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The Macroeconomic Effects of Budget Deficits in Greece: A VAR-VECM Approach

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Abstract

This paper investigates the causal links between budget deficit (BD) and other macroeconomic variables such as Consumer Price Index (CPI), Gross Domestic Product (GDP) and Nominal Effective Exchange Rate (NEER) for Greece, during the period 1980-2009. Empirical evidence based on Variance Error Correction Model (VECM) and variance decomposition estimates indicate that the variables under study are cointegrated and that one-way causalities exist running from NEER to BD and from BD to GDP. Moreover, results imply that bidirectional causal links between NEER and CPI exist in the case of Greece while GDP granger-causes CPI. However, this study finds no significant links between budget deficit and inflation in the case of Greece. Therefore, this paper highlights the fact that NEER has a direct impact on Greece's budget deficit, which is in line with the majority of relevant academic works. So, the Greek government should closely monitor the impact of NEER on the budget deficit of Greece, especially under the severe macroeconomic pressure that the sovereign debt crisis causes on the Greek economy since 2009.

Keywords: Budget Deficits, Nominal Effective Exchange Rates, Cointegration, Vector Error Correction Model, Variance Decomposition.
JEL Classification Codes: C54, E31, E43

1. Introduction

It is widely accepted that the interrelationships between budget deficits, money growth and inflation have been at the center of the monetary economics academic research. Furthermore, it is a fact that every country eternally strives to achieve high growth rates, negative budget deficits, high employment rates and low inflation. However, very few countries succeed in striking a balance between microeconomic and macroeconomic objectives.

In this spectrum, it is often argued that monetization of budget deficit is the basic cause of inflation especially in developing countries. Budget deficit reduces the supply of loanable funds, driving up the interest rates and crowds out investment. In an open economy, the reduced supply of loanable funds will lead to higher interest rates and lower net foreign investment since the savings kept

at home now earns higher rates of return and investing abroad is less attractive while domestic residents buy fewer foreign assets. Higher interest rates also attract foreign investors, who want to earn higher returns. Hence budget deficits raise interest rates (both domestic and foreign) causing net foreign investment to fall. Because net foreign investment is reduced, people need less foreign currency to buy foreign assets and hence the real exchange rates rise. Hence in an open economy, government budget deficits raise real interest rates, crowd out domestic investment, and cause the other currencies to appreciate the domestic currency and further deteriorate the trade deficit. However, there appears to be no consensus, in the relevant literature on the existence and the direction of the relationships between budget deficit and key macroeconomic variables.

Budget deficits are inflationary in the monetarist framework only to the extent that they are monetized. Sargent and Wallace (1981), on the other hand, argue that the monetarist arithmetic might be misleading as it ignores the fact that governments are constrained by their inter-temporal budget. According to this study, tight money may lead to an unsustainable debt financing process and thus higher inflation in the long run. In this framework, inflation is a fiscal-driven monetary phenomenon, and nominal monetary growth is endogenously determined by the need to finance exogenously given deficit to satisfy the budget constraint. However, in the fiscal theory of the price level (FTPL), there is virtually no role for money in the determination of prices in a non-Ricardian world (Woodford, 1995; Christiano and Fitzgerald, 2000; Woodford, 2001; Buiter, 2002). According to the FTPL, prices adjust to increases in nominal private sector wealth resulting from bond-financed deficits. In this non-Ricardian world, inflation is a symptom of too much nominal wealth chasing too few goods.

Annual budget deficits in Greece are definitely a key macroeconomic variable mostly due to the recent economic breakdown under the pressure of the global financial crisis of 2009. In general, Greece is a developed country with a high standard of living and Human Development Index (HDI), ranking 22nd in the world in 2010 (Human Development Reports, 2010). According to Eurostat data, Gross Domestic Product (GDP) per inhabitant in purchasing power standards (PPS) stood at 95 per cent of the EU average in 2008. Moreover, Greece's GDP growth has been higher than the EU average, since the early 1990's. On the other hand, the Greek economy faces significant problems, including rising unemployment levels, an inefficient bureaucracy, tax evasion and corruption. In 2009, Greece had the EU's second lowest Index of Economic Freedom (after Poland), ranking 81st in the world. The country suffers from high levels of political and economic corruption and low global competitiveness compared to its EU partners. After 15 consecutive years of economic growth, Greece entered recession in 2009. By the end of 2009, the Greek economy faced the highest budget deficit and government debt to GDP ratios in the EU. The 2009 budget deficit stood at 15.4% of GDP. This and the rising debt levels (127% of GDP in 2009) led to rising borrowing costs, resulting to a severe financial crisis.

Thereupon, the central objective of this study is to investigate the causal links between budget deficits and other macroeconomic variables such as Nominal Effective Exchange Rate (NEER), inflation (as measured by CPI) and GDP by giving special emphasis on the budget deficit – exchange rate relationship in Greece. For this purpose cointegration test is employed, Granger-causality using Vector Error Correction Models (VECM) and Variance Decomposition analysis for the period 1980-2009.

This study is motivated by a number of factors. First, there is a lack of studies investigating the interdependence of budget deficits and other macroeconomic variables for Greece. Second, it enriches the existing literature on the budget deficit-exchange rate relationship by providing new evidence for a developed EU country (i.e. Greece), which is under severe macroeconomic pressure due to the global financial crisis of 2009. Third, it covers a period which includes some of the most important macroeconomic, political and social transformations leading to a more open, integrated and therefore more globalized Greek economy.

The rest of the paper is organized as follows. Section 2 briefly reviews the literature. Section 3 presents the data and methodology employed. Section 4 presents the empirical results, while concluding remarks with some policy implications are presented in Section 5.

2. Literature Review

In the literature of budget deficits a special interest has been given on the budget deficit-exchange rate relationship. This section briefly analyses some of these studies before proceeding to studies dealing with the relationships between budget deficit and other macroeconomic variables.

Evans (1985, 1987) and Barro (1987) found no causal relationship between budget deficits and interest rates in the US. On the other hand, Hoelscher (1986) and Cebula and Koch (1989), found that federal budget deficits have contributed to higher levels of interest rate yields. Knoester and Mak (1994) showed that only in Germany (among eight OECD economies) does the government budget deficit contribute significantly to the explanation of higher interest rates. Evans (1985) suggests that federal deficits affect consumption and interest rates whereas Bernheim (1989) finds evidence to the contrary. Regardless of various studies, the reality is that the presence of large budget deficits in both developed and developing countries have adversely affected economic growth.

Furthermore, few studies have explored the impact of budget deficits on the value of the domestic currency, though there is some literature on relationship between current account deficit and government deficit (e.g. Abell, 1990). It is widely accepted that the short run impact of budget deficits on exchange rates has led to the uncertainty in the nature of the relationship between the two variables. Krugman (1995) and Sachs (1985) argued that lower budget deficit lowers the value of the dollar. There are numerous studies in the literature holding this opinion, mostly in the case of the US (Mundell, 1963; Fleming, 1962; Dornbusch, 1976). Other economists including Evans (1986) argue that lower deficit might actually appreciate the dollar in the short run. Cantor and Driskill (1995) suggest that the possibility of both short run and long run appreciation of a currency to fiscal contraction hinges on domestic country being a large debtor. Feldstein (1986) seminal work points out that appreciation of the dollar in the 1980s coincided with high budget deficits. A few more studies arrived at a similar conclusion using empirical analysis (Alse and Bahmani-Oskooee, 1992; Oskooee and Payesteh 1993). A similar phenomenon has been found in Canada where budget deficits contributed to appreciation of the Canadian dollar (Wijnbergen, 1987). Evans (1986) has found no evidence of the presence of any relationship between budget deficit and value of domestic currency and suggests that budget deficits are a sign of weakness in the economy (and quite possibly a sign of future inflation). Another paper by Evans (1987) proposes that high budget deficits do not necessarily lead to a strong currency. He argues that if the budget deficit affects aggregate demand, it might result in higher price levels and in turn lead to domestic currency losing its value. Beck (1993) tests the significance of budget deficit and government spending changes on exchange rates in five industrialized countries: U.S., Germany, Japan, U.K. and Canada, and finds that there exists a negative relationship between budget deficit and exchange rates in all the cases except Japan.

There have been other studies on the impact of budget deficits on other macroeconomic variables such as inflation and money supply. McMillin (1986) finds evidence that budget deficits cause inflation. Similar results are also reported by other researchers (Edwards and Tabellini, 1991; Favero and Spinelli, 1999; Metin, 1998; Özatay, 2000). On the contrary, other studies refute this finding and suggest that budget deficits do not contribute significantly to higher inflation (Karras, 1994; King and Plosser, 1985). It has also been stated that depending on the degree of independence the Central bank enjoys, it may resort to monetize the deficit in the current period or in future periods (Sargent and Wallace, 1981). Turnovsky and Wohar (1987) have argued that the empirical results depend on the exchange rate regime under which the economies operate. In terms of the relationship between budget deficits and money supply, some studies have found evidence in favor of the debt monetization hypothesis (Allen and Smith, 1983), while others have reached the opposite results (Niskanen, 1978). Inflationary conditions could worsen through printing more money; crowding out effect, which leads to an excessive issue of government bonds, since they constitute a substantial part of money supply. Therefore, higher budget deficits could aggravate the inflationary conditions in the economy, contributing to the presence of a depreciated domestic currency.

3. Data and Methodology

This survey employs data that consist of annual observations during the period 1980-2009. Budget deficit (BD) and Nominal Effective Exchange Rate (NEER) figures are calculated by employing data obtained from the World Development Indicators (i.e. the World Bank database). Consumer Price Index (CPI) data are also gathered from World Development Indicators. Finally, Gross Domestic Product (GDP) data are derived from UNCTAD (i.e. United Nations database).

The econometric methodology firstly examines the stationarity properties of the univariate time series. Augmented Dickey-Fuller (ADF) test has been used to test the unit roots of the concerned time series variables (Dickey and Fuller, 1979). It consists of running a regression of the first difference of the series against the series lagged once, lagged difference terms, and optionally, by employing a constant and a time trend. This can be expressed as:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + ... + \Gamma_{k-1} \Delta z_{t-k-1} \Pi z_{t-1} + \mu + \varepsilon_t : \quad \text{(Model 1)}$$

The test for a unit root is conducted on the coefficient of (y_{t-1}) in the regression. If the coefficient is significantly different from zero then the hypothesis that (y) contains a unit root is rejected. Rejection of the null hypothesis implies stationarity.

Furthermore, the time series has to be examined for co-integration. Co-integration analysis helps to identify long-run economic relationships between two or several variables and to avoid the risk of spurious regression. Co-integration analysis is important because if two non-stationary variables are cointegrated, a Vector Autoregression (VAR) model in the first difference is misspecified due to the effect of a common trend. If a cointegration relationship is identified, the model should include residuals from the vectors (lagged one period) in the dynamic Vector Error Correcting Mechanism (VECM) system. In this stage, the Johansen (1988) cointegration test is used to identify a cointegrating relationship among the variables. Within the Johansen multivariate cointegrating framework, the following system is estimated:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + ... + \Gamma_{k-1} \Delta z_{t-k-1} \Pi z_{t-1} + \mu + \varepsilon_t : t = 1,.., T \quad \text{(Model 2)}$$

where, Δ is the first difference operator, z' denotes a vector of variables, $\varepsilon_t \sim$ n iid $(0,\sigma^2)$, μ is a drift parameter, and Π is a (p x p) matrix of the form $\Pi = \alpha\beta'$, where α and β are both (p x r) matrices of full rank, with β containing the r cointegrating relationships and α carrying the corresponding adjustment coefficients in each of the r vectors. The Johansen approach can be used to carry out Granger causality tests as well. In the Johansen framework, the first step is the estimation of an unrestricted, closed p-th order VAR in k variables. Johansen (1988) suggested two tests statistics to determine the cointegration rank. The first of these is known as the trace statistic:

$$N\{trace(r_0 / k) = -T \sum_{i=r_0+1}^{k} \ln(1 - \hat{\lambda}_i) \quad \text{(Model 3)}$$

where, $\hat{\lambda}_i$ are the estimated eigenvalues $\lambda_1 > \lambda_2 > \lambda_3 > \ldots > \lambda_\kappa$ and r_0 ranges from zero to k-1 depending upon the stage in the sequence. This is the relevant test statistics for the null hypothesis $r \leq r_0$ against the alternative $r \geq r_o+1$. The second test statistic is the maximum eigenvalue test known as λ_{max}; we denote it as λ_{max} (r_0). This is closely related to the trace statistic, but arises from changing the alternative hypothesis from $r \geq r_o+1$ to $r = r_o+1$. The idea is trying to improve the power of the test by limiting the alternative to a co-integration rank which is just by one more than the null hypothesis. The λ_{max} test statistic is:

$$\lambda_{max}(r_0) = - T \text{ in } (1 - \lambda_i) \text{ for } i = r_0 + 1 \quad \text{(Model 4)}$$

The null hypothesis is that there are r cointegrating vectors, against the alternative of r + 1 cointegrating vectors. Johansen and Juselius (1990) indicated that the trace test might lack power relative to the maximum eigenvalue test. Based on the power of the test, the maximum eigenvalue test statistic is often preferred.

According to Granger (1969), Y is said to "Granger-cause" X if and only if X is better predicted by using the past values of Y than by not doing so with the past values of X being used in either case. In short, if a scalar Y can help to forecast another scalar X, then we say that Y Granger-causes X. If Y causes X and X does not cause Y, it is said that unidirectional causality exists from Y to

X. If Y does not cause X and X does not cause Y, then X and Y are statistically independent. If Y causes X and X causes Y, it is said that feedback exists between X and Y. Essentially, Granger's definition of causality is framed in terms of predictability. Therefore, if budget deficit shares a long-run relationship with other macroeconomic variables under study, the next step is to examine causality, since if two or more variables are cointegrated; there is causality in at least one direction. We proceed to determine whether deficits Granger-cause exchange rates and other variables and vice-versa, using Vector Error Correction Model (VECM). According to Engle and Granger (1987), if two variables are cointegrated, then a more comprehensive test of causality, which has become known as an error-correction model, should be adopted. The VEC specification restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics. The cointegration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

4. Empirical Results

Table 1 reports the descriptive statistics for the sample of the four macroeconomic variables for the case of Greece. Overall, calculations indicate that all variables are not normally distributed and are characterized as leptokurtic and skewed.

Table 1: Descriptive Statistics

Statistics	BD	CPI	GDP	NEER
Mean	-7.275633	11.25437	126.9273	192.4369
Median	-6.167000	9.929922	113.8450	114.8308
Maximum	-0.161000	24.87481	184.0360	581.3450
Minimum	-36.11700	1.211683	97.21500	95.04583
Std. Dev.	7.377782	7.951607	28.81473	144.6766
Skewness	2.313291	0.279649	0.811981	0.303810
Kurtosis	1.825908	1.541579	2.238208	1.250262
Jarque-Bera	4.10898	3.049760	4.021972	3.81497
Probability	0.138486	0.217647	0.133857	0.20607

Table 2 displays the estimates of the Augmented Dickey – Fuller (ADF) test in levels and in first differences of the data with an intercept, with an intercept and trend and with no intercept or trend. The tests have been performed on the basis of 5 percent significance level, using the McKinnon Critical Values. Initially, ADF test with an intercept implies that all variables are not stationary at levels even at 10 percent level of significance. However, at 1st differences CPI is stationary at 1 percent significance level and all other three variables are stationary at 5 percent. Similarly, the test with an intercept and trend at levels presents no significance at any accepted significance level. On the other hand, at 1st differences all variables are integrated of order one. ADF test with no intercept or trend reports that at levels none of the examined variables have a unit root. However, at 1st differences CPI and NEER are both stationary at 1 percent, while BD and GDP are stationary at 5 percent. Collectively, all test results imply that all variables are not stationary at levels at any accepted level of significance (i.e. 5 percent significance level or above). These are stationary variables at 1st differences. So, robust results indicate that all variables are integrated of order one i.e. I (1) for the case of Greece.

Table 2: Augmented Dickey – Fuller Unit Root Test Results

Variables	Test with Intercept		Test with Intercept and Trend		Test with no Intercept or Trend	
	Levels	1st Differences	Levels	1st Differences	Levels	1st Differences
BD	-0.9185	-3.0538**	-0.7536	-5.2698***	-0.5896	-3.5968**
CPI	-1.2647	-5.0163***	-2.7604	-4.9736***	-1.4168	-4.5896***
GDP	-1.3769	-3.0168**	-1.9192	-4.0168**	-1.2156	-2.6385**
NEER	-1.2658	-3.4067**	-2.9867	-3.7168**	-0.8569	-4.0314***

Note: *, **, *** denote significance at 10%, 5% and 1% respectively. This note also applies to the subsequent tables.

Table 3 provides the results from the application of Johansen cointegration test among the data set. Empirical findings show that both the maximum eigenvalue and the trace tests reject the null hypothesis of no cointegration at the 5 percent significance level according to critical value estimates. Therefore, the empirical findings lead to the conclusion that a long run relationship between budget deficit, inflation, GDP and exchange rates exists.

Table 3: Johansen Co-integration Test Results

Null Hypothesis	Trace Statistic	5% Critical Value	Maximum Eigenvalue Statistic	5% Critical Value
r* = 0	61.5720**	54.0790	29.2278**	28.5088
r ≤ 1	30.3121	35.1927	19.2731	22.2996
r ≤ 2	13.0710	20.2618	9.9292	15.8921

Note: * r is the number of co-integrating vectors under the null hypothesis.

Table 4 presents the causality tests as performed using the VECM approach. The empirical findings suggest that there is a significant unidirectional causal relationship between exchange rates and budget deficits running from NEER to BD. Furthermore, regarding the interrelationship between GDP and BD we are obliged to reject the null hypothesis of no granger causality between these two variables since there is a unidirectional causal relationship running from BD to GDP. However, this survey could not document any further causal relationships between budget deficits and inflation in the case of Greece. On the other hand from the application of the VECM approach it is also evident that there is a significant long–run equilibrium relationship between exchange rates and CPI and that GDP granger-causes inflation.

Table 4: Granger Causality using VECM

Error Correction:	D(BD)	D(CPI)	D(GDP)	D(NEER)
CointEq1	0.004517 (0.01352) [1.73405]**	-0.017584 (0.00946) [-1.85803]**	-0.000146 (0.01206) [-0.01214]	0.275463 (0.03414) [2.06756]***
D(BD (-1))	0.735196 (0.34737) [0.11648]	0.144833 (0.24311) [0.59574]	0.760418 (0.30978) [2.45472]***	-0.786150 (0.87712) [-0.89629]
D(CPI (-1))	0.075408 (0.33253) [0.22677]	0.057487 (0.23273) [0.24702]	0.111983 (0.29654) [0.37763]	-1.344591 (0.83965) [-1.71137]**
D(GDP (-1))	-0.031247 (0.27820) [-0.11232]	0.426460 (0.19470) [2.19030]***	0.452074 (0.24809) [1.82219]**	0.203693 (0.70246) [0.28997]
D(NEER (-1))	-0.013984 (0.05863) [-1.73849]**	0.060125 (0.04104) [1.76516]**	0.049581 (0.05229) [0.94821]	-0.132822 (0.14805) [-0.89712]
C	-0.188567 (1.97917) [-0.09528]	-3.000235 (1.38517) [-0.76597]	2.750295 (1.76500) [0.55824]	-17.62302 (4.99749) [-1.12638]

Variance decomposition results are reported from Tables 5.1 to 5.4. This analysis is employed as additional evidence presenting more detailed information regarding the variance relations between the selected macroeconomic variables.

Table 5.1 reveals that with a lag of seven periods CPI results the variance of BD by 6.18 percent and 6.47 percent by the end of the ten periods. It is also reported that GDP with lag of seven periods explains the budget deficits in Greece by 4.48 percent and 16.02 percent with lag of ten periods. Finally, a significant part of budget deficits' variance is caused by exchange rates since with a seven period lag 61.89 percent of BD is explained by NEER and by the end of the ten-year lag 83.97 percent of budget deficits' variance is caused by nominal effective exchange rates.

Table 5.1: Variance Decomposition of Budget Deficit (BD)

Period	S.E.	BD	CPI	GDP	NEER
1	2.52274	100.0000	0.000000	0.000000	0.159198
2	4.41757	89.49693	0.001366	0.366316	1.501452
3	6.19829	89.03553	0.432896	0.245389	5.046145
4	7.86819	78.00747	1.443600	0.233706	13.51299
5	9.31492	76.21765	2.782717	0.723422	28.22961
6	10.40897	73.40887	4.375274	1.987429	46.06092
7	11.09083	69.13467	6.183987	4.477336	61.89430
8	11.50708	63.20635	7.882251	8.684449	73.21701
9	12.22813	57.52881	8.350560	13.81584	80.23217
10	14.31925	57.14186	6.467812	16.01570	83.96816

Table 5.2 shows the variance decomposition calculations for inflation. The variance of the CPI explained by budget deficit is 47.15 percent with lag of seven periods increased to 66.12 percent by the end of ten periods. Moreover, GDP explains the 7.13 percent of budget deficits' variance at lag of seven periods while only the 6.14 percent is explained at the end of the ten periods. Finally, CPI's variance is not significantly influenced by the NEER.

Table 5.2: Variance Decomposition of CPI

Period	S.E.	BD	CPI	GDP	NEER
1	2.522739	1.761770	98.23823	0.000000	0.000000
2	4.417566	4.022884	84.89961	10.25678	0.820732
3	6.198289	3.258014	82.57014	11.92858	2.243271
4	7.868188	6.587665	78.04293	12.11870	3.250702
5	9.314920	17.08249	68.08705	11.12400	3.706464
6	10.40897	32.34451	54.81554	9.191795	3.648151
7	11.09083	47.14717	42.44126	7.134832	3.276740
8	11.50708	58.04975	33.43030	5.689265	2.830686
9	12.22813	64.26087	28.03053	5.255460	2.453139
10	14.31925	66.12369	25.54683	6.136485	2.192991

The variance decomposition of GDP as tabulated in Table 5.3 reports that the 94.44 percent of GDP's variance can be explained by budget deficit at the end of the seven periods. This percentage is still significant by the end of the ten periods reaching 92.47 percent. However, only the 2.74 percent of GDP is caused by CPI at the end of the seven periods, which is increased to 6.05 by the end of the ten years. Finally this analysis provides no evidence of significant relationships between the variance of GDP and NEER.

Table 5.3: Variance Decomposition of GDP

Period	S.E.	BD	CPI	GDP	NEER
1	2.522739	11.52005	0.439717	88.04023	0.000000
2	4.417566	54.18308	0.221837	45.48611	0.108970
3	6.198289	76.46895	0.353833	23.08050	0.096719
4	7.868188	86.37987	0.717638	12.82046	0.082024
5	9.314920	91.13302	1.261938	7.538066	0.066977
6	10.40897	93.45656	1.942694	4.549886	0.050861
7	11.09083	94.43521	2.743709	2.785578	0.035500
8	11.50708	94.52161	3.673812	1.781262	0.023317
9	12.22813	93.87289	4.761841	1.347894	0.017374
10	14.31925	92.46506	6.052697	1.459781	0.022459

The results for variance decomposition of NEER are presented in Table 5.4. These calculations indicate that with lag of seven periods the 61.89 percent of exchange rates variance is caused by budget deficit, which is significantly increased to 83.97 percent by the end of the ten years period. On the other hand, only the 4.46 percent of NEER's variance is explained by the variance of CPI at the end of seven periods, which is decreased at 3.78 percent by the end of the ten years. Finally, regarding the variance relationship between exchange rate and GDP we could not establish any significant variance link.

Table 5.4: Variance Decomposition of NEER

Period	S.E.	BD	CPI	GDP	NEER
1	2.522739	0.000000	20.93441	0.166926	78.73947
2	4.417566	0.135385	18.52144	0.472424	79.50468
3	6.198289	0.286188	15.22367	0.326317	79.40387
4	7.868188	0.315226	12.01898	0.497113	73.97091
5	9.314920	0.276207	8.944942	0.939696	61.88575
6	10.40897	0.228428	6.286778	1.202050	46.45025
7	11.09083	0.204003	4.456470	1.099862	32.54936
8	11.50708	0.226950	3.545276	0.801644	22.43607
9	12.22813	0.304788	3.384673	0.548619	15.83454
10	14.31925	0.374628	3.778068	0.529665	11.72410

5. Summary and Concluding Remarks

This survey provides exhaustive evidence on the causal relationships between budget deficit and other macroeconomic variables (i.e. inflation, GDP and nominal effective exchange rates) by employing annual observations during the period 1980-2009 for the case of Greece.

It is widely accepted by the academic community that macroeconomic variables such as budget deficits, inflation, GDP and exchange rates are closely related on each other. The macroeconomic literature provides evidence that in a closed economy the budget deficit negatively influences public savings reducing the level of loanable funds. On the other hand, in an open economy, the reduced supply of loanable funds causes a significant increase of interest rates and decrease of demand for foreign investments due to the fact that savings earn more in this case than investing in foreign currency. However, higher domestic interest rates attract more foreign capital penetration. So, the decline in the demand for foreign currency will greatly affect exchange rates, which in turn influence inflation (i.e. Consumer Price Index).

On the empirical analysis, this survey provides evidence that all variables are integrated of order one as various forms of Augmented Dickey-Fuller (ADF) test indicate. On this basis, the Johansen cointegration test was employed. Results of maximum eigenvalue and trace tests reject the null hypothesis of no cointegration. So, long run relationships exist between the selected variables and in order to document and analyze these links thoroughly the Vector Error Correction Mechanism (VECM) was employed. VECM results for the case of Greece reveal that there is a unidirectional causal link running from nominal effective exchange rates to budget deficits at 5 percent significance level. Furthermore, empirical calculations imply that there is a one-way causal link running from budget deficit to GDP. On the other hand, it should be mentioned that we would expect to trace relationships between budget deficits and CPI as the macroeconomic theory implies. However, this paper could not present any empirical results pointing on this direction. Nevertheless, regarding the other tested macroeconomic variables we documented bidirectional causal links between exchange rates and inflation and unidirectional relationships running from GDP to CPI.

Furthermore, this study provides empirical evidence from the application of the variance decomposition method. Exchange rates produce the 83.97 percent of variance in budget deficit at the end of ten periods, while GDP and CPI cause 16.02 percent and 6.47 percent respectively.

Interestingly, the effect of NEER on variance of budget deficit has been increasing during the whole ten-year periods. Furthermore, budget deficit and GDP cause 66.12 percent and 6.14 percent respectively of variance in inflation while NEER explains only the 2.19 percent at the end of ten periods. On the other hand, regarding variance decomposition of GDP budget deficit explains the 92.47 percent of variance at the end of the ten periods, while CPI causes only the 6.05 percent. Finally, the effect of CPI on the variance of exchange rates has been decreasing during the whole ten-year period starting from 20.93 percent with lag of one period to only 3.78 percent at the end of the ten periods.

This study has provided robust empirical evidence on the relations of important macroeconomic variables with special interest on the budget deficit links with other variables (i.e. GDP, CPI and NEER) for a developed EU and EMU member country, Greece. The results conform to established theory as enunciated by Mankiw (2002). These predictions could assist policy makers as well as quantitative analysts by giving useful information regarding the behavior and relationships of important macroeconomic variables. For this purpose, the VECM approach and variance decomposition method have been employed after the application of ADF test and Johansen cointegration test. However, it is important to highlight that results may be sensitive to the choice of sample period, selection of variables and methodology adopted. This also indicates the sensitivity of Granger causality and that is why results based on Granger causality should be interpreted with care. Finally, future research may examine the causal links between budget deficits and other macroeconomic variables for Greece by covering a switch from a strong bull to a severe bear market situation under the debt crisis of 2010.

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