

The Causal Relationship between Government Expenditure and Tax Revenue in Barbados

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ABSTRACT

Solving the budget deficit problem is a concern for many countries; some economists emphasized tax increases or tax cuts, while others favour spending cuts. This paper investigates the interrelationship between total government expenditure and total tax revenue in Barbados using a multivariate cointegrating model. The technique of Granger Causality is also applied to determine the causal relationship. In the long run bidirectional causality existed for both high and low frequency data, while in the short run there was no interdependence among the variables using annual data. In Addition, results using quarterly data suggested that revenue unidirectional Granger-cause changes in government expenditure.

INTRODUCTION

Escalating fiscal deficits are known to have adverse effects on an economy, varying from high real interest rates, a decline in private sector investment and an increase in the rate of inflation. Sargent and Wallace (1981) argued that the real driving force behind inflation is not the growth of the money supply but the level of government debt. Government incurs debt when its expenditure exceeds its revenue collections, the budget deficit. Theory postulates that the financing of deficits through the issuance of bonds/securities will also add to or worsen the debt levels of a country.

Given the severe impact deficits have on the development of a country, research literature has focused on solving the problem of when a country spends more than it earns. There is the widely held view that a reduction in government expenditure is the optimal solution to solving the fiscal deficit rather than an increase in taxes. These advocates believe that the more a government receives in taxes the more that government will spend, which in turn could lead to a situation where the deficit is unchanged or have deteriorated. This line of thought is known as the tax-and-spend hypothesis. Others argue against this, and postulated that tax increases will not lead to an expansion in spending; rather they perceived it as a useful approach for reducing the deficit together with a contraction in government expenditure. The casual relationship between government expenditure and government revenues has also been explained by the spend-and-tax hypothesis or fiscal synchronization. Spend-and-tax occurs when government spending is undertaken before revenue is determined, while fiscal synchronization is attained when government revenue and government expenditure is determined at the same time.

The government sector of Barbados has been growing steadily during the period of analysis 1980-2008, as measured by the ratio of total government expenditure to Gross Domestic Product. In 1980 the government sector expanded from around 27.3% to roughly 39.4% of the economy at the end of 2008. Figure 1 illustrates the growing imbalance between expenditures and revenues in Barbados, which has become a cause of concern. The ratio of expenditure to GDP consistently exceeded the ratio of tax revenue to GDP during the 1980-2008 periods, except in 1994. The positive gap between expenditures and revenue is representative of the required financing for the deficit. This expansion of financing from year to year has eventually translated

into higher debt levels for Barbados. The ratio of total debt to GDP grew from 28.5% at the beginning of 1980 to 87.9% at the end of 2008.

Figure 1

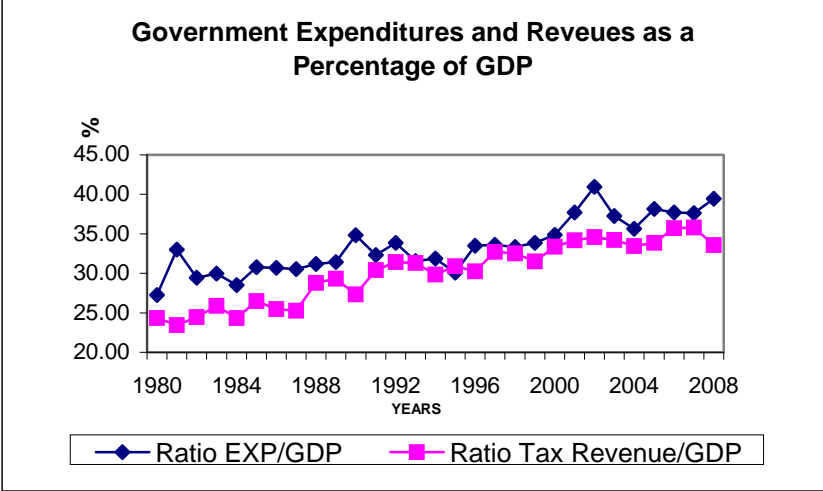


Figure 1 also depicts that the disparity between expenditures and receipts were substantial during the early 1980's, however this gap was narrowed from 1991, as Barbados underwent structural adjustment policies. This relatively balanced association between revenues and expenditures continued until 1999. However, expenditure growth returned to its upward trend from the year 2000 and reached its peak in 2002 when the ratio of expenditure to GDP was approximately 40.9%, while the ratio of revenue to GDP was 34.5%. In the following years, expenditure as a ratio of GDP continued to outpace the ratio of revenue to GDP. Little attempt was made to raise taxes in lieu of the expanding fiscal deficit of government.

Given the growing disparity between revenue and expenditure the paper seeks to examine the linkage between these variables as it becomes crucial in finding the optimal solution to controlling the fiscal imbalance of the Government. The size of a fiscal deficit of an economy also plays an important role in determining the level of financial assistance, if any, a country is likely to receive from major financial institutions in times of distress or economic hardships hence maintaining a prudent fiscal deficit is essential. Furthermore, the paper is a later edition of Craigwell, Hyginus and Mascoll (1994) who used quarterly data from 1973 to 1989. Our

study differs as it analyses both annual and quarterly data from 1980 to 2008 to determine if the linkage previously found is applicable today and whether the results are sensitive to the frequency of the data.

Literature Review

There are varying views on the government taxation and spending nexus. Among these are the views of Wildavsky (1988); stated that in the USA spending and taxation are independent in that when Government makes a decision to undertake capital spending no regard is given to taxation. Similarly, Hoover and Sheffrin (1992) empirical analysis of the tax and spend nexus concluded that in the U.S. government's decision to tax are independent from its decision to spend. This view of independence between taxes and spending is contrary to the views of many researchers whom have found an interdependent relationship between the two variables. One such study was that conducted by Friedman (1982) noted that tax hikes lead to increase government spending; hence the deficit remains unchanged or grows larger. Consequently, Friedman proposed tax cuts as a means of controlling the fiscal deficits in the sense that in light of cutting taxes, the government deficit would be larger, hence placing undue pressure on the Government to reduce the fiscal deficit. Friedman found a positive causal relationship between spending and taxation. Buchanan and Wagner (1977, 1978) also found that taxes cause spending. However, the direction of the relationship was negative. Instead like Friedman who propose tax cuts, Buchan and Wager propose tax increases, in that persons would perceive that the cost of government programs have become more expensive, thus resulting in a reduction in spending, hence their concluded that a tax increase along with reduced spending can curtail the deficit.

In contrast Barro (1979) noted that taxes follow spending. He argued that short-lived increases in government expenditure (arising from natural crises) become long lasting and result in tax increases to finance the excessive spending. Hence Barro suggested that in order for government to control budget deficits it must cut spending. The final view on the tax and spend nexus was pioneered by Musgrave (1966) and Meltzer and Richard (1981) and suggested that both taxation and spending is determined simultaneously. The studies in this area are contradictory as they found several different rationales for the tax and spend nexus.

Below are empirical findings of the tax-and-spend and spend-and-tax debate as follows:

Moalusi (2004) examined the casual relationship between government expenditure and government revenue in Botswana. The author then determined whether the fiscal policies in Botswana during the period 1976 to 2000 are determined by tax-and-spend, spend-and-tax or fiscal synchronization. The study was conducted utilizing both a bivariate and multivariate Granger casualty model. The author concluded that in Botswana there is a unidirectional relationship between government expenditure and government revenue running from revenue to spending, which in turn supports the tax-and-spend hypothesis. However, the relationship between expenditure and revenue was found to be negative.

In a similar paper Darrat (1998) investigated the interrelationship between government spending and revenues in Turkey using both bivariate and multivariate co-integrating models. The author found a stable long run relationship between the two variables, where taxes unidirectionally Granger-cause negative changes in spending. As a result, it was noted that an increase in taxes in Turkey is the best way to manage budget deficits.

Mithani and Khoon (1999) incorporated the effect of seasonality while examining the causal relationship between quarterly government expenditure and government revenue in Malaysia during the period 1970 to 1994. The authors found a unidirectional casual influence from government expenditure to tax revenue in the short run. Furthermore they noted that spending decisions within Malaysia not only influence the tax burden of individuals but the size and growth of the fiscal deficit.

In examining the linkage between taxes and expenditures for the 1961-1990 period in the G7 countries Owoye (1995) used both cointegration and error-correction models. The study found bidirectional causality exists between government taxes and expenditures in all the G7 countries, with the exception of Japan and Italy. In Japan and Italy causality ran from government taxes to expenditures.

Another study, conducted by Konukcu and Tosun (2007) employed Granger causality to analyse the relationship between expenditures and receipts in Belarus, Kazakhstan, the Kyrgyz Republic

and the Russian Federation. The authors found that the tax-and-spend hypothesis existed in Belarus and the Russian Federation, while evidenced, showed that Kazakhstan and the Kyrgyz Republic were supportive of fiscal synchronization.

Manage N. and Marlow M. (2001) investigated the interdependence between government expenditures and tax receipts in the USA during the period 1929-1930 by using the Granger causality test. The authors tested the association between revenues and expenditures by using three alternative measures of the dependent and independent variables. The first regression was estimated using real variables; the second nominal variables and the third regression also used nominal variables, however net interest payments were deducted from total expenditures. Given the alternative specifications the authors found varying results of the nexus between revenues and expenditures. The majority of the findings indicated bidirectional causality between receipts and expenditures, while the remainder exhibited a unidirectional causal link which runs from budget receipts to budget expenditures. The authors noted that their results do not favor tax increases over expenditure reductions as a means of closing future deficit levels of the Federal government.

In the Caribbean region work undertaken by Craigwell, Mascoll and Leon (1989) examined government revenue and expenditure causality in Barbados during the period 1973 to 1989. The authors found causality occurred from government expenditure to revenue.

Stylized facts: fiscal trends in Barbados

Within the period of analysis, the years 1984-1990 were considered one of extreme to moderate fiscal disequilibrium. During this period the average annual deficit to GDP was approximately 5.1%. In the following years Barbados instituted a major programme of macroeconomic stabilisation and adjustment where the Government of Barbados sought financial assistance from the IMF. In this regard, Government adopted contractionary fiscal policies to sterilise a rising current account deficit and the fall-off in the net international reserves (NIR). These contractionary measures involved an 8% cut in public sector wages, an 11% reduction in the labour force of the Government as well as a wage freeze in 1992. Additionally, a stabilisation tax on incomes was imposed along with a consumption tax and a tax on luxury imports. This adoption of contractionary fiscal policy was the most memorable in the history of Barbados.

The post adjustment period of 1992 to 2001 registered relatively low fiscal disequilibrium. The year 2002 and onwards was characterized by relatively weak fiscal effort as the deficit averaged 3.7% of GDP. Throughout the years there were several reforms undertaken in Barbados, which served to shift the bulk of revenue being collected from direct taxation to indirect taxes as well as to lessen the tax burden of individuals as well. Tax reform was also one of the major drivers used to facilitate economic growth and increase employment opportunities. The tax reforms included changes to the basic and marginal tax rates, an increase in the income tax threshold as well as other initiatives, which shifted the bulk of revenue being collected from direct taxation to indirect taxes. Consequently, in 1997 the value-added tax (VAT) was introduced, it replaced approximately 11 taxes and at the time was deemed to be simple to administer, neutral and an efficient means of collecting revenue. These reforms also acted as a means of reducing the tax burden of residents, businesses and providing incentives to foreign companies wishing to set up business in Barbados.

Several concessions were also made available to the productive sectors of the economy in attempt to make them more viable. With these many concessions and reductions in tax rates the growth of government revenue heavily depended upon the VAT. With VAT being the primary earner of government revenue, it was still not sufficient to curtail the problem of rising budget deficits.

Data and Methodology

Data

This study utilizes annual and quarterly data on government spending, government revenue, and Gross Domestic Product (GDP). Government expenditure consists of both current and capital expenditure less interest payments, while government revenue is a measure of both direct and indirect taxes and gross domestic product is a measure of economic output. The data for Barbados (1980-2008) is obtained from the Central Bank of Barbados Economic and Financial Statistics as well as the Annual Statistical Digest. All variables are expressed in real terms (the GDP deflator was used) and in natural logarithms. Throughout this study, T denotes the natural logarithm of government revenue, G denotes the natural logarithm of government spending and Y represents the natural logarithm of gross domestic product.

Methodology

The methodology to be used in this study is Granger's (1969, 1980) notion of causality based on a temporal ordering and incremental predictability criteria. This study focuses on Granger causality between government spending (G) and taxes (T) in Barbados; therefore we limit our analysis to only these two variables. A stationary time series (K) is said to Granger-cause another stationary time series (R) if the prediction error from regressing K on T decreases by using past values of K in addition to using past values of T .

In order to perform the causality tests it is necessary to determine the stochastic properties of each time series. For the annual data, tests for unit roots were implemented using three standard tests - the Augmented Dickey-Fuller (ADF) test by Dickey and Fuller (1979, 1981), the Philips Perron (PP) (1988) and the KPSS test by Kwiatkowski et al (1992). Both the ADF and the PP test, assumes the series are non-stationary, hence failure to reject the null hypothesis implied the time series has a unit root. In contrast, the KPSS test postulates that the series is (trend) stationary under the null against the alternative of non-stationary of the series. However, the Hegy test was adopted to analyze the integrated order of the quarterly series.

The methodology proposed by Hylleberg and associates – commonly known as Hegy, was adopted analyze the integrated properties of the data, particularly to account for the seasonal elements that may exist in the data. The number of seasonal unit roots in a univariate time series can be determined by estimating the auxiliary regression (equation 1) proposed by Hegy.¹

$$\Delta_4 y_t = \mu_t + \pi_1 y_{1,t-1} + \pi_2 y_{2,t-1} + \pi_3 y_{3,t-2} + \pi_4 y_{3,t-1} + \sum_{j=1}^k c_j \Delta_4 y_{t-j} + \varepsilon_t \quad (1)$$

where, $\mu_t = \mu_1 D_{1,t} + \mu_2 D_{2,t} + \mu_3 D_{3,t} + \mu_4 D_{4,t} + \mu_5 t$

$$y_{1,t} = (1 + B + B^2 + B^3) y_t$$

$$y_{2,t} = -(1 - B + B^2 - B^3) y_t$$

$$y_{3,t} = -(1 - B^2) y_t$$

and where t in the μ_t component refers to a deterministic trend. The regression equation 1 can be estimated using OLS. This auxiliary regression originates from the fact that $\Delta_4 = (1 - B^4)$ can be decomposed as $(1 - B^4) = (1 - B) \times (1 + B)(1 - iB)(1 + iB)$, where $(1 - B)$ corresponds to the nonseasonal unit root, $(1 + B)$ corresponds to the seasonal unit root at the biannual frequency and $(1 - iB)$ and $(1 + iB)$ corresponds to the seasonal unit root at the annual frequency (Franses et al, 1998). The null hypothesis for the Hegy test assumes that each π_i is zero, which implies the existence of stochastic seasonality. In particular, π_1 and π_2 corresponds to the zero frequency and biannual frequency respectively, while the F-test of the null hypothesis that $\pi_3 = \pi_4 = 0$ is used to determine whether a unit root at the annual frequency exist. Rejection of the F-test implies that no seasonal unit root exist at the annual frequency.

If each variable is integrated of order (0), $G_t \sim I(0)$, $T_t \sim I(0)$ and $Y_t \sim I(0)$, then the appropriate model is vector autoregressive in levels (VAR-L) as given by [system 1]

$$\begin{aligned} G_t &= a_1 + \sum_{i=1} \beta_{1i} G_{t-i} + \sum_{i=1} \lambda_{1i} T_{t-i} + \sum_{i=1} \phi_{1i} Y_{t-i} + \varepsilon_{1t} \\ T_t &= b_1 + \sum_{j=1} \alpha_{1j} T_{t-j} + \sum_{j=1} \kappa_{1j} G_{t-j} + \sum_{j=1} \rho_{1j} Y_{t-j} + \mu_{1t} \end{aligned} \quad [\text{System 1}]$$

If each variable is integrated of order (1), $G_t \sim I(1)$, $T_t \sim I(1)$ and $Y_t \sim I(1)$, and the variables are not cointegrated then the appropriate model is vector autoregressive in first differences levels (VAR-D) as given by [system 2]

¹ See Mills and Mills (2009), da Silva Lopes and Montanes (2005), Kunst (1993), Mithani and Khoon (1999) and Franses and Vogelsang (1998) for details on the Hegy test.

$$\begin{aligned}\Delta G_t &= a_2 + \sum_{i=1} \beta_{2i} \Delta G_{t-i} + \sum_{i=1} \lambda_{2i} \Delta T_{t-i} + \sum_{i=1} \phi_{2i} \Delta Y_{t-i} + \varepsilon_{2t} \\ \Delta T_t &= b_2 + \sum_{j=1} \alpha_{2j} \Delta T_{t-j} + \sum_{j=1} \kappa_{2j} \Delta G_{t-j} + \sum_{j=1} \rho_{2j} \Delta Y_{t-j} + \mu_{2t} \quad [\text{system 2}]\end{aligned}$$

In the case each variable is integrated of order (1), $LG_t \sim I(1)$ and $LT_t \sim I(1)$, and the variables are cointegrated then the appropriate model is vector error correction model (VECM) as given by [system 3], where the (ECM) is the error correction mechanism derived from the residuals of the appropriate long-run relationship among the variables.

$$\begin{aligned}\Delta G_t &= a_3 + \sum_{i=1} \beta_{3i} \Delta G_{t-i} + \sum_{i=1} \lambda_{3i} \Delta T_{t-i} + \sum_{i=1} \phi_{3i} \Delta Y_{t-i} + \xi_i (ECM)_{t-1} + \varepsilon_{3t} \\ \Delta T_t &= b_3 + \sum_{j=1} \alpha_{3j} \Delta T_{t-j} + \sum_{j=1} \kappa_{3j} \Delta G_{t-j} + \sum_{j=1} \rho_{3j} \Delta Y_{t-j} + \eta_j (ECM)_{t-1} + \mu_{3t} \quad [\text{system 3}]\end{aligned}$$

To examine the cointegrating properties of the variables before testing for Granger casualty we utilize the maximum likelihood method developed by Johansen (1988). This approach is suited to detect stationary linear combinations or a long-run relationship (i.e. cointegration relationships) between $I(1)$ variables.

If the variables are found to be stationary in the long run hence they possess a long-run equilibrium relationship. However, if the variables are expressed as first-differences as the stationarity requirement dictates then the long-run relationship would not be captured. Based on the findings of the unit root test, we utilize equation 3, the vector error correction model, as noted by the Granger's (1986) Representation Theorem to investigate the causal relation among the variables. In this regard the appropriate lag length of the model was determined to acquire the necessary Gaussian error terms. In general the model that minimizes the Akaike Information Criteria (AIC) and the Schwartz Information Criterion (SIC) is selected as the one with the optimal lag length.

EMPIRICAL RESULTS

Table 1 – Unit Root Tests – Annual Data

Variables	ADF		PP		KPSS	
	Level	1 st Difference	Level	1 st Difference	Level	1 st Difference
G	-1.9743	-6.7618***	-3.2340	-6.4263***	0.6933++	0.1161
T	-2.4146	-5.9049***	-2.3768	-5.8703***	0.6898++	0.1095
Y	-2.7051	-3.4538**	-2.4505	-3.4765**	0.5508++	0.1156

Notes: *, **, *** are the MacKinnon critical values for the rejection of the null hypothesis of a unit root at the 10%, 5% and 1% levels respectively, for both the ADF and PP tests, while +, ++, +++ are the critical values for the LM statistic of the KPSS test and denote rejection of the null hypothesis of stationarity at the 10%, 5% and 1%, respectively (based upon the asymptotic results presented in KPSS(1992) -Table 1, pp.166.

Unit Root Test Results and Cointegration – Annual Data

Table 1 shows the degree of integration for each of the three variables. We conclude that each of the variables contain a unit root at the 5% level of significance and becomes stationary when expressed in first differences of natural logarithms. This therefore implies that all variable are integrated of other one, I (1).

The Johansen test was then conducted to determine whether at least one cointegrating relationship existed between the variables. Table 2 reports the results from the Johansen test, and shows that both the maximum eigenvalue and the trace tests rejected the null hypothesis of no cointegrating relationship at the 5% level. By each statistic, one cointegrating relationship was found.

Table 2 – Johansen Test – Annual Data

Variables	Max Eigen Statistic	5% Critical Value	Trace Statistic	5% Critical Value
G, T and Y				
H ₀ : r=0	37.43**	25.82	59.16**	42.92
H ₀ : r ≤ 1	11.4	19.39	21.74	25.87
H ₀ : r ≤ 2	10.34	12.52	10.34	12.52

Notes: ** Denotes rejection of H₀ at 5% level of significance.

Unit Root Test Results and Cointegration – Quarterly Data

Table 3 – Hegy Test

Variable		π_1	π_2	F 34
G	I, SD, TR	-1.74	-3.73***	17.96***
	I, SD	1.11	-3.63***	19.92***
	I, TR	-1.98	-1.69*	2.51*
	I	1.07	-1.60	2.73*
	-	1.72	-1.64	2.74*
T	I, SD, TR	-2.60	-3.60***	10.97***
	I, SD	0.53	-3.47***	11.75***
	I, TR	-2.82	-3.53***	0.98
	I	0.41	-3.38***	0.97
	-	2.45**	-3.40***	0.98
Y	I, SD, TR	-2.68	-2.88**	6.52**
	I, SD	-0.51	-2.80*	6.95
	I, TR	-2.76	-1.70*	1.91
	I	-0.60	-1.66*	2.08
	-	1.24	-1.66*	2.15

Notes: I, SD and TR represent the intercept, the seasonal dummies and the trend component respectively, while the ‘-’ indicate the absence of all deterministic components. * denotes significance at 10% level, ** denotes significance at the 5% level and *** denotes significance at the 1% level (Mithani and Khoon, 1999).

The Hegy test (Table 3) shows that when all deterministic components (intercept, trend, seasonal dummies) are included in the regression, each of the series, G, T and Y, only contains a non-seasonal unit root. Further, the results appear to be sensitive to the removal of the deterministic components, which therefore suggest that the seasonality in these variables is not stochastic. In particular, when the seasonal dummies are removed from the regression, a unit root becomes present at the annual frequency for all the variables at the 5% level of significance, while G and Y also obtain unit roots at the biannual frequency.

Normally, the standard cointegration tests are inappropriate when seasonal unit roots exist. However, since the Hegy test showed only a non-seasonal unit root existed for each of the variables, the study applies the Johansen methodology to determine whether the variables are cointegrated. Table 4 provides the results of the cointegration test. The Likelihood Ratio (LR)

test statistic indicates the existence of two cointegrating relationships at the 1% level of significance.

Table 4 – Johansen Test – Quarterly Data

H ₀	LR	P Value	90%	95%	99%
	84.56**				
0	*	0.0000	39.73	42.77	48.7
	39.28**				
1	*	0.0004	23.32	25.73	30.67
2	6.55	0.4043	10.68	12.45	16.22

Notes: *** Denotes rejection of H₀ at 1% level of significance. This estimation included: intercept, trend and seasonal dummies.

Granger Causality Test Results

System 3, as outlined in the methodology, was adopted to investigate the Granger causality among the variables of interest for both the annual and quarterly data. Table 5 reports the F-statistic and the t-statistic on the lagged ECM term only for the variables of interest. The F-statistic indicates the significance of the Wald Test on the short run coefficients, while the significance of the ECM term denotes the long-run relationship.

Table 5 – Granger Causality Test

Null Hypothesis	F-Statistic	T-Statistic on ECM _{t-1}
Annual		
T does not Granger cause G	0.969	-3.185*
G does not Granger cause T	0.052	-3.381*
Quarterly		
T does not Granger cause G	3.361*	-2.323*
G does not Granger cause T	0.834	-2.379*

Notes: * Denotes rejection of H₀ at 5% level

The results show that there is bidirectional causality between government expenditure and tax revenue for both annual and quarterly data over the long term, as shown by the ECM terms. However, for annual data the F-statistic (short run) could not be rejected for both cases, that is taxes does not Granger cause expenditure and government outlays does not Granger cause taxes. This suggests that in the short run there is an absence of coordination between revenue and

expenditure decisions. The results for the quarterly data, suggest that in the short-run unidirectional causality runs from taxes to government expenditures indicative of the tax-and-spend hypothesis. Our results in the short-run appear to be sensitive to the frequency of the data. However, according to the theoretical propositions our findings allow us to highlight that an increase in tax revenue will most likely translate into more spending by Government, which in turn can result in a larger budget deficit. Of particular note, the results for Barbados are also supportive of the findings of Craigwell, Mascoll and Leon (1989).

CONCLUSION

This paper investigates the causal relationship between government spending and taxes for Barbados. The empirical analysis incorporates the cointegrating properties of the variables using a multivariate model, which includes real GDP. Both annual and quarterly data were used in the study to determine the sensitive of the results to the frequency of the data. The Hegy test was also used to model the seasonality component of the data. In this regard, the model supported the existence of two long-run equilibrium relationships among the three variables. Furthermore, the results allow us to conclude that raising taxes in an effort to control rising budget deficits might not prove to be the optimal solution to the budget deficit phenomena.

Finally this paper clarifies the policy implications of recent deficit reducing packages that emphasize tax increases over spending reductions. Thus any policy decisions to reduce budget deficits via revenues may not result in deficit reduction. On the other hand, government should try to raise taxes and cut spending simultaneously in an effort to control budget deficits as evidenced by the long run results.

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