Greece and Turkey:
A Comprehensive, Critical Review of the Defense Economics Literature (as of December 2002)

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Abstract: This chapter contains a comprehensive, critical review, as of December 2002, of the entire literature on the economics of military affairs in Greece and Turkey. In particular, I review (a) arms race models, (b) models of the demand for military expenditure, (c) models measuring the economic impact of military expenditure, (d) the literature and issues relating to indigenous arms production, and (e) a few papers dealing with other aspects of the economics of military affairs of Greece and Turkey. I conclude with a number of summary lessons and observations of how future research might improve upon the existing body of work.

Greece and Turkey: A Comprehensive, Critical Review of the Defense Economics Literature (as of December 2002)*

Introduction and issues

The purpose of this chapter is twofold. First, I offer (as of December 2002) a comprehensive, critical review of the extensive literature on Turkish and Greek military expenditure, its politico-military underpinnings, and its micro and macroeconomic effects. Second, I point to shortcomings and gaps in the literature.

Greco-Turkish relations since 1923

Some facts of the relevant history of the Greco-Turkish conflict are quickly told. Both the Greek and the Turkish governments agree, as do the scholars, that following the peace treaty of Lausanne and the founding of modern Turkey in 1923, the countries enjoyed a period of mutual friendship under Greek Premier Venizelos and Turkish President Atatürk (Demirel, 1998/99; Stephanopoulos, 1998/99). Substantial Turkish minorities lived in northern Greece and in Bulgaria, and large numbers of Greek population pockets existed in Turkey.[1] Greeks and Turks also shared, in varying population percentages, a number of Aegean islands. Both nations joined NATO in 1952, constituting NATO's southeastern flank, and both sent troops to Korea during the Korean war (Krebs, 1999, p. 358). For Greece, joining NATO was a decisive event, following, as it did, the defeat of communist forces in its five year civil war of 1944-1949, but this gave its army an overly prominent role in public affairs, culminating in a military dictatorship which lasted from 1967 to 1974. Turkey also saw episodes of military rule, namely from 1960-1961, 1971-1973, and 1980-1983.

The island of Cyprus – the most prominent bone of contention between Greece and Turkey – had been leased by the British from the Ottoman empire since 1878 and came under direct British rule in 1914. Over Turkish-Cypriot unease, Greek-Cypriot guerilla unrest developed on the island in the 1930s, eventually resulting in an independent and Greek-Cypriot dominated Cyprus by 1960 (Turan and Barlas, 1999, pp. 474-475). Even though the new constitution guaranteed representation to both population segments, Greco-Turkish conflicts in and over Cyprus broke out several times throughout the 1960s. Only a "most brutal diplomatic note" by US President Johnson prevented a planned Turkish invasion of Cyprus in 1964 (Krebs, 1999, p. 361). Then, in the summer of 1974, a Greek-inspired coup on Cyprus led not only to the Turkish invasion of the northern part of the island but also to the fall of the Greek military dictatorship in Athens. In consequence of the invasion, Turkey now holds about 40 percent of the island's territory and 17 percent of the population live in northern Cyprus. Turk-Cypriots declared an independent Turkish Republic of Northern Cyprus (TRNC) on 15

November 1983, an entity recognized only by Turkey.

Apart from Cyprus, there are four other primary areas of dispute between Greece and Turkey. They are: (a) disputes over the extent of territorial waters in the Aegean; (b) disputes over the extent of territorial airspace; (c) disputes over continental shelf rights; and (d) disputes over Greek militarization of certain Aegean islands. Since 1974, the countries' respective forces were placed on full alert in 1987, 1994, and 1996, narrowly avoiding war between Greece and Turkey (Athanassiou and Kollias, 2000; Matthews, 1999). Both countries very much look to the United States in particular to help mediate their conflict which, with the end of the bipolar NATO-Warsaw Pact hostility, has taken on renewed urgency (Krebs, 1999).

Greco-Turkish cooperation

Despite its history of sharp conflict, it must be pointed out that, except for Cyprus, the "Turko-Greek relationship has been characterized by peace" (Turan and Barlas, 1999, p. 486), albeit an uneasy and fragile one, and that Greece and Turkey cooperate in a number of venues. Both joined NATO on 18 February 1952; both contributed to NATO-led peacekeeping forces in Bosnia and Albania (Turan and Barlas, 1999, p. 482); Greece is a member of the EU since 1 January 1981 and, after long opposition (Constas, 1995, p. 78; Neal and Barbezat, 1998, p. 360), it recently – in March 1997 – supported Turkey's application for full EU membership if only because Greece's interests are better served with Turkey in the EU than outside the EU (Kurop, 1998). Turkey has been an associate EU member since 1964 and was admitted to full candidacy status in December 1999. Greece and Turkey are both members of the Black Sea economic cooperation area, alongside Albania, Armenia, Azerbaijan, Bulgaria, Georgia, Moldova, Romania, Russia, and the Ukraine, a region comparable in size and population to the EU (Sen, 1993). The association was formed by non-binding declaration in Istanbul on 25 June 1992. And in Athens, on 12 January 1999, Albania, Bulgaria, Greece, Italy, Macedonia, Romania, and Turkey signed an agreement to complete arrangements for a regional peacekeeping force (*NOD & Conversion*, No. 48, June 1999, p. 20).

While Greece is embedded in, and ethnic-Greek populations are strewn across, the tumultuous Balkans, Turkey is not only surrounded by highly insecure and volatile countries, such as Iran, Iraq, and Syria and the newly independent follow-on states of the former Soviet Union but also faces internal security considerations regarding Islamic fundamentalism and its restive population of ethnic Kurds. Thus, both countries should greatly benefit from settling their mutual differences.

The Greek and Turkish economies

In mid-2001, Greece's population stood at 10.6 million people while Turkey's was at 66.2

million people. Greece's population growth is near-zero, while Turkey's population tripled between 1950 to 1995 and averaged 1.5 percent per year since then. For the 1980s, Greece's economy has been in almost continuous doldrums since joining the EU in 1981, resting on "generous subsidies and agricultural protection provided by the European Community ... directed as political favors inside Greece rather than used as incentives to promote economic growth and efficiency" (Neal and Barbezat, 1998, p. 299). The situation has changed for the better in the 1990s as Greece fulfilled membership criteria in its bid to join the European monetary union. In contrast, Turkey's economy grew apace despite two drastic recessions in 1980 and in 1994. However, Turkey suffers especially from its lack of monetary discipline, as evidenced by its long-standing hyperinflationary conditions. Overall, Greek gross national income *per capita* is nearly five times as large as that of Turkey. But Greece's overall GNI of $124.6 billion is only three-quarters of Turkey's $167.3 billion.[2, 3]

Military expenditure, armed forces, and arms production

Part of the confusion of findings in the empirical studies (reviewed in the next section) stems from whether or not to use *levels* of military expenditure or the *share* of military expenditure out of GDP. Frequently, the results of the studies, and their interpretation, appear to depend critically on whether *level* or *share* data are used. Use of *share* data confers certain statistical advantages, e.g., comparability of shares across countries, the convenience of not having to deal with deflators, or with exchange rate conversions into a common currency. But one must agree with Smith's (1998) sentiment that statistical convenience may not supplant substantive considerations. For instance, Georgiou, Kapopoulos, and Lazaretou (1996) tested for the presence of a Greco-Turkish arms race rivalry using shares of military expenditure in GDP, whereas Kollias and Makrydakis (1997b) used levels of military expenditures. The former found little evidence of an arms race, the latter found strong evidence of an arms race. Neither discusses the use of their respective data.

When the substantive concern is about the economic impact of military expenditure on variables of economic performance, such as economic growth, *share* data may be appropriate (yet see Sandler and Hartley, 1995, pp. 210-211 and Gold, 1997, p. 110). But when analyzing imminent military threat and testing for the presence or absence of an arms race, it is proper to use *level* data or better yet, *stock* data, since levels and stocks indicate actual or expected fighting capabilities of oneself vis-à-vis the putative adversary.[4] For example, between 1950 and 1985 Turkey's *share* of military expenditure out of its GDP hovered between 3.8 and 6.0 percent, averaging close to five percent. Yet in absolute, inflation-adjusted terms, its military expenditure increased ninefold, matching Greek absolute, inflation-adjusted military expenditure. After 1985, economic exhaustion in Greece induced it to hold its military spending steady in nominal terms, thus declining in real terms, and declining as a

share of Greek GDP. In contrast, since 1985 Turkey's absolute, inflation-adjusted military spending substantially outpaces that of Greece. Clearly, for the consideration of whether or not there existed an arms race, Greece would pay attention to Turkish capabilities reflected in absolute (levels), not in relative (shares) spending and in accumulated spending (stocks). In this case, the nod of approval here must go to Kollias and Makrydakis (1997b).[5]

But the co-author (Kollias) who correctly used levels data in 1997 used a *mixture* of level and share data in 1995. Writing a demand equation to determine the *level* of Greek military expenditure, Kollias (1995a) uses the *share* of Turkish military spending to Turkish GDP among the independent variables (p. 311). But why would the Greek politico-military establishment orient its level of military needs on Turkey's share? Irrespective of what the statistical analysis purports to show, it appears to me that it uses the wrong data to begin with. But following Anderton (1989), and to his credit, it is Kollias who for the Greco-Turkish case first pointed out that military capability is not appropriately measured in levels of military expenditure *per se* either but rather in the men and machines (military labor and capital), i.e., by the stock of military capability, that such expenditure finances (Kollias, 1996, especially pp. 222-225). In the process, Kollias uncovers an increasing ratio of Turkish to Greek armed forces, i.e., a quantitative armed force superiority by Turkey that apparently induced Greece to increase its capital intensity per Greek soldier.[6] In this regard, it is of importance to note that Greece and Turkey are ranked number nine and three, respectively, in the league of the world's largest arms importers and both have recently announced multi-billion dollar expansions of their indigenous arms production industry: Greece by US$ 15 billion for 1996-2000 and Turkey by US $31 billion for 1997-2006 (Matthews, 1999).[7] Although the countries' arms industries predates the Turkish invasion of Cyprus in 1974, both countries stepped up their indigenous arms production efforts in response to that invasion and to arms embargoes imposed on them by the US in particular.

When I examine specific models further on, we need to pay special attention to the use of data.

Models and methods; findings and results

With few exceptions, which will be discussed, the defense economics literature regarding Greece and Turkey confines itself to four major topics: (a) is there, or was there, an arms race between Turkey and Greece? (b) what determines the demand for military expenditure; (c) what is the impact, if any, of military expenditure on economic growth in Turkey and in Greece; and (d) what is the nature, extent, and impact of indigenous arms production in these countries? Take each in turn.

Arms race

In the literature I found nine attempts to model and test for the existence of an arms race between Greece and Turkey.[8,9] These are summarized in the table A1 in the appendix.[10] Even though the descriptive literature appears to suggest that, on balance, Greece fears Turkey more than Turkey fears Greece, leading one to expect that Greece would follow Turkish military spending, some of the statistical results in the earlier papers suggest the opposite: changes in Greek military expenditure appear to be followed by corresponding changes in Turkish military expenditure (Greece "leads," Turkey "follows"). One study finds bi-directional causality, others find no arms race relation whatsoever.

Whatever the statistical results, one of the problems with this literature is that whether or not the statistical results are in line with or contrary to one's expectations, *post hoc* rationalization is easy. Assume for instance that Greek military expenditure did follow Turkey's (the *a priori* expectation in Stavrinos, 1992, p. 124 and Georgiou *et al*., 1996, p. 232). In that case the rationalization is that Greece does not wish to fall behind Turkey.[11] Then suppose the opposite case: Turkish military expenditure follow Greece's. Now the rationalization is that Turkey does not wish for Greece to catch up (Stavrinos, 1992, p. 124). This raises the question of exactly what constitutes an arms race. Here, at least, the authors all agree. According to Stavrinos (1992, p. 122) and Georgiou *et al*. (1996, p. 236), if causality is found to run one way only then the "results do not support the basic hypothesis of an arms race process according to which current defence expenditure decisions are based on the opponent's past behaviour." Kollias and Makrydakis (1997b, p. 362) agree: "military expenditure aggregates should Granger cause each other." But Granger-causality, as Stavrinos (1992, p. 120, fn. 4) rightly points out, is not the same thing as causality in a philosophical sense. Here, Granger-causality is the statistical equivalent to Richardson-type action-reaction models (Dunne, Nikolaidou, Smith, 1999, p. 3). But those, surely, are not the only way to conceive of arms or other races. If one country does not wish to *fall behind*, or does not wish the other to *catch up*, is that not a race? To jump for one moment to another world region, if India follows China, and Pakistan follows India, do India and Pakistan race each other? Does an arms race exist only if it is mutual? I think not.

This is not merely a technical point and is more important than is at first apparent. This has to do with one of the most puzzling oddities of the entire set of literature. Of the dozens of empirical papers under review, only two – and none of the nine arms race models – explicitly consider the impact of the non-Greek external security environment on Turkey, or the impact of Islamic fundamentalism within Turkey, or the impact of Turkey's wrangling with its Kurdish population (the exceptions are Chletsos and Kollias, 1995b and Sezgin, 1998 [2001]).[12] That is, high levels of Turkish military expenditure, for reasons unrelated to Greece, may "falsely" have caused Greece to try to race (to catch up to) Turkey. Alternatively, high levels in Greek

military expenditure – for reasons unrelated to Turkey, viz., the volatile situation in the Balkans – may "falsely" have induced Turkey to *also* keep pace with Greece, in addition to its other security concerns. A Richardson arms race model, in Granger-causality form, cannot capture these complexities, and the reported findings are therefore uninformative in a substantive sense. "When we apply statistical tests, what we are almost invariably testing are characteristics of specific models, not theories," writes Smith (1998, p. 421).

I have been much impressed by figure 1 in Kollias and Makrydakis (1997b, p. 366). It shows the logarithms of the levels of Greek and Turkish military expenditure from 1950-1995. (These are annual data from various SIPRI yearbooks, expressed in constant 1985 US-dollar.) From 1950 to 1966 both increase in line with each other, but Greek military expenditure is at a lower level than Turkey's. The years 1967 and 1968 mark a structural break in the series, catch-up years as it were, and from then on until 1985 Greek and Turkish levels of military expenditure almost perfectly overlap each other. As from 1986, another visually clear structural break occurs: Turkey's military expenditure continues to rise, while Greece's stays almost perfectly flat so that the disparity between Greek and Turkish military expenditure grows in Turkey's favor. "Authors," writes Smith, "should persuade the reader that they understand the data and are able to describe their statistical characteristics. Often the best way to do this is with well chosen pictures ..." (Smith, 1998, p. 422). Well chosen pictures are rare in the literature under review, and figure 1 in Kollias and Makrydakis (1997b) is an excellent exception. It is remarkable that none of the earlier authors would have looked at the raw numbers, for the statistical analysis merely confirms what the figure makes amply clear: Greece's and Turkey's military expenditure were cointegrated until 1985 but not thereafter. If there was an arms race, it stopped in 1985. "Many articles give the impression," continues Smith, "that the authors have applied the statistical procedures without looking at the data" (Smith, 1998, p. 423). Or, as Andrew Lang put it: "He uses statistics as a drunken man uses lampposts – for support rather than for illumination"[13]

Smith heeds his own advice and produces a figure for levels of military expenditure in Turkey and Greece from 1960-1996 (in Dunne, Nikolaidou, Smith, 1999, p. 7) but there are some astonishing differences to the figure produced by Kollias and Makrydakis (1997b, p. 366).[14] For instance, the first structural break occurs not in 1967 and 1968 but rather from 1966 to 1974 and the second structural break occurs not with 1986 but in 1989/90. Moreover, in the figure by Dunne, Nikolaidou, and Smith, the level of Greek military spending is higher, sometimes drastically higher, than that of Turkey from 1966 to 1975, but in the figure of Kollias and Makrydakis the lines for military spending of the two countries are nearly equal and cross each other twice. Why do these substantive differences arise? The only difference I could locate is that Kollias and Makrydakis used SIRPI data indexed to constant 1985 US-dollars, whereas Dunne, Nikolaidou, and Smith used SIPRI data indexed to constant 1990 US-dollars. If a change in the base-year by a mere five years leads to such drastic differences

in the time-series of military expenditures for Greece and Turkey, one wonders about the validity of the statistical results, regardless of the degree of statistical sophistication.

In addition, with regard to the *share* of military expenditure in GDP, Dunne, Nikolaidou, and Smith insert a revealing footnote according to which Turkey's shares as reported in the 1998 SIPRI yearbook are much smaller than those reported in previous yearbooks and this is "not due to a change in the levels of military expenditure but to revisions in GDP series" (fn. 2, p. 7). In any event, after applying an array of cointegration, ECM, and VAR models, Dunne, Nikolaidou, and Smith are unable to find statistical evidence of an arms race between Turkey and Greece: "... there is some evidence of cointegration in Greece and Turkey," they write (p. 14) "but not in the form of a long run arms race. The results we get are difficult to interpret and extremely sensitive to minor features of the specification." In contrast, Kollias and Makrydakis (1997b) do find a systematic arms race but only if the statistical work includes a term to account for the second structural break in 1985.

So, is there, or was there, an arms race between Greece and Turkey? Whereas the statistical analysis is often handled masterly, the pre-statistical work is, too often, *ad hoc* and weak. Much the same has been pointed out by Anderton's general review of arms race models (1989) and by Alogoskoufis and Smith (1991) with respect to the use and misuse of error-correction models (ECMs), and this is well acknowledged in Georgiou's application to Greece and Turkey: "... suffice it to say that a mechanical approach is implicit in most A-R [action-reaction, i.e., Richardson type] models, no matter how sophisticated" (1990, p. 71). But since a draft version of the present chapter first appeared in 1999, three new papers have been published that provide more clarity. First, Smith, Sola, and Spagnolo (2000) model the relation between the two countries in a novel way as a bivariate regime-switching model. Instead of finding a traditional action-reaction arms race, their empirical findings "suggest substantial political inertia," i.e., if one country adopts a high military expenditure posture, so does the other, and if one country adopts a low military expenditure posture, so does the other. If Greece and Turkey are arms racing, then not against but with each other, as if they were jogging partners. Their military expenditure speeds up together and slows down together. The only misgiving I have about this paper is that it uses share data instead of level data. In another new paper, Kollias and Paleologou (2002) find bi-directional causality but emanating more strongly from the Turkish than from the Greek side. That is, "Greek defence spending is not autonomous but rather its size depends on the size of Turkish military expenditure to a larger extent than Turkish military expenditure depends on Greek defence spending" (p. 327). And Öcal (2002) uses non-linear smooth transition regression which investigates asymmetric responses in the military expenditure of the two countries. He finds that "increases and decreases in TME [Turkish military expenditure] growth carry asymmetric effects on GME [Greek military expenditure] growth, with the former being much more substantial than the latter" (p. 415). Both of the latter studies use level data.

Still, it seems to me that the relation between Greece and Turkey needs to be modeled as an overlapping relation: Turkey has a set of internal and external security concerns, part of which concern Greece, and Greece has a set of primarily external security concerns, part of which concern Turkey. None have security concerns that are exclusively related to each other and that's where all the arms race models fail because that is all they model (including Majeski, 1985, which I did not discuss in detail). Moreover, I am persuaded by the data that after the second structural break (either with 1985 and with 1989/90), the arms race, if any, between Greece and Turkey ended. Since then Greece appears to follow Turkey's level of military expenditure.

Single-equation demand for (causality of) military expenditure and Granger-causality papers

I have seen nine papers on the demand for Greek military expenditure[15] and five papers on the demand for Turkish military expenditure (two papers treat both countries; see tables A2 and A3 for summaries).

TURKEY

The first piece on Turkey (Chletsos and Kollias, 1995b) covers the 1960-1992 time period. It initially specifies demand for Turkish military spending (in real terms) as a function of NATO military spending (as a share of NATO GDP, excluding the figures for Greece and Turkey), as a function of Greek military spending (in level terms, presumably in real terms), and as a function of Turkish GDP (in real terms). The paper does not say, but presumably the figures are in US dollars. This is one of only two papers I found (the other being Sezgin, 1998 [2001]) that explicitly considers Turkey's Kurdish problem, modeled by means of a dummy variable (1 for 1989-1992; 0 otherwise) which turns out to be positive and statistically significant, as does the Cyprus dummy.

The most curious result of the paper is that the long-run, cointegrated demand equation shows a statistically significant and positive effect of Greek military spending on Turkish military expenditure, an effect that completely disappears in the short-run, error-corrected estimation. Also, in the long-run equation the coefficients for Cyprus and the Kurdish problem appear statistically insignificant (the t-values are low; p-values are not reported) whereas in the short-run equation, the authors specifically state the statistically significant positive effects (p. 72). This raises a couple of econometric issues: (a) what exactly is the econometrics of dummy variables in error-correction models (can they be treated like the intercept?), and (b) how shall we interpret the finding that Greek military spending is influential on Turkey's in the long-run but not at all in the short-run equation? In an important paper, Alogoskoufis and Smith (1991)

show that there are at least three approaches to and interpretations of ECMs (Phillips, Sargan and Hendry, and Engle and Granger). With the one recent exception noted earlier (Kollias and Paleologou, 2002), the contributors to the Greek-Turkish empirical literature invariably rely on the Engle-Granger interpretation. Alogoskoufis and Smith point out that the Phillips, and Sargan and Hendry approach does not necessarily yield coefficients that possess "a theoretical interpretation" (p. 104). In particular, the long-run coefficients "will reflect equilibrium, adjustment and expectations parameters" (p. 105) and that "parameterisations with quite different theoretical interpretations are observationally equivalent ... [and] ... the estimates themselves cannot inform us about the appropriate interpretation" (p. 106). In contrast, the Engle and Granger approach treats long-run equilibrium as a statistical, rather than substantive, phenomenon. The Engle-Granger approach is essentially an a-theoretical line of inquiry interested in statistical properties of time-series rather than in substantive questions of decision-making for economic actors. "... the economic interpretation of the estimated parameters is problematic ... [and does not] ... provide a satisfactory solution to the identification problem" (p. 110).

A second piece on Turkey – by Kollias and Makrydakis (1997a) – tests for Granger-causality between growth rates in GDP and the share of military expenditure in GDP. There are no other variables considered, other than a couple of dummy variables for the Cyprus crisis in the mid-1970s and it is perhaps not quite proper of me to treat this as a "demand" equation for military expenditure. Running two-variable Granger-causality equations implies the absence of an underlying, explicit theoretical framework with which to interpret the estimated parameters. The paper's conclusion is therefore overstated: the "empirical findings indicate unequivocally the absence of any causal relationship between the military expenditure and the growth rate in Turkey for the 1954-1993 period." It is overstated since, in essence, we have here a complex two-variable correlation test and no accounting for possible third-variable effects. The finding is presaged by the excellent figure 2 (Kollias and Makrydakis, 1997a, p. 200) which visually shows a nearly constant share of military expenditure in GDP relative to wildly fluctuating GDP growth rates. I note, once again, that there is no discussion of why the *share* of military expenditure GDP is used, rather than the level of military expenditure.

A third paper (Kollias, 1995c) treats both Turkey's and Greece's demand for military spending. As regards Turkey, the estimated equation is

$$MT_t = a + bAFgr_t + cMGRps_t$$

where MT is Turkish military expenditure as a share of GDP, AFgr is the number of Greek armed forces (in thousands), and MGRps is Greek military expenditure per soldier in constant US$ 1986. (The subscript *t* stands for time, 1970-1991). Both variables result in positive and statistically significant estimated coefficients. However, when correcting for the presence of

autocorrelation only MGRps remains significant. And when a dummy variable for the Cyprus conflict is added, none of the variables are statistically significant, and neither are they when lagged variables are used. Thus, the demand equation does not seem to capture underlying data-generating process and is not particularly informative for policy-purposes. A fourth paper that deals with both countries is Dunne, Nikolaidou, and Vougas (1998 [2001]). It also is a pure Granger-causality study and finds no cointegration between economic growth and the level of military expenditure for 1963-1996 but does find statistically significant negative uni-directional Granger-causality running from military spending to economic growth.

The fifth paper (Sezgin and Yildirim, 2002) – written in response to the earlier version of this chapter – uses an altogether different technique: an autoregressive distributive lag (ARDL) model. This is attractive for several reasons, including that the stationary of the underlying variables is not an econometric issue with this technique. Moreover, the paper uses data up to 1998, considerably lengthening the time-period under consideration, and it uses an explicit theory of the demand for military expenditure by taking account of external and internal security factors, budgetary and administrative factors, the influence of the armed forces, and of shock factors such as military coups. Unfortunately, despite acknowledging my concerns about the use of share data (milex/GDP) when estimating demand for military expenditure (p. 123), the study nonetheless uses such data. The practical justification is that when external security factors (e.g., NATO, Greece) are included in the modeling, the data have to be comparable across the entities. This is true from a practical point of view but in the end we want to answer substantive questions. I suggest that perhaps a way around this problem is to create a military spending index for each country and use deviations from each country's index as the relevant "threat" variable that others might respond to. The advantage is that indices are comparable while each index remains data in level form. At it is, the Sezgin and Yildirim (2002) paper finds that changes in the demand for Turkish military burden (military expenditure as a share of GDP) depend in the short-run, positively and statistically significantly, on changes in its own lagged value (i.e., inertia), on changes in NATO's military burden, and on changes in Greece's contemporaneous and lagged military burden. Negative influences are changes in Turkish income and changes in its balance of trade. Income and balance of trade remain negative determinants in the long-run as well, but the only positive determinant that remains is NATO's military burden.

Other demand equations for Turkish military expenditure are found only within the context of simultaneous equation systems discussed in the next section. The following subsection examines the more numerous works that attempt to capture the Greek demand for military expenditure.

GREECE

As regards the nine studies on the demand for Greek military expenditure, two use a simple OLS regression framework, five employ cointegration and error-correction models (two of which are Granger-causality studies), one study uses two models of welfare-maximization under constraints, and the final one applies a neural-network model to the data (Refenes, Kollias, Zapranis, 1995). This last paper, whose purpose concerns the predictive power, both in forecast errors and turning-point errors, of neural network as compared to regression analysis, is an interesting and novel piece of work.[16] For the time period of 1962-1990, the model captures the growth rate of Greek military expenditure in time $t + 1$ as a function of (a) the ratio of Greek to Turkish armed forces; (b) constant Greek military expenditure per soldier; (c) constant Turkish military expenditure per soldier; (d) Greek military expenditure as a percentage of Greek GDP; and (e) Turkish military expenditure as a percentage of Turkish GDP (Refenes, Kollias, Zapranis, 1995, p. 33). The conclusion of that study is that the least-squares error of the neural network "is much better than [in the] regression, but more important is the fact that the neural network is capable of predicting directional changes far more accurately than the regression" (p. 35). But is the regression a valid regression on an underlying hypothesized data-generating process, or is it a straw man? Refenes *et al*. never make the case for their particular regression, nor are the regression diagnostics convincing. For example, even though p-values are not reported, not one of the independent variables appears statistically significant (i.e., the t-values are relatively small) and there is likely a fair amount of uncorrected multi-collinearity among the independent variables. This does not strike me as a good demand equation for Greek military expenditure, although the point of the paper – on neural networks – is of course well taken.

This leaves eight papers. As mentioned, one (Kollias, 1995c) treats both Turkey's and Greece's demand for military spending. As regards Greece, the estimated equation is

$$MG_t = a + bAFtur_t + cMTURps_t$$

where MG is Greek military expenditure as a share of GDP, AFtur is the number of Turkish armed forces (in thousands), and MTURps is Greek military expenditure per soldier in constant US$ 1986. (The subscript *t* stands for time, 1970-1991). Both variables result in positive and statistically significant estimated coefficients. When correcting for the presence of autocorrelation both variables remain significant. When a dummy variable is added to capture the effect of the Cyprus conflict the dummy is statistically insignificant. An equation run with lagged variables turns up only statistically insignificant coefficients.

This leaves seven papers. For data covering 1970-1990, Kollias (1993a) writes this model:

$$MG = a_0 + a_1DUM + a_2MT + u_t$$

where MG and MT are Greek and Turkish military expenditure as a percentage of GDP, and the dummy variable is set to equal one for all post-1974 years. The coefficients on the independent variables turn out to be positive and statistically significant. A second model is

$$MGRps = a_0 + a_1DUM + a_2AFrat + a_3MTSrat + u_t$$

where MGRps is Greek military spending per soldier, AFrat is the ratio of Greek to Turkish armed forces, and MTSrat is the ratio of Greek military expenditure per soldier to Turkish military expenditure per soldier. Again, the coefficients for all independent variables are statistically significant and positive, except that for AFrat which is negative, i.e., the higher is the ratio of Greek to Turkish armed forces, the smaller is Greek military expenditure per soldier. The R^2 statistic for both models is high (0.87 and 0.94). The paper does not provide much by way of regression diagnostics and, as we shall see, econometric questions of time-series stationarity, cointegration, and error-correction methods quickly became prominent in the literature – often at the expense of continued substantive thinking about the nature of the underlying problem.

For data covering 1962-1988, Kapopoulos and Lazaretou (1993, p. 77) specify this model:

$$MGR_t = c_0 + c_1\, SMTU_t + c_2\, SMUS_t + c_3\, Y_t + u_t$$

MGR, the level of inflation-adjusted Greek military expenditure, is a function of the share of Turkish military expenditure in GDP, the share of US military spending in GDP, and the level of Greek inflation-adjusted, civilian GDP (u is the error term). On the face of it, does the equation make sense, irrespective of what the statistical runs may or may not purport to show? The authors present a figure (figure 3, on p. 76) of Greek, Turkish, and US respective shares of military expenditure to GDP, and they discuss some highlights of the figure. I will make but one observation. According to that figure, the share of Turkish military expenditure in GDP rose and peaked in 1980 (at around four percent, but the precise number is irrelevant to the argument I am making). According to the theory described in the narrative and embodied in the model to be estimated, a rise in the *share* of Turkish military expenditure to GDP should induce the *level* of inflation-adjusted Greek military spending to rise. But why? After all, 1980 was a year in which Turkey experienced a severe recession. While the military expenditure *share* in GDP rose, inflation-adjusted Turkish military expenditure actually *fell*, and I would expect that Greek policymakers were happy to see that. In other words, I do not believe that the model is a sufficiently accurate description of real-world events and therefore do not accept

the conclusion which "indicates that an increased growth rate of the Turkish share [of military expenditure in GDP] is interpreted by Greek defence policy makers as signalling an increase in tension and, thus, an increase in war threat" (Kapopoulos and Lazaretou, 1993, p. 83). The cointegration tests and error-correction model that are packaged in-between the model and the conclusions are therefore irrelevant.

We are left with five papers. For data covering 1960-1994, Kollias (1995a, p. 311) uses this model:

$$grm_t = a_0 + a_1\, tur_t + a_2\, nato_t + a_3\, gdp_t + g_t$$

The level of Greek military expenditure, grm, is made a function of the share of Turkish military expenditure in Turkish GDP, the average share of military expenditure in NATO GDP (excluding Greece and Turkey), and real Greek GDP, plus an error term. Dummy variables for Cyprus for 1974 and for political changes in Greece in 1981 round out another version of the model.[17] Like Kapopoulos and Lazaretou (1993), Kollias uses cointegration tests and an error-correction model and like them he mixes level and share data and is therefore subject to the same critique: inasmuch as changes in the military expenditure *share* in GDP can follow either from changes in military expenditure or from changes in GDP, it is not clear at all why share changes in one country, Turkey, should lead to level changes in another, Greece. Of the remaining four papers, Kollias (1996) uses exactly the same model as Kollias (1995a) but for a slightly different time period (1960-1992 in the 1996 paper as compared to 1960-1994 in the 1995a paper). The 1996 paper contains more variations on the basic model as well as a few additional dummy variables; the estimation method is the same (i.e., cointegration and error-correction), and the reported results are substantively the same as well. So, of course, is the critique.

The paper by Avramides (1997) breaks new ground in that it attempts to derive a military expenditure function from economic principles rather than from *ad hoc* reasoning (p. 146). Indeed, the paper uses two variants on maximizing a social-welfare function under constraints, one based on levels, the other, separately, on shares. But when it comes to specify the military expenditure (or security) function within the utility-maximizing framework, Avramides is as *ad hoc* in the picking of the relevant variables to be included in the model as the other authors are. Even so, it is a promising paper, and to his credit Avramides is extensive in his elaboration and reasoning of why certain variables are chosen for inclusion. Following a Stone-Geary utility specification, his demand for military expenditure equation is (Avramides, 1997, p. 158):

$$D = ad_0 + (1-a)(m/P_D) - (1-a)?_D(P_C/P_D) + ad_1T + ad_2A + ad_3MN + ad_4MN74 + ad_5dum67$$

D is real Greek military expenditure; T is Turkish real military expenditure; A is real US military expenditure, and MN is the sum of military expenditure of Mediterranean NATO members. All variables are expressed in levels. To capture changed relations and tension among Mediterranean NATO allies after 1974, MN74 is a slope dummy variable that is set to zero for 1950-1974 and set to one thereafter until 1989. The dum67 is an intercept dummy to account for Greek military dictatorship from 1967-1974. The US variable is included because of the strong US presence in Greece since the 1950s.[18] This equation is subjected to cointegration tests and error-correction. The results suggest that in the long-run Greece catches up to ("follows") Turkish military expenditure and is a free-rider on US and Mediterranean military expenditure before 1974. After 1974, Greece seems to follow Mediterranean NATO allies' military expenditure. The error-corrected short-run estimation also indicates that Greek changes in its level of military expenditure reacts to contemporaneous and lagged changes in the level of Turkish military expenditure.

Avramides then estimates a share-equation based on Deaton-Muellbauer. The equation becomes:

$$DY = a_0 + d_1 \ln P_D + d_1 \ln P_C + ß_D \ln m + a_1 TY + a_2 AY + a_3 MNY + a_4 MNY74 + a_5 dum67$$

where DY, TY, AY, MNY are shares instead of levels of the previously defined variables (we can ignore the other variables for our purposes here). The equation failed to cointegrate – indicating the absence of a long-run relation among the variables – perhaps on account of the "non-linearities which its logarithmic variables imply" (p. 170). Dropping the price index terms and, later, the US term and the 1967 dummy, Avramides arrives at his final Deaton-Muellbauer short-run demand estimation. Unfortunately, the table that reports the estimates (table 4, p. 174) leaves the substantive question on the relation of Turkish to Greek military expenditure shares undecided as it misprints either the estimate of the coefficient or its associated t-statistic for the crucial variable of concern: the change in the share of Turkish military expenditure in GDP carries a negative sign (i.e., the higher this change, the lower the corresponding change in the share of Greek military expenditure in GDP which is counter-intuitive), but its t-statistic is reported with a positive sign. Since the estimate and the t-statistic must possess the same sign, there must be a misprint in the published results.

Nonetheless, Avramides' primary conclusion is that "levels of defence expenditures and their GDP shares cannot be taken as similar measures of intentions or perceptions ... Our interpretation here is that they are different indicators: levels of expenditures approximate the actual activity, whereas GDP shares approximate willingness. Income shares of defence indicates how much sacrifice a country is prepared to withstand for security, whereas levels of military expenditures show how much security is actually obtained" (p. 173), entirely in

keeping with one of the primary themes in this chapter.

Finally, in a technically interesting Granger-causality paper, Kollias and Makrydakis (2000) identify a structural break in 1973/74 in both the Greek military burden and Greek GDP growth rate series: the growth rate series shows a structural break possibly because of the 1973/74 oil crisis, and the military burden series shows a break because of the 1974 Cyprus crisis. Including a test for such structural breaks, the Granger-causality estimates "suggest the absence of any causal relationship between the military expenditure and the growth rate in Greece for the 1955-93 period" (p. 180).

This finding is in line with Dunne, Nikolaidou, and Vougas (1998 [2001]). After first-differencing their data for 1963-1996 to adjust for non-stationarity and accounting for the Cyprus invasion by means of a dummy variable, they find "no causality from military burden to growth or vice versa" (p. 19). Interestingly, they also ran the Granger-causality models *without* adjusting for the data's long-run properties and found Granger-causality from military spending to growth. Properly specifying the model to account for the nature of the data and for external shocks (Cyprus) thus makes an important difference in the findings.

TO SUM UP

Where do we stand with regard to understanding the demand for military expenditure in Greece and in Turkey? To be forthright, we stand on shaky ground.

For the case of Greece, we have nine papers, but only one survives – and ends up supporting – my critique. That paper (Avramides, 1997) suggests that Greek military expenditure reacts to or follows Turkish military expenditure for the time period 1950-1989. However, in light of the significant break in the time series in 1985, uncovered by Kollias and Makrydakis (1997b) in the context of their arms race paper, my suspicion is that Avramides' substantive finding might disappear if he were to rerun his Stone-Geary formulation for a time period reaching into the 1990s and accounting for the structural break in 1985. Moreover, since Avramides' time series stops with the end of the cold war, we do not know whether and if so how the behavior of Greek military expenditure changed to accommodate the post-cold war world. In a word, we do not really know much at all about the determinants of Greek military spending either. That is a bleak conclusion to draw from all the good effort sophisticated researchers have expended on this topic. (We will see later that the various papers by Andreou *et al*. offer a different look at Greek demand for military expenditure.)

For the case of Turkey, we have four papers (Chletsos and Kollias, 1995b, Kollias, 1995c, Kollias and Makrydakis, 1997a, and Dunne, Nikolaidou, and Vougas, 1998 [2001]). Despite a series of potential econometric problems, the first two suggest that Turkey's demand for military expenditure might be influenced less by Greece and more by its internal security problems. The third and fourth papers are Granger-causality papers between GDP growth and

military spending rather than an estimation of a demand function *per se*. At this stage, I am not aware of any other pertinent paper (not in the English language at any rate). This would seem a serious shortcoming in the literature. If we take Avramides' findings as granted – that Greece's military expenditure follow Turkey's – then my hunch is that identifying the drivers of Turkish military expenditure would be quite important for Greek military policy and budget planners. And if we found that Turkish military expenditure is driven as much by NATO commitments, fears of Islamic fundamentalism, and the desire to suppress Kurdish militants as by disagreements with Greece, it might help make the case for reduced Greek military outlays as at least some Turkish military expenditure is not desired, and perhaps not deployable, against Greece. I am speculating of course but in so doing indicate that an understanding of Turkish military outlays is important not just for Turkey.

Economic impact of military expenditure

I am aware of eleven papers on Greece and of six on Turkey (one paper that address both countries). I use the same procedure as applied to the previous sections and will review, tediously, each paper in turn and conclude with summary observations.[19] With regard to the econometric modeling strategy employed, two of the six papers on Turkey are highly similar (Sezgin, 1997; Özsoy, 2000). Both take off on what in the literature has come to be called a Feder-type model or Feder-Ram model (Feder, 1983; Ram, 1986; Biswas and Ram, 1986).[20] The model is a production function model with a civilian and a military sector in the case of Sezgin's paper and a civilian, non-military public, and military public sector in the case of Özsoy. Both papers include terms to capture the effects of investment, labor, and human capital on economic growth. In addition, Özsoy's paper includes a term to capture the impact of Greek military efforts on Turkish economic performance. The mathematics of the models work out so that one can eventually compute statistical estimates of the military sector's (a) total effect on the economy; (b) externality or spill-over effects of the military sector on other sectors; and (c) factor-productivity differentials among sectors.

What are the results? Apart from the variables of immediate interest, i.e., those related to the military sector, what strikes me about the results is that in both cases *investment* turns out to be statistically insignificant.[21] *Labor* also turns up statistically insignificant in Özsoy's case, but positive and significant in Sezgin's paper. *Human capital* is statistically insignificant in both papers. A production function model – for any country – in which investment, labor, and human capital nearly all turn out to be statistically insignificant raises questions about the model and/or the underlying data. For example, both authors use education spending as a proxy for human capital, and the proxy may simply not be good enough to capture the intended theoretical construct. Given these observation, both papers find a positive, and statistically significant, total effect of the Turkish military sector on Turkish economic growth for the time

period 1949-1993 in Sezgin's case and 1950-1992 in Özsoy's case. Sezgin finds a statistically significant and negative externality effect of the military sector and also computes a negative factor-productivity differential, saying that the military sector is less productive of economic growth than is the civilian sector in Turkey. Özsoy's findings are somewhat different. In his most extensive runs, he finds investment, labor, and human capital statistically insignificant but the non-military public sector, the military public sector, and the civilian sector *per se* all make statistically significant positive contributions. When the equation is changed and run to estimate externality effects, however, all variables turn out statistically insignificantly different from zero except for the externality effect of the nonmilitary public sector (whose effect is estimated as positive).[22]

In an interesting exercise, first performed by Ward, Davis, and Lofdahl (1995), Sezgin computes rolling estimates over 24-year sub-periods (from 1950-1973 through 1970-1993) and finds that the size and externality effects of the military sector in Turkey are large and statistically significant in the early time periods, but gradually decline and become statistically insignificant in the later time periods. This suggests that if Turkey did, at one time, receive positive economic spin-off effects from its military sector, that these effects have vanished over time. This conclusion is contrary to Sezgin's own ("Turkish defence spending is not detrimental for the Turkish economy; on the contrary, it helps economic growth," p. 407), and it is also contrary to Özsoy's ("... the net impact of the military public sector on overall economic growth was positive ...," 2000, p.155). In other words, looking at the same tables of numeric estimates, Sezgin and Özsoy arrive at the conclusion that the military sector in Turkey has stimulated Turkish economic growth; I am more skeptical and remain unconvinced in light of the poor performance of the investment, labor, and human capital variables in the models, and especially in light of Sezgin's own rolling 24-year estimates.[23]

In the third paper, published since the draft of this chapter first appeared, Sezgin (2000) overturns the findings of his earlier (1997) paper. Acknowledging its poor results, and noticing the non-stationary of the variables used, this time he applies first-differencing to make the variables stationary before using them in the Feder-type model. The estimation results are dramatically changed: without exception, all variables – investment, labor force, human capital, and the size and externality effects of the military sector – are positive with respect to the rate of change of economic growth and are so at statistical significance of 0.05 or better. Introducing a (modest) lag structure improves the statistical results further. This is impressive, and I wish Sezgin had once again applied the 24-year rolling estimates to investigate the contribution of the military sector over time. Sezgin's (2000) finding is supported by Yildirim and Sezgin (2002), the fourth paper under review. That paper employs a technically well-executed vector autoregressive and vector error-correction model (VAR and VEC) and finds positive effects of military expenditure on Turkey's economy, both in the short and the long-run equations.

In the fifth paper, Sezgin (1998 [2001]) applies a Deger-type simultaneous equation model to level data in real terms for 1956-1994. Due to non-stationarity in the time-series, the data are first-differenced. Once more, he finds a positive effect of Turkish military spending on economic growth but no effect on savings and the trade balance. The determinants of Turkish military expenditure are, statistically, Turkish income, the Kurdish conflict, and Greek military expenditures. However, the paper does not include a computation of the system wide net effect of military spending on economic growth, dg/dm. Even though the military expenditure term is not statistically significant in the separate savings and trade balance equations, that does not imply that dg/dm would be positive. But even if it were, one cannot conclude that military spending enhances economic growth since alternative spending may have increased economic growth and enhanced human development even more.

Suppose we take the findings and interpretation at face value. Then, exactly what is it about the military sector that makes it contribute positively to economic growth? What are the channels by which public spending on the military stimulates GDP? And are we to expect a negative impact on economic growth if Turkey's military expenditures were to fall? I think not (see, e.g., Özmucur, 1996, reviewed later in this chapter). Additional thought and research is needed to address these questions.

I turn to the sixth paper on Turkey (Sezgin, 1999) later on in a different context. For now, I turn to the eleven studies on Greece. The first is Kollias (1994b) who uses a Keynesian national-income equation set-up and estimates this log-linear equation for 1963-1990:[24]

$$GDP_t = a_0 + a_1\, ME/GDP_t + a_2\, I/GDP_t + a_3\, POP_t + u_t$$

where GDP is in level form at constant prices, ME/GDP and I/GDP are military expenditure and investment shares in GDP and POP is the population growth rate. After cointegration tests and error-correction, the estimates for the long-run equation suggest that a_1 is statistically significant and positive (so is a_3 but with a negative sign; we are not told the significance level of a_2 only that the t-statistic is a low 1.11). The error-corrected short-run equation shows, in one of two runs, a positive and statistically significant effect of the change in the military expenditure share in GDP on the change in Greek GDP. In a separate step, Kollias then estimates investment and savings equations

$$I/GDP_t = ?_0 + ?_1\, ME/GDP_t + ?_2\, GDPpc_t + ?_3\, GDP_t + u_t$$

$$S/GDP_t = d_0 + d_1\, ME/GDP_t + d_2\, GDPpc_t + d_3\, GDP_t + u_t$$

where GDPpc is *per capita* GDP at constant prices. After cointegration and error-correction, the ME/GDP variable is statistically significant and negative in both cases leading to the result

that military expenditure, on the one hand, appears to stimulate economic growth but, on the other hand, reduces the savings and investment shares in GDP.

In response to an earlier paper by Kollias (Kollias, 1993b, which is discussed in the next section), Antonakis (1995) published a piece in which he estimated this growth equation for 1958-1990:

$$G_t = a_0 + a_1 \, APS + a_2 \, (ME/Y)_t + a_3 \, (Y/P)_t + a_4 \, (Pl)_t + a_5 \, (P^*)_t + u_t$$

where G is Greece's annual rate of GDP growth; APS its average savings to GDP ratio; ME/Y the share of military expenditure in GDP; Y/P is *per capita* GDP; Pl is the annual rate of population growth and P* is the annual rate of change of the GDP price deflator. After various corrections, all versions of this equation result in negative coefficient estimates for the ME/Y term at the conventional one to ten percent levels of statistical significance. It is a well-done paper that continues to test for omitted variables, lagged variables, intercept and slope dummy shifts, etc. In all runs, the coefficient of ME/Y remains negative.

Thus far, the difference merely stems from estimating different growth equations:

Kollias: $GDP_t = a_0 + a_1 \, ME/GDP_t + a_2 \, I/GDP_t + a_3 \, POP_t + u_t$

Antonkais: $G_t = a_0 + a_1 \, APS + a_2 \, (ME/Y)_t + a_3 \, (Y/P)_t + a_4 \, (Pl)_t + a_5 \, (P\cdot)_t + u_t$

In a further paper, Antonakis (1996a) estimates single equations and a system of simultaneous equations for 1958-1990, following Deger's (1986) widely adopted approach. The growth equation is the same as in Antonakis (1995). In various versions of the savings equation, military expenditure consistently turns up with a statistically significant negative sign. The third equation is in essence a demand equation for military expenditure which then enters the other two equations in simultaneous fashion. What is interesting about this equation is that it makes no reference at all to Turkey's military expenditure except for a 1974 dummy term. It appears to be a well-specified equation and researchers might wish to look at it purely from the point of view of a demand equation for Greek military expenditure. The final three-equation model is estimated using 3SLS. The coefficient of military expenditure as a share of GDP in the growth equation is -1.552 but +2.833 in the savings equation. The net effect, dg/dm, is computed as -1.106, i.e., a one-unit increase in military expenditure as a share of GDP sacrifices about 1.1 units in economic growth. Apparently, a debate is shaping up over which modeling approach – Antonakis versus Kollias – better gets at the underlying issues. In a further paper, Antonakis (1997a) again uses a three-equation system for Greece for data for 1960-1990 but arrives at somewhat different results. Here, for example, the coefficient of the share of military spending in GDP is positive, rather than negative, in the savings equation (in

both the single-equation OLS estimate and the simultaneous equation 3SLS estimate) and the overall effect of the military spending share on GDP growth, dg/dm, is now only -0.4 or about one-third of the effect estimated in his (1996a) paper.

Using a different modeling approach, a similar debate might shape up between Antonakis and Sezgin. Antonakis (1997b) uses a Feder-type production function approach for data pertaining to 1958-1991. The empirical results maintain his findings of a statistically significant negative net effect of military burden on Greek GDP growth, even when the sample is split into pre- and post-1974 (pre- and post-Cyprus) sub-samples. Sezgin (2000) uses an interesting approach: he uses a Feder-type (production function) model as well as a Deger-type (simultaneous equation) model and compares the results of the two. The Feder-type model, with its possibility to compute total, size, externality, and factor-productivity differential effects, shows no effect of military expenditure on GDP growth in Greece for 1959-1994. In contrast, the Deger-type model showed a positive coefficient of military burden on GDP growth and a negative coefficient in the savings equation. Regrettably, Sezgin does not compute the *net* multiplier effect, dg/dm.

Sezgin's Deger-type model differs from Antonakis' (1996a) in two important respects. First, Sezgin converts all variables into first differences, to take out non-stationarity. Whereas Antonakis deals with the effect of the GDP *share* of military expenditure on GDP *growth*, Sezgin deals with the change in the *level* of military expenditure on the change in the *level* of GDP. Second, unlike Antonakis, Sezgin puts Turkish and NATO military expenditure into the Greek military expenditure demand function (and both are positive and highly significant, statistically). The present chapter is not the place to do so, but it would serve the research community well if a separate research effort were undertaken to disentangle the simultaneous equation and statistical approaches presented by Antonakis, Kollias, and Sezgin. In this regard, note that the question of *levels* against *shares* has come up again. Whereas in the single-equation context I am confident that levels should be used for military expenditure demand equations and shares for economic growth equations, I express no opinion on whether to use levels or shares in the simultaneous equation context where the military expenditure demand equation feeds into the economic growth equation. My main point here is that we need more thorough-going research on the proper selection of the variables underlying the models we estimate.[25]

Interestingly enough, a new paper by Dunne and Nikolaidou (1999 [2001]) uses the same approach as Antonakis and Sezgin for Greece for 1960-1996. This four-equation model (growth, savings, trade balance, and military expenditure), applied to first-differenced data, is unusual in that its estimates find a consistent, statistically significant negative effect of military spending on economic growth, savings, and the trade balance. The combined direct and indirect effects are computed as dg/dm = -0.026; dS/dm = -3.21; dTB/dm = -0.136. Note that the estimated dg/dm is small and *much* smaller than Antonakis' various estimates.

Thus far, all papers reviewed relied on aggregate military expenditure data. Chletsos and Kollias (1995a) are the first to use Greek military expenditure data disaggregated into personnel (wages and allowances) and procurement (equipment and construction) spending. They estimate three single equations, for total Greek consumption, for total Greek investment, and for Greek military expenditure, to learn whether running these equations with total, personnel, or procurement military spending results in discernable differences. I have a number of misgivings about the construction of the particular equations but I call attention to the paper in that it is the first I could find to use disaggregated military expenditure data on Greece.

In a conference paper, Sezgin (1999) also applied disaggregated data, in his case in comparative fashion to Greece and to Turkey. Using data for 1975 to 1996 for Turkey and 1977-1996 for Greece, Sezgin estimates cointegrated and error-corrected regression equations as follows:

$$Y = a_0 + a_1 I + a_2 L + a_3 EQU + a_4 NEQU + u_t$$

where Y is the level of GDP; I is the level of investment; L is the level of civilian labor force;[26] EQU is the share of military equipment spending in total military spending; and NEQU is the share of military non-equipment spending to total military spending. All data are deflated to adjust for inflation and converted to logarithms. In the long-run equation for Turkey, the coefficients for I, L, and EQU are positive and statistically significant, as is that for a time-trend variable. The coefficient for NEQU is insignificant. In the error-corrected short-run equation, only the investment variable gave a statistically significant and positive coefficient (along with that for the error term, of course). In the case of Greece, only investment and the trend variable turned up with statistically significant (and positive) coefficients. In contrast, the short-run equation showed all variables as statistically significant (positive for investment, labor, and non-equipment military spending; negative for equipment military spending; and the error term).

There is an important methodological issue here: throughout the paper, Sezgin repeatedly refers to equipment and non-equipment *spending*, but checking the reference to his table 1 (Sezgin, 1999, p. 21) reveals that the data are *shares* of such spending in total military expenditure, thus resulting in a mixture of level and share data once again. To rectify this problem, I would recommend the following procedure: since the absolute, inflation-adjusted, level of military expenditure is known, it is a simple matter to convert the equipment and non-equipment *shares* to their absolute equivalents. For example, if Turkish military expenditure in 1994 was 2,184.7 billion liras (Sezgin, 1997) and the equipment share was 29.3 percent (Sezgin, 1999), then the lira-equivalent of military equipment purchases was 640.1 billion Turkish lira. The estimations could then be rerun but with the assurance that levels are compared to levels. My guess is that the results will not change in substance, but at least we would be more reassured about them.

A more complex model for Greece was constructed by Balfoussias and Stavrinos (1996). It disaggregates military expenditure data (personnel against everything else, mostly procurement) and consists of eight simultaneous equations to be estimated. Procurement spending is dependent on its own lagged value, on Turkish and NATO military expenditure, and on GDP and the government deficit. In contrast, personnel spending is modeled to depend on its own lagged value, inflation and lagged inflation, the unemployment rate, and lagged government deficit. Public non-military spending is a function of its own lagged value, GDP, inflation, and the lagged deficit. And so on. The variables are in real terms and in level form.[27] The model includes fiscal and monetary variables, accounts for real GDP, inflation, and unemployment and is, structurally, a Keynesian demand model. It is well thought through, well specified, and theoretically coherent but leaves out the savings and trade balance aspects that Deger (1986) introduced into the literature. With data for 1960-1992, a 3SLS system estimation suggests that the direct impact of lagged military personnel and procurement expenditure on economic growth is statistically significant and positive. Before being carried away by that conclusion, however, it must be noted that this model is a precursor to a 330 equation model (90 stochastic and 240 identities) which I discuss later on.

Finally, there is a paper by Athanassiou, Kollias, and Zografakis (1998 [2002]) that tries a different modeling approach. It is reviewed in a later section.

Indigenous arms production

Most studies on Turkey's and Greece's indigenous arms production sector are descriptive in nature. Recent summative overviews are given in Sezgin (1997, pp. 389-396) on Turkey and Kollias (1995a, pp. 314-317) on Greece which contain references to earlier literature. Antonakis (1996b) writes specifically on procurement offset programs with regard to the Greek military industry. Finally, for both countries Matthews (1999) contains a detailed, up-to-date, descriptive study with many literature references. None of these descriptive studies explicitly consider the opportunity cost military industry imposes.

That issue – the issue of opportunity cost – came up in an analytical exchange between Kollias (1993b) and Antonakis (1995). Kollias (1993b) attempted to answer this question: are there any spin-offs from military expenditure to production in arms production relevant industries? To answer this question, Kollias identifies five manufacturing sectors (basic metals; metal products; non-electrical machinery; electrical machinery; and transport equipment) relevant to arms production and estimates the following equations, one for each of the five industries:[28]

$$X_{it} = a_{0i} + a_{1i}\, ME_t + a_{2i}\, MAN_t + u_{it}$$

where X_{it} is the output index of the ith industry in time t. ME is military expenditure (in real terms), and MAN is the output index in total manufacturing. Kollias then re-estimates the equations where ME is lagged by one period. After correcting for autoregression, in most cases the coefficient of military expenditure is negative, in a few cases positive but not statistically significant. From this, Kollias concludes that "in the case of Greece spin-off effects are not strong at all ... such effects may be occasionally positive but they are extremely weak and negligible. Indeed, the negative signs in some of the cases may be pointing to the adverse effects of military spending ..." (Kollias, 1993b, pp. 161-162).

Antonakis (1995) took issue with these conclusions. In particular, he argued that Kollias had neglected the opportunity costs involved. To rectify this, Antonakis developed an equation to capture the impact of military expenditure on Greek economic growth, as discussed in a previous section.

I shall not here go into the descriptive details of the arms industries in Greece and Turkey but merely wish to point to some overarching trends.

- both countries' arms industries are at least a hundred years old;[29]
- both countries, after 1974, diversified away from relying solely on the US as their major arms supplier;
- both countries' indigenous arms industrial efforts picked up sharply after 1974, the goal being some measure of weapons self-sufficiency;
- both countries created super-agencies under whose tutelage various state arms manufacturers were created;
- Greece's arms industry still is primarily state-owned, highly inefficient, and underutilizes its capacity; only very recently are a number of these firms being privatized. In contrast, the Turkish arms industry began privatization and foreign joint-venture participation in 1983 (rather than mere license production);
- both countries still expend majority proportions of their procurement funds on arms imports;
- both countries' arms industries are diversified into air, land, and sea transportation systems, ordnance, and information technology and associated electronics, but Turkey's arms industry appears substantially more diverse than that of Greece;
- both countries' arms industries cooperative heavily with foreign countries by means of joint-ventures and similar arrangements;
- both countries, despite strenuous intentions to the contrary, export few indigenously produced arms;
- both countries have official direct offset policies, i.e., procurement offsets directly related to their respective armaments industries;
- Turkey is still subject to some arms supply restrictions and, consequently, has tightened its

arms collaboration with former Soviet-block countries and with Israel and Singapore in particular.

The pervasiveness of increased foreign participation in indigenous arms production, coupled with direct offset requirements, creates some unusual difficulties. For example, the winner of Greece's offset order for main battle tanks (MBTs) will automatically be excluded from bidding on Turkey's order, and Israel Aircraft Industries (IAI) decided in 1997 not to bid on upgrade work on Greek F-4 Phantom aircraft in order not to offend Turkey which had signed an upgrade contract with IAI on 26 Turkish F-4 aircraft (Matthews, 1999).

The literature does not indicate, for either country, that indigenous arms production *per se* has brought economic benefits. Earnings from arms exports appear to be very small for both countries. I am not aware of a reasonably recent evaluation of military offsets in Turkey. Offsets, in the case of Greece, appear not yet effective (Antonakis, 1996b). Without doubt, there is some degree of job creation and import-substitution taking place, but at what economic cost is unclear. For example, with less than 10,000 arms-production related jobs in Greece and perhaps between 20,000 and 30,000 in Turkey, the relevant question is what *alternative* job creation and economic stimulus could have been provided had the employed resources been applied to non-military sectors. Specifically, I am not aware of any study that would have estimated the cost of pure imports set against the cost of co-production. For example, suppose the pure import of a particular item would cost $40 million whereas the co-produced item would cost $45 million, of which say $20 million are for imported parts and components. In this case, the *net* cost is higher ($45mn > $40mn) but the foreign exchange cost is lower ($40mn > $25mn). For example, in the case of Greece, Antonakis (1996b, p. 167) writes: "... the Greek government does not claim that all co-produced goods cost no more than an off-the-shelf purchase without offsets. On the contrary, it is believed that this option results in higher costs ..." This higher cost essentially is the domestic economic price for some degree of self-sufficiency. It would be nice to know exactly how high this price is. To the best of my knowledge, detailed studies addressing the question of opportunity costs in this sense from a microeconomic point or field-study point of view have not yet been conducted.

Another aspect, pointed out by Candemir (1995), is that both Turkey and Greece received substantial amounts of US military aid in outright grants and low-interest loans to acquire US weapons, support services, and to train their soldiers and officers. Thus the net import cost or foreign exchange cost of arms imports might be substantially lower than official sources, such as US ACDA, would imply.

Regarding Turkey's arms industry, there are a number of interesting themes emerging from the work of Günlük-Senesen (1993a, 1993b, 1994, 1995). One theme concerns the constellation of events that induces Turkey to pursue an arms import substitution path: as part of NAT0-Europe and of a restive region, faced with restrictions on the use of imported arms,

Turkey wishes to maintain an independent arms production capacity. This is highlighted by its war in the late 1980s and early 1990s with the People's Army for the Liberation of Kurdistan, the PKK, and the emerging conflict over water resources with Syria and Iraq (the sources of both the Tigris and Euphrates are in Turkey). The breakup of the Soviet empire led to the creation of volatile Islamist, Turk-speaking republics on Turkey's border and of course there is the continuing conflict in the Aegean Sea with Greece, especially over Cyprus. A second theme involves the unusual financing of Turkey's arms production efforts in which a Defense Industries Support Fund (DISF) receives funding from special levies placed on earned income, on fuel, alcohol, and cigarette consumption, on legal gambling and betting, on bank interest earning collections, and so on. Indeed, Turkish men can make substantial payments to "exempt" themselves from military service. A share of these payments also goes toward the DISF to fund indigenous arms production. All this in addition to "regular" fund transfers via the defense budget and the general budget. The DISF is substantial and not usually accounted for in the computation of Turkey's defense budget (see Günlük-Senesen, 1999 [2001], on which more below). Neither is OYAK, the "Armed Forces Trust and Pension Fund," included in the defense budget. OYAK, begun in 1961, is a conglomerate consisting of vast holdings in Turkey's civilian economy, from supermarket chains, to real estate, insurance and banking companies, the automotive and petroleum industry, tourism, cement, food-marketing, and other industries (Parla, 1998). OYAK is among the top-five conglomerates in Turkey and achieves its economic success by means of a "unique and unprecedented set of subsidies and legal privileges" (Parla, 1998, p. 32): it is exempt from all taxes and its members pay statutory dues (army regulars, defense ministry employees, etc., even those not entitled to any benefits!). A similar fund was established, with similar privileges, in 1987: called TSKGV, it funds defense projects by means of vast involvement in Turkey's civilian economy. The distortionary impact of these activities, military mercantilism, as Parla, calls it, is unaccounted for. As an economist, one suspects that the welfare effects are negative.

A third theme in Günlük-Senesen's work concerns the question of the plain sense and non-sense of indigenous arms-import substituting production, of "going it alone". Initially, Turkey's arms production program was very much geared at arms independence in a literal sense. In practice, however, Turkey quickly resorted to joint venture co-production, an arrangement however under which foreign governments restrict Turkey from freely using transferred technology. For instance, NATO weapons and co-produced weapons may not be used in Turkey's war with the PKK, whence Turkey turned to Romania, Russia, and Pakistan to supply those needs. But beyond that, there is increasing unhappiness in Turkey itself about the apparent lack of quality of the requested armaments and an increasing recognition that technological progress in the western countries makes Turkey's ambitions to be a self-sufficient, fully independent arms manufacturer unrealistic. The best Turkey might hope for is to become a bit-player, supplying parts in which it can specialize to be assembled into larger

weapons systems. The best Turkey can hope for, in other words, is to become part of the newly globalizing arms industry (see Brauer, 2002). But Turkey's military and political leaders appear unwilling, at this stage, to grant the point and change policy. Perhaps eventual membership not only in NATO but also in the EU will allow Turkey to integrate into the emerging European co-research, co-development, and co-production sphere and, most likely, help save it untold economic resources.

I am not aware of a similar detailed look (in English, at any rate) at the Greek armaments industry.

Other studies on the economics of military affairs concerning Turkey and Greece

Athanassiou and Kollias (2000) present estimates on the effect of the Greek-Turkish rivalry on flows of foreign direct investment (FDI) into either country. Greek-Turkish rivalry is measured in terms of expected airspace violations by Turkish aircraft, as defined by the Greek Ministry of Defense. The expectations component is measured as $t+1$ of actual violations. Controlling for a variety of other variables, and using quarterly data for 1992 to 1997, the statistical results show a strong negative relation between expected airspace violations – as an indicator of increased tension – and FDI flows to Greece. A similar equation for Turkey, where airspace violations enter as a lagged variable, also results in a strongly negative impact on the flow of FDI to Turkey. This study may be criticized on a number of counts, but as so often with Kollias' work what is commendable is his willingness to explore new avenues of getting at the substantive problems at hand. The authors also use the same idea of military tension as reflected in airspace violations to examine the effect on foreign *trade*, instead of foreign *investment* (Athanassiou and Kollias, 2002). A novel idea here is that military tension might affect not only the demand for trade (i.e., imports) but also its supply (i.e., other countries' exports). The empirical work employs quarterly data for 1992:1 to 1998:3 which includes three tense periods between the countries (1994, 1996, 1997/8). The economic data are in logs in constant 1990 prices in local currency. In a two-step procedure, the effect of tension and GDP on import prices is calculated. The fitted values for import prices are then used, in the second step, to estimate the effect of tension on import quantities. The results for Turkey are that, in step one, higher tension is associated with increases in import prices and that, in step two, higher tension is associated with lower levels of imports. For Greece, the same result obtains but the p-value for the second step is, at 0.14, outside the usually accepted range of 0.10 or less. Also, the regression diagnostics for the Greek model are not quite as strong as for the Turkish model. (Results for exports were not reported since they showed no statistical significance.) Again, there are a number of data and econometric problems one could go into. But the authors are suitably circumspect and merely claim that the analysis is suggestive of option-value trading behavior under military tension, i.e., the option-value of waiting to trade

rise when tension increases. Foregone trading of course is an opportunity costs of military affairs.

Balfoussias and Stavrinos (1996) employ a large-scale macroeconometric model consisting of some 330 equations (90 stochastic and 240 identities) to simulate the effects of possible reductions in Greek military expenditure. The scenarios involve an annual five percentage point reduction in Greek nominal military expenditure for 1995 to 2000, to be taken from procurement, leaving military personnel outlays unaffected. The savings are applied as follows: (a) to public consumption; (b) to public investment; and (c) to tax reduction. The military data are disaggregated into personnel (wages, etc.) and everything else (mostly imported procurement items). Without exception, relative to the baseline scenario without changes in military spending, the disarmament and reallocation scenarios result in higher GDP growth, higher private consumption, lower unemployment, and an improved balance of payments. Private investment increases beyond the reference projection in two of the three scenarios and drops slightly below the growth of the baseline scenario in the public consumption scenario. However, because Greece is a relatively open economy, the authors argue that the simulated effects of disarmament are "relatively minor" (p. 212), as indeed they are. For example, GDP in 2000 is projected to grow by 3.8 percent in the baseline scenario. In the tax reduction scenario, GDP would grow by an additional one percent of 3.8 percent, i.e., by 3.838 percent. This is one of the more satisfying models I have encountered in the literature under review. The simulations permit one to put a price or opportunity cost on alternatives foregone.

A similar disarmament modeling effort was undertaken for Turkey (Özmucur, 1996). His model indicates that any peace dividend "may prove substantial if resources can be directed towards government non-military investment" (p. 215), a conclusion in rather sharp contrast with Sezgin and Özsoy.[30] In an interesting twist, and before studying the impact of disarmament on Turkish economic performance variables, Özmucur finds substantial negative, and statistically significant, correlation coefficients between the budgetary shares of Turkish military expenditure and those on expenditure on health and education for data from 1924-1994 (as does Özsoy, 2002). Over the entire time period, military expenditure exceeded that of health and education combined. Regarding the simulation, the model used consists of 27 stochastic equations and 30 identities and is estimated over quarterly data for 28 observations (1987:1 to 1993:4). Government spending is split into non-military and military expenditures, as are government investment expenditure and merchandise imports.

The model contains aggregate supply and demand blocks, and blocks for the labor market, balance of payments, prices, the public, and the financial sector. The simulations are run for 1995:1 to 2004:4 to obtain a baseline solution. Then military expenditure as a share of GDP is reduced by one percentage point and four scenarios are simulated. In the first scenario, funds are taken from military imports (20 percent), and military current (31 percent) and investment (46 percent) expenditure. The funds are applied to deficit reduction. In the second scenario,

military imports are reduced by half (50 percent), military current spending by 15 percent, and military investment by 46.5 percent and applied mostly to improve the balance of payments. The third scenario applies reductions as in scenario 1 but uses the funds for tax reductions. Finally, the fourth scenario also reduces military outlays as in scenarios 1 and 3 and applies the saved funds to non-military public investment. Scenario 4 turns out to be most desirable in terms of the model criteria: GDP, inflation, unemployment, balance of payments, real wages, and labor productivity. GDP for instance increases by an additional 2.7 percentage points relative to the baseline scenario, involving a substantial gain in living standards. What is likeable about this model is that it considers target variables other than mere GDP and that, although fundamentally a Keynesian demand model, it includes a four-sector supply side.

Finally, there is a paper by Athanassiou, Kollias, and Zografakis (1998 [2002])[31] that tries a different modeling approach. It uses a CGE (computable general equilibrium) model to simulate how the Greek economy might have performed had its military expenditure been on par with average NATO military expenditure for 1988-1996. Instead of computing a peace dividend by simulating future events, the paper computes the opportunity cost incurred by simulating a counter-factual past. There are five scenarios. The baseline scenario reduces military spending by 25 percent (to the NATO average as a percentage of GDP). The second scenario compensates for this decrease by equi-proportionally increasing the shares of non-military government spending in three categories: education, health, other government. Scenarios three to five compensate by shifting the entire military spending reduction into only one of the other three government spending categories. Effects are computed for a variety of standard economic indicators (GDP and its constituent components, real wages, consumer inflation, employment) and for the impact on industrial structure and income distribution. Summarizing the set of resulting estimates is difficult but as a generalization one can say that the opportunity cost is on the order of a foregone ten percent increase in GDP growth: that is, GDP could have been on the order of 2.2 percent per year instead of 2.0 percent per year. This is small on an annual basis, but by the power of compounding cumulates rapidly into appreciably larger percentages.

Tradeoff questions are also at the heart of new work by Günlük-Senesen (2001). This work goes back to the question of financing Turkish arms production and shows the substantial, and increasing, difference between military spending in Turkey as measured by budget data as against military spending that includes DISF funding. DISF arms import funding alone amounts to about 2 percent of total Turkish imports, absorbs about 4 percent of its total export earnings, and constitutes about 5 percent of its trade deficit, writes Günlük-Senesen (2001, p. 43). She also finds that since 1986, official budget data systematically, increasingly, and drastically underestimate Turkey's military expenditure. Using budget data, Turkish military expenditure increased by 66 percent between 1980 and 1997. Using her augmented data, the increase amounted to 89 percent, and more rapidly rising the more recent the data point (2001,

pp. 32-40). I would recommend to all participants in the literature to rerun their various models with Günlük-Senesen's data. As we saw, the more recent consensus appears to be that Turkish military expenditure exerts positive effects on its economic growth and induces Greece to try to keep up with Turkey. One must wonder whether and how these conclusions might change in light of the augmented data.

In a conference paper, Günlük-Senesen (1999 [2002]) examines the effect of Turkey's security expenditures on its horrendous government budget deficit. Adjusting for inflation and population growth, she finds that until the late 1980s the relative growth rates of security expenditures (internal and external, i.e., police and army) did not appear to vary in unusual ways relative to the variation in the entire government budget. But as from the up-tick in the conflict against the PKK, in the late 1980s to about 1993, there is a sustained, disproportionally large increase in the security expenditure share relative to the budget shares of all other government expenditure categories. This increase came to an end only with the severe 1994 recession in Turkey.[32] Part of this paper was later published in revised form (2002). The conclusions there are more moderately expressed than I have done here. As a share of the primary budget, security spending (external and internal combined) oscillated between 20.2 and 24.0 percent between 1983 and 1998. Health and education spending varied between 17.2 and 29.6 percent, averaging about 25 percent in the 1990s. Since security spending is stable and health and education spending rising, something else had to give. It is budget allocations to infrastructure which plummet from a high of 28.9 percent in 1986 to a mere 13.1 percent in 1998. However, DISF contributions are extra-budgetary allocations to purchase military equipment. Thirty percent of equipment purchases are financed from the budget, and another twenty percent from DISF, with the remainder coming from US aid, NATO military infrastructure funds, and other sources.

Finally, there are four papers that *presume* the existence of an arms race between Greece and Turkey and, based on this presumption, go on to investigate other aspects. Andreou and Zombanakis (2000) use a neural-network model to identify and estimate the source of pressures on Greek military debt and Greek military burden (military expenditure over GDP). They posit two sources: financial pressures reflected in the economic variables of the two countries, and population characteristics, especially the much larger, and faster growing, Turkish population. The set-up of the thinking behind the modeling is pleasing. I have noted earlier that the overwhelming number of papers in this literature focus on financial variables (either as share or level data) and that little attention is given to military *capacity* and *stock* data. By including population and armed forces data, this paper resurrects the few earlier attempts in this direction. Using data from 1961-1996 the paper finds, not implausibly, that the population variables – military expenditure per soldier, armed forces per 100,000 people in the population, and population growth rates – outperform the financial-data based models. In an extension the authors then run an OLS regression to learn how the results of the neural

network exercise holds up against a more traditional technique. Fascinatingly, OLS reports nearly identical findings (table 6, on p. 422): the regression using population-based variables is much stronger, statistically, than the regression using financial variables. It should be noted that the reference to an "arms race" between the two countries is utterly superfluous. The findings – that population variables are strongly associated with Greek military debt and its military burden – are independent of whether or not there is an arms race.

A year later, Andreou and Zombanakis (2001) employed another neural network model to explore the impact of demographic developments on the *relative security* of the Greek-Cypriot alliance.[33] On account of the earlier paper, relative security is defined in terms of the population growth rates of the three countries involved and arms race scenarios are simulated. The escalation and de-escalation scenarios are generated by increasing and decreasing the financial variables in an unspecified manner. The findings are in line with expectations: when all three countries either escalate or de-escalate, the relative security of the alliance increases (where – surely – an "increase" in security from escalation is a figment of perception rather than a militarily relevant phenomenon). When Greek and Cyprus escalate and Turkey does not, the relative security of the former increases slightly. Conversely, when Turkey escalates and the others do not, the latter's relative security falls precipitously. Interestingly, all input variables are financial in nature and the output variable – relative security – is population-based. This reverses the causality found in the prior paper. It is plausible that a growing population affords a country the opportunity to expend more on its military sector and therefore put economic pressure on the other country. But it is not clear why financials should lead to population growth differences that the countries involved might perceive as threatening. The policy conclusions the paper offers are also disappointing. The authors argue that "Greece has no choice but to follow up the ambitious 25-year Turkish armaments programme" and that "the results of the 'Turkey escalates-Cyprus and Greece reduce' scenario are discouraging due to their lowest relative security values and, consequently, their poor contribution to peace promotion, something that must be taken [in]to consideration by the one-sided disarmament policy followers" (p. 320). An alternative would be joint arms reductions within the context of the EU and NATO. Another alternative is unilateral arms reductions in Greece, again on the basis of tighter integration into the EU and NATO. That this needs to be considered, even if reluctantly, emerges from a third Andreou paper (Andreou, Parsopoulos, Vrahatis, and Zombanakis, 2002) which finds "that the current defence burden of the two allies [Greece and Cyprus] seems to be driving their economies beyond capacity limits" (p. 329). Ultimately, however, they end up recommending that Greece and Cyprus consider upgrading its military "property resources" (p. 340), i.e., the capital-intensity of their armed forces. This seems to me unduly ill-considered. I will argue below that economists have a professional obligation to study other alternatives. If the objective is security and Turkey's manpower advantage is overwhelming Greece and Cyprus economically, surely there are alternatives to be explored

other than increasing the capital-intensity of their armed forces. After all, if Greece and Cyprus pursued the Andreou *et al*. recommendation, Turkey could then switch into a capital-intensive mode as well, so that the long-run determinant of the relation still is based on Turkey's demographic advantages.

A final paper examines "the effects that arms imports have on the military balance between ... two recipient countries" (Kollias and Sirakoulis, 2002, p. 137). Unlike most papers reviewed here, it is a purely theoretical paper without an empirical component. The price country A pays for arms imported from international oligopolistic arms sellers, relative to the price country B pays, is the main determinant in each country's security function. This drives, as we know from earlier literature, domestic arms production but also provides sellers with the opportunity to influence the conflict-potential balance between the countries (Kollias and Sirakoulis, 2002, p. 143).

Summary and gaps

Let me summarize my findings and then point to a number of gaps in the literature on the economics of military affairs in Greece and Turkey.

Summary

First, as is equally true of other branches of the literature on the economics of military affairs, data and data sources in this literature on Greece and Turkey are not always well reported. Although there are outstanding exceptions, there are numerous examples were the exact data source is left unspecified, there are confusions about the units of measurement used in the analysis, data are rarely printed out in full or otherwise made easily accessible, and they are seldom displayed visually for easy inspection by the reader. In many instances, authors are not sufficiently cautious in labeling the variables used in their analyses. For instance, an author may refer to military expenditure but leaves open whether the level or the share (in GDP) is meant. In this literature, this turns out to be problematic as levels and shares measure different substantive things: levels (and stocks) of military expenditure measure capabilities and, possibly, intentions, whereas the share of military expenditure in GDP does not. Moreover, a number of authors freely mix up level and share data without an underlying discussion about the appropriateness of this procedure. For instance, by what reasoning would Greek policy makers be concerned about a higher share of military expenditure in Turkey in 1980 when, in the same year, Turkey's level of military expenditure actually fell?[34] In future, authors need to take care to more cautiously and precisely describe their data to themselves and to their readers prior to the application of inferential statistics.

Second, with respect to the reviewed arms race models I find that we may speak of an

arms race between Greece and Turkey from 1950 to about the mid- to late-1980s, but not thereafter. There are two particular shortcomings in the arms race literature. First, the possibility of an arms race between Greece and Turkey is modeled purely in the Richardson-type, Granger-causality mode where an arms race exists only if it is *mutual*. I argue that this is too narrow a view of an arms race. If one country follows the other, it is racing, whether the racing is mutual or not. Second, all of the arms race models focus solely on Greece and Turkey and utterly disregard that Turkey was not and is not Greece's only security concern and, vice versa, that Greece was not and is not Turkey's only security concern.

Third, with respect to the single-equation models of the demand of military expenditure there are five papers available on Turkey. Two of these are Granger-causality papers and, as discussed in the body of the text, should perhaps have been put into a separate section by themselves since an investigation of mutual causality between two variables can hardly be thought of as a proper demand equation. Of the remaining papers, one is an error-correction mechanism paper that opens a host of problems regarding the proper economic interpretation of econometrically estimated coefficients of an ECM equation. Still, this paper suggests that Turkish military spending is more sensitive to the Kurdish rebellion than to Greek military spending. However, the data period covered ends in 1992, and for the fourth (innovative but inconclusive) paper the data period ends in 1991. This would mean, astonishingly, that we know virtually nothing about the demand for military expenditure in Turkey, certainly not for the 1990s. Only one paper, the fifth, extends the data series to 1998. It finds that Turkish milex is determined by inertia as well as by NATO's and Greece's milex in the short-run; in the long-run only NATO's milex effect is positive on Turkey's milex (and income and the balance of payments effects are negative). This conclusion is qualified in that some of the simultaneous equation models reviewed later do contain a military demand equation, but the objective there is not strictly to model demand for military expenditure but to capture interaction terms between military expenditure and, ultimately, variables of economic performance such as economic growth.

With regard to Greece, I have inspected nine pieces on the demand for military expenditure. Again, several papers are really Granger-causality papers and should perhaps have been treated in a section of their own as they do not strictly model "demand" for military expenditure. The other papers vary, over time, from simple to very complex models and statistical treatment. At first, Greek military expenditure is treated as a function merely of Turkey's. Then, armed force ratios and military expenditure per soldier are added to the models, but still only for Greece and Turkey. Then US and NATO military spending are added. Then Greece's GDP is added but already a mixing of level and share data occurs which in my opinion invalidates the statistical results. Moreover, security concerns other than over Turkey are never modeled in the equations for Greece. The most complex model, by Avramides (1997) supports my contention that levels and shares of military spending measure

different things and should not be mixed in the same equation. Substantively, Avramides finds that Greek military expenditure tends to react to or follow Turkey's from 1950 to 1989, mirroring my conclusion from the arms race studies. It would be very interesting to rerun Avramides' model for data in the 1990s to see if the relation he found broke down.

Fourth, there are numerous studies on the economic impact of military expenditure. Regrettably, invariably economic impact is taken to mean economic growth. There are no studies, for instance, on the impact of military expenditure on human development for which economic growth may or may not be a reasonable and reliable proxy (see, e.g., Brauer, 1996). Three of the papers on Turkey use a Feder-Ram production function model. Sandler and Hartley (1995, p. 206, 208-209) describe how this type of model is inherently structured to "find" positive contributions of military expenditure to economic growth, and indeed that is what these two studies do find and that makes them suspicious: what have we found if a model inherently is set up to find what we found? Moreover, only in the third, and most recent, of these studies do investment, labor, and human capital appear to make the expected positive contribution to economic growth. Unfortunately, the author (Sezgin) does not rerun the model for a large number of 24-year subperiods as he did in his earlier paper (1997) where he found that the positive contribution of military expenditure to economic growth wanes to statistical insignificance the closer the time period comes to the present day. A Deger-type model finds a direct positive effect of military spending on economic growth but a system-wide effect (direct and indirect) is not computed. A large-scale macro model run on Turkish data (albeit only as from 1987 onward) shows significant negative effects of military spending on economic growth and other macro indicators. On balance, I am more persuaded now than I was in 1999 (when the draft version of this chapter appeared) to accept that the effect of military expenditure on Turkish economic growth may be positive but if so, this would merely shift the discussion to the question of the underlying mechanism: exactly why would we observe this effect? What is it about military expenditure that other forms of expenditure cannot do for economic growth? How large does military expenditure have to become before negative returns set in?

The papers on Greece are, in large part, a battle between Christos Kollias and Nicholas Antonakis reaching exactly opposite conclusions: for Kollias the impact of Greek military expenditure on savings is negative and, on economic growth, positive, whereas Antonakis finds a positive impact on savings and a negative one on growth. In this instance, I should like to give my nod of approval to Antonakis, if only because he eventually expands his models to a simultaneous equation system and hence is able to capture a richer set of interplays. However, Sezgin (2000) is also employing a simultaneous equation system with results exactly opposite to Antonakis (i.e., in line with Kollias' findings). Some researcher would do well to assess these models from an economic and econometric point of view to learn which one(s) are of greatest merit. One technical problem, in any event, is that the simultaneous approaches freely

mix level and share data and my guess is that this is not a proper procedure to use.

Fifth, regarding indigenous arms production I point to the overarching descriptive trends reported above. In terms of an economic evaluation, little work appears to have been done on estimating the opportunity cost of indigenous arms production *per se*. For example, although several tens of thousands of jobs have been created in the Greek and Turkish arms industries, no direct assessment appears available to tell us what economic development and growth was sacrificed by shifting these human resources into arms production. One exception is a recent conference paper by Athanassiou *et al*. (1998 [2002]) that looked at military spending as a whole, rather than at arms production in particular. Likewise, I am not aware of any study that would measure the difference between indigenous arms production as compared to off-the-shelf imported arms although several recent papers begin at least to ask the relevant, critical questions.

Sixth, other studies. One innovative, but preliminary, study attempts to measure the impact of military tension between Turkey and Greece on the flow of foreign direct investment (FDI) and finds that increased tension contributes negatively to FDI flows. A similar study finds that military tension appears to drive up import prices and drives down import quantities. Further, two large-scale macroeconometric studies, one each on Greece and Turkey, simulate the impact of reductions in military expenditure on a variety of economic performance variables. Both were published in 1996, both are technically excellent studies, and both have not been cited much at all in the post-1996 literature. They both find that reductions in military expenditure would benefit both countries. The benefit is very small for Greece but rather substantial for Turkey if the most promising simulated scenarios were actually implemented. Both models are satisfying in that they include supply and demand equations, fiscal and monetary policy equations, and so on. Finally, a set of interesting papers by Andreou *et al*. examines the effect of Turkey's large population on Greece and Cyprus. The results are plausible, for instance, that the latter two countries are nearing their economic capacity-limit of keeping up, militarily, with Turkey, but the policy conclusions are not.

In 1999, I wrote that "in sum, the knowledge gained is slim." With an additional dozen or so studies published in the three years since, I am a bit more confident about the state of our knowledge. I retain my opinion that there may have been an arms race between Greece and Turkey but it probably ceased in the mid- to late 1980s. The more interesting approach is to ask, as Andreou *et al*. do: whether or not there is an arms race, or even supposing that there is one, what should Greece (and Cyprus) do? If one makes a friend of an "enemy," has one not won a victory as well? Thus, research on Greece might fruitfully explore realistic, feasible options in this direction.

With regard to the demand for military expenditure in Greece and Turkey, the preponderance of evidence suggests that Turkey determines its military expenditure on account of a number of factors of which Greece is but one, whereas Greece's military expenditure is

more nearly determined by Turkish military expenditure alone. However, only a single study extends the data series deep into the 1990s. Moreover, precious few of the studies reviewed take, for Greece, non-Turkish, or, for Turkey, non-Greek security concerns into account which makes all of these studies weak.

Regarding the impact of military expenditure on economic performance, the studies on Greece are exactly off-setting and contradictory, and on Turkey perhaps the victim of the particular modeling (Feder-Ram) approach. Even if we grant that the impact of military expenditure on growth was "positive," only three studies get at the issue of the opportunity cost of military expenditure and all three suggest that cuts in military expenditure would benefit both Greece and Turkey. Similarly, regarding indigenous arms production, while we are fairly well informed descriptively about the nature and extent of such production, there is little by way of assessing the economic or opportunity cost of putting financial, physical, and human resources to arms production.

Gaps and shortcomings

I now turn to view the literature from a somewhat broader perspective. First, I find that even though the literature is highly focused on military expenditure, it is not in fact well focused at all. It does not, for example, examine the *internal* decision-making processes that generate levels of military expenditure within Greece and Turkey. Virtually all one finds is the occasional use of a dummy variable for Greece's and for Turkey's military governments or for Greece's military (1967-1974) and socialist government that came to power in 1981. But that is not the same as examining the issue from the point of view of administrative or bureaucratic processes within each country, say by means of a public choice model. Some models, indeed many models, employ variables for *lagged* military expenditure but this is almost always a "decision" stemming from lag-length determinations in running cointegrated regressions rather than a substantive decision based, for instance, on considerations of inertia in military expenditure budgets. When econometrics determines substance, something is amiss (Smith, 1998).

Second, and to me the most surprising aspect of the literature on the economics of military affairs in Greece and Turkey is how little it concerns itself with *political economy* and how much the literature narrowly sticks to *pure* economics, *mathematical statistics*, and *econometrics*. To be sure, one finds references to the political, military, and strategic literature but that literature does not seem to appreciably influence the modeling and econometric efforts. Lack of political economy is most obvious in the case of the demand for military expenditure equations where Greek military expenditure is almost exclusively modeled in terms of its perceived threat from Turkey, and vice versa. As I insisted earlier, Greece is bound into the unstable Balkans and surely the determinants of its level of military expenditure do not drive solely on Turkey or even NATO *per se*. Throughout Greece's post-world war II history,

Greece has faced *gradations of threat* from a variety of quarters, first the threat of Soviet-style communism via indigenous Greek communist efforts (1944-1949), then the external Soviet communist threat primarily via Bulgaria, then the integration into NATO (in 1952) which freed both Greece and Turkey to reactivate, after a three-decade hiatus, diverging interests over Cyprus (Sezer, 1991, p. 117; Krebs, 1999), then the threat of an internal Greek military dictatorship (1967-1974) that was partly responsible for Turkey's invasion of Cyprus, then the threat of a highly restive Balkan region, the threat of Turkey itself, the threat to Greece by virtue of the role NATO assigned to Greece for the duration of the cold war; and the threat of NATO's possible disintegration with the end of the cold war (see, e.g., Platias, 1991; Constas, 1995; Krebs, 1999). The analysis of the economics of military affairs within and between Greece and Turkey, and the associated econometric modeling efforts, fall far short of the richness of Greece post-world war II history.

Similarly, Turkey's levels of military expenditure are largely modeled on Greece's, but rarely, and never completely, on Turkey's other security problems, both internal (Islamic fundamentalism and Kurdish rebellions) and external (Iran, Iraq, Syria, etc.). Turkey's role within NATO, pre- and post-cold war, is almost never discussed in the economics literature. For that one must turn, again, to the political science and international relations literature (e.g., Sezer, 1991; Platias, 1991; Constas, 1995; Krebs, 1999).

Third, with one exception (Smith, Sola, and Spagnolo, 2000), the extant economics literature never addresses the disagreements and conflict between Greece and Turkey from a game-theoretic view, nor does it offer an economic analysis of possible, preferably irreversible, solutions. After all, the heart of economics is about interests and how interests, given available resources and constraints, lead to behaviors and outcomes. Economics is therefore also about agents' attempts to change resources and constraints – one's own and one's opponents' – so as to affect behavior and outcomes. Krebs (1999), for instance, contains an exceptionally good account of that and how membership in NATO permitted both Greece and Turkey to resume and intensify their disagreements, but the economics literature is devoid of corresponding analyses.

Fourth, in its focus on the Cyprus conflict in particular, the literature overlooks a rich and complex set of competition *and* cooperation between Greece and Turkey since 1923. The most advanced analysis is again offered by Krebs (1999) who makes, for Greece and Turkey, a persuasive case for his central claim "that [an] alliance [such as NATO] can deepen and intensify conflict among its members" (p. 345). It is remarkable that Greece and Turkey resumed mutual hostility – after three decades of peace – upon joining NATO in 1952. But while competition and cooperation far surpass the issue of Cyprus, it appears equally clear that the resolution of the Cyprus issue is the key that would permit both countries to resolve their other, "follow-on" problems as well. Interestingly, Sezer (1991) makes the perceptive observation that the young, independent nation of Cyprus made the mistake in the early 1960s

not to develop "a distinct Cypriot national identity" (p. 121) that might have removed the Cyprus issue from the Greek and Turkish agendas. (Likewise, I might add, Greece and Turkey could have removed the Cyprus issue, by renouncing any special allegiance to Cyprus.)

In a word, economists have made little contribution to understand and model the institutional setup, interests, constraints, and dynamics under which Greece and Turkey operate.[35] The literature, as presently constituted, has reached the point of declining returns. Running more single or simultaneous regression equations, even when incorporating all the latest quirks of mathematical statistics, is unlikely to much advance our substantive knowledge. Newer work, such as Smith, Sola, and Spagnolo, 2000, and the papers by Andreou *et al*. are likely to be of more productive of new insights.

Fifth, what is especially overlooked is an assessment of the potential benefits from dispute settlement and active economic and security cooperation between Greece and Turkey. As detailed earlier in this chapter, I find the econometric results purporting to show positive effects of military expenditure on the economies of Greece and Turkey somewhat difficult to believe. But suppose they were correct. Then, what is the opportunity cost of foregoing settlement and cooperation in the Balkans and the Black Sea region? Greece and Turkey, jointly, could make giant strides in pacification of the entire region and they could, jointly, like France and Germany for the European Union, become the powerhouse that spurs economic development across the Black Sea.[36]

What are the prospects? To be sure, militarily Turkey has the upper hand and the onus is on the quality of Greek foreign policy making. Turkey is large and mighty and very much a secular, but Islamic NATO front line state. Turkish and/or Muslim minorities dot the Balkans much more so than Balkan minorities speckle Turkey. But Greece is economically more advanced than Turkey, it does control most of the Aegean, there are sizeable Greek minorities in the Balkans as well (which affords opportunities for Balkan cooperation), Greece is a member of the EU and, even after admitting Turkey to EU membership *candidacy*, therefore controls actual *accession* of EU-aspirants to the EU, and Greece could become a member of a EU foreign policy and defense club that might replace, and certainly augment, NATOs increasingly shaky defense guarantee.[37] In a word, Greece's hand of cards is not empty if it would but lose its "introverted security orientation" (Constas, 1995, p. 73), fear of encirclement (Albania, Macedonia, Turkey, Turkey-linked Bulgaria), and settle down toward sustained negotiation. Neither is Turkey's hand quite as strong as it may appear to myopic Greece. The Southwest Asiatic nations surrounding Turkey are a restive lot that could quickly strain Turkey's capabilities. Resolution of differences between Israel and Syria would free the latter to turn unwelcome attention to Turkey. Resolution of western differences with Iran and Iraq would free them to turn to Turkey and dispute its current regional power status as Turkey's US support might wane. Clearly, both Greece's and Turkey's external security environment is volatile and fleeting enough to encourage both to settle and jointly become

stronger.

Perhaps it takes a pair of statesmen like Venizelos and Atatürk in the early 1920s. Were Turkey to become a regional superpower (Constas, 1995, p. 85) and Greece isolated, it would be too late for Greece to settle for much. And were Greece to tie up the Balkans within an EU context and Turkey to become embroiled in southwest or central Asian conflicts, then Turkey would likely hold the losing hand. In distinction to political scientists focusing on costly maintenance of strategic balance (e.g., Turan and Barlas, 1999), I like to think that this is an example of economists pointing to the benefits to be had from cooperation.

Notes

* The original draft of this paper was researched and written in the summer of 1999 and presented at the Middle Eastern Technical University (METU) Conference III, Ankara, Turkey, September 1999. A condensed version of that paper was first published as Brauer (2002). In it, I thanked conference participants for comments and Mr. Ihsan Tayfur for research assistance. I also expressed my sincere thanks to Stelios Makrydakis and Christos Kollias for taking the time to comment on the draft paper and to correct some errors of mine. Christos Kollias and Gülay Günlük-Senesen also assisted me to obtain papers that were very difficult to trace down and find. I am grateful for their help. For purposes of the present chapter, the 1999 draft has been updated so that the discussion is current as of December 2002. Of course, I alone am responsible for any remaining errors of fact, omission, and interpretation.

1. The Turkish victory over Greek forces at Smyrna in August 1921 ended 2000 years of continuous Hellenic settlement in Asia Minor, leaving large numbers of Greeks "stranded" in Turkey (see Matthews, 1999, p. 52 and literature cited there). Also see the article and map supplement in *National Geographic* magazine (December 1999).

2. Greek 2001 GNI *per capita* is given as US$11,780, as against only US$2,530 in Turkey, a ratio of about 4.7:1. "GNI, gross national income, measures the total domestic and foreign income claimed by the residents of the economy. It comprises GDP plus net factor income from abroad, which is the income residents receive from abroad for factor services (labor and capital) less similar payments made to non-residents who contributed to the domestic production." (See worldbank.org/data/countrydata/countrydata.html tables for Greece and Turkey, respectively; accessed 8 February 2003).

3. Current overviews on the Greek and Turkish economies are available at the OECD and IMF web sites, www.oecd.org and www.imf.org. On the role of the public sectors in Greece

and in Turkey, see Neal and Barbezat, 1998.

4. Avramides (1997, p. 173) expresses a similar sentiment. Georgiou *et al*. (1996, p. 230) cite Smith (1989, p. 352) according to whom shares "... can be used as a signal or a measure of commitment to defence" but citing Smith is not equivalent to a discussion of whether or not the use of share data is appropriate for establishing the presence or absence of an arms race. Moreover, the citation is incorrect. It actually reads "shares ... are widely used as a signal or a measure of commitment to defence" (Smith, 1989, p. 352). Smith intended this as a statement of fact, not necessarily as a nod of approval.

5. Reliable military expenditure data is notoriously difficult to obtain. Since both Greece and Turkey are NATO members, NATO data is comparable. See http://www.nato.int/docu/pr/2001/table3.pdf. The Stockholm International Peace Research Institute (SIPRI) also is a popular source of military expenditure data. It may be reached at http://www.sipri.se/ [both accessed 8 February 2003].

6. Kollias (1996) then mis-measures this capital intensity. He measures it as "military expenditure per soldier" (p. 224) whereas it should be measured as equipment stock per soldier. There are two issues here. First, only the equipment and directly associated support part of total military spending should be counted, excluding personnel and indirect support expenses. Second, military expenditure even if correctly measured as equipment spending is a *flow* variable whereas capability depends on *stocks*. Thus, the correct measure would be stocks-per-soldier, uneasily aggregated by some form of currency valuation. Kollias appears to have been the first to examine armed force and "capital intensity" ratios in Kollias, 1993a and 1994a.

7. The SIPRI Yearbook 1999 (table 11.2) ranks Turkey in spot number three ($6,615 billion) for the years 1994-1998 and Greece in sixth place ($4,754). The numbers are SIPRI's "trend-indicator" values in constant 1990 US dollars. The US and Germany are, by far, the most prominent arms suppliers to both Turkey and Greece.

8. There is an earlier contribution, Majeski and Jones (1981), but its results are included in Majeski (1985) which I do review.

9. Another four papers *presume* the existence of an arms race (Andreou and Zombanakis, 2000; Andreou and Zombanakis, 2001; Kollias and Sirakoulis, 2002; and Andreou, Parsopoulos, Vrahatis, and Zombanakis, 2002). They are discussed in a later section.

10. In tables A1 to A5 I summarize the results for statistically significant variables although occasional reference is made to other variables. Since authors usually report results for a large number of statistical runs, I tend to summarize the results only for the analyses on which the authors themselves implicitly or explicitly put the greatest weight, usually their last run.

11. And indeed, as discussed in the next sub-section, the demand for military expenditure models for Greece regularly find a strong, positive influence of contemporaneous and lagged Turkish military expenditure on Greek military expenditure.

12. The first paper is a working paper, the second, indicated with square brackets [...], is the published version.

13. Quoted from Wonnacott and Wonnacott, *Introductory Statistics* (New York: J. Wiley, 4th edition, 1987, p. 3).

14. That is, differences apart from the fact that the figure in Kollias and Makrydakis (1997b, p. 366) is in log terms and the figure in Dunne, Nikolaidou, Smith (1999, p. 7) is in level terms (which is merely a scaling or display difference).

15. A tenth paper on Greece (Antonakis and Karavidas, 1990) is published in Italian and not discussed in any detail here. As best as I can determine, the paper finds that the Greek demand for military spending between 1958-1986 is primarily determined by a 1974 Cyprus dummy and lagged Greek military spending (t-1).

16. I might add that Christos Kollias frequently authors and co-authors pieces containing novel approaches.

17. Throughout this literature, use of the NATO military expenditure variable is problematic. The Vietnam war for instance clearly was primarily a US concern and drove up US military spending beyond some baseline NATO-associated military spending. By the same token, Greek and Turkish spending were heavily influenced by the 1974 invasion of Cyprus, just as Portugal's spending was heavily influenced in the mid-1970s by the turmoil in its former African colonies of Mozambique and Angola. Lumping all NATO military spending together without separating out non-NATO spending may skew the statistical results. See Oneal (1990) for details.

18. P_C and P_D are civilian and military price indices, respectively, and m is domestic spending. $?_D$ is "subsistence" defense requirement.

19. "Economic impact" is understood in the literature as the impact of military expenditure on economic growth. There is one paper that finds that Greek military expenditure from 1960-1992 appear to have positively influenced employment levels in Greece (Chletsos and Kollias, 1997, p. 446).

20. There have been a number of applications of and variations on the Feder-Ram neoclassical production function model in the defense economics literature. They include Alexander (1990) for 9 developed countries 1974-1985; Atesoglu and Mueller (1990) for the US 1949-1989; Huang and Mintz (1990) for the US 1952-1988; Huang and Mintz (1991) for the US 1952-1988; Ward *et al.* (1991) on India 1950-1987; Ward and Davis (1992) for the US 1948-1990; Mueller and Atesoglu (1993) for the US 1948-1990, Alexander (1995) for 11 developed countries 1966-1988; Ward, Davis, and Lofdahl (1995) for the US 1889-1991 and Japan 1879-1990; Antonakis (1997b) for Greece 1958-1991; and Herrera (1998) for Pakistan 1960-1993; and a review by Ram (1995).

21. In some equations, investment is positive and significant but, as mentioned before, I tend to look at authors' "last run."

22. But unlike Sezgin, Özsoy computes a positive factor-productivity differential for the military sector, meaning that it is more productive than the nonmilitary public sector.

23. In addition, some theoretical and empirical doubts have been raised about Ram's model by Carr (1989) and Rao (1989). For instance, Carr points out that a goodly portion of government spending is intermediate rather than final output – in a national accounting sense – and that government spending data cannot therefore be treated as final output data as all these models do. However, the defense economics literature tends to overlook this and other objections to Ram's model. (Also see Ram's reply, 1989).

24. Kollias (1994b) is identical to Kollias (1995b) with respect to the estimated equation. The earlier paper contains additional material.

25. On the question of the suitability of the Feder-type model (e.g., implicitly it postulates causality running from military expenditures to economic growth rather than vice versa) see LaCivita and Frederiksen (1991) and on the interpretation of the coefficients see Carr (1989), Rao (1989), Ram (1989), Sandler and Hartley (1995), and Alexander (1995, esp. pp. 18-19).

26. Actually, it is unclear from the paper whether levels or growth rates are used. The paper says "... this study modelled economic growth as ...," then provides the equation repeated above and continues, "where Y is [...] gross domestic product; ... I is fixed capital formation,

L is civilian employed labour force ..."

27. There are two variables, government current expenditure and government deficit, were the authors do not specifically state whether or not the variable is in real or nominal terms. All other variables are explicitly referred to in real terms (see Balfoussias and Stavrinos, 1996, p. 213).

28. This follows Kennedy's (1974) notion of countries' "potential defense capacity," also empirically employed by Wulf (1983) and Brauer (1991; 2000).

29. In the case of Turkey, it can be traced back to the 11th century (see, Akgul, 1988).

30. "... empirical evidence showed that Turkish defence spending is not detrimental for the Turkish economy; on the contrary, it helps economic growth" (Sezgin, 1997, p. 407). "Due to the positive effects of the nonmilitary and military sectors on Turkish economic growth, the results reported here suggest that the Turkish government should not make drastic resource-allocation changes between nonmilitary and military public spending" (Özsoy, 2000, p.156).

31. A similar paper appeared as Athanassiou, Kollias, Nikolaidou, and Zografais (2002).

32. I am interpreting her findings more strongly than she herself does in her paper, but that reflects my reading of her figure 6 in particular (in the 1999 conference paper). The share changes essentially exhibit a random-walk pattern for the entire period, 1971-1997 except for 1988-1994 when security expenditures make disproportionally large contributions to Turkey's run-away budget deficits. This effect would be exacerbated if interest payment on the deficit-incurred debts could be properly allocated to the relevant functional budget categories.

33. Unfortunately, nowhere in the paper do its authors tell us which years the underlying empirical data cover. One can infer, however, that the early 1960s to late 1990s are included.

34. Because of a severe recession in 1980, Turkish GDP fell more than its military expenditure fell, thus driving up the share of military expenditure in GDP.

35. There is a burgeoning literature on the politics and economics of international institutions. For recent work see, e.g., Aggarwal, 1998a and 1998b. On institutional economics pertaining to NATO see, e.g., Sandler and Hartley, 1999.

36. An altogether different opportunity cost concerns of course the number of lives lost. For example, *The Economist* magazine reports (20 February 1999, p. 16) that the Turkish-Kurdish conflict has cost more than 30,000 lives.

37. NATOs defense "guarantees" is often misunderstood. Indeed, it is *wrong* to understand it as a guarantee at all. Article 5 of the NATO treaty merely pledges the allies to "consult as a group ... prior to determining the necessary response ... [It] does not commit the allies to an automatic military response, or any necessary response" (Sandler and Hartley, 1999, pp. 25-26) and certainly not in the case of conflict between two of its own members.

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Short biography

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Appendix A1: Greek-Turkish arms race models

Author(s)	Model	Sample period	Remarks	Conclusion
Majeski (1985)	Expectations-augmented Richardson-type model modeled as Granger-causality	1949-1975	Use log/levels and difference data	"significant and reciprocal interaction" among Greece and Turkey
Georgiou (1990)	Richardson-type arms race model based on McGuire and on Desai/Blake	1958-1987	Uses share data; OLS estimations	Milex is influenced more by inertia effects in one's own country than by milex in the other country
Stavrinos (1992)	Granger-causality	1949-1988	Uses level data; cointegration; ECM	Instantaneous, uni-directional causality from Greece to Turkey
Georgiou, Kapopoulos, Lazaretou (1996)	Granger-causality; 3 models: (a) based on McGuire; (b) based on Desai/Blake; and (c) error-corrected VAR	1960-1990	Uses milex as share of GDP; OLS estimations	One-way Granger-causality only, viz., from chg in the log of Greek milex share to that of Turkey
Kollias and Makrydakis (1997b)	Cointegrated Granger-causality model; vector error corrected VAR	1950-1995	Uses levels of milex; two dummies for 1975 and 1981 (lagged Cyprus and lagged military government in Turkey); shift parameter for structural break in cointegrated series in 1985	Bi-directional, instantaneous causality of Greek by Turkish and of Turkish by Greek milex up until 1985
Dunne, Nikolaidou, and Smith (1999)	Richardson-type model	1960-1996	Cointegration; ECM; VAR; uses logarithms of levels data and step-dummy for Cyprus	"Some evidence of cointegration ... but not in the form of long-run arms race"; VAR "fails to find any reasonable result"

Smith, Sola, and Spagnolo (2000)	Bivariate regime-switching model	1958-1997	Uses share data (milex/GDP)	Finds little support for action-reaction arms race; instead finds policy inertia: high (low) milex is followed by high (low) milex
Kollias and Paleologou (2002)	Engle-Granger vs Hendry-Ericsson causality	1950-1999	Uses logarithms of levels data	Finds bidirectional causality where Greece's milex depends more strongly on Turkey's than vice versa
Öcal (2002)	Non-linear Smooth Transition Regression (STR)	1956-1994	Uses logarithms of levels data	Finds substantial nonlinearities with effects on Turkey on Greece stronger than vice versa

Appendix A2: Models of the demand for Turkish military expenditure

Author(s)	Model	Sample period	Remarks	Conclusion
Chletsos and Kollias (1995b)	Single equation ECM model	1960-1992	ECM; mixes share and level data; includes Cyprus and Kurd dummies	Suggests that in the short run, Turkish milex is sensitive to internal security problems (Kurds) more so than to external (Greece) threats
Kollias (1995c)	Single equation for Turkish milex demand	1970-1991	OLS, Cochrane-Orcutt; uses milex per soldier as a quality of capital index	Finds that Turkish milex is influenced by Turkish armed forces and Turkish milex per soldier only in certain specifications of the estimating equation
Kollias and Makrydakis (1997a)	Granger-causality between economic growth and share of milex in GDP	1954-1993	Variables adjusted to make them stationary; two Cyprus dummies (1974, 1976); OLS estimation of VAR	no Granger-causality between GDP growth rates and share of milex in GDP
Dunne, Nikolaidou, and Vougas (1998, 2001)	Granger-causality with cointegration and structural break	1963-1996	Cointegration; ECM	Finds unidirectional, negative Granger-causality from milex to econ. growth.
Sezgin and Yildirim (2002)	autoregressive distributive lag	1951-1998	Uses share data and growth rates	Finds that Turkish milex is determined by inertia as well as by NATO's and Greece's milex in the short-run; in the long-run only NATO's milex effect is positive on Turkey's milex (and income and the balance of payments effects are negative)

Appendix A3: Models of the demand for Greek military expenditure

Author(s)	Model	Sample period	Remarks	Conclusion
Kollias (1993a)	Greek milex as share of GDP depends on Turkish milex as share of GDP, plus Cyprus dummy variable	1970-1990	Single equation; OLS	Positive effect of Cyprus dummy and Turkish milex share on Greek milex share; similar for equation using ratio of Greek to Turkish armed forces (negative sign) and Greek/Turkish milex per soldier
Kapopoulos and Lazaretou (1993)	Level of Greek milex = f (Turkish milex/GDP, US milex/GDP, level of Greek civilian GDP)	1962-1988	Single equation; cointegration; ECM	Long-run: positive effect of Turkish milex/GDP and Greek civilian output; negative effect of US milex/GDP; Short-run: positive inertia effect of lagged Greek level of milex; positive effect of lagged Turkish milex/GDP and of US milex/GDP; positive effect of Cyprus (1974) dummy
Refenes, Kollias, Zapranis (1995)	Neural network vs. regression analysis; Greek milex growth rate in t+1 = f (ratio of G/T armed force, Greek milex per soldier, Turkish milex per soldier, Greek milex share in GDP, and Turkish milex share in GDP	1962-1990	Uses milex per soldier	Neural network shows smaller forecasting errors and captures directional changes better than regression forecast does; Greek milex growth rate highly sensitive to ratio of armed forces, also positively responds to Turkish milex per soldier and to Greek milex/GDP
Kollias (1995a)	Demand equation for level of Greek milex $grm_t = a_0 + a_1\, tur_t + a_2\, nato_t + a_3\, gdp_t + g_t$	1960-1994	cointegration; ECM	Level of Greek milex depends strongly on share of Turkish milex and on Greek GDP; dummy for Cyprus (1974) positive; a dummy for Greek socialists coming to power in 1981 is positive and significant
Kollias (1995c)	Single equation for Greek milex demand	1970-1991	OLS, Cochrane-Orcutt; uses milex per soldier as a quality of capital index	Finds that Greek milex is heavily influenced by Turkish armed forces and Turkish milex per soldier

Kollias (1996)	Demand equations: (a) for level of Greek milex; (b) for level of Greek milex per Greek soldier	1960-1992	(a) levels and shares of milex mixed; cointegration; ECM; OLS estimations (b) OLS with Cochran-Orcutt iteration	Level of Greek milex depends strongly on share of Turkish milex and on Greek GDP; ditto for changes in level of Greek milex; dummies for specific Greek-Turkish conflict years are insignificant.; a dummy for Greek socialists coming to power in 1981 is positive and significant; (b) Greek milex per soldier negatively related to ratio of Greek/Turkish armed forces, and positively related to level of Turkish milex and milex per soldier
Avramides (1997)	Stone-Geary (S/G) model and Deaton-Muellbauer (D/M) model; with slope and intercept shift dummies; levels and chg in level data for S/G; budget share data for D/M	1950-1989	SG: Long-run OLS on cointegrated variables; short-run ECM;	S/G: • Long-run: Greek milex follows Turkish milex and free-rides on US milex within NATO; post-1974, Greece follows NATO; 1967 coup in Greece resulted in positive and significant shift of Greek milex • Short-run: chg in Greek milex strongly respond to contemporaneous chg and two-period lag in Turkish milex D/M: • Long-run: same as S/G • Short-run: typo in table but chg in Greek milex share appear to follow contemporaneous chg in Turkish milex shares; moreover, Greek milex appears income and milex price inelastic
Dunne, Nikolaidou, and Vougas (1998, 2001)	Granger-causality with cointegration and structural break	1963-1996	Cointegration; ECM	Finds Granger-causality from milex to growth when no data adjustments are made; when non-stationarity and Cyprus shocks are modeled, Granger-causality vanishes.
Kollias and Makrydakis (2000)	Granger-causality model with test for structural breaks	1955-1993	Cointegration; ECM	Accounting for structural breaks in 1973/74, finds no Granger-causality between economic growth rates and military burden (milex/GDP)

Appendix A4: Models of the economic impact of Turkish military expenditure

Author(s)	Model	Sample period	Remarks	Conclusion
Sezgin (1997)	Feder-type model (with human capital)	1949-1993	Single equation; two sectors (mil., civilian); OLS estimation	Total effect of milex on growth positive; size effect positive and externality effect negative; both become stat. insignificant over time; no effect of investment nor of human capital
Sezgin (1998, 2001)	Deger-type model	1956-1994	Differenced data; data mostly in inflation-adjusted level form; OLS, 2SLS, 3SLS	positive effect of milex on growth; no effect of milex on savings or trade balance; determinants of Turkish milex are Turkish income, the Kurdish conflict, and Greek milex; no computation of system wide net effect, dg/dm.
Sezgin (1999)	Cointegration; error-correction; GDP = f (I, L, equipm. milex, non-equip. milex)	1975-1996	Disaggregated data for equipment and non-equipment milex	Long-run: positive significant effect of equipment milex on GDP; Short-run: significant effects only for investment
Özsoy (2000)	Feder-type model (includes human capital effect and milex of adversary, i.e., Greece on Turkey)	1950-1992	Single equation; three sectors (civilian, non-military public, and military public); OLS estimation	Positive externality effect of non-military public sector; no effect of milex. (positive only in restricted models); no effect of Greek milex on Turkish growth; factor productivity differential of Turkish milex negative; no effect of investment, labor, human capital, civilian sectors either
Sezgin (2000)	Feder-type model (with human capital)	1950-1994	Single equation; two sectors (mil., civilian); OLS estimation, first differenced, and various lags	Total effect of milex on growth positive; size and externality effects positive; positive contribution by investment, labor force, and human capital
Yildirim and Sezgin (2002)	VAR and VEC	1949-1994	Includes Cyprus and economic policy dummies	Positive short and long-run effects of milex on economic growth

Appendix A5: Models of the economic impact of Greek military expenditure

Author(s)	Model	Sample period	Remarks	Conclusion
Kollias (1994b)	GDP = f (ME/GDP), I/GDP, POP	1963-1990	Single equation; cointegration; ECM; level data for GDP, share data for milex; share data for investment; growth rate data for population	Long-run: positive effect of milex share on GDP growth; insignificant effect on investment share; Short-run: positive effect of chg in milex share on chg in GDP; ditto for chg in investment share and for chg in lagged GDP; savings and investment shares in GDP are negatively related to milex/GDP
Antonakis (1995)	GDP growth rate = f (savings rate, milex/GDP, per capita GDP, pop growth, inflation)	1958-1990	OLS	Negative effect of milex/GDP on investment/GDP; negative effect of milex/GDP on GDP growth rate
Kollias (1995b)	GDP = f (ME/GDP), I/GDP, POP	1963-1990	Single equation; cointegration; ECM; level data for GDP, share data for milex; share data for investment; growth rate data for population	Long-run: positive effect of milex share on GDP growth; insign. effect on investment share; Short-run: positive effect of chg in milex share on chg in GDP; ditto for chg in investment share and for chg in lagged GDP
Antonakis (1996a)	Deger-type model	1958-1990	Three equation (growth, savings, milex); 3SLS; milex measures as share of GDP	Negative effect of milex on growth; positive effect of milex on savings; positive inertia (one lag) of milex on milex; overall *net* effect negative (dg/dm = - 1.106)
Chletsos and Kollias (1995a)	Keynesian national income equations	1974-1990	Three single equations (consumption, investment, milex); OLS estimation	Positive direct effect of milex on consumption; negative impact on investment; no net effect calculated
Balfoussias and Stavrinos (1996)	Keynesian demand-model	1960-1992	Eight equations simultaneous system; disaggregated milex data	Positive direct effect of milex personnel and milex procurement on real GDP.

Antonakis (1997a)	Deger-type model	1960-1990	Three equation model; OLS and 3SLS	Positive effect of m on g for single equation; but overall negative effect of about -0.4 for dg/dm.
Antonakis (1997b)	Feder-type model	1958-1991	Single equation, two-sector model (mil., non-mil.); OLS estimation	Negative effect of milex on growth
Sezgin (1999)	Cointegration; error-correction; GDP = f (I, L, equipm. milex, non-equip. milex)	1977-1996	Disaggregated data for equipment and non-equipment milex	Long-run: significant effects only for investment Short-run: negative effect of equipment on GDP; positive effect of non-equipment on GDP
Sezgin (2000)	Feder-type model	1959-1994	Single equation; first differences in some variables; OLS estimation	No effect of milex on growth
	Deger-type model	1958-1994	Three equations (growth, savings,, milex); OLS, 2SLS, 3SLS; all variables first-differenced	Positive effect of milex on growth but negative on savings; positive effect of Turkish milex, NATO, and Cyprus dummy on Greek milex; no *net* effect computed
Dunne and Nikolaidou (1999)	Deger-type model	1960-1996	Four equations (growth, savings, trade balance, milex); OLS, 2SLS, 3SLS; all variables first differenced	Negative effect of milex on growth, savings, and trade balance; dg/dm = - 0.026; dS/dm = -3.21; dTB/dm = -0.136.