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AN ALLIANCE BETWEEN CYPRUS AND GREECE: ASSESSING ITS PARTNERS' RELATIVE SECURITY CONTRIBUTION

A. S. ANDREOU[a,†], K. E. PARSOPOULOS[b,‡], M. N. VRAHATIS[b,§] and
G. A. ZOMBANAKIS[c,*]

[a]*University of Cyprus, Department of Computer Science, 75 Kallipoleos str., PO Box 20537, CY1678 Nicosia, Cyprus;* [b]*University of Patras, Department of Mathematics, Patras 26500, Greece;* [c]*Research Department, Bank of Greece, 21 Panepistimiou str., Athens 10250, Greece*

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The issue that this paper tackles is the assessment of the relative security benefits that Cyprus and Greece derive in the context of their cooperation on defence matters. This form of cooperation, known as the 'Integrated Defence Space Doctrine', aims at defending their interests in the Aegean Sea and the broader East Mediterranean theatre. The paper relies heavily on earlier research on this topic, which deals with the Greek–Cypriot alliance facing an arms race against Turkey, and uses a coefficient especially designed to assess the optimal levels of security and the associated defence expenditure of the two allies. A comparison of the relative security coefficient values for the two allies suggests that the security benefit that Greece derives thanks to its alliance with Cyprus exceeds the corresponding Cypriot benefit by far. Given the importance assigned to human resources by this index, in conjunction with the demographic problems of Greece, this conclusion justifies the recent Greek defence policy revision, emphasizing quality, capital equipment and flexibility of forces. This revision aims at satisfying the security requirements of the alliance and the increasing demands of an arms race against Turkey.

Keywords: Optimal control; Defence expenditure; Arms race; Relative military security

JEL codes: C61; H56

INTRODUCTION

This paper aims at supplementing earlier work on the cooperation concerning defence matters between Greece and Cyprus. In fact, the term 'Integrated Defence Space Doctrine', according to the Hellenic Ministry of Defence, 'describes a purely defensive dogma, the scope of which is to face any form of offensive action against one or both of the allies. It aims, in addition, at defending the strategic and political interests of the two allies in the Aegean Sea and the

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† Corresponding author. E-mail aandreou@ucy.ac.cy
‡ E-mail: kostasp@math.upatras.gr
§ E-mail: vrahatis@math.upatras.gr
* E-mail: gzombanakis@bankofgreece.gr
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broader East Mediterranean area in an environment of an arms race against Turkey' (Hellenic Ministry of Defence, 2000). This paper focuses on the relative security contribution of Greece and Cyprus in the alliance and the benefits that each side derives. This is an issue that has assumed particular interest in relation to Cyprus's full EU membership and the anticipated reactions from the part of the new Islamist government of Turkey since early November 2002.[1] Concerning Greece, the issue of burden sharing has acquired increasing importance during the recent past, given the restrictions imposed on the defence equipment purchases of the country by the Conventional Forces in Europe (CFE) Treaty,[2] and the additional burden imposed on the country's economy by its commitments to NATO and the Euro-army.[3]

To this end, we shall borrow the econometric model we used in Andreou *et al.* (2002) and use it as a constraints structure in order to calculate the maximum relative security for each of the two participants in this alliance, compatible with the 'optimal' defence burden. The latter shall be defined as the defence spending allowed by the constraints imposed by the economies of the two allies. This means that the resulting values will be 'optimal' only in the strict economic sense of the word, without any political or strategic considerations involved.[4] Moreover, these values being 'optimal' bear the element of an ideal value, which implies that their attainment involves no peace dividend. Any elements of opportunity cost in the form of the peace divided may be introduced only in cases in which the two allies proceed to spend on defence over and above what these optimal values suggest.

By using the relative security index, especially designed to reflect pronounced population rate differences in cases of an alliance facing a common threat (Andreou and Zombanakis 2001), the optimization procedure takes into account the spillover effects enjoyed by Greece and Cyprus in the context of the Integrated Defence Space Doctrine. The results will be provided in terms of an optimal control solution, using the Interior Penalty Function Method, with Steepest Descent and Armijo Line Search (presented in the Appendix), after a brief literature overview. The technical concepts concerning the model are discussed in the third section, while the results of our experiments and the conclusions derived are given in the fourth and fifth sections respectively.

LITERATURE OVERVIEW

Given the space restrictions usually imposed on journal articles, we shall avoid mentioning the bulk of the relevant literature by simply referring to a number of comprehensive reviews, such as Hartley and Sandler (1995) and Brauer (2002). There are, however, certain very interesting issues that must be awarded particular importance since they provide the guidelines for this paper.

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[1] 'The landslide victory of the Justice and Development Party (JDP) in the 3 November 2002 elections marked the beginning of a new era in Turkish politics, with potentially profound repercussions for domestic and foreign policies. Both its opponents and supporters perceive the JDP as having an Islamist agenda. Although in the short term it is likely to concentrate on consolidating its grip on power rather than trying to erode the secular principles enshrined in the Turkish constitution, there are already signs that the Turkish establishment – led by the military – is mobilising to restrict the JDP's room for manoeuvre and undermine its authority by targeting the JDP leader, Recep Tayyip Erdogan' (IISS, 2002).

[2] The CFE Treaty imposes a ceiling on the purchases of the participant countries regarding tanks, armoured vehicles, artillery, helicopters and fighter planes. The Treaty also provides for a ceiling on the armed forces personnel of the countries involved. It is important to remember that Turkey has never signed this treaty.

[3] The extent to which the NATO and Euro-army commitments burden the Greek defence budget can be realized by considering that the cost of just one of about ten programmes required, namely that of the procurement of 10 to 12 transport aircraft (C17 Globemaster or Airbus 400M), amounts to roughly $1.8 billion.

[4] Introducing the role of geopolitical or strategic criteria in such issues requires the use of Fuzzy Logic, which represents, however, a completely different approach to the problem (see for example Andreou *et al.*, 2003).

The first issue concerns the question of the so-called 'Integrated Defence Space Doctrine', the formal term for the alliance between Greece and Cyprus. There are very few sources in the literature describing the '*de jure*' structure of this alliance (Hellenic Ministry of Defence, 2000). This is a fact, which may justify, partly at least, the objections occasionally raised with regard to adopting the term 'Integrated Defence Space Doctrine' as representing a formal alliance structure. In its '*de facto*' form, however, this cooperation regarding defence matters between Cyprus and Greece has been fully operational for about 20 years or so. Indeed, its orientation and scope are very clearly reflected in the scenarios of all joint bilateral military exercises undertaken by the two allies, like Nikiforos-Toxotis, for example, and in the forms of joint operational training, such as combat search and rescue. Its technical description, therefore, may be very well depicted using the standard theory of alliances. In fact, Hartley and Sandler (1995, p. 19) suggest that the military cooperation between Cyprus and Greece tends to be close to the so-called 'pure public good model'.[5]

The second issue to establish is the arms race between Greece and Turkey. Unlike what has been supported by Brauer (2003), the proof of the existence of an arms race between the two sides is not taken as a priori given by earlier research on this topic. On the contrary, as advised by Taylor (1995), the proof on the basis of advanced time-series techniques such as neural networks and genetic algorithms, used, for example, by Kuo and Reitsch (1995) or Andreou and Zombanakis (2000), has been proven to be clearly superior to the conventional techniques such as OLS, which provide contradictory results on the issue of an arms race between Greece and Turkey (Brauer, 2003). In fact, as Brauer (2003, pp. 6–7) points out,

> so, is there an arms race between Greece and Turkey? We cannot tell until authors extract from complex realities an underlying theory of data generating processes poured into causal models, and then to put these models to a statistical test.
>
> In particular, it seems to me, the relation between Greece and Turkey needs to be modelled not as Granger-causality but as an overlapping relation (a regular system of two simultaneous equations) … Neither 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.

Papers such as the ones already mentioned clearly follow Brauer's suggestions using time-series techniques, and are relieved of the model reliability problems, while explicitly introducing a measure of relative security concern between the two sides. This relative security measure, which relies on the population growth rates of both allies and Turkey has assumed the role of a spill variable as suggested by the conventional theory of alliances and the theory of the demand for defence expenditure (Sandler and Hartley, 1995). It has been proven to be suitable in cases like the arms race between Greece and Turkey, in which the population variable has played a leading role, at least until the very recent past, when the Greek authorities decided to change their philosophy on this issue, realizing the clear comparative advantage of Turkey in the field of human resources. It will be shown how this measure must be adopted to the human resources endowments of each of the three countries involved, namely Greece, Cyprus and Turkey, in order to reflect the relative security of each of the two participants in the Integrated Defence Space Doctrine.

The only paper using a small, highly aggregated model emphasizing the defence expenditure of Greece and Cyprus in terms of a constraints structure to perform a dynamic

[5] The terms 'integrated' and 'space' are much more suitable to describing the corresponding Greek terms, compared with 'joined' and 'area' used by some authors respectively. Indeed, the term 'joined' is much weaker compared with 'integrated', since the degree to which two sides may join one another may vary from a loose to a very tight extreme. The word 'integrated', on the other hand, reflects exactly what the two allies aim at building: a completely unified front against any outside threat in the area. As regards the term 'space' it is more suitable to be used as a counterpart of the 'vital space' ('lebensraum') which represents a major long-term argument brought forward by Turkey to support its ambitions for expansion in the Aegean (Andreou and Zombanakis, 2000).

optimization is Andreou *et al.* (2002). In this case, however, the proof of an arms race between Greece and Turkey has already been established in the sources cited earlier. The method thus leads to determining the ideal or optimal values for those variables, to the extent, of course, that these are attainable. It is important to stress once again that the derived values for defence expenditure are characterized as optimal in the strict economics sense without involving any constraints of a strategic or tactical nature – an issue beyond the scope of this paper. The optimal control analysis, therefore, will specify the defence expenditure that the two allies are able to afford in the context of the theory of alliances in its 'pure public good model' version.

TECHNICAL CONCEPTS

The model we shall be using as a constraints structure for the dynamic optimization procedure has already been extensively described in Andreou *et al.* (2002) and is presented in the Appendix along with its basic diagnostic tests for convenience. The equations describing the demand for defence expenditure for Greece and Cyprus, however, have been modified compared with their original version, as explained below, while the rest of the model equations retain their original specification and role in the model. It is a small, highly aggregated model of six equations representing the economies of Greece and Cyprus, based on previous research (Stavrinos and Zombanakis, 1998). Its emphasis for both allies lies on defence expenditure, while variables expressing the Turkish side are taken as exogenous.

The Demand for Defence Expenditure and the Security Function

Following the standard theory, the demand for defence expenditure for each of the two allies, namely Greece and Cyprus, is represented in Andreou *et al.* (2002) as follows:

$$\mathrm{GDEF} = f(\mathrm{GGDP}, \mathrm{GNDEF}, \mathrm{GBOP}, \mathrm{DRDL}, \mathrm{RSG_C}, \mathrm{TDEF}) \tag{1}$$

$$\mathrm{CDEF} = f(\mathrm{CGDP}, \mathrm{CNDEF}, \mathrm{CBOP}, \mathrm{DLCP}, \mathrm{RSC_G}, \mathrm{TDEF}) \tag{2}$$

where GDEF and CDEF are the corresponding GDP shares of defence expenditure for the two allies. GBOP and CBOP represent the Greek and Cypriot balance-of-payments deficits as a share in their respective GDP, while DRDL and DLCP stand for the two countries' respective currency rates against the US dollar. The use of both the balance of payments deficit and the exchange rate in these equations has been considered necessary given that the former provides the constraint imposed by the external sector to defence spending while the latter approximates the price variable which, when it comes to defence procurement, cannot always be reliably estimated (Hartley and Sandler, 1995).[6] Concerning the role of GNDEF and CNDEF, these aim at underlining the trade-off between defence and non-defence expenditure, introducing the dimension of the peace dividend in the equation, while the threat variable in both cases is TDEF, which represents the share of defence expenditure in the Turkish GDP. Finally, special attention should be drawn to the spillover variable: one might be tempted to argue that a suitable spillover variable would be the military burden of the NATO countries except Greece and Turkey. We feel, however, that since our aim is to concentrate on the Greek–Cypriot alliance,

[6] Some figures denoting the applied side of the problem indicate the extent to which the external constraint for a small, open economy can be binding. In the case of Greece, for example, the purchase of 170 Leopards (€1.7 billion), or four Type 214 submarines (€1.5 billion), is disproportionately hard for the country's €8 billion annual current account deficit to bear.

expressed through the Integrated Defence Space Doctrine, what is required is an alternative measure tailored to fit this particular case. We have chosen, therefore to use a measure of relative security as a result of the two countries' alliance that assesses the security that one ally enjoys thanks to the contribution of the other ally in terms of population growth rates. It follows, therefore, that this index, proposed by Andreou and Zombanakis (2001), can be used as a spillover variable. In fact, the authors provide its full technical background, showing that it is applicable to cases in which the role of the substantial difference in human resources endowments between the two sides involved in an arms race is decisive. The measure of this relative security coefficient that describes the relative security of Greece with reference to Cyprus is given by:

$$\mathrm{RSGc} = \exp[x] \tag{3}$$

where x stands for the ratio of the difference between the Cypriot and the Greek population rates of change over the corresponding Turkish figure, as follows:

$$x = (\dot{p}_{\mathrm{C}} - \dot{p}_{\mathrm{G}}) / \dot{p}_{\mathrm{T}} \tag{3a}$$

Following the same reasoning, the corresponding measure describing the relative security of Cyprus with reference to Greece is given by:

$$\mathrm{RSC_G} = \exp[y] \tag{4}$$

where y stands for the ratio of the difference between the Greek and the Cypriot population rates of change over the corresponding Turkish figure, as follows:

$$y = (\dot{p}_{\mathrm{G}} - \dot{p}_{\mathrm{C}}) / \dot{p}_{\mathrm{T}} \tag{4a}$$

On the basis of equations (3), (3a), (4) and (4a), one may be tempted to argue that the ideal alliance target for a balance between the two sides concerning security would be a value of $\mathrm{RSG_C} = \mathrm{RSC_G} = 2.718$, once x assumes the value of unity. Under the circumstances, however, this is a prohibitive restriction, meaning that the applied side of the matter calls for a more realistic constraint. It must be borne in mind, however, that this relative security coefficient comprising the population characteristics of the two sides involved in an arms race includes more than meets the eye. In fact, the role of the population growth in the relative security index is not only associated with the possibilities to increase manpower in the armed forces, something which, anyway, does not necessarily agree with the doctrines of modern warfare tactics. It is also linked with the continuous and pressing demands of Turkey to increase its vital space justified by the population explosion in the country (Andreou and Zombanakis 2000).[7] We

[7] It is certainly a fact that these demands have been repeatedly expressed through statements, the diplomatic flavour of which leaves a lot to be desired. Thus, Defence Minister H. Isik declared in his speech on 23 February 1978 that 'The entire (Turkish) nation depends on Greek pressure which is trying to strangle the country, encircling Turkey from the west and preventing access to the Mediterranean Sea … The Turkish nation must unite to face the problem of the Aegean and of Greek pressure which will encircle western Turkey with the aim of strangling it'. Premier S. Demirel seems to insist in his statement on 24 August 1976 that 'For six hundred years the Aegean islands were ours and in the hands of the Ottomans' while Premier S. Irmak pointed out on 18 January 1975 that 'The Aegean Sea belongs to us. This is something that must be understood by all. We do not intend to innovate in matters of foreign policy. If the honour and interests of the Turkish nation are threatened, we shall knock the enemy's block off!' Finally, Foreign Minister Gyunes wrote in Huryett on 20 July 1980 that 'Cyprus is as valuable as the right hand of a country which is interested in its defence or its expansionary plans'. This is just a small sample of a wide collection of similar statements that describes the Turkish formal view on the subject. Turning to the applied side of things, the persistence of the Turkish authorities on their views regarding their need for vital space is reflected in the large number of Turks being moved to the northern part of Cyprus and the thousands of refugees fleeing from Turkey to Greece every year.

feel, therefore, that, given the particularity of the Greek–Turkish arms race, which is affected to a large extent by population developments in the countries involved, the identities (3) and (4) can serve as a security function entering the allies' utility function.[8]

The Output Equation

This section serves as a brief reminder of what we have already pointed out regarding the specification of the output equations used (Andreou *et al.* 2002). Indeed, the GDP in the two countries is determined on the basis of a behavioural equation rather than an identity, given that the optimization procedure requires that an emphasis is placed on the shares of the various GDP components in it. Thus, equations (5) and (6) given below describe growth in the two allied countries in terms of its main ingredients: accumulation of physical capital as investment in Greece and Cyprus, GTI and CTI, respectively, non-defence expenditure, and net imports of goods and services as an indication of the external constraint imposed on the growth rate of the economy. Finally, the local currency exchange rate is included given that it has been a very popular policy instrument for the period under study. Thus, the GDP in both countries is determined as follows:

$$\mathrm{GGDP} = f(\mathrm{GNDEF},\ \mathrm{GTI},\ \mathrm{GBOP},\ \mathrm{DRDL}) \tag{5}$$

$$\mathrm{CGDP} = f(\mathrm{CNDEF},\ \mathrm{CTI},\ \mathrm{GBOP},\ \mathrm{DLCP}) \tag{6}$$

It must be borne in mind that given the trade-off between non-defence and defence expenditure (Benoit, 1978), the latter can be thought of as implicitly introduced in these functions to account for the direct effects of military spending on growth in the form of spin-offs, either favourable or adverse (Sandler and Hartley 1995).[9]

The Population Equation

Equations (7) and (8) underline the importance of human resources in the Greek–Turkish conflict (Andreou and Zombanakis, 2000, 2001) as follows.[10]

$$\mathrm{GPOP} = f(\mathrm{GGDP},\ \mathrm{GDEF},\ \mathrm{GNDEF},\ \mathrm{GCPI}) \tag{7}$$

$$\mathrm{CPOP} = f(\mathrm{CGDP},\ \mathrm{CDEF},\ \mathrm{CNDEF},\ \mathrm{CCPI}) \tag{8}$$

where GCPI and CCPI are the Greek and Cypriot consumer price indices, the role of which – along with that of GNDEF and CNDEF in determining population growth – is decisive (Ehrlich and Lui, 1997). In fact, the consumer price index is included in the function in order to introduce the budget constraint imposed on low-income families that cannot afford to contribute to the population growth.

[8] See, for example, Bruce (1990).

[9] General surveys of the effects of military expenditure on growth and development are given in Renner (1992), Isard and Anderton (1992), Pivetti (1992), Mintz and Stevenson (1995), and Ward *et al.* (1995), among others. For comprehensive bibliographies in English see Klein *et al.* (1995), and Hartley and Hooper (1990).

[10] For a very useful review on the subject we resorted to Ehrlich and Lui (1997).

Comments on the Equation Estimates

All variables in the stochastic equations have been expressed in natural logs and tested for integration with the RES terms indicating the residual item of the corresponding long-run version of each equation. All series have been found to be I(1), that is, stationary in their first differences, on the basis of the ADF test, while the estimation period undertaken ranges between 1960 and 2000, following which the government embarked on a number of revisions concerning the defence dogma of Greece. The short-run estimates presented in the Appendix comprise an error-correction model, with all coefficients bearing the expected signs and accompanied by their *t*-values in parentheses, while the explanatory power of all six equations is satisfactory.

The trade-off between defence and non-defence expenditure is underlined in the cases of both Greek and Cypriot demand for defence expenditure, where the spill and threat variables seem to be important determinants. With regard to the spill variable, in particular, the different signs in the estimates of the two allies reflect differences in the demographic developments, which reveal an endowment asymmetry issue (Sandler 1992). The positive sign of the GDP variable in both equations indicates that defence is regarded as a normal good by the alliance members, as is usually the case in the majority of sources in the literature, with all implications that such a finding may entail on the issue of free-riding (Olson and Zeckhauser, 1966). The long time lag required for the income variable to affect military spending is expected given the long-term horizon of the various defence procurement programmes that represent a considerable part of military spending in the two allied countries. The income inelasticity of defence expenditure in both equations underlines one of the major issues that this paper points out, namely the necessity to adhere to the defence expenditure programmes undertaken. The negative sign of the balance of payments coefficient in both cases designates the external constraint imposed on the defence procurement programmes, a constraint reinforced by the exchange rate effect, the coefficient in all cases indicating an inelastic response of defence expenditure to these variables. Attention is required when interpreting the difference in the sign of the exchange rate coefficient between the Greek and the Cypriot cases, which is due to the inversion of the parity fraction in the case of Cyprus.

All estimates in the output equations bear the expected sign and are statistically significant with a marginal exception in the case of the exchange rate in the Greek case. This point and the low elasticity derived in both equations are related to the controversy associated with the effects of a domestic currency devaluation on the rate of growth (Zombanakis 1998) while attention is drawn to the difference in the sign of the exchange rate coefficient between the Greek and the Cypriot case due to the inverse format of the latter.

In the case of the population equations, the constraint imposed on the population growth due to the standard of living is approximated by the consumer price index, the reaction to which turns out to be quite significant, however highly inelastic in both cases. Finally, devoting funds to non-defence activities seems to contribute to the population increase, but this is not the case for defence expenditure, at least in the case of the equation for Greece.

Given this set of equations as a constraint structure, the optimization problem is formulated by requiring the minimization of a ‘welfare function’, the arguments of which are the squared deviations of the endogenous variables from their respective targets, while the weights assigned to all endogenous variables are equal to unity. The policy instruments used are the GDP shares of defence expenditure in the two allied countries while the algorithm itself involves an Interior Penalty Function Method, with Steepest Descent and Armijo Line Search (Vrahatis *et al.*, 2000; Parsopoulos and Vrahatis, 2001; Parsopoulos *et al.*, 2001; Andreou *et al.*, 2002).

Whereas the equations above have been estimated for the period between 1960 and 2000, the optimization exercise concentrates on the last 11 years, namely 1990 to 2000. The restriction of the optimization period aims at avoiding the adverse repercussions of a large number of structural reforms, mostly of political nature, affecting Greece and Cyprus during the previous three decades.[11]

EMPIRICAL RESULTS

The optimization problem is formulated by requiring the minimization of a 'welfare function', the arguments of which are the squared deviations of the endogenous variables of the model shown in the Appendix from their respective targets, as these reflect the assumptions of the two policy scenarios. Following one reference or baseline scenario that involves a dynamic simulation of the model, free of any policy measures, two additional policy scenarios are introduced according to which either Greece or Cyprus undertakes the burden of counterbalancing the Turkish advantage in terms of human resources. This will require a number of demographic policy measures taken by either ally, which are expected to lead to raising its rate of population growth. In such a case, and according to equations (3) and (4), the security alliance target in both cases must be set as $RSG_C = RSC_G = 2.718$, once x assumes the value of unity; that is, as long as population developments on the Greek/Cypriot alliance side counterbalance the Turkish generous population rates of increase – a rather demanding target one must admit. If this is the case, then the numerator must equal the denominator of x yielding a value of unity, the log of which is 2.718.

The results obtained by the optimization procedure are very interesting and reflect the choices of the Greek armed forces as these are expressed through the recent dogma change. Indeed, the benefits in terms of security that Greece derives out of its alliance with Cyprus are shown to be multiple compared with those that Cyprus derives out of this alliance (Figure 1). Since, however, the demographic developments in Cyprus (Government of Cyprus, 2001) are much more promising compared to those in Greece (Hellenic Republic, 2001) this conclusion is not as preposterous as it appears at a first glance. This is a benefit that allows Greece to concentrate on advanced defence equipment and technology rather than manpower, an obviously expensive alternative, as the relevant defence expenditure figures indicate (Figure 2). Indeed, the average optimal value derived by the model approaches 4.5%, about one percentage point higher than the corresponding optimal defence expenditure levels calculated in our earlier research (Andreou *et al.*, 2002). This margin is not at all negligible bearing in mind that it could buy Greece an extra 60 F-16s or about 30 F-15s, a fighter plane rejected a few years ago on the grounds of a very high price. A further interesting finding is that this average optimal defence expenditure deviates from its target value, as this is set by the Greek authorities in the context of an arms race, by less than 40% compared with a more than 50% average deviation in the Cypriot case (Figure 3). An important consequence of these substantial deviations figures is that the attainable average relative security in

[11] The period between 1960 and 1990 involves a large number of exogenous disturbances mostly of political nature, which have been the cause of structural reforms, not necessarily for the better. Thus, between 1960 and 1967 there was extensive political instability in Greece while in Cyprus there was extensive action of EOKA against the British authorities and the Turkish Cypriots. 1967 marks the beginning of the seven-year dictatorship in Greece, following which the 1974 Turkish invasion in Cyprus took place. Finally, 1987 marks still one more Greek–Turkish crisis, followed by prolonged political unrest and three consecutive parliamentary elections between 1989 and 1990. The above do not exhaust the list. They are simply some of the events during this period, which will certainly introduce statistical problems in the analysis, unless, of course, one resorts to artificial neural networks (NN) or genetic algorithms to avoid the complications of the traditional methods. We have already used NN repeatedly in the past (Andreou and Zombanakis, 2000, 2001) with very successful results. The only reason why we have not resorted to NN in this case is that optimal control suggests the use of a constraints structure along the lines of a traditional econometric model.

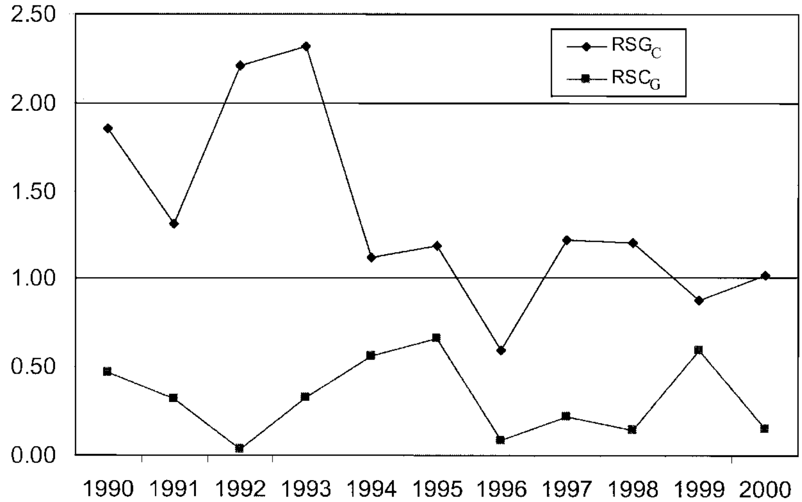

FIGURE 1 Relative security of Greece (RSG_C) and Cyprus (RSC_G) (optimal values).

Greece deviates from its desired target of unity by only about 25%, as opposed to 42% in the case of Cyprus (Figure 4).

The defence expenditure deviation figures are considerably lower when measuring the gap between actual and optimal values (Figure 5), which amounts to an average of just 7.5%, and 18.5% in favour of the actual defence expenditure in Greece and Cyprus, respectively. It seems reasonable to argue that these figures can be taken to approximate the peace dividend following a conversion from defence to non-defence expenditure in the economies of the two allies (Intriligator, 1996).

The final interesting conclusion concerns the choice of the ally that will be more successful in undertaking the human resources policy of the alliance in view of Turkish superiority as regards population developments. All our experiments lead to the conclusion that the relative

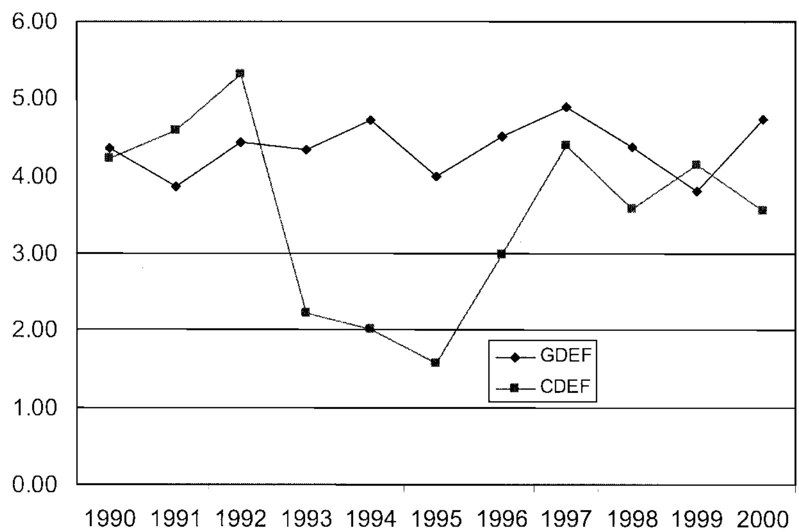

FIGURE 2 Defence expenditure of Greece (GDEF) and Cyprus (CDEF) (optimal values in terms of GDP shares).

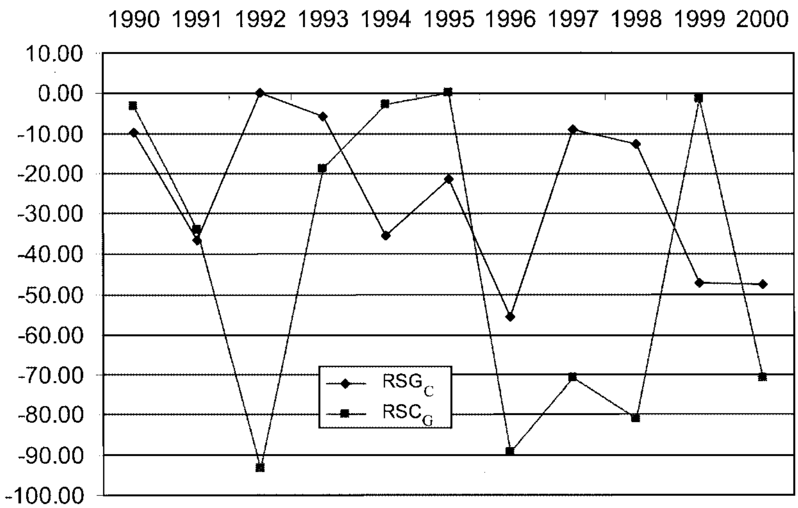

FIGURE 3 Relative security deviations (%) of Greece (RSG_C) and Cyprus (RSC_G) (optimal with respect to target values).

security of both allies is maximized if Cyprus undertakes the task of counterbalancing the population developments that turn the relative security indices in favour of Turkey (Table I). This is rather straightforward given the better demographic performance of Cyprus in comparison to Greece and bearing in mind the structure of the relative security indices that rely exclusively on the demographic developments of the two sides.

Some clarification is required at this point. Given the pronounced population differences in level terms between Greece and Cyprus on one hand, and Turkey on the other, it would be unrealistic to suggest that the alliance between the two partners may have any chances of relying successfully on the Cypriot side for the provision of its personnel. The reader will notice, however, that the relative security index relies exclusively on population rates rather than levels and, in this respect, Cyprus has a clear advantage over Greece. Our suggestion, therefore, implies only that, to the extent that the alliance between Greece and Cyprus must focus

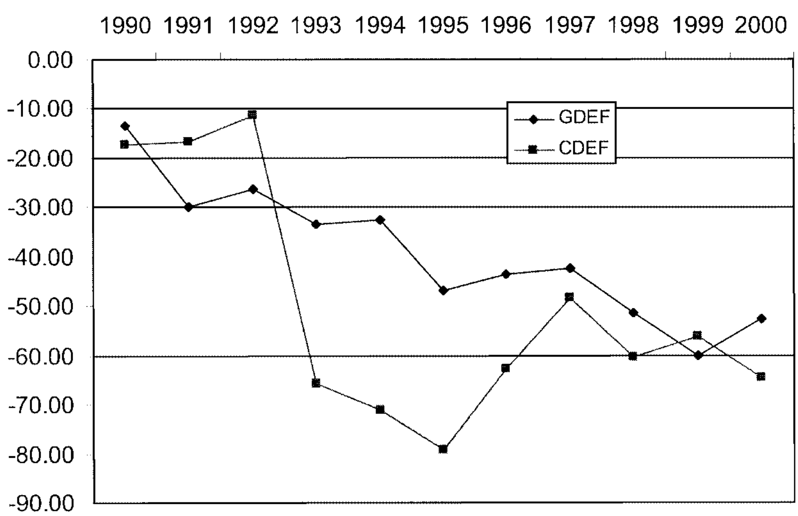

FIGURE 4 Defence expenditure deviations (%) of Greece (GDEF) and Cyprus (CDEF) (optimal with respect to target values).

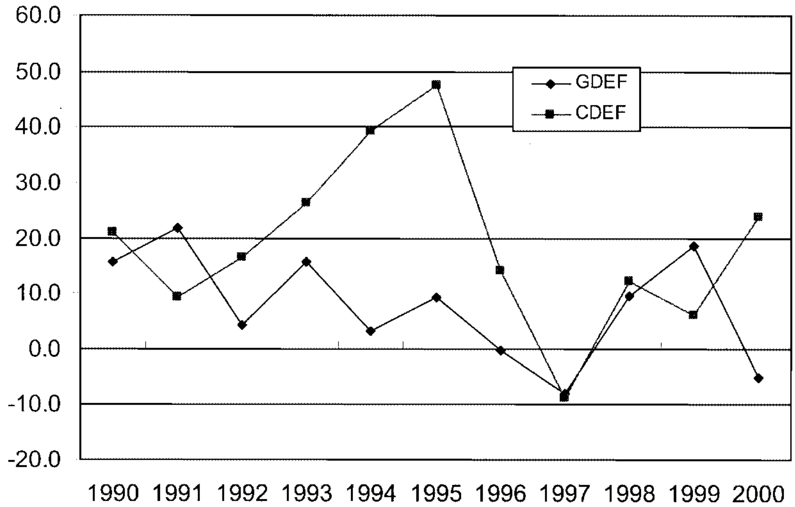

FIGURE 5 Defence expenditure deviations (%) of Greece (GDEF) and Cyprus (CDEF) (actual with respect to optimal values).

on its human resources aspect, then the task must be assigned to Cyprus rather than Greece due to the higher population growth of the former. We have already mentioned that, given the population rates of the three countries involved in the relative security index, the target set in the optimization procedure in terms of counterbalancing the Turkish population advantage is unrealistic in the sense that will take the policy makers ages to attain, if they ever do. Our suggestion is, however, certainly in the right direction, since the performance of Greece in the demographic field has been rather disappointing, especially during the recent past.

A second point worth mentioning is the fact that, once Cyprus undertakes the burden of counterbalancing the relative security gap against Turkey, then the actual defence expenditure of Greece is allowed to deviate from its optimal values by almost twice as much compared with the baseline figures mentioned before. The explanation in this case once again confirms the reasoning behind the change in the defence dogma since the human resources dimension applies to Cyprus, while Greece shifts to the more expensive solution emphasising technology and modern equipment.

CONCLUSIONS

The results discussed above may be summarized as follows:

(1) The returns in terms of relative security that Greece derives as a result of its alliance with Cyprus are considerably higher compared with the benefits of its ally.
(2) The resulting average peace dividend, measured as the deviations of the actual from the optimal defence expenditure values for the two allies, does not exceed 10% and 20% for

TABLE I Human Resources (HR) Policy Effectiveness by Individual Ally

HR policy assigned to:	RSC_G	RSG_C	*GDEF*	*CDEF*
Greece	0.28	1.31	4.37	3.39
Cyprus	0.41	1.35	4.12	3.61

Greece and Cyprus, respectively. It is important to remember that the values derived are 'optimal' only from the economics point of view, which is compatible to the constraints imposed by the model. Such values, therefore, are expected to differ compared to the corresponding actual values, which can be considered as '*de facto* optimal' since their choice involves, in addition, geopolitical and strategic criteria that do not enter our constraints structure. Thus, the difference between the two aims at pointing out the resources devoted to defence over and above what the constrained optimization procedure indicates and may be regarded as the cost suffered as a result of the arms race in which Greece and Cyprus are involved against Turkey.

(3) Under the circumstances, therefore, it might be worthwhile considering the possibility of assigning the alliance needs in terms of capital resources development and modernization to Greece, while Cyprus may be assigned to cope with the human resources in terms of manpower requirements of both allies. Raising the relative security coefficient that relies exclusively on human resources is a Herculean task that will be better undertaken by Cyprus, given its better demographic performance in comparison to its ally. It is straightforward that Cyprus cannot possibly rely on just a few thousand young people manning the alliance forces every year. This suggestion involves a much heavier reliance on human resources, possibly on the basis of professionals rather than conscripts. This form of burden sharing, however, will allow Greece more degrees of freedom to shift resources to capital equipment, technology and modernization of its armed forces, something that will counterbalance the weakness of both allies in the area of population developments vis-à-vis Turkey. We have pointed out, however, that this expensive task faces a number of additional constraints imposed by the Conventional Forces in Europe (CFE) Treaty and the increased defence requirements of the NATO and the Euro-army, not necessarily coinciding with the Greek national defence priorities.

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Appendix A. Model Equations for Greece (*t*-values in Parentheses)*

	GGDP	*GDEF*	*GPOP*
C	0.022 (3.281)	–0.029 (–2.553)	0.001 (1.371)
GNDEF		–4.872 (–17.598)	0.012 (1.837)
GNDEF(–1)	0.100 (1.931)		
GTIS	0.235 (6.350)		
GBOP(–1)		–0.295 (–4.859)	
GBOP(–4)	–0.056 (–1.878)		
DRDL	–0.062 (–1.635)	0.547 (8.289)	
GGDP			0.026 (2.286)
GGDP(–1)	0.476 (4.869)		
GGDP(–2)		0.354 (2.102)	
GCPI(–2)			–0.0003 (–4.927)
RSG_C(–1)		0.010 (2.327)	
GDEF(–3)			–0.005 (–2.001)
GPOP(–1)			0.635 (6.606)
TDEF		0.112 (2.197)	
RES(–1)	–0.048 (–1.984)	–0.147 (–1.904)	–0.113 (–3.054)
DGGDP	–0.047 (–5.416)		
DDIC	0.048 (5.994)		
DGDEF		0.086 (9.881)	
DGDEMO			0.006 (5.547)

*Three equations are constructed by taking the variable written at the head of columns two, three and four, respectively, as the dependent one.

Appendix B. Model Equations for Cyprus (*t*-values in Parentheses)*

	CGDP	*CDEF*	*CPOP*
C	0.052 (9.331)	0.024 (1.521)	–0.004 (–0.614)
CNDEF	0.227 (2.953)	–16.595 (–26.348)	
CNDEF(–4)			0.055 (1.889)
CBOP	–0.515 (–6.520)		
CBOP(–1)		–0.367 (–2.037)	
DLCP	0.250 (3.189)	–0.455 (–2.578)	
CGDP			
CGDP(–2)			0.065 (1.823)
CGDP(–3)		0.372 (2.197)	
CCPI			–0.016 (–4.026)
RSC_G(–2)		–0.014 (–1.538)	
CDEF(–3)			
CPOP(–1)			
TDEF		0.418 (3.320)	
RES(–1)	–0.164 (–7.383)	–0.704 (–5.442)	–0.382 (–8.645)
DCGDP	0.130 (10.071)		
DCINV			0.031 (5.275)
DCDEF		0.210 (8.222)	
DCDEMO			–0.118 (–10.175)
TIME			0.004 (8.886)

*Three equations are constructed by taking the variable written at the head of columns two, three and four, respectively, as the dependent one.

Appendix C. Variables and Data Sources*

Code	*Data series*	*Source*
GGDP	GDP of Greece, Constant Prices	Greek National Accounts
CGDP	GDP of Cyprus, Constant Prices	Cypriot National Accounts
GTIS	Greek Government Total Investment Expenditure (share of GDP)	Greek National Accounts
GDEF	Defence Expenditure of Greece (share of GDP)	SIPRI
CDEF	Defence Expenditure of Cyprus (share of GDP)	SIPRI
TDEF	Defence Expenditure of Turkey (share of GDP)	SIPRI
GNDEF	Non-Defence Government Expenditure of Greece (share of GDP)	Greek National Accounts
CNDEF	Non-Defence Government Expenditure of Cyprus (share of GDP)	Cypriot National Accounts
GBOP	Greek Balance-of-Payments Deficit (share of GDP)	Greek National Accounts
CBOP	Cypriot Balance-of-Payments Deficit (share of GDP)	Cypriot National Accounts
DRDL	Drachma/U.S. Dollar Exchange Rate	Bank of Greece
DLCP	U.S. Dollar/Cypriot Pound Exchange Rate	I.F.S.
GCPI	Greek Consumer Price Index	I.F.S.
CCPI	Cypriot Consumer Price Index	I.F.S.
GPOP	Greek Population Growth	I.F.S.
CPOP	Cypriot Population Growth	I.F.S.

*Given the length of the estimation period, it has already been explained in the literature (Sandler and Hartley, 1995, p. 61) that the dummies used in the equations tackle the effects of structural changes or crises incidents between the two sides. The details for the dummies used are extensively described in Andreou *et al.* (2002).

Appendix D. Equation Diagnostics and ADF Values for the Residuals of their Long-run Versions

DEP. VBLE	R^2	*DW*	*SE*	*ADF*	*J-B*	*ARCH F(Pr)*
GGDP	0.88	2.39	0.016	–2.84	0.77	0.09 (0.76)
GDEF	0.98	1.87	0.025	–2.59	0.66	0.27 (0.60)
GPOP	0.81	1.86	0.002	–3.33	1.54	0.64 (0.42)
CGDP	0.84	2.02	0.033	–2.76	1.70	0.32 (0.57)
CDEF	0.97	1.60	0.060	–3.98	0.04	0.87 (0.35)
CPOP	0.91	1.41	0.012	–2.06*	1.17	0.30 (0.58)

*All ADF tests indicate that the series are I(0) at a 1% level, except equation (14), which describes the behaviour of the Cypriot population, which is I(0) at a 5% level. The J-B (Jarque-Bera statistic) show that the errors are normally distributed while the ARCH figures for autoregressive conditional heteroscedasticity are not significant.