Government spending and revenues in the Greek economy: Evidence from nonlinear cointegration

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Abstract

This paper attempts to re-evaluate the long-run macroeconomic relationship between government revenues and expenditures of the Greek economy over the period 1999 to 2010. The empirical analysis applies the newly developed asymmetric ARDL cointegration methodology of Shin, Yu and Greenwood-Nimmo (2011) which permits more flexibility in the dynamic adjustment process towards equilibrium, than in the classical case of a linear model. Our findings point towards the fiscal synchronization hypothesis, supporting evidence of asymmetric interactions between the two fiscal components in both the long- and the short-run time horizon. More particularly, in the long-run, the negative changes of expenditures dominate the response of revenues, while the opposite applies in the response of expenditures.

Keywords: Budget Deficit, Fiscal Policy, NARDL Cointegration, Greek Economy.

JEL Classification: C13, C22, E62.

1. Introduction

The establishment of the Economic and Monetary Union (EMU), and the Stability and Growth Pact (SGP), ever since the Maastricht Treaty (1992) in particular, along with the current international debt and deficit crisis, has stimulated a tremendous interest over fiscal performance within the EU. European rules demand that the overall budget must be balanced over the medium run; while the fiscal framework of the EMU aims to combine budgetary discipline with avoidance of excessive deficit positions (deficits and debt of 3 and 60 percent of GDP, respectively) and, the requirement of the SGP to achieve a budgetary position *close-to-balance* and, most preferably, *in-surplus*. This fiscal rule, then, focuses on balancing the budget; that is, balancing the difference between total revenues and expenditures, and securing fiscal discipline which allows the implementation of an effective monetary policy through the common currency. The identification of the revenue-expenditure pattern is fundamental to set the appropriate strategy for fiscal discipline[1] and is relevant to the existence and direction of the causal linkages between revenues and expenditures, considering that the background concern of fiscal discipline is directly related to possible, if not certain, spending and deficit bias in the fiscal policymaking.

With special reference to the Greek economy, and in particular, ever since 2003, that is two years after the Greek accession to the euro zone currency, a temporary budget surplus turned into a threatening budget deficit. Fiscal year 2003 ended with a 5,6% deficit; while the year of Olympics reached a threatening 7,4% level, whereas the fiscal year 2010 deficit was that as of 1995, at a 10,5%. Simultaneously, public debt as of 2003 reached 107,8% of GDP, advancing at 142,8% in 2010. The latter events perplexed the government revenue-expenditure nexus so much that the uncontrollable debt explosion by 2010 resulted in rescuing the economy from defaulting, through IMF and EU joined forces. Under these conditions, investigating the government revenue-expenditure complexities of the Greek economy stands more than obvious and more than necessary.

In this article we investigate the revenue-expenditure nexus accounting for possible asymmetric fluctuations of revenues over expenditures and *vice versa*. In the light of an asymmetric adjustment process, the empirical justification of the nexus could help more effectively towards fiscal discipline. To address the above research questions, we apply the

[1] Investigating the relationship between government revenues and expenditures also provides the framework to address the issue of budget sustainability. Most relevant studies either focus on testing the discounted public deficit or the debt for stationarity (Hamilton and Flavin, 1986; Holmes *et al.* 2010; and others), or on the detection of a long-run relationship between government revenues and spending, adopting the cointegration framework (Trehan and Walsh, 1988 and 1991; Haug, 1991; and others).

recently developed nonlinear ARDL cointegration methodology (NARDL), proposed by Shin, Yu and Greenwood-Nimmo (2011), which allows for asymmetry in both the long- and the short-run dynamics of the examined relationship.

The rest of the article is structured as follows: Section 2 discusses the revenue-expenditure nexus and the relevant literature for Greece. Section 3 describes the applied nonlinear ARDL cointegration methodology, while section 4 presents the empirical results. The last section provides a summary and conclusions.

2. The revenue-expenditure nexus in the context of the Greek economy

In the relevant revenue-expenditure literature[2], four alternative testable hypotheses set forth below, determine the causal linkages between budget revenues and expenditures; namely, tax-and-spend, spend-and-tax, fiscal synchronization and, institutional separation.

The tax-and-spend hypothesis, proposed by Friedman (1978), argues that increases in state taxes will lead to increases in expenditures such that budget deficit reduction becomes unlikely. This hypothesis is supported by the existence of unidirectional causality from revenues (i.e. taxes) to expenditures (i.e. spending). Consequently, imposition of higher taxes in order to restrict the size of the budget deficit would rather raise it instead (Friedman, 1978). The Buchanan and Wagner (1978) version of the tax-and-spend hypothesis argues that increasing tax revenues, reduces government expenditures via fiscal illusion; that is, the public perceives the use of indirect (rather than direct) taxation to finance government spending as being cheaper, even though they are paying for this spending through inflation, crowding out of the private sector and higher interest rates. This latter version of the tax-and-spend hypothesis is supported by a negative unidirectional causality from revenues to expenditures. Actually, whenever tax cuts are positively associated with significant increases in expenditures, a perverse effect appears where tax cuts are unaccompanied by spending cuts. In this respect, the fiscal illusion hypothesis, which is based on the public’s subjective perceptions of the cost of government spending, seems closer to asymmetric responses of revenue effects in expenditure equations. Bohn (1991), Mounts and Sowell (1997), Hatemi-J and Shukur (1999), Garcia and Henin (1999), Chang et al. (2002), Narayan and Narayan (2006), Payne et al. (2008) have provided evidence for the tax-and-spend hypothesis.

The spend-and-tax hypothesis states that spending decisions are made first and, the adjustment in tax revenues are following second. Peacock and Wiseman (1979) argue that

[2] For an international survey of the empirical literature regarding the revenue-expenditure nexus up to 2003, see Payne (2003).

during a crisis period, temporary increases in government spending will lead to permanent tax increases. Nevertheless, Barro (1979) asserts that, finally, expenditures are financed by higher future taxes and, the budget deficit reduction can only be achieved through spending cuts. Whatever the case, the spend-and-tax hypothesis leads to the existence of a positive unidirectional causality from government expenditures (i.e. spending) to revenues (i.e. taxes). Evidence in favor of the spend-and-tax hypothesis has been provided by Von Fusterberg et al. (1985 & 1986), Koren and Stiassny (1995), Ross and Payne (1998), Park (1998), Saunoris and Payne (2010).

According to the fiscal synchronization hypothesis, revenues and expenditures are adjusted simultaneously (Musgrave, 1966; Meltzer and Richard, 1981). This implies a bi-directional causality between revenues and expenditures. The studies of Miller and Russek (1990), Hasan and Sukar (1995), Li (2001) have provided evidence for the fiscal synchronization hypothesis. Finally, the institutional separation hypothesis (Wildavsky, 1988) states that decisions on revenues are independent from decisions on expenditures. In their study, Baghestani and McNown (1994) found no relation between revenues and expenditures, supporting this hypothesis.

Regarding our prime research interest, that is the case of the Greek economy, several studies have investigated the revenue-expenditure nexus. Most of them provide evidence for the spend-and-tax hypothesis (Joulfaian and Mookerjee, 1991; Provopoulos and Zambaras, 1991; Kollias and Makrydakis, 1995 & 2000; Hodroyiannis and Papapetrou, 1996; Vamvoukas, 1997; Afonso and Rault, 2009; Paleologou, 2013) while Katrakilidis (1997), and Kollias and Paleologou (2006) support the fiscal synchronization hypothesis.

More particularly, Joulfaian and Mookerjee (1991) using annual data from 1961 to 1986, and applying VAR analysis, support the spend-and-tax hypothesis for Austria, Finland, France, Japan, UK, USA, and among them, Greece. Provopoulos and Zambaras (1991) tested for Granger type causality and concluded in favor of the spend-and-tax hypothesis, supporting that the large deficits of the Greek public sector are mainly due to the fast growing government expenditures during the 1980's.

Kollias and Makridakis (1995), applied the Engle and Granger cointegration methodology (1987) along with error correction modeling, using Greek annual data from 1950-1990. Their results pointed also towards the spend-and-tax hypothesis. Hodroyiannis and Papapetrou (1996), employed the Johansen and Juselius (1990) cointegration methodology and Granger causality tests, over the period 1957 up to 1993. They showed that there is a long run relationship between Greek government spending and revenues, supporting the spend-and-tax hypothesis.

Vamvoukas (1997) used annual data series over the period 1948 up to 1992, and applied the Johansen and Juselius (1990) cointegration procedure and error correction modeling. His findings also supported the spend-and-tax hypothesis for Greece. Kollias and Makridakis (2000) employed the Engle and Granger cointegration methodology (1987) along with error correction modeling, over the period 1960-1995 and indicated that the fiscal synchronization is the case for Greece and Ireland; tax and spending decisions are taken simultaneously by their fiscal authority. They also provided evidence for the tax-and-spend hypothesis for Spain and for the institutional separation hypothesis for Portugal.

Afonso and Raul (2009), using bootstrap panel analysis, found spend-and-tax causality for Italy, France, Spain, Greece, and Portugal; while, tax-and-spend evidence was supported for Germany, Belgium, Austria, Finland and the UK. In a recent study, Paleologou (2013) adopted a nonlinear framework with structural breaks and asymmetries focusing on Germany, Greece and Sweden. Using data that cover the period 1965-2009, the evidence provided for Germany and Sweden, supported the fiscal synchronization hypothesis, while for Greece the spend-and-tax hypothesis is supported with asymmetric adjustment towards the long-run equilibrium.

On the other hand, the studies of Katrakilidis (1997), and Kollias and Paleologou (2006), supported the fiscal synchronisation hypothesis. Specifically, Katrakilidis (1997) applied the Johansen and Juselius (1990) cointegration technique and error correction modeling and concluded in favor of a two-way causal relationship between government spending and revenues, for the Greek economy, over the period 1974-1991. Kollias and Paleologou (2006) investigated the revenue-expenditure nexus, in the case of the 15 members of the EU, over the period from 1960 up to 2002. Using a VECM framework, they showed that the fiscal synchronisation hypothesis is supported for Denmark, Greece, Ireland, The Netherlands, Portugal and Sweden while, in the case of Austria, Belgium and Germany, the results point to the institutional separation hypothesis.

3. The nonlinear ARDL cointegration methodology

We employ the recently developed nonlinear ARDL cointegration methodology (NARDL), to allow for asymmetric effects both in the long- and the short-run. The technique was advanced by Shin et al. (2011) and is an asymmetric expansion of the linear ARDL model (Pesaran and Shin, 1999; Pesaran et al., 2001).

Following Schorderet (2003) and Shin *et al.* (2011), we consider the following nonlinear asymmetric cointegrating regression:

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t \tag{1}$$

where β^+ and β^- are the associated long-run parameters and x_t is a k×1 vector of regressors decomposed as:

$$x_t = x_0 + x_t^+ + x_t^- \tag{2}$$

where, x_t^+ and x_t^- are partial sum processes of positive and negative changes in x_t:

$$x_t^+ = \sum_{i=1}^{t} \Delta x_i^+ = \sum_{i=1}^{t} \max(\Delta x_i, 0) \tag{3}$$

and

$$x_t^- = \sum_{i=1}^{t} \Delta x_i^- = \sum_{i=1}^{t} \min(\Delta x_i, 0) \tag{4}$$

Shin *et al*. (2011) showed that by associating (1) with the linear ARDL(*p*,*q*) model (Pesaran and Shin, 1999; Pesaran *et al.*, 2001), we can obtain the NARDL(*p*,*q*) model[3]:

$$\Delta y_t = \alpha_0 + \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{i=1}^{p-1} \varphi_i \Delta y_{t-i} + \sum_{i=0}^{q} (\pi_i^+ \Delta x_{t-i}^+ + \pi_i^- \Delta x_{t-i}^-) + e_t \tag{5}$$

for $\iota = 1,...,q$ with $\theta^+ = -\rho\beta^+$ and $\theta^- = -\rho\beta^-$.

The first step of the empirical analysis is to estimate the NARDL(*p*,q) model (5) by standard OLS. Step two, tests for an asymmetric (nonlinear) cointegrating relationship between the levels of the variables y_t, x_t^+, x_t^-. In particular, the joint null hypothesis of no cointegration, $\rho = \theta^+ = \theta^- = 0$, is tested, by means of the bounds-testing procedure advanced by Pesaran *et al.* (2001) and Shin *et al.* (2011), based on a modified F-test (denoted by F_{PSS}). The relevant testing procedure uses two critical bounds; the upper and the lower. If the empirical value of the F_{PSS} statistic exceeds the upper bound, then there is evidence of a long-run equilibrium relationship; if it lies below the lower critical bound the null hypothesis cannot be rejected; and if it lies between the critical bounds the test is inconclusive. Finally, in step three, we test for long and short-run symmetry, using standard Wald tests. For long-run symmetry the relevant joint null hypothesis is $-\theta^+/\rho = -\theta^-/\rho$, while for short-run symmetry, the joint null hypothesis is $\sum_{i=0}^{q} \pi_i^+ = \sum_{i=0}^{q} \pi_i^-$.

[3] For an extensive derivation of the model see Shin et al. (2011)

4. Empirical Results

The data employed cover the period 1999Q1 to 2010Q3 and are collected from the IMF's database. The examined variables are the general government revenues (RE_t) and the general government expenditures (EX_t), both in logarithmic form ($lnRE_t$ and $lnEX_t$).

According to the ARDL cointegration method, it is not necessary to pretest the integration properties of the variables. However, the presence of I(2) variables turns the computed F-statistics invalid (Ouattara, 2004). In Table 1, the results from the Augmented Dickey-Fuller (1979) unit root test and the KPSS (Kwiatkowski et al., 1992) stationarity test suggest that $lnRE_t$ and $lnEX_t$ are non-stationary in levels while, they turn stationary in first differences.

[Table 1 about here]

We additionally apply the Zivot-Andrews (1992) unit root test that allows for one endogenous structural break in the series. The null hypothesis is that of a unit root against the alternative of a trend stationary process with one unknown break. The test is applied under three alternative model specifications, A, B and C. Model A allows for a change in the level of the series; Model B allows for a change in the slope of the trend of the series; Model C allows for changes in the level and slope of the trend of the series. The results, presented in Table 2, suggest that both examined variables turn to trend break stationary processes in first differences.

[Table 2 about here]

Confirming the order of integration of the variables involved, we test next, for nonlinear cointegration by estimating the following general form NARDL(p,q) models:

$$\Delta lnRE_t = \alpha_0 + \rho lnRE_{t-1} + \theta^{+} lnEX^{+}_{t-1} + \theta^{-} lnEX^{-}_{t-1} + \sum_{i=1}^{p-1} \varphi_i \Delta lnRE_{t-i} + \sum_{i=0}^{q} \pi_i^{+} \Delta lnEX^{+}_{t-i} + \sum_{i=0}^{q} \pi_i^{-} \Delta lnEX^{-}_{t-i} + e_t \quad (6)$$

$$\Delta lnEX_t = \alpha_0 + \rho lnEX_{t-1} + \theta^{+} lnRE^{+}_{t-1} + \theta^{-} lnRE^{-}_{t-1} + \sum_{i=1}^{p-1} \varphi_i \Delta lnEX_{t-i} + \sum_{i=0}^{q} \pi_i^{+} \Delta lnRE^{+}_{t-i} + \sum_{i=0}^{q} \pi_i^{-} \Delta lnRE^{-}_{t-i} + e_t \quad (7)$$

where, $lnRE^{+}$, $lnRE^{-}$, $lnEX^{+}$ and $lnEX^{-}$ are partial sums of positive and negative changes in $lnRE$ and $lnEX$, respectively. The selection of the optimal NARDL specifications, is based on the general-to-specific approach, and the final estimates, using OLS, are presented in Table 3.

Next, we proceed with the cointegration tests, and in particular, we test the joint null hypothesis of no cointegration $\rho = \theta^{+} = \theta^{-} = 0$, in both models (6) and (7). The results reveal statistically significant evidence in favor of the existence of a long-run cointegrating relationship between the examined variables (F_{PSS}, Table 3). Indeed, the computed values of the F_{PSS} statistics turned out to be 19.610 and 11.124, respectively. Since they both exceed the upper bound critical value[4] (5.764) we conclude in favor of cointegration.

[Table 3 about here]

We further proceed to test for symmetry and apply standard Wald tests in both the long- (W_{LR}) and the short-run (W_{SR}) time horizon. Regarding the long-run, the results suggest rejection of the null hypothesis of long-run symmetry between the positive and negative components of the examined variables, in both models. More specifically, for model (6) the Wald test (W_{LR}) is found 9.905 (p-value=0.002), while for model (7) it is found 221.480 (p-value=0.000). For the short-run, the results indicate that for models (6), the Wald test rejects the null hypothesis of additive short-run symmetry (W_{SR}=45.764, p-value=0.0000). Similarly, the results from model (7), also suggest the rejection of the null hypothesis (W_{SR}=16.002, p-value=0.000), implying asymmetry in the short-run from revenues towards expenditures.

Having established long-run asymmetry in both estimated models (6) and (7), we proceed to the analysis of the long-run asymmetric dynamics based on the results presented in Table 3. In model (6), we note that significance is confirmed for both positive (L^{+}_{EX}) and negative (L^{-}_{EX}) long-run coefficients of government expenditures, with the signs in line with the reported literature. In particular, the effect of the positive component of expenditures on revenues is significant, with a 1% increase of expenditures, resulting in a 3.9% rise in revenues. On the other hand, the effect of the negative component of expenditures on revenues is also significant though larger in magnitude, with a 1% decrease of expenditures resulting in a nearly 5.7% decrease in revenues. Simply put, in the long-run, negative changes of expenditures have a considerably larger impact on the revenues compared to the positive ones.

[4] Following Shin *et al*. (2011), we adopted a conservative approach to the choice of critical values and employed k=1.

Regarding the long-run effects of revenues on expenditures, the results also support the existence of asymmetric effects. More particularly, there is a statistically significant impact from the positive component of revenues on expenditures (L^{+}_{RE}), with a 1% increase of revenues yielding a rise of 0.68% on expenditures. The impact of the negative component (L^{-}_{RE}) on expenditures is comparatively smaller (0.27%) and also found statistically significant. Therefore, positive changes of revenues dominate the response of expenditures, compared to the negative ones.

5. Summary and conclusions

In this article, we adopted the newly developed nonlinear ARDL cointegration methodology (NARDL), to investigate the response of Greek government spending to Greek government revenues' changes and *vice versa*, during the period 1999Q1 to 2010Q3. In doing so, we estimated a macroeconomic model for government expenditures under an asymmetric ARDL structure, involving the positive and negative partial sum decompositions of the government revenues. The opposite macro-econometric structure for government revenues was similarly considered.

Our findings support clearly asymmetric fiscal adjustments; that is Greek government revenues (expenditures) react differently to increases and decreases of expenditures (revenues) in the long-run. More particularly, in the long-run, the negative changes of expenditures have a larger impact on the revenues compared to the positive ones. On the other hand, revenue increases in the long run, affecting government expenditures greater than reductions.

Overall, then, our results support the fiscal synchronization hypothesis for the Greek economy. The policy implications derived from our findings suggest that budget deficit's reduction could be achieved through government expenditures reduction, accompanied by contemporaneous and new tax controls. Fiscal discipline, in effect, requires greater economic policy coordination. This necessity, among others, involves foremost tax reforms and decreases in government expenditures, along with all appropriate corrections of the institutional weaknesses that cause instability to the fiscal path mainly. The current profile of the Greek economy reveals that over the last decade, Greek fiscal policy performed rather unproductively, promoting uncontrolled public spending that became allover hazardous for the entire economy.

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Table 1. ADF unit root and KPSS stationarity tests

	ADF				KPSS	
Variable	C	k	C/T	k	C	C/T
$lnRE_t$	-0.615	7	-2.588	4	0.855***	0.106
$lnEX_t$	-1.849	3	-3.199	4	0.874***	0.489***
$\Delta lnRE_t$	-5.090***	6	-4.829***	6	0.322	0.177**
$\Delta lnEX_t$	-3.936***	4	-4.040**	4	0.3431	0.1445

Notes: ADF and KPSS denote the Augmented Dickey-Fuller unit root test and the Kwiatkowski-Phillips-Schmidt-Shin stationarity test, respectively. Δ denotes first-differences. k denotes the optimal lag structure of the ADF test which is chosen based on the Akaike Information Criterion. The respective 1% then 5% and 10% critical values for the ADF test are −3.58, −2.93, −2.60 and −4.15, −3.50, −3.18 for models C and C/T respectively. The respective 1% then 5% and 10% critical values for the KPSS test are 0.739, 0.463, 0.347 and 0.216, 0.146, 0.119 for models C and C/T respectively. *** and ** denote significance at the 1 and 5% levels, respectively.

Table 2. Zivot-Andrews unit root test with one structural break

	Model A		Model B		Model C	
Variable	ZA	T_b	ZA	T_b	ZA	T_b
$lnRE_t$	-4.325	2009:01	-3.940	2008:03	-4.556	2007:02
$lnEX_t$	-3.972	2007:02	-3.261	2003:03	-3.840	2008:01
$\Delta lnRE_t$	-7.284***	2009:01	-5.526***	2007:03	-7.035***	2009:01
$\Delta lnEX_t$	-12.644***	2006:01	-12.409***	2009:01	-12.537***	2006:01

Notes: ZA is the Zivot and Andrews (1992) test statistic. Δ denotes first differences. T_b denotes the time of break. Model A allows for a change in the level of the series; Model B allows for a change in the slope of the trend of the series; Model C allows for changes in both the level and slope of the trend of the series; The critical values were obtained from Zivot and Andrews (1992). *** denotes statistical significance at the 1% level.

Table 3. Dynamic asymmetric estimation of the revenue-expenditure nexus

Dependent Variable: $\Delta lnRE_t$			Dependent Variable: $\Delta lnEX_t$		
Variable	Coefficient	Standard Error	Variable	Coefficient	Standard Error
Constant	3.778***	1.044	*Constant*	18.042***	3.285
$lnRE_{t-1}$	-0.432***	0.107	$lnEX_{t-1}$	-1.890***	0.347
$lnEX^{+}_{t-1}$	1.728***	0.298	$lnRE^{+}_{t-1}$	1.289**	0.258
$lnEX^{-}_{t-1}$	2.480***	0.435	$lnRE^{-}_{t-1}$	0.527***	0.237
$\Delta lnRE_{t-3}$	-0.662***	0.175	$\Delta lnEX_{t-1}$	0.920***	0.251
$\Delta lnRE_{t-4}$	-0.725**	0.257	$\Delta lnEX_{t-2}$	0.471**	0.207
$\Delta lnRE_{t-5}$	-0.815***	0.225	$\Delta lnRE^{+}_{t-1}$	-2.694***	0.402
$\Delta lnRE_{t-6}$	-0.833***	0.162	$\Delta lnRE^{+}_{t-2}$	-1.017***	0.381
$\Delta lnRE_{t-7}$	-0.941***	0.122	$\Delta lnRE^{-}_{t-8}$	-1.279***	0.439
$\Delta lnEX^{+}_{t-1}$	-0.812***	0.265	$\Delta lnRE^{-}_{t-3}$	-0.852**	0.354
$\Delta lnEX^{+}_{t-2}$	-0.600**	0.210	$\Delta lnRE^{-}_{t-6}$	1.118**	0.409
$\Delta lnEX^{+}_{t-3}$	0.562***	0.162			
$\Delta lnEX^{+}_{t-4}$	0.621***	0.175			
$\Delta lnEX^{+}_{t-5}$	1.218***	0.212			
$\Delta lnEX^{+}_{t-6}$	0.490***	0.169			
$\Delta lnEX^{-}_{t}$	0.956***	0.162			
$\Delta lnEX^{-}_{t-1}$	-1.467***	0.305			
$\Delta lnEX^{-}_{t-2}$	-0.659***	0.194			
$\Delta lnEX^{-}_{t-3}$	-0.680***	0.152			
$\Delta lnEX^{-}_{t-5}$	-0.651***	0.164			
$\Delta lnEX^{-}_{t-6}$	-0.905***	0.164			
$\Delta lnEX^{-}_{t-7}$	-0.390***	0.131			
F_{PSS}	19.610		F_{PSS}	11.124	
L^{+}_{EX}	3.994***		L^{+}_{RE}	0.682***	
L^{-}_{EX}	5.731***		L^{-}_{RE}	0.279**	
W_{LR}	9.905 [0.002]		W_{LR}	221.480 [0.000]	
W_{SR}	45.764 [0.000]		W_{SR}	16.002 [0.000]	
R^2	0.987		R^2	0.907	
$\overline{R}^2$	0.970		$\overline{R}^2$	0.873	
X^2_{SC}	6.770 [0.149]		X^2_{SC}	2.465 [0.651]	
X^2_{FF}	0.038 [0.844]		X^2_{FF}	1.449 [0.229]	
X^2_{NORM}	0.480 [0.783]		X^2_{NORM}	0.623 [0.732]	
X^2_{HET}	0.455 [0.500]		X^2_{HET}	0.327 [0.567]	

Notes: The superscripts " + " and " – " denote positive and negative partial sums, respectively. F_{PSS} denotes the F-statistic testing the null hypothesis: $\rho = \theta^{+} = \theta^{-} = 0$. For k=1 and at the 5% level of significance, the pair of critical values (bounds) for the F_{PSS} are 4.934-5.764 and have been obtained from Pesaran and Pesaran (2009). L^{+} and L^{-} are the estimated long-run coefficients defined by $\hat{\beta}^{+} = -\hat{\theta}^{+} / \hat{\rho}$ and $\hat{\beta}^{-} = -\hat{\theta}^{-} / \hat{\rho}$, respectively. X^2_{SC} , X^2_{FF} , X^2_{NORM} and X^2_{HET} denote LM tests for serial correlation, functional form, normality and heteroscedasticity, respectively. W_{LR} refers to the Wald test of long-run symmetry defined by: $-\hat{\theta}^{+} / \hat{\rho} = -\hat{\theta}^{-} / \hat{\rho}$. W_{SR} refers to the Wald test of the additive short-run symmetry condition defined by: $\sum_{i=0}^{q} \pi_i^{+} = \sum_{i=0}^{q} \pi_i^{-}$. *** and ** denote significance at the 1 and 5%, levels, respectively.