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SHORT - AND LONG-RUN EFFECTS OF BUDGET DEFICITS ON INTEREST RATES

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Abstract

This paper, using data of the Greek economy and taking previous empirical work as its point of departure, explores the linkage between budget deficits and interest rates. Within the methodological framework of cointegration, ECM strategy, and several diagnostic and specification tests, the main purpose of this paper is to test empirically the Keynesian proposition and the Ricardian equivalence hypothesis. From the perspective of this study, the empirical findings support the Keynesian model of a significant and positive relationship between budget deficits and interest rates (JEL H60, H62).

1. Introduction

In recent years the relationship between fiscal deficits and interest rates has been a main objective of applied macroeconomics and international economics. A considerable number of studies analysing the links between government deficits and interest rates have led to conflicting empirical results. Based on annual data of the Greek economy, this paper examines the cointegratedness of the time series and estimates the implied Error-Correction Model (ECM), in order to investigate the linkage between deficit and interest rate. The main target of this paper is to test empirically the validity and rationale of Keynesian and Ricardian equivalence paradigms. With a few exceptions, most empirical work testing the Keynesian proposition and the Ricardian equivalence hypothesis has used U.S. data.

Empirical studies by M. Feldstein (1982), J. Barth, et al (1984-85), V. Tanzi (1987), K Zahid (1988), R. Cebula (1988, 1993), L. Thomas and A.

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Abderrezak (1988), A. Bovenberg (1988), G. Laumas (1989), J. Abell (1990), S. Allen (1990), S. Miller and F. Russek (1991), P. Dua (1993), and P. Raynold (1994) argue in favour of the keynesian proposition (conventional view) about a positive relationship between government deficits and interest rates. On the other hand, R. Barro (1974, 1986, 1987), G. Dwyer (1982), C. Plosser (1982), G. Hoelscher (1983), P. Evans (1985, 1987, 1988, 1994), W. McMillin (1986), P. Siklos (1988), P. Dua and H. Arora (1989), A. Darrat (1989, 1990), and T. Beard and W. McMillin (1991) refute the Keynesian proposition, supporting the view either that government deficits negatively influence interest rates, or that interest rates and deficits follow an independent trend.

According to the Keynesian model an increase in government deficits stimulates output and employment, driving up interest rates and crowding out private investment. On the other hand, after increasing government deficits the Ricardian equivalence hypothesis attributes no effects on the economy. In the framework of the Ricardian equivalence, increasing deficits imply future taxes of which the present value equals the value of the deficit. However, the rise of deficits has no effects at all on the variables which determine economic activity, such as real output, interest rates, employment, inflation, current account, etc, because rational agents considering this equivalence will behave as if deficits do not exist.

This paper is organized as follows. In section II several issues related to data and methodology are discussed. Section III presents the empirical findings and section IV provides a brief summary and conclusions.

2. Data and Methodology

In December 1991 the European Community Countries agreed at Maastricht to fulfil a number of quantitative and qualitative objectives in order to establish a single market and an economic and monetary union by 1999 at the latest. According to the fiscal rules of Maastricth, general government deficits should be below 3% of GNP and general government gross debt as a ratio of GNP should be below 60% . Several contributions on the Maastricht targets argue that monetary unification without fiscal convergence might cause monetary and economic instability . According to the convergence criteria of the Treaty, nominal interest rates must be a little higher than the average achieved by the three lowest-inflation member countries.

The convergence criteria of the Maastricht Treaty represent a difficult quantitative target for Greece. From an average of 2.9% of GNP between 1949-1970, the actual budget deficit jumped to an average of 10.0% in 1970-1994. Within the theoretical framework of the Keynesian proposition, one would predict that the level of nominal interest rate of government bonds and treasury bills should have increased since 1970. In fact, between 1970 and 1994 the average nominal interest rate on one year yield bonds and treasury-bills rose from 6.0% to 20.0%, indicating that the interest rate during this period followed a path resembling that of the deficit. As will be seen, the empirical findings in table III confirm the validity and consistency of the Keynesian proposition.

In constructing the interest rate equation we have taken into account previous empirical work on the relationship between budget deficits and interest rates. Our purpose in constructing the interest rate equation was to include all the variables which affect the behaviour of the interest rate. The omission of variables may lead to spurious and biased results. Based on economic modelling of previous studies examining the relationship between budget deficits and interest rates, the following interest rate regression equation is considered:

$$INTR_t=a_0+a_1RGNP_t+a_2UNML_t+a_3INFL_t+a_4BDEF_t+a_5M_t+a_6GE_t+a_7GT_t+u_t \quad (1)$$

where= a_0, a_1, a_2, a_3, a_4, a_5, a_6, a_7 are parameters; INTRE is the average nominal interest rate on one year yield bonds and treasury bills; RGNP is the real Gross National Product; the unemployment rate series (UNML) is the annual average of the seasonally adjusted monthly unemployment rates; INFL is the inflation rate calculated by CPI (Consumer Price Index); BDEF is the actual budget deficit in real terms; M is the money supply M_1 in real terms; GE is the government current expenditure on goods and services in real terms; GT is the government current transfers in real terms; u is a white noise disturbance term; and t stands for time. The actual budget deficit (BDEF) is measured as the difference between expenditures, including payments on debt service, and receipts. We derive BDEF, M, GE, and GT by dividing nominal data by the CPI.[4]

Following R. Barro (1981, 1987) and the other advocates of the Ricardian equivalence hypothesis, we decompose government spending into permanent and transitory components.[5] This decomposition is very important, otherwise "both the deficit and debt variables may have elements of simultaneity bias in them" (J. Seater, 1993, p. 175). Including budget deficit in an interest rate regression while excluding government purchases may introduce omitted variable bias. It is possible for statistical results to ascribe to budget deficits effects which actually should be attributed to government purchases. Transfer payments in Greece have, to a great extent, a temporary character. Transfer payments to households include purchases such as civil service pensions, current transfers to public funds, unemployment insurance, transfers for social security and health, etc, which are substantially affected by political conditions, the financial situation of public corporations and enterprises, the level of unemployment, etc. Therefore, in testing the validity of Keynesian and Ricardian equivalence paradigms and specifying properly the interest rate regression 1, we decompose the total government spending into permanent and temporary purchases and introduce the GE and GT series.

3. Cointegration, EMC Results

3.1. Integration, Cointegration

At first, we implement unit root tests and cointegration tests using both deterministic and non-deterministic trends. If the variables of our interest rate model are considered as stochastic trends and if they follow a common long-run equilibrium relationship, then the variables should be cointegrated. Before examining cointegration the first step is to perform tests for stationarity in order to explore whether each of the series has a stochastic trend. The application of cointegration tests requires that the series should be nonstationary and integrated of the same order. The second step is to examine whether stochastic trends in the series of the regression model 1 are related, denoting that they move together.

The estimation of the system covers the time periods 1949-1994, 1953-1994 and 1957-1994, where official data are available for the variables of the model. In testing for stationarity of the individual time-series, we use the Augmented Dickey-Fuller (ADF) test. The null hypothesis to be tested is that the series under examination has a unit root against the alternative hypothesis that it does not. Table I reports unit root tests. The ADF tests indicate that on levels the null hypothesis of a unit root cannot be rejected for all of the variables. Using differenced data the computed ADF tests suggest that the null hypothesis is rejected for the individual series and the variable INTR, RGDP, UNML, INFL, BDEF, M, GE and GT are integrated of order I(1).

We chose the cointegration tests of S. Johansen (1988, 1991, 1992) because it employs the well-accepted likelihood ratio statistics. According to J. Gonzalo (1994), the Johansen maximum likelihood procedure for cointegration is a better technique compared to both single equation methods and alternative multivariate methods. Tests for cointegration are presented in table II. In determining the number of cointegrating vectors r, we use the maximal eigenvalue likelihood ratio statistics, λmax. According to S. Johansen, the statistical power of the maximal eigenvalue test is higher than that of the trace test. The null hypothesis to be tested is that there can be r cointegrating vectors among the variables of the interest rate model 1.

Using either linear deterministic trend or no deterministic trend in the data and if the order of the underlying VAR model is one or two years lag respectively, the LR-tests are statistically significant across the time periods 1949-1994, 1953-1994 and 1957-1994, rejecting the null hypothesis of noncointegration. The series INTR follows a stable and strong long-run relationship with the group of independent variables. These results are consistent with the theoretical background of both the Keynesian and the Ricardian equivalence paradigms.

The Johansen cointegration technique indicated the existence of more than one cointegrating vector, indicating that the system under examination is stationary in more than one direction and hence it is more stable. D. Dickey et al (1994, p. 22), examining the strategy of cointegration techniques and the significance of cointegration tests, argue that "the more cointegrating vectors there are, the more stable the system... it is desirable for an economic system to be stationary in as many directions as possible". The existence of more than one long-run cointegrated relationship between a set of variables has significant implications for policy decision making. In fact, in the framework of cointegrated series, policy makers could determine their targets on one variable seeking to stabilize effectively the long-run level of some others.

3.2. ECM Strategy, Results

If variables are non-stationary, the OLS coefficients may appear spuriously significant. A common practice is to difference the variables to make them stationary and then to regress the model. However, differencing variables causes the loss of valuable long-run information, so that the correlation between dependent and explanatory variables can be at least partly spurious.

In recent years the Error-Correction Model (ECM) has obtained popularity in applied economics, because it provides an answer to problem of spurious correlation .

R. Engle and C.W. Granger (1987) maintain that cointegrated variables must have an ECM representation. The main reason for the popularity of cointegration analysis is that it provides a formal background for testing and estimating long-run equilibrium relationships among economic variables. Taking into account that in model 1 the disequilibrium error term u_t, is stationary and the series are integrated of order one, the following standard ECM formulation can be estimated by OLS:

$$\Delta INTR_t=\gamma_1\Delta RGNP_t+\gamma_2\Delta UNML_t+\gamma_3\Delta INFL_t+\gamma_4\Delta BDEF_t+\gamma_5\Delta M_t + \gamma_6\Delta GE_t+\gamma_7\Delta GT_t+\delta_1 EC_{t-1}+\varepsilon_t \quad (2)$$

where Δ is the difference operator; t stands for time; and ε_t is a white noise error term. The ECM model 2 is nested within equation 1 and can be estimated by OLS. In the ECM representation 2 short-run dynamics are captured by the first differences of the variables and long-run dynamics are reflected through the one-lagged error-correction term EC_{t-1}. The regressor EC_{t-1} corresponds to the lagged residuals from the regression model 1 and we expect $\delta_1<0$. The coefficients γ_1, γ_2, γ_3, γ_4, γ_5,γ_6, γ_7 are short-run parameters measuring the immediate impact of independent variables on ΔINTR and the parameter δ_1 is the long-run parameter providing long-run effects. In this way, the parameters involve predictions about the long- and short-run dynamics of the ECM formulation 2. Notice that the ECM model 2 does not contain an intercept term, because the error-correction term EC_{t-1} already includes an estimate of it.

As mentioned, the omission of important variables could affect the relationship between budget deficit and interest rate. Several authors include the unemployment rate in the set of explanatory variables, since the unemployment rate reflects overall economic activity and in part explains the behaviour of interest rate. Consequently, by including the unemployment rate in the group of independent variables, we improve the explanatory power of our interest regression model. The sign on unemployment rate is likely to be negative or positive. However, if increasing unemployment rates signal economic uncertainty, this might produce a positive sign on unemployment rate.

ΔRGNP is expected to have a positive sign, because fluctuations of economic activity influence the behaviour of interest rates positively. Interest rates increase during the expansion phase of the business cycle and decrease during recessions. The coefficient of ΔINFL is expected to have a positive sign. Supposing nominal interest rates are constant, an increase in inflation rate could cause income redistribution effects between debtors and creditors. A rise in inflation rate should put upward pressure on the level of interest rates in order to avoid income redistribution effects. The variable ΔM should exhibit a negative sign. An increase in money supply will increase real income which will affect savings positively, causing lower interest rates. In other words, in order for individuals and households to be willing to hold real money balances, the level of interest rates must fall.

In table III we present statistical results for the ECM representation 2. We do not add lags for each of the independent variables in order to conserve degrees of freedom. The empirical findings support the Keynesian proposition and call in question the Ricardian equivalence hypothesis. The coefficients on ΔRGNP, ΔUNML, ΔINFL, ΔBDEF, ΔM, AGE have the right sign and are significantly different from zero. The coefficient on ΔGT is statistically insignificant. The t — ratio for the EC_{t-1} term is significant even at the 1 percent level. In general, the robustness of the statistical results is not altered when the sample range is varied, indicating a positive and significant effect of ΔBDEF and AGE on ΔINTR.

The insignificance attached to ΔGT may be attributed to the close correlation between budget deficits and transfer payments, in that budget deficits and temporary purchases usually move together. If budget deficits constitute a better measure of temporary spending than the ΔGT series, then it is possible that the ΔBDEF series may enter the ECM model with a significant coefficient and the ΔGT series with an insignificant coefficient. This is why the significance attached to the ΔBDEF series is the same, whether or not the ΔGT series is dropped from the system. The findings of the diagnostic and specification tests indicate that the ECM representation 2 is correctly specified. The Chow test is used to examine the structural stability of the ECM model. Choosing 1971, 1974 and 1977 as the sample breaking dates, the F-statistics confirm that the estimated values of the parameters yield a stable solution which is not sensitive to changes in the sample range.

The RESET (Regression Specification Test) statistics reveal no serious omission of variables, indicating the correct specification of the model. The ARCH (AutoRegressive Conditional Heteroskedasticity) tests suggest that the errors are homoskedastic and independent of the regressors. The BG (Breusch-Godfrey) tests evidence no significant serial correlation in the disturbances of the error term. The JB (Jarque-Bera) statistics suggest that the disturbances of the regressions are normally distributed. The White F-statistics reveal the absence of simultaneity bias in the estimates. Overall, the statistical results of Chow, RESET, ARCH, BG, JB and White tests are significant and robust. In this sense, our empirical evidence supports the validity of the Keynesian proposition.

The significance of the BDEF coefficient might indicate income redistribution effects related to a deficit for tax swap. It is obvious that holders of government bonds differ substantially from low income families (individuals) who are taxed in order for the government to collect taxes in order to service national bebt. Since low income families cannot avoid the taxes levied, they will be compelled to change their economic decisions if the government in its fiscal policy mix swaps deficit for taxes. In such a case, increasing deficits causes redistribution effects in favour of holders of government bonds, the deficit appears to be net wealth and thus Ricardian equivalence is invalidated . In Greece, between 1980 and 1994, budget revenues from direct and indirect taxes as a ratio of GNP increased from 18.4% to 27% and the payments on service of the central government debt rose from 3.1% to 24% of GNP.

4. Summary and Conclusions

The purpose of this paper was to test the much debated link between actual budget deficit and nominal interest rate through specifying the appropriate dependent variable and the set of explanatory variables based on the alternative specifications of interest rate regressions of previous studies. This paper employs a methodological framework based on cointegration analysis, Error-Correction modelling, specification and diagnostic tests. A considerable number of empirical studies provide controversial results on the validity and rationale of the Keynesian and Ricardian paradigms. Nevertheless, most empirical studies examining the linkage between budget deficits and interest rates utilize data of the U.S. economy.

Hence there is a need for further investigation of this issue using data from other countries with different structures. Using annual data of the Greek economy based on economic modelling of previous studies and decomposing government spending into permanent and transitory components, the object of this paper was to test both paradigms empirically. In our ECM formulation 2 we include several important economic variables which have a significant influence on and are influenced by budget deficit and interest rate. No inclusion of these variables could lead to the derivation of biased and inefficient empirical results.

Before testing the null hypothesis of noncointegration, we first perform unit-root tests. The reported t — values of the augmented Dickey-Fuller (ADF) test indicate that the model variables appear to be difference stationary, implying that the unit-root hypothesis is rejected. The cointegration test methodology of S. Johansen (1988, 1991, 1992) confirms that in all time periods the series of the eight-variable system (INTR, BDEF, RGNP, UNML, INFL, GE, GT, M) are tied together in a long-run stable and strong equilibrium relationship, rejecting the null hypothesis of noncointegration. In this way, the eight-variable system makes sense and consequently both Keynesian proposition and Ricardian equivalence can be empirically tested.

In our analysis we apply the ECM technique to avoid the spurious regression phenomenon. In the interest rate equation 2 all variables are in first differences and the error-correction term (EC_{t-1}) is added to the group of regressors. The ECM representation 2 involves a parameterization which combines long- and short-run effects. The parameter δ_1 which appears in the disequilibrium error term EC_{t-1} is the long-run parameter and the parameters γ_1, γ_2, γ_3, γ_4, γ_5, γ_6, γ_7 are the short-run parameters which depict the direct impact effect on the dependent variable ΔINTR.

Based on the ECM model estimates, we find strong support for the existence of a short- and long-run relationship between interest rate and budget deficit. Although the regressor ΔGT has an insignificant coefficient, when the series ΔGT is dropped from the system the coefficients in the ECM are significant, different from zero, and the diagnostic and specification tests yield satisfactory results. Overall, the findings of the ECM representation appear to support the empirical framework and rationale of the Keynesian proposition.

TABLE I

Unit - Root Tests

Variable	Levels			First Differences		
	1949-1994	1953-1994	1957-1994	1949-1994	1953-1994	1957-1994
I. With-constant, with-time trend						
INTRt	-1.74	-1.96	-2.51	-4.89*	-4.77*	-4.52*
RGNPt	-1.58	-1.14	-0.89	-3.67**	-3.74**	-3.66**
UNMLt	-1.53	-1.48	-1.51	-4.33*	-4.21*	-4.14*
INFLt	-2.67	-2.36	-2.47	-5.29*	-5.43*	-5.26*
BDEFt	-0.06	-0.33	-0.62	-6.35*	-6.24*	-5.99*
Mt	-0.70	-0.62	-0.72	-4.74*	-4.81*	-4.85*
GEt	-1.80	-1.71	-1.50	-4.25*	-4.19*	-4.07*
GTt	-2.30	-2.36	-2.33	-5.18*	-5.06*	-4.91*
II. With-constant, no time trend						
INTRt	0.24	0.17	0.08	-4.53*	-4.45*	-4.26*
RGNPt	-0.21	-0.70	-1.02	-3.72*	-3.78*	-3.68*
UNMLt	-1.65	-1.58	-1.54	-4.13*	-4.01*	-3.82*
INFLt	-1.73	-1.74	-1.75	-5.38*	-5.53*	-5.32*
BDEFt	2.61	2.42	2.13	-4.63*	-4.57*	-4.47*
Mt	-1.27	-1.62	-1.95	-4.50*	-4.42*	-4.19*
GEt	-0.48	-0.64	-0.85	-4.34*	-4.27*	-4.10*
GTt	0.08	-0.11	-0.41	-5.09*	-5.03*	-4.99*

* Significant at the 1% level, ** Significant at the 5% level

Notes: We use the augmented Dickey-Fuller (ADF) unit-root test. All equations are estimated with one year lag length on the dependent variable. All numbers given are t — values. The source of critical values for ADF tests is Mackinnon's tables (1991). The stationarity tests are conducted using the ADF regressions of the form:

$$\Delta Y_t = a_0 + a_1 t + pY_{t-1} + \sum_{i=1}^{k} \lambda_i \Delta Y_{t-1} + u_t. \tag{3}$$

and

$$\Delta Y_t = a_0 + pY_{t-1} + \sum_{i=1}^{k} \lambda_i \Delta Y_{t-1} + u_t. \tag{4}$$

where ΔY are the first differences of the series Y, k is the lag order and t stands for time. Breusch-Godfrey statistics suggest that the residuals for all regression equations are white noise.

TABLE II

Cointegration Tests Based on Johansen Maximum Likelihood Procedure

	λmax Rank Tests							
	H_0:r=0	H_0:1=1	H_0:r=2	H_0:r=3	H_0:r=4	H_0:r=5	H_0:r=6	H_0:r=7
A. Linear deterministic trend in data and a constant								
1949-1994								
- one year lag	272.7*	196.0*	133.1*	90.1*	57.9*	32.1**	12.3	0.1
- two years lag	301.9*	216.3*	149.6*	104.3*	68.1*	37.2*	17.7**	0.7
1953-1994								
- one year lag	262.5*	180.7*	122.1*	81.7*	52.8**	28.1	10.5	0.6
- two years lag	308.7*	224.7*	160.4*	107.0*	69.8*	39.1**	18.7	0.2
1957-1994								
- one year lag	248.3*	172.5*	120.5*	83.6*	55.4*	29.0	13.1	0.9
- two years lag	297.1*	208.8*	151.2*	103.2*	69.3*	36.4**	17.0	0.7
B. No deterministic trend in data and no constant								
1949-1994								
- one year lag	239.9*	162.1*	109.4*	75.0*	48.7*	27.7**	9.4	0.2
- two years lag	281.9*	208.3*	140.3*	96.0*	61.5*	29.6**	8.9	0.1
1953-1994								
- one year lag	227.1*	148.7*	99.1*	68.3*	42.2**	24.5**	9.3	0.3
- two years lag	279.7*	204.5*	138.1*	94.2*	60.1*	28.1**	7.8	0.2
1957-1994								
- one year lag	220.6*	144.7*	100.5*	71.3*	43.2**	25.0**	8.6	0.4
- two years lag	276.1*	197.6*	138.1*	95.2*	60.2*	28.8**	9.4	1.6

* denotes rejection of the null hypothesis at the 1% significance level

** denotes rejection of the null hypothesis at the 5% significance level

Notes: The Johansen maximum likelihood cointegration procedure is applied to the eight-variable system (INTRt, $RGNP_t$, $UNML_t$, $INFL_t$, $BDEF_t$, GE_t, GT_t, M_{1t}). The reported maximal eigenvalue likelihood ratio statistics, λmax, are calculated within the framework established by Johansen (1991); for the computation of the maximal eigenvalue likelihood ratio statistics, λmax, see also the tables of Osterwald-Lenum (1992). The order of the underlying VAR model is one and two years lag. r is the number of cointegrating vectors.

TABLE ΠΙ

Determinants of the ΔM_t-ECM Approach

	1949-1994		1953-1994		1957-1994	
	1	2	1	2	1	2
$\Delta RGNP_t$	0.019	0.018	0.019	0.018	0.018	0.017
	(1.980)	(1.901)	(1.885)	(1.808)	(1.847)	(1.781)
$\Delta UNML_t$	0.476	0.461	0.512	0.493	0.582	0.563
	(2.136)	(2.067)	(2.216)	(2.125)	(2.496)	(2.417)
$\Delta INFL_t$	0.125	0.126	0.142	0.143	0.143	0.144
	(5.270)	(5.280)	(5.431)	(5.385)	(5.386)	(5.373)
$\Delta BDEF_t$	0.222	0.167	0.223	0.161	0.218	0.163
	(1.994)	(1.654)	(1.956)	(1.553)	(1.919)	(1.582)
ΔGE_t	0.772	0.637	0.784	0.625	0.745	0.599
	(2.816)	(2.684)	(2.765)	(2.549)	(2.594)	(2.426)
ΔGT_t	-0.247	-	-0.281	-	-0.254	-
	(-1.079)		(-1.186)		(-1.065)	
ΔM_{t-1}	-0.601	-0.665	-0.519	-0.595	-0.485	-0.557
	(-2.181)	(-2.479)	(-1.839)	(-2.164)	(-1.713)	(-2.030)
EC_{t-1}	-1.008	-0.991	-0.986	-0.970	-1.044	-1.035
	(-5.516)	(-5.405)	(-5.210)	(-5.091)	(-5.472)	(-5.408)
R^2	0.549	0.543	0.565	0.556	0.603	0.598
DW	1.956	1.944	1.955	1.960	1.936	1.951
SER	0.679	0.684	0.696	0.703	0.697	0.702
Chow (1971)	1.370	1.331	1.198	1.135	1.085	0.954
Chow (1974)	0.922	0.896	0.759	0.716	0.748	0.599
Chow (1977)	1.108	1.050	0.995	0.906	0.841	0.669
JB	1.368	2.216	1.089	1.742	1.809	2.370
RESET	1.901	1.533	1.362	1.134	1.217	1.054
WT	0.485	0.698	0.420	0.599	0.264	0.367
ARCH (2)	0.410	0.571	0.328	0.456	0.164	0.146
ARCH (3)	0.432	0.388	0.311	0.286	0.704	0.327
BG (2)	0.455	0.974	0.444	1.121	1.333	1.974
BG (3)	0.297	0.704	0.293	0.728	0.911	1.320

Notes: Asymptotic t-statistics in parentheses. $\overline{R}^2$ is the asjusted R^2. DW is the Durbin - Watson statistics. SER is the Standard Error of Regression. Chow is the F-statistic for structural change in 1971, 1974 and 1977. JB is the Jarque-Bera test of the normality of the regression residuals. RESET is the Ramsey F-statistic for omitted variables. WT is the White

F-statistic for simultaneity bias. BG is the Breusch-Godfrey F-statistics, where numbers in parentheses are the lag lengths of the residuals. ARCH is the AutoRegressive Conditional Heteroskedasticity F-statistic (number in parentheses is the lag lengths). EC_{t-1} is the error-correction term lagged one period obtained from the corresponding regression.

Notes

1. B. Bernheim (1989) and J. Seater (1993) provide a detailed analysis of the theoretical and empirical evidence regarding the Keynesian and Ricardian equivalence paradigms.

2. However, the fiscal rules on deficits and debt are not rigid. According to Article 104c of the Treaty of Maastricht, deficit/GNP and debt/GNP ratios above 3% and 60% respectively will not be considered excessive if they are decreasing sufficiently and have made steady progress towards the convergence criteria by 1999.

3. For more details on this matter, see W. Buiter et al. (1993) and B. Eichengreen (1993).

4. The statistical data are taken from the Ministry of Finance, the Statistical Service of the Ministry of Labour, the Bank of Greece and the National Statistical Service of Greece. The UNML in the period 1949-1959 is calculated taking into account the results of the population censuses for the years 1951 and 1961. From 1949-1957 the data for INTR refer to the general interest rate for long-term loans to manufacturing and mining. The monetary aggregate M_1 includes M_o (banknotes and coins) plus private sight deposits.

5. J. Seater (1993) provides a complete analysis on this point.

6. For a detailed analysis of spurious correlations and the ECM methodology used in this paper, see W. Enders (1995) and L. Thomas (1997).

7. According to the Ricardian equivalence government spending, permanent and transitory, may have a positive effect on interest rates, but the level of interest rate is independent of the level of budget deficit, i.e. $\gamma 4 = 0$, see R. Barro (1986, 1987) and P. Evans (1985, 1987).

8. For the importance of the net wealth effect of both Keynesian and Ricardian equivalence paradigms, see Barth et al (1986).

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