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Policy Regime Changes and the Long-Run Sustainability of Fiscal Policy: An Application to Greece

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ABSTRACT*

This paper assesses empirically the hypothesis of long-run fiscal policy sustainability in the possible presence of regime shifts for the case of the Greek economy during the 1958-1992 period. The Zivot-Andrews sequential integratibility testing procedure which allows for the endogenous determination of possible regime changes, is deployed to this end. The empirical evidence reached supports strongly the failure of the Greek government to satisfy intertemporal budget balance in the long-run and identifies as the cause of this failure a deterministic policy regime shift taking place in 1975.

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1. INTRODUCTION

The large fiscal deficits witnessed in many developed economies over the past fifteen years have given rise to a heated debate among economists concerning the ability of national governments to maintain debt financed fiscal expansions in the long-run without defaulting on their debt. In principle, a government will be able to sustain fiscal deficits as long as it can raise the necessary funds by borrowing. Although such a policy may be feasible in the short run, the ability of the government to service its debt by resorting to further borrowing is likely to be questioned once the deficits become persistent. The consequences of persistent deficit finance policies range in severity from output growth slowdown due to private investment crowding out, to partial monetisation of the debt with its well known inflationary repercussions or, even, to the prospect of eventual insolvency. In effect, an answer to the crucial question of whether current fiscal deficits can continue unhindered in the long-run is of particular interest to the policymaker. If the answer to this question is affirmative then the fiscal stance is said to be sustainable. Although defining sustainability presents no complications, assessing its validity is intrinsically difficult. During the last decade a voluminous literature has been developed focusing on evaluating the sustainability of a government's fiscal financial strategy. The principal approaches suggested for assessing this concept can be classified into three categories. The first is the accounting approach chiefly developed by Buiter (1983, 1985, 1990). This methodology derives estimates of sustainable deficit levels as those that can be funded under feasible rates of growth, real interest rate, and inflation without raising the debt-to-GDP ratio. The second defines three indicators, one for each time horizon - short, medium, and long-run - defined as the difference between the sustainable tax or expenditure rate that satisfies the intertemporal budget constraint and the current tax or expenditure rate, respectively [Blanchard et al. (1990)]. The third approach owing to Hamilton and Flavin (1986) and further developed by Trehan and Walsh (1988, 1991), Kremers (1988, 1989), Wilcox (1989), Buiter and Patel (1992) and Wickens and Uctum (1993) concentrates on deriving the testable implications of the government intertemporal budget constraint. These take the shape of specific restrictions on the data generating process (DGP henceforth) of certain key fiscal aggregates, such as the inclusive-of-interest deficit, whose validity can be assessed by means of standard unit root tests. Among the aforementioned approaches the latter, which is also known as the no-Ponzi game condition approach, has gained in popularity due to its amenability to econometric analysis. Applications of this methodology appear in a number of recent studies such as those of Kremers (1988), Wilcox (1989), Trehan and Walsh (1991), and Hakkio and Rush (1991) for the US, Buiter and Patel (1992) for India, and Kapopoulos (1993) for Greece.

The issue of long-run fiscal policy sustainability is particularly topical in the case of the Greek economy. The past twenty years have seen a gradual deterioration of the state of Greek public finances. Following the restoration of democracy in 1974, successive governments, in their attempt to accommodate the public demand for income redistribution and an expanded role for the state, adopted policies characterised by proliferating deficit finance practices. Since the beginning of the 1980's, the size of fiscal deficits, both in real and GDP terms, started to acquire perilous proportions. As a result, the central government debt to GDP ratio, that was standing at 27.6% at the end of 1979, has almost quadruple reaching 101.4% in 1992. These fiscal developments have inevitably raised voices of concern as to the ability of the Greek government to maintain such policies over an infinite time horizon without facing the danger of eventual insolvency. Are these voices just or simply overstate the potential long-run implications of the present fiscal stance? In this study we attempt to address this question by empirically assessing the validity of intertemporal budget balance in Greece using annual data on central government debt and deficits covering the 1958-1992 period.

The theoretical framework utilised is that of the no-Ponzi game condition approach. The empirical analysis is divided into two parts. In the first part we go along the traditional path of subjecting the fiscal aggregates to standard unit root testing. We differentiate, nonetheless, our approach from previous literature by testing additionally the null of stationarity through the application of the Kwiatkowski, Phillips, Schmidt, and Shin (1992) testing procedure. The combined use of this newly developed test with the traditional unit root testing methods is hoped to reduce any biases stemming from the small sample available for estimation. In the second part, the fiscal policy sustainability hypothesis is re-examined through the adoption of the recently proposed sequential unit root testing procedure of Zivot and Andrews (1992). It is common knowledge that the presence of structural breaks in the data could bias standard integratibility tests toward favouring the unit root null [see, Perron (1989) and Hendry and Neale (1989)]. This source of bias is likely to be rather significant in the case of Greece. The country's macroeconomic performance during the post-war period appears to have been influenced by significant economic and political changes. The two oil price shocks in 1973 and 1979, the transition to democracy in 1974, the abandonment of fixed exchange rates in 1975, the accession to the European Community in 1981 are some of the most important sample specific events that could be identified as potentially important structural breaks.[1] The Zivot-Andrews testing procedure through its property of permitting the endogenous determination of any possible regime shifts is hoped to help us adduce more concrete evidence on the form of non-stationarities present in the data. Determining the form of non-stationarity that gives rise to rejections of the sustainability hypothesis is imperative in an

[1]. For an extensive discussion of Greece's post-war macroeconomic performance the reader is referred to Athanassiou (1990), and Alogoskoufis (1995).

economic theory context too. Evidence of unsustainable fiscal policies due to the detection of stochastic trends in the data suggest permanent effects of shocks on the future values of fiscal aggregates and, in effect, eventual insolvency of the government. On the contrary, evidence of unsustainability arising from deterministic components, such as a shifting mean or a changing trend, imply transitory effects, so that the danger of insolvency can be removed following an appropriate fiscal reform.

The remainder of the paper is organised as follows. Section 2 discusses the theoretical underpinnings of intertemporal budget balance, its association to the long-run fiscal policy sustainability hypothesis, and its testable implications. In Section 3 the findings of the econometric evaluation of the hypothesis at issue are presented. Since we find evidence of unsustainable fiscal policies, Section 4 comments on the menu of policy options open to the Greek government as means of avoiding insolvency. Our main conclusions are summarised in Section 5.

2. THE GOVERNMENT INTERTEMPORAL BUDGET CONSTRAINT

Consider the stylised government budget constraint at time t:

$$b_t = (1 + r_{t-1})b_{t-1} + d_t \tag{2-1}$$

where b_t is the debt to GDP ratio at the end of period t, d_t is the end of period net-of-interest deficit cast in terms of nominal GDP, and r_t is the period t real *ex post* rate of interest during period t adjusted for real output growth.

Let us assume that the output adjusted real interest rate is constant and positive, i.e. $r>0$. In order to obtain the intertemporal budget constraint (IBC henceforth) for the government, we take expectations of 2-1 conditional on time $t-1$, and through recursive elimination of the future values of the debt to GDP ratio we arrive at,

$$b_{t-1} = -\sum_{j=0}^{\infty}(1+r)^{-(j+1)}E_{t-1}d_{t+j} + \lim_{j\to\infty}(1+r)^{-(j+1)}E_{t-1}b_{t+j} \tag{2-2}$$

For intertemporal budget balance the transversality condition should hold, that is the present value of the debt to GDP ratio far into the future should decline as the planning horizon recedes. In notation terms this implies that

$$\lim_{j\to\infty}(1+r)^{-(j+1)}E_{t-1}b_{t+j} = 0 \tag{2-3}$$

If condition 2-3 holds the government IBC is given by

$$b_{t-1} = -\sum_{j=0}^{\infty}(1+r)^{-(j+1)}E_{t-1}d_{t+j} \tag{2-4}$$

expression 2-4 suggests that for fiscal policy to be sustainable the government should run future surpluses equal, in expected present value terms, to its current outstanding debt. Of course the government IBC can also be cast in nominal or in real terms. In this case sustainability implies that nominal or real debt must grow at a rate below the nominal or real interest rate respectively [Kremers (1989)]. However, unlike the latter two versions of the

theory, expressing the government IBC in ratio to GDP terms has the added advantage of removing the effects of non-stationarity owing to inflation and real GDP growth [Wickens and Uctum (1993)].

The requirement that budget processes be sustainable implies that Ponzi games are ruled out as a viable option. In other words, further new borrowing cannot be used indefinitely as a method of financing interest payments on existing debt. Such an option would be open to the policymaker on the proviso of the real interest rate being lower than the growth rate of the economy. This is the case if the economy under consideration is dynamically inefficient in the sense of Abel et al. (1989) but then the solvency constraint or, equivalently, the transversality condition need not be satisfied. In such an economy, current deficits are without repercussions to future surpluses.

Under the hypothesis of a constant and positive expected interest rate r, the transversality condition 2-3 and, in consequence, the sustainability hypothesis has some interesting testable implications. The latter have been extensively discussed in a series of recent articles [see, for instance, Hamilton and Flavin (1986), Trehan and Walsh (1988, 1991), Buiter and Patel (1992), and Wickens and Uctum (1993) to name only a few] and relate principally to the joint process generating b_t and d_t. Assuming that condition 2-3 holds, expression 2-4 can be rewritten as

$$b_{t-1} = -(1+r)^{-1}\sum_{j=0}^{\infty}(1+r)^{-j}E_{t-1}d_{t+j} \tag{2-5}$$

multiplying 2-5 by minus one gives

$$-b_{t-1} = (1+r)^{-1}\sum_{j=0}^{\infty}(1+r)^{-j}E_{t-1}d_{t+j} \tag{2-6}$$

multiplying 2-5 by *(1+r)* and adding the resultant expression to 2-6 yields

$$rb_{t-1} + d_t = -\sum_{j=1}^{\infty}(1+r)^{-j}E_{t-1}\Delta d_{t+j} \tag{2-7}$$

or equivalently due to the government budget identity 2-1

$$\Delta b_t = -\sum_{j=1}^{\infty}(1+r)^{-j}E_{t-1}\Delta d_{t+j} \tag{2-8}$$

A sufficient condition for government intertemporal budget balance can now be derived if specific assumptions concerning the form of the unknown data generating processes of d_t and b_t are made. Trehan and Walsh (1991) have shown that, under a constant expected interest rate and difference stationary debt and interest-exclusive deficit variates, a sufficient condition for the fulfilment of the government IBC in the long-run is that Δb_t, which is equal to the inclusive-of-interest deficit $rb_{t-1} + d_t$ due to 2-1, should be generated by a zero-mean covariance stationary process. This condition implies in turn that b_t and d_t are cointegrated with cointegrating vector $[r \quad 1]$.[2] The logic of these theoretical results is evident from equations 2-7 and 2-8 where the inclusive-of-interest deficit expressed as either Δb_t or $rb_{t-1} + d_t$ equals an infinite sum of stationary variables. Hence, the empirical assessment of the sustainability hypothesis amounts to testing whether $rb_{t-1} + d_t$ or alternatively the first difference of the debt to GDP ratio follows an I(0) process that involves no deterministic components.[3] The exclusion of a zero deterministic trend in the DGP of Δb_t intends to remove the possibility of an eventual insolvency still looming [see, Buiter and Patel (1992)], while that of a zero mean inclusive-of-interest deficit eliminates the prospect of a positive drift in the DGP of d_t violating intertemporal budget balance [see, Trehan and Walsh (1988, 1991)]. Although the latter condition is a rather strong one to impose, it happens to have practical economic interest as most economies have the tendency to run constantly primary deficits and not surpluses.

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[2]. More formal proofs of the conditions required for long-run fiscal policy sustainability with I(1) variables can be found in Trehan and Walsh (1988, 1991) and Wickens and Uctum (1993).

[3]. It should be noted at this point that this result is very much dependent upon the assumption of a constant interest rate. If the constancy of the expected interest rate is relaxed a cointegration test can no longer be applied yet the test on the stationarity of the inclusive-of-interest deficit still holds constituting a sufficient condition for intertemporal budget balance. All that is needed in this case is a strictly positive expected rate of interest [Trehan and Walsh (1991)]. Alternatively, the focus of attention from an empirical viewpoint could shift from the inclusive-of-interest deficit to the discounted debt to GDP ratio variable. For a comprehensive discussion of the theory underlying the variable rate approach the reader is referred to Wilcox (1989).

3. IS THE GREEK FISCAL POLICY SUSTAINABLE IN THE LONG-RUN?

The empirical evaluation of the fiscal policy sustainability hypothesis is undertaken for the case of Greece using data of annual frequency for the period spanning from 1958 to 1992. The ratios of central government debt and interest-exclusive deficit to GDP are plotted in Figure 1, while the inclusive-of-interest deficit, also expressed as a ratio to GDP, appears in Figure 2. A casual inspection of the first diagram reveals that the central government debt/GDP ratio has been increasing almost steadily over the entire period under examination with the rate of change accelerating after the mid 1970's. Since then the variable at issue appears to have been set on a rather explosive path. Figure 2 shows quite lucidly that the inclusive-of interest deficit, that is Δb_t, has exhibited a fairly stable over time evolution up to around 1975-1976. From this point onward, however, the series shows signs of an upward trending behaviour signalling the potentially non-stationary nature of the DGP describing b_t as well as the probable presence of a structural break in the data. The prospect of non-stationary behaviour cannot be ruled out for the seignorage adjusted interest-exclusive primary deficit, that is d_t, too. The latter variable appears to have evolved in an almost parallel fashion to Δb_t, as examination of Figure 1 will convince us. Moreover, it should be mentioned that interest rates on public debt have been negative for most of the sample period. Taking the interest rate on 12 month treasury bills as an illustrative example and adjusting it for inflation and real output growth, we find that r_t assumes negative values from 1960 to 1986 and has a within sample mean value of -3.44%. In spite of the prolonged negativity of the interest rate, we will proceed with our empirical analysis by postulating that the Greek economy is not dynamically inefficient.[4] The detailed definitions and sources of all data series used in the study appear in the Data Appendix.

In order to assess the validity of the transversality condition the form of the DGP describing b_t ought to be identified. The explosive pattern unveiled by the visual inspection of the data suggests that an I(2) process or a polynomial trend stationary process or even a process involving a combination of unit root, shifting mean, and breaking trend components emerge as reasonable candidates for the DGP of the aforementioned variable. Discriminating,

[4]. Buiter and Patel (1992) in their innovative study of the solvency hypothesis for the Indian economy deal with the negative values of the interest rate by adopting the same hypothesis with regard to the issue of dynamic efficiency.

Figure 1

Central government debt and interest-exclusive deficit to GDP ratios

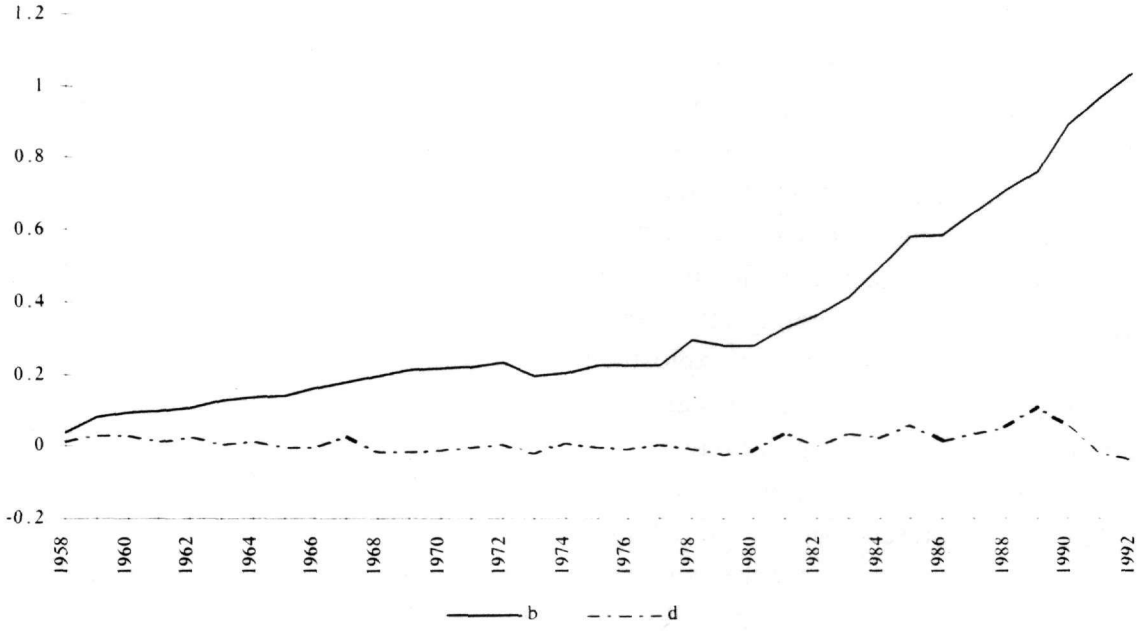
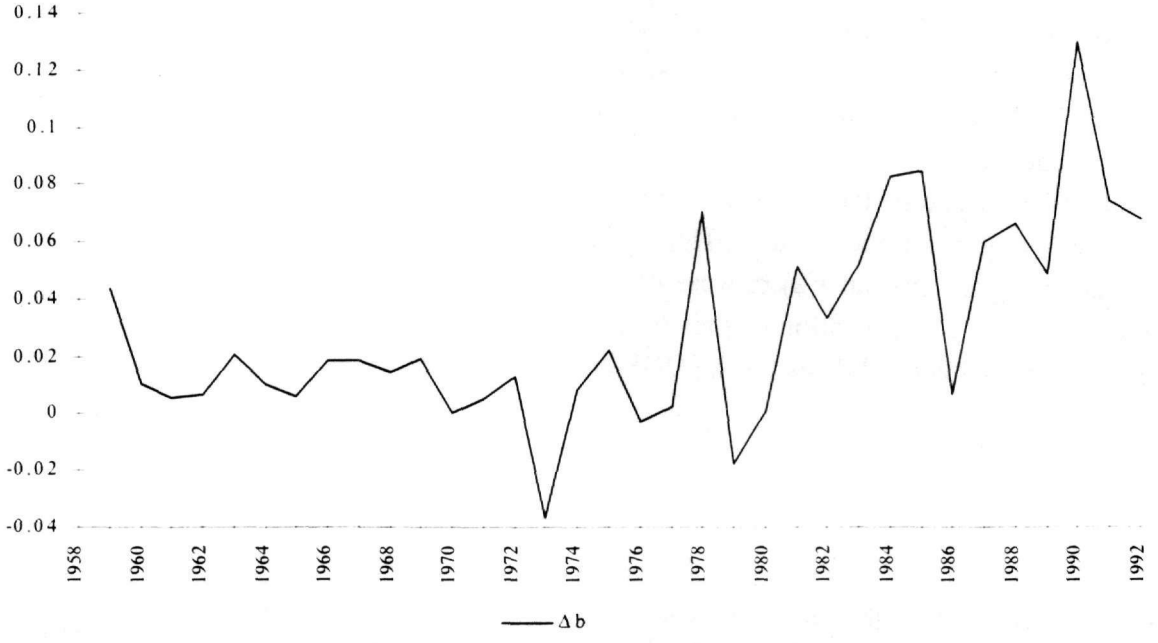


Figure 2

Central government interest-inclusive deficit to GDP ratio



nonetheless, between these alternative time-series representations is not likely to be an easy task because the processes in question tend to be observationally equivalent in samples as small as the one available for the conduct of the present study. With this observation in mind and the fact that regression based unit root tests will in general be biased toward favouring the I(1) null in the presence of structural breaks [see Perron (1989) and Hendry and Neale (1989)], the scope of our empirical analysis will be twofold. First, the time-series properties of the variables of interest will be investigated through the application of unit-root and stationarity tests so that an initial verdict can be returned on the concept of fiscal policy sustainability. Recall that the signalling out of any of the aforementioned representations for b_t is synonymous to the eventual insolvency of the Greek government under unchanged policies. Secondly, the issue of a policy regime change, that seems to be lurking behind the intertemporal evolution of the debt/GDP ratio, influencing the outcome of integratibility tests will be formally addressed by means of recently developed sequential unit root testing procedures that permit the endogenous determination of any possible structural breaks in the data.

3.1. Testing for the order of integration

The historical series on central government debt b_t and net-of-interest deficit d_t are examined for the presence of unit roots in their autoregressive representation by means of the standard Augmented Dickey-Fuller (ADF) testing principle.[5] The computation of the ADF test statistics for the variable of interest, say X_t, is based on the application of the following auxiliary regression:

$$X_t = \gamma + \delta t + \rho X_{t-1} + \sum_{i=1}^{k} c_i \Delta X_{t-i} + \varepsilon_t \qquad (3\text{-}1)$$

where ε_t is a sequence of normal, independent random variables with mean 0 and variance σ^2. Expression 3-1 permits the evaluation of the most general alternative hypothesis that of

[5]. The Phillips and Perron (1988) semi-parametric tests (PP) which allow ε_t to follow a weakly dependent and heterogenously distributed process have also been computed for the series in question. Since, however, their verdict is in agreement with the ADF and KPSS procedures are not reported for reasons of brevity. Moreover, recent Monte-Carlo studies have shown that ADF tests are quite robust to departures from normality and heteroscedasticity [see, Handa and Ma (1989)] and exhibit a superior small sample performance to their PP equivalents [see, Schwert (1989) and Campbell and Perron (1992)].

stationarity around a deterministic trend[6]. Simpler alternative hypotheses, such as that of zero-mean stationarity, can be assessed by subsequent specification testing on the significance of the deterministic terms in the auxiliary regression. The Φ_2 and Φ_3 statistics, which test the joint hypotheses H_0: $\gamma=\delta=0$ and $\rho=1$ and H_0^* : $\delta=0$ and $\rho=1$ respectively, are used to this end. The maximum lag length k adopted for correcting serial correlation in the associated ADF auxiliary regressions is determined on the basis of evidence provided by sequential t-type tests on the significance of the highest order lag in the estimated autoregression coupled with extensive residual diagnostic testing [see, Ng and Perron (1995)]. In addition to the ADF tests, we have also evaluated directly the hypothesis of stationarity by implementing the recently developed η_μ and η_τ tests of Kwiatkowski, Phillips, Schmidt, and Shin (1992) or in terms of their initials KPSS thereafter.[7] The KPSS semi-parametric procedure tests for level (η_μ) or trend stationarity (η_τ) against the alternative of a unit root and its combined use with the ADF tests is likely to enable more clear-cut conclusions to be drawn with regard to the order of integration of the series under investigation given the small size of our sample. Finally, the first and second differences of the variables of interest are subjected to the same battery of tests in accordance to the suggestions of Dickey and Pantula (1987) so that the presence of higher order integrated processes, whose presence seems probable from the pre-test diagrammatic analysis of the data, can also be examined.

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[6]. The adoption of 3-1 serves an additional purpose. Due to the presence of the deterministic trend in its specification, it renders the tests invariant to the different values of the drift parameter [see, Kiviet and Phillips (1992)].

[7]. The KPSS test statistic for level or trend stationarity is given by:

$$\eta = \frac{1}{s^2(k)T^2}\sum_{t=1}^{T} S_t^2$$

where $S_t = \sum_{i=1}^{t} u_i$, u_t are the residuals from the regression of X_t on a constant or a constant and a trend for level or trend stationarity respectively, $s^2(k)$ is the non-parametric estimate of the variance of u_t, and k stands for the lag truncation parameter.

Table 1

Unit root and stationarity tests

Variable	Dickey-Fuller Tests				KPSS Tests	
	t_{ADF}	k	Φ_2	Φ_3	η_μ	η_τ
b_t	1.856	0	20.528**	11.264**	0.842**	0.227**
Δb_t	-1.739	2	2.131	2.553	0.632*	0.198*
$\Delta^2 b_t$	9.236**	1	28.666**	42.994**	0.125	0.06
d_t	-3.044	0	3.215	4.77	0.22	0.165*
Δd_t	4.909**	2	8.595**	12.753**	0.122	0.108
$\Delta^2 d_t$	6.837**	2	15.587**	23.373**	0.087	0.087

Notes:

- * and ** indicate significance at 5% and 1% respectively.
- η_μ, and η_τ stand for the KPSS tests for level and trend stationarity respectively. The l(4) formula of Schwert (1987) is used for the determination of the lag truncation parameter. The critical values for these tests appear in Table 1 in Kwiatkowski et al. (1992).
- The ADF auxiliary regressions are fitted with both a constant and a trend. The critical values for the t_{ADF}, Φ_2, and Φ_3 statistics are taken from Table 8.5.2 in Fuller (1976) and Tables V and VI in Dickey and Fuller (1981) respectively.
- k is the lag truncation parameter.

Table 1 reports the outcome of the ADF and KPSS tests on the variables under investigation. The value of the ADF test for the level of b_t is quite large and positive suggesting the presence of at least one unit root. This finding is corroborated by the η_μ and η_τ statistics which strongly reject the I(0) null at the 99% confidence level. Nonetheless, the hypotheses that b_t is generated by either a driftless random walk or a non-zero drift I(1) process is also rejected by the Φ_2 and Φ_3 statistics, pointing to the conclusion that the debt/GDP ratio probably exhibits a more general form of non-stationarity. This suspicion finds evidence of support when the results on the interest-inclusive deficit variable, that is Δb_t, are examined. Both testing principles support the hypothesis of Δb_t evolving according to a zero-drift I(1) process and, consequently, indicate the existence of two unit roots in the DGP

of b_t. As to the process driving the net-of-interest deficit, the relevant statistics of Table 1 indicate that the series in question turns out to be explained by a driftless random walk. Under the light of the theoretical arguments presented earlier, the presence of a unit root in the process describing the interest-exclusive deficit implies that b_t should be at most I(1) for the transversality condition to be met. The detected presence of two unit roots in b_t or, equivalently, the non-stationarity of the inclusive-of-interest deficit Δb_t is sufficient to vitiate the condition for solvency suggesting unequivocally that the Greek government will eventually default on its debt unless corrective action is taken that will render the DGP stationary.

3.2. Testing for a change in regime

Before the aforementioned integratibility results are adopted, another facet of the DGP driving the variable which is central to the evaluation of the sustainability hypothesis, i.e. Δb_t, merits further elaboration. As it has been argued earlier, the presence of a structural break or breaks in the time-series representation of the debt to GDP ratio cannot be ruled out from the outset. If such a break or breaks exist in the data, the unit root test results reached may in fact be biased. The testing procedures applied so far do not permit for such a possibility to be formally assessed. Since the identification of a shifting mean and/or a segmented trend could offer additional evidence in favour of the unit root null or evidence of a fiscal policy regime shift to which the marked explosiveness of the debt/GDP ratio, especially since the mid 1970's, may be attributed, investigating for the potential impact of such deterministic components constitutes an exercise of increased empirical interest.

At a univariate level the most commonly used method for evaluating the unit root null against the alternative hypothesis of level shift and/or trend shift stationarity is the Perron (1989) type unit root tests. These tests permit for stationarity with a shift in the mean and/or the slope of the trend coefficient under the alternative through the introduction of appropriately defined dummy variables in the ADF auxiliary regression. Recently, though, this method of approaching the problem has been criticised as inadequate. Christiano (1992) shows that these tests are severely biased toward rejecting the no-structural break hypothesis, i.e. the unit root null. The source of the bias resides with the selection of the dates the breaks presumably occur being based on either visual pre-test examination of the data or *a priori* information or a combination of both. A class of unit root tests that circumvents the aforementioned shortcomings through the endogenous selection of the break points has been proposed by Zivot and Andrews (1992). These tests modify the Perron (1989) testing procedure by considering a random walk process with drift that excludes any structural change under the null. The relevant alternative hypothesis is still a trend stationary process

with a one-time break in the trend function but the precise timing of the break is taken to be unknown. The breakpoint selection procedure then relies on identifying the breakpoint that produces the lowest value, over all possible breakpoints, of the relevant one sided unit root t-statistic, denoted by $t_{inf}(\lambda)$, where λ stands for the break fraction in the sample. Depending on the postulated alternative hypothesis, the ADF auxiliary regression applied to the data can take various forms the most general of which is:

$$X_t = \gamma + \varphi DU_t(\lambda) + \vartheta DT(\lambda) + \delta t + \rho X_{t-1} + \sum_{j=1}^{k} c_j \Delta X_{t-j} + e_t \qquad (3\text{-}2)$$

where, t=1,2,...,T, $\lambda = T_b / T$, T_b is the break, $DU_t(\lambda) = 1$ if $t > T\lambda$ or 0 otherwise, and $DT_t(\lambda) = t - T\lambda$ if $t > T\lambda$ or 0 otherwise. This general formulation, termed Model C by Zivot and Andrews (ZA for short), is appropriate for evaluating the alternative hypothesis of stationarity around a deterministic trend and a shift in mean. Appraisal of simpler alternatives, such as that of stationarity around a segmented trend (Model B) or that of trend stationarity with a shift in mean (Model A), is feasible through elimination of $DU_t(\lambda)$ or $DT_t(\lambda)$ from 3-2 respectively. The estimation of the relevant auxiliary regression is performed sequentially with the breakpoint $\lambda = T_b / T$ ranging from $2 + k / T$ to $(T-1)/T$. Tables 2, 3, and 4 in Zivot and Andrews (1992) contain both asymptotic and fixed λ critical values against which the lowest unit root t statistic obtained through this sequential procedure can be compared.

Allowing therefore for the endogenous determination of structural breaks, the inclusive-of-interest deficit/GDP ratio is subjected to the ZA treatment in an attempt to investigate whether any significant change in the fiscal policy regime has taken place during the period under study. The sequence of the unit root t-ratios produced from estimating a Model B auxiliary regression with the break function λ ranging from 0.08 to 0.97 are reported graphically in Figure 3, while Table 2 documents the estimated regression that contains $t_{inf}(\hat{\lambda})$, i.e. the quantity that gives the highest weight to the segmented trend alternative.[8] The maximum lag length required for serial correlation correction has been determined in two stages. First, the robustness of the estimated breakpoint has been established by performing the ZA procedure for various values of k, and secondly, following the fixing of the breakpoint,

[8]. The selection of a Model B type of regression for Δb_t has been made following the estimation of the most general formulation permitted by the Zivot-Andrews procedure, that is Model C. The outcome of this estimation, which is not reported herein for reasons of brevity, showed no evidence of a shift in the drift parameter.

Table 2

The Zivot-Andrews unit root test

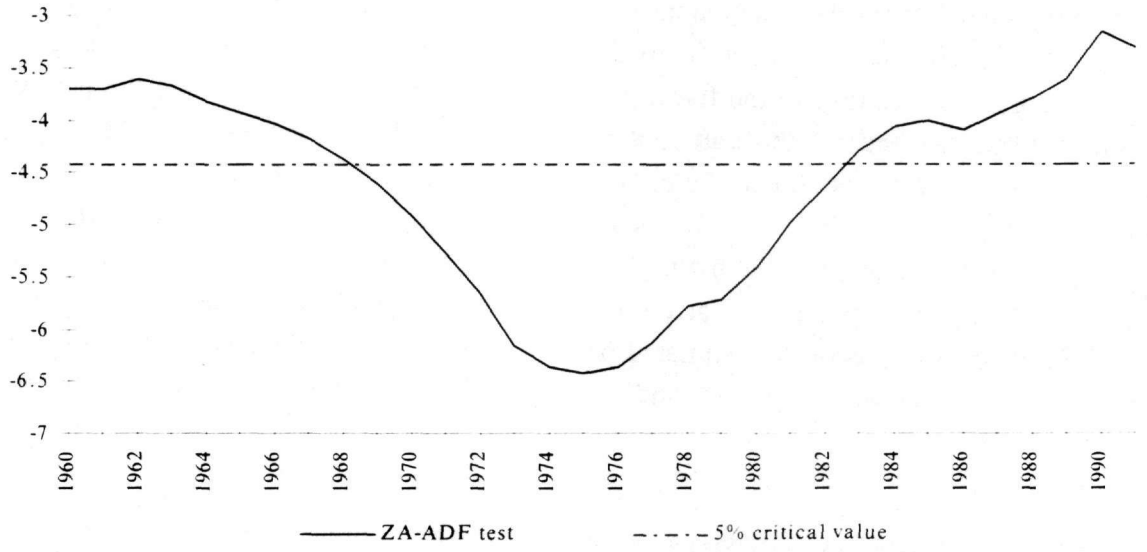
Model applied: $X_t = \gamma + \vartheta DT_t(\lambda) + \delta t + \rho X_{t-1} + \sum_{j=1}^{k} c_j \Delta X_{t-j} + e_t$							
Variable	$\hat{T}_B$	k	$\hat{\gamma}$	$\hat{\vartheta}$	$\hat{\delta}$	$\hat{\rho}$	S.E.
Δb_t	1975 (λ = 0.51)	1	0.039 [2.417]	0.011 [4.355]	-0.002 [-1.789]	-0.801 [-6.414**]	0.022

Notes:

- t-statistics are in brackets. The t-statistic for $\hat{\rho}$ is the $t_{inf}(\hat{\lambda})$ for testing $\rho = 1$.
- * and ** indicate significance at 5% and 1% respectively using either the asymptotic or the fixed break-point critical values from Table 3 appearing in Zivot and Andrews (1992).
- S.E. stands for the standard error of the equation.
- λ is the sample break function and k represents the lag truncation parameter.

Figure 3

Sequential ZA unit root tests for the interest-inclusive deficit to GDP ratio



the value of the lag truncation parameter corresponding to the auxiliary regression containing $t_{inf}(\hat{\lambda})$ has been determined according to the procedure followed for the standard ADF tests.

Examination of Figure 3 reveals that the unit root null is decisively rejected. The values assumed by the unit root t-statistic are clearly below the 5% asymptotic critical value line over a range of λ values with the lowest t-value being encountered in 1975. As Table 2 shows the $t_{inf}(\hat{\lambda})$ is equal to -6.414, which is significant even at the 1% level, while the coefficient of the segmented trend dummy is also, in terms of conventional asymptotics,[9] significantly different from zero. Hence, the presence of two unit roots in the autoregressive representation of b_t established in the previous section on the basis of standard ADF tests is not grounded by the ZA tests. The latter show that the interest-inclusive deficit turns out to be stationary around a deterministic segmented trend and, in effect, the source of the encountered long-run unsustainability of Greek fiscal policy is not stochastic but deterministic in nature.[10] To put it differently, had there been for the policy regime change in 1975 intertemporal budget balance would have been satisfied. Moreover, the estimated occurrence of the regime change in 1975 accords with the recently expressed view by Athanassiou (1990) and Alogoskoufis (1995) that the deterioration in Greece's macroeconomic performance is due to a regime change in the mid 1970's. Both authors explicitly or implicitly divide the post-war era in two sub-periods, the pre 1974 and the post 1974 one, on the basis of the political, economic, and institutional changes brought about following the restoration of democracy in 1974 as well as the marked difference in macroeconomic performance characterising the two sub-periods. We, on the other hand, have treated the breakpoint as unknown and allowed its data based determination. The encountered one year discrepancy can be justified if one takes the stand that economic agents do not adjust instantaneously to shocks. There will be a learning transmission period in which the agents will form expectations about future variables still weighting up the past.

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[9]. Zivot and Andrews (1992) have not tabulated asymptotic critical values for the deterministic components. In effect, resorting to the standard normal distribution for critical values provides a workable approximation for drawing tentative inferences.

[10]. The level of the debt to GDP ratio has also been subjected to the ZA test. The sequentially estimated t statistics were found insignificant over the entire λ range establishing the presence of a single unit root in the DGP of b_t. Specifically, the value of $t_{inf}(\hat{\lambda})$ corresponds to 1978 and amounts to -3.852 (k=0).

4. POLICY OPTIONS FOR ATTAINING A SUSTAINABLE FISCAL POLICY IN GREECE

The rejection of the solvency hypothesis established by the empirical analysis of the previous section leaves unanswered the question of selecting the appropriate policy measures toward restoring fiscal equilibrium in Greece.

Given the goals set by the 1994-1999 Convergence Programme for meeting the terms of the Maastricht Treaty and secure the country's participation in the Economic and Monetary Union, the menu of policy options available to the Greek government for reducing the real value of the debt seem to be rather limited. Principally, the government could try to cut down government consumption expenditure and/or increase current revenues with a view to achieving primary budget surpluses so that existing debt could be bought back. The option of raising revenue from Treasury's seigniorage is no longer open to the government since the Maastricht Treaty (articles 104 and 104b) does not allow the monetary financing of budget deficits. Alternatively a reduction of public capital formation could increase primary surpluses contributing to a consistent set of fiscal plans. Unfortunately, improvement of Greek infrastructure is urgently needed in order to increase productivity and attract domestic and foreign investment [see, Christodoulakis (1993)], boosting economic growth and increasing the tax base and tax revenues as well. An increase in the cash return on the public sector capital stock in excess of its opportunity cost would also raise government revenue. In Greece, however, many forms of government capital have a net cash return which is persistently negative. Finally, the real value of debt and debt service could be reduced by partial repudiation (forced loans, special capital levies on public debt, etc.). But even this option is not without serious shortcomings. Apart from being electorally costly, it could have negative repercussions on the financial sector as a whole leading to a risk premium being added to the interest rate on new government borrowing. The 1991 capitalisation of a substantial amount of interest payments owed to the banking sector by the Greek government may be regarded as a form of repudiation (see, Budget Reports 1991-1994).

It should be noted that the evidence presented above for an unsustainable fiscal policy provides no indication concerning the time path of future primary surpluses nor about the maximum limit beyond which the debt/GDP ratio is not allowed to go. This is because the analysis was based on the implicit assumption of non-distortionary taxation and the economy being fully described by a rational representative agent. If these assumptions are abandoned, the increasing marginal costs of taxation become evident. The rising marginal tax costs stem from both the distortionary effects of taxation on output and the tax base and the distributional consequences of the rise in the tax burden required to service the debt. The latter is expected to be a serious problem in the case of Greece due to the existence of widespread tax evasion,

tax avoidance and an extended underground economy so that the composition of the effective tax base does not reflect the actual distribution of income. The main distributional consequences of increased taxation in Greece are rising collection and compliance costs and also greater political resistance to tax rises, leading to further tax evasion. The Greek tax system is characterised by economists and administrative officials alike as excessively distortionary (see, for instance, the Budget Report and the General Budget of 1995). Restricting ourselves to only a brief characterisation, it suffices to say that there is such a huge range of exemptions, omissions, deductions, preferential rates, tax incentives as well as hundreds of small taxes introduced on an *ad hoc* basis over the years which have not even been identified or listed as yet.

Assuming that the above costs are an increasing and strictly convex function of the tax burden, there are only finite levels of the debt/GDP ratio which are feasible. For Greece, it seems that the upper limit of a feasible debt-to-GDP ratio has not only been exceeded but also is expected to be lower than in other European countries where tax systems are much more efficient. It is characteristic that although many of the major institutional tax rates in Greece are about equal to and in some cases above the EU average, the total tax yield is lower than the corresponding EU average in terms of GDP. This is an indication that the cost of exacting more tax revenue is so high in Greece that, unless public consumption expenditures are cut, debt explosion may become unavoidable.

5. CONCLUSIONS

In this paper we have been concerned with empirically investigating the long-run sustainability of fiscal policy in Greece during the period spanning from 1958 to 1992. The theoretical framework has been provided by the government intertemporal budget constraint and its testable implications on the process driving the inclusive-of-interest deficit. In contrast to previous studies, considerable effort has been devoted in addressing the issue of unit root tests being adversely affected by the possible presence of policy regime shifts in the data. This source of potential bias has been dealt with by implementing the recently introduced Zivot-Andrews sequential unit-root tests and empirically evaluating the question of the fiscal stance having undergone a regime shift during the estimation period.

The results reached on the basis of the empirical analysis conducted herein offer overwhelming evidence against the Greek government satisfying its IBC in the long-run. The cause of the detected unsustainability of Greek fiscal policy has been found to be non-stochastic in nature stemming from a deterministic policy regime change estimated to occur in 1975. This finding is at variance to the outcome of the usual integratibility tests which attribute the rejection of the theory to the existence of a stochastic trend in the autoregressive representation of the interest-inclusive deficit. More importantly, though, the estimated breakpoint accords with the historical identification in the literature of two different political and economic regimes characterising post-war macroeconomic developments in Greece. Finally, the vindication of a policy regime change being the cause of the marked unsustainability of Greek fiscal policy suggests that the problem is effectively "home-made". Hence if the adverse inflationary implications of persistent deficits and the prospect of eventual insolvency are to be avoided in the near future, a careful and systematic remedial policy has to be adopted so that the upward trend of the debt to GDP ratio can be reversed. Given the limited menu of policy options open to the Greek government and the highly distortionary nature of the tax system, we feel that such a remedial policy should focus on the curbing of public consumption expenditure, the rationalisation of the tax system and the broadening of the tax base.

6. DATA APPENDIX

6.1. Definition of variables

The variables used in the study are defined as follows:

- b_t is the stock of outstanding central government debt expressed as ratio to nominal GDP.

- d_t is the primary net-of-interest deficit inclusive of revenue from seignorage. This quantity is obtained through subtraction of government revenue, amortisation, and interest payments (expressed as ratios to GDP) from the total government expenditure to GDP ratio, and subsequent adjustment of the resulting series by the inflation and real output growth adjusted seignorage. The revenue from seignorage is set equal to the change of the monetary base between periods t and $t-1$ while the monetary base corresponds to the Bank of Greece M0 published series.

- r_t is the real 12 month treasury bill rate adjusted for real output growth.

- The GDP deflator is obtained as the ratio of nominal to real GDP (base year: 1985).

6.2. The data sources

- The nominal series on central government debt and the monetary base are taken from *The Long-Run Statistical Series of the Greek Economy, The Bank of Greece (1992)* while those on total government expenditure, interest payments, amortisation, and tax revenues are from *The Monthly Statistical Bulletin, Bank of Greece, various issues.*

- The nominal rate of interest on 12-month treasury bills is obtained from *The Bank of Greece, Economic Research Division* and *The Economic Bulletin, Bank of Greece, various issues.*

- The statistical series on nominal and real GDP are taken from *The National Accounts, Main Aggregates, OECD, various issues.*

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