 2)}$$

where X is a vector with $(n \times 1)$ dimension; n is the number of variables in the model (in this article, $n = 2$); ε is a vector of error terms with $(n \times 1)$ dimension; A is an $(n \times n)$ matrix of parameters; I is an $(n \times n)$ identity matrix; $\pi = (A - 1)$ is the number of co-integrating vectors; p is the order of autoregressive process; π is the number of co-integrating vectors; and Δ stands for the first difference. One may obtain the number of co-integrating vector by checking the significance of the character roots λ of π. If the variables are not co-integrated, the rank of π is zero.

The co-integration and error correction model identifies the long-run equilibrium among two or more time series variables. If two or more series are found to be co-integrated, those series will move together in the long run. In order to have co-integration in series, all series must first be integrated in the same order. Therefore, prior to testing for co-integration, an Augmented Dickey-Fuller test is performed on both the level and first-difference of the growth rates in per capita and the defense spending. The null hypothesis is that each series has a unit root. Table 3 presents the results.

Then, the co-integration test is applied. Johansen created test statistics of λ trace and λ max to test for the co-integration. R represents the order of co-integration. The co-integration test is performed at the order of zero to three. The result appears in Table 4.

To substantiate the co-integration result and estimate the temporal causality, as well as the relationship between defense spending (armed forces personnel) and economic development, all variables are treated as endogenous in two separate VAR models. This study runs two separate system equations of a 2-variable VAR model instead of one 4-variable model to avoid any misspecification due to multicollinearity between DEF and PERS.

A standard VAR can track in innovations in one series on the other one over varying time lags. Briefly stated, in a VAR model, every equation has the same right hand variables, and those variables include lagged values of all the endogenous variables. The inclusion of lagged values of the endogenous variables is intended to eliminate estimation bias associated with simultaneity and serial correlation. The following VAR are estimated using lags for each of the endogenous variables and four constants to capture the effects of exogenous variables including rule of law, investment, education, life expectancy, and fertility rates (see Equations 3 through 6). The VAR models in standard form are specified as follows:

Defense Spending and Economic Development System Equation:

$$PCI_t = \varphi_{10} + \varphi_{11} PCI_{t-1} + \varphi_{12} DEF_{t-1} + \varepsilon_{1t} \qquad \text{(Equation 3)}$$

$$DEF_t = \varphi_{20} + \varphi_{21} PCI_{t-1} + \varphi_{22} DEF_{t-1} + \varepsilon_{2t} \qquad \text{(Equation 4)}$$

Armed Forces Personnel and Economic Development System Equation:

$$PCI_t = \Omega_{10} + \Omega_{11} PCI_{t-1} + \Omega_{12} PERS_{t-1} + \nu_{1t} \qquad \text{(Equation 5)}$$

$$PERS_t = \Omega_{20} + \Omega_{21} PCI_{t-1} + \Omega_{22} PERS_{t-1} + \nu_{2t} \qquad \text{(Equation 6)}$$

where PCI is growth in economic development per capita; DEF is growth in defense spending per capita; and PERS is growth in armed forces personnel. A_{i0} is element i of the vector A_0; φ_{i0} and Ω_{i0} are the constant terms; φ_{ij} and Ω_{ij} are the elements in row i and column j of the matrix A_1; and ε_{it} and ν_{it} are innovations for PCI, DEF, and PERS.

According to the VAR model represented in Equations 3 to 6, this study expects initial defense spending (and armed forces personnel) to negatively affect subsequent rates of economic development ($\varphi_{12}, \Omega_{12} < 0$). To render the innovations uncorrelated, the innovations are purged of any shared component before estimation of the parameters. Firstly, the impulse-response functions (IRF) are estimated to examine the effects of an innovation in a given variable on the endogenous variables that appear in the model. The response functions are equivalent to dynamic multipliers providing an estimate of the current and future response of a variable in the left-hand side of the equation to an innovation in one of the variables in the right-hand side of the system. Results are reported in Table 5.

Secondly, variance decomposition estimates are used to trace out the effects of innovations in all series. The decomposed variance estimates are indicative of the magnitude and the longevity of the variance in the system variables that can be attributed to an external shock. Results of variance decomposition and Granger-causality are reported in Table 6.

Empirical Analysis

The Augmented Dickey-Fuller test indicates the following results (see Table 3). From Panel A, at the 5 percent significance level, the null hypothesis of having a unit root in each level series cannot be rejected. This implies that each series is nonstationary or has a unit root. However, in Panel B the null hypothesis of each differenced series having a unit root is rejected. This means that each series is stationary after the first difference. Also, the Phillips-Perron (PP) unit root test, which accounts for a plausible structural change in the series that could occur due to the political changes in Lebanon during the early 1990s, shows similar results. This indicates that all level series contain a single unit root and that all series (PCI, DEF, and PERS) are integrated at the order 1, I(1).

Table 3. Augmented Dickey-Fuller Unit Root Test

Series	Lag (p)	ADF (p)	PP (p)
Panel A: Level Series			
PCI	0	-2.08	0.58
DEF	5	-1.92	-2.70
PERS	2	-2.63	-1.29
Panel B: First Differenced Series			
DPCI	0	-5.17*	-21.08*
DDEF	0	-5.02*	-61.88*
DPERS	1	3.83*	-32.13*

N.B. PCI denotes growth in per capita income (i.e., economic development per capita); DEF denotes growth in defense spending per capita; PERS denotes growth in armed forces personnel. Variables beginning with D represent data after taking the first-difference. All variables are presented in log form. See details of unit root test in Enders (1995: pp 211-215).
*Indicates rejection of the null hypothesis of nonstationarity at less than 5% level of significance.

The co-integration results of DEF and PCI in Table 4 show the following. Firstly, the value of λ trace at $R = 0$ is 20.05, which exceeds the 95 percent critical value of the λ trace statistic. Hence, the null hypothesis of no-cointegrating vectors ($R = 0$) is rejected and the null hypothesis of $R = 1$ against the alternative of two or three co-integrating vectors ($R > 1$) is accepted. Since the λ trace statistic of $R = 1$ and $R > 1$ is 3.97, which is less than the 7.41 of the 95 percent critical level, the null hypothesis of $R = 1$ is not rejected. It may be concluded that there is a single co-integrating vector. Also, the λ max test reports that the null of $R = 1$ (against the alternative of $R = 2$) is not rejected. Thus, it is concluded that PCI and DEF co-move together in the long run. Similarly, PERS and PCI results show that the null hypothesis of $R = 1$ cannot be rejected. Therefore, this indicates that PERS and PCI series co-move together.

Table 4. Co-Integration Test Results

DEF and PCI			
Null Hypothesis	Alternative Hypothesis	Values	95% Critical Value
λ trace tests			λ trace value
$R = 0$	$R > 0$	20.05*	15.68
$R = 1$	$R > 1$	3.97	7.41
λ max tests			λ max value
$R = 0$	$R = 1$	19.77*	12.18
$R = 1$	$R = 2$	3.82	7.41
PERS and PCI			
Null Hypothesis	Alternative Hypothesis	Values	95% Critical Value
λ trace tests			λ trace value
$R = 0$	$R > 0$	22.16*	15.68
$R = 1$	$R > 1$	4.35	7.41
λ max tests			λ max tests
$R = 0$	$R = 1$	18.12*	12.18
$R = 1$	$R = 2$	4.21	7.41

N.B. All variables are tested on lag length of 2. Lag length is selected based on the results from Akaike's Information Criterion (AIC) and Schwartz Bayesian criterion (SBC). Lag length is selected based on forecasting performance. The lag that yields the best forecasting performance is the one that yields the lowest sum of square residuals. Although it is highly reasonable to use lags 3 to 12, the test results indicate that these lags did not have predicting power because they yielded high sum of squared residuals. See more details of lag length selection in Enders (1995: p 88). *R* denotes the rank of co-integration. N=60 observations.
*Indicates rejection of the null hypothesis of no co-integration at 5% level of significance.

If there exists a co-integrating vector between two series, there is causality among these variables in at least one direction. While there appears to be co-movement between each pair of series, to substantiate the results of the co-integration analysis and test further for any causality, a VAR test coupled with impulse-response functions, variance decompositions, and Granger-causality are employed. The impulse-response function for each variable that stem from innovations in its own lagged values against time is first examined. Casual observations demonstrate that the response from a shock to the endogenous variable is swift and tends to last for about three periods. Results indicate that all variables (PCI, DEF, and PERS) are exogenous.

VAR results support the hypotheses (see Table 5). Findings of Model 1 show that the impact of defense spending negatively and statistically predicts economic development at the 1% level of significance. Model 2 results indicate that the effect of armed forces personnel as a percentage of labor force negatively and significantly affects economic development. Both VAR models show a unidirectional impact from lagged defense spending and lagged armed personnel on the steady position of economic development. The implications of the estimated coefficients of both models are as follows: (1) a one percent increase in the armed forces personnel as a ratio of the labor force tends to hinder economic development per capita by 0.46 %; and (2) a one percent GNI devoted for defense spending tends to hamper economic development by 0.6 %.

Table 5. Vector Autoregression (VAR) Results

Model 1: PCI and DEF		
	Lag PCI	Lag DEF
PCI	0.726***	-0.613***
	(0.102)	(0.089)
DEF	0.43	0.388**
	(0.312)	(0.15)
Model 2: PCI and PERS		
	Lag PCI	Lag PERS
PCI	0.741***	-0.465***
	(0.148)	(0.11)
PERS	0.22	0.831**
	(0.18)	(0.365)

N.B. PCI, DEF, and PERS denote economic growth per capita, growth in defense spending per capita, and growth in armed personnel ratio, respectively.
Standard errors are reported in parentheses.
N=60 observations.
** indicates 5% level of significance.
*** indicates 1% level of significance.

The Variance Decompositions test in Table 6 shows that all series explain their own past values. PCI explains about 99% of its forecast error variance, while DEF and PERS explain 95 and 93% of their own forecast error variance, respectively. This variance decomposition test implies that past values of economic development, defense spending, and armed personnel also help predict their future values. Defense spending explains 4.59% of forecast error variance of PCI, while PCI explains only 0.12% of forecast error variance of defense spending. Similarly, armed forces personnel explain 5.36% of forecast error variance of PCI, while economic development explains a mere 0.09% of forecast error variance of PERS.

The Granger causality test (shown enclosed in parentheses in Table 6) confirms the results of VAR (Table 5), where growth in both defense spending and armed personnel Granger-cause economic development, separately. The Granger causality test indicates that the effects of DEF and PERS on PCI are highly and statistically significant at the 1% level of significance.

Also, in line with the VAR results, the Granger test indicates no significant impact from PCI on either DEF or PERS.

All the aforementioned econometric findings are substantiated and tell nearly the same story, which is that defense spending, whether measured by military expenditures or by the armed forces as a percentage of labor force, significantly hinders economic development in Lebanon. More importantly, the size of the diverted growth in human defense resources (more army recruits) occupies more than two-third of the total defense spending, leaving less than one-third for the physical component (e.g., equipment, materials, buildings, tanks, vehicles, etc.).

Table 6. Variance Decomposition and Granger-Causality Results

Model 1: PCI and DEF		
	Lag PCI	Lag DEF
PCI	99.83 (0.000)	4.59 (0.01)
DEF	0.12 (0.21)	95.31 (0.022)
Model 2: PCI and PERS		
	Lag PCI	Lag PERS
PCI	98.66 (0.000)	5.36 (0.01)
PERS	0.09 (0.28)	93.01 (0.03)

N.B. PCI, DEF, and PERS denote growth in per capita income, growth in defense spending per capita, and growth in the ratio of armed personnel to labor force, respectively.
Granger-causality results are reported in parentheses.

Conclusions and Policy Implications

This is the first empirical study that investigates the relationship between defense spending and economic development in Lebanon. The novelty of this study is that it assesses the size and direction of the human resource aspect of defense spending, as measured by the ratio of armed personnel to labor force. It adopts the modern co - integration and VAR techniques to estimate the long-term co-movement of the series, as well as their potential temporal causality.

Results show that total defense spending retards Lebanon's economic development significantly. The timeliness of this study occurs at a time when Lebanon faces serious public debt and budget deficit crises. Thus, it may help to shed light on an under-addressed, yet essential, component of government expenditures, i.e. defense spending. In turn, defense spending is one of the major avenues where spending cuts could be realized. However, the government has not yet addressed this critical issue sufficiently and adequately. For instance, defense spending as a percentage of total public expenditures dropped from 9.96 in 2001 to just 9.63 in 2002, a mere 0.33 percentage point (Lebanese Ministry of Finance, 2002).

Furthermore, results indicate that human resources diverted towards armed personnel hinder Lebanon's growth rate. For instance, most official attempts have focused on increasing public revenues through introducing a 10% value added tax (VAT), increasing different taxes (e.g., electricity, phone, gas, real estate), improving tax collections (unfortunately, only from certain regions of the country), and so on. What remains undone is a serious attempt to contain public expenditures, primarily public human resources. In addition to the burden of interest payments that devours most of the budget, the inflated public wage bill including armed personnel remains a major hindrance and practically untouchable.

The co-integration results of this study show that in the long - term, defense spending and armed personnel co-move inversely with economic development. VAR results show that every 1% of GNI devoted to defense spending robs Lebanon of about 0.62% of economic growth. Additional findings indicate that every 1% in armed personnel diverted from labor force costs Lebanon about 0.46% of economic development (or about US$86 million annually in 1999 exchange rate).

Perhaps most interestingly, findings reveal that diverting human resources relative to total resources of physical and human, away from the private sector may be at least three times more distorting than diverting physical resources (e.g., land, building, and materials). This supports the main hypothesis and is consistent with the modern globalization view, which reverses the conventional view and prioritizes the dominance of human resources over physical ones. This implies that the inflating size of the armed personnel hampers growth much more than the other physical allocations.

Now that the civil war is over and the government has finished its aggressive human resource defense policy to contain former militia members, the government should abandon its expansionary defense policy. This recent policy increased the number of armed personnel by 54% in about 5 years to reach 58 thousand (or about 4% of the total labor force) coupled with inconsistent and unparalleled increases in benefits. The implication is that the Lebanese government should cut its military expenditures, mainly by decreasing or controlling the number of armed personnel, or even more feasibly by redirecting armed personnel's efforts towards productive social development projects.

The current over-capacity in army personnel could be trained and efficiently utilized for social development projects and other public services. For instance, many army personnel could plug in the current needs for public auditors (a serious need at the Ministry of Finance) and utility tax collectors. They could assist in building, repairing, maintaining and enhancing public infrastructures, such as the water supply pipes, new water canals, public parks, animal and environmental reservations.

Equally important for the survival of such proposal is a well communicated message that portrays such social contributions (especially in rural and deprived areas) conducted by the armed forces personnel (soldiers and officers) as being equally significant, noble, patriotic, and consistent with their initial defense/military duties. Working on such development projects may also be Pareto superior to Lebanon, through cutting public expenses, improving standards of living, narrowing income disparities, and perhaps promoting aggregate growth. This reallocation of human resources away from defense and towards development projects is an interesting topic for future research.

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