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Abstract

The relationship between government revenue and government expenditure is important, given its relevance for policy especially with respect to the budget deficit. The purpose of this paper is to investigate the relationship between government revenue and government expenditure in Namibia. It investigates the causal relationship between government revenue and government expenditure using Granger causality test through cointegrated vector autoregression (VAR) methods for the period the period 1977 to 2007. The paper tests whether government revenue causes government expenditure or whether the causality runs from government expenditure to government revenue, and if there is bi-directional causality. The results show that there is unidirectional causality from government revenue to government expenditure. This suggests unsustainable fiscal imbalances (deficit) can be mitigated by policies that stimulate government revenue.

Keywords: government expenditure, government revenue, causality, cointegration, test, revenue-spend, spend-revenue, fiscal synchronisation, Namibia

JEL: H0, H2, H5, C22, C32, C5, C50

1. Introduction

A sound fiscal policy is important to promote price stability and sustain growth in output and employment. Fiscal policy is regarded as an instrument that can be used to lessen short-run fluctuations in output and employment in many debates of macroeconomic policy. It can also be used to bring the economy to its potential level. If policymakers understand the relationship between government expenditure and government revenue, continuous government deficits can be prevented. Hence the relationship between government expenditure and government revenue has attracted significant interest. This is due to the fact that the relationship between government revenue and expenditure has an impact on the budget deficit. The causal relationship between government revenue and expenditure has remained an empirically debatable issue in the field of public finance. The question of which variable takes precedence over the other has been a central issue to this debate.

On the theoretical front, several hypotheses have resulted from the causal relationship between government revenue and government expenditure (Li, 2001; Fasano and Wang, 2002; Narayan and Narayan, 2006; Gounder *et al.* 2007). The first hypothesis is the revenue-spend hypothesis where raising revenue leads to more expenditure. The causality runs from government revenue to government expenditure. The second hypothesis is spend- revenue which states that changes in government expenditure cause changes in government revenue. This hypothesis was advocated by Peacock and Wiseman (1979). The third hypothesis is fiscal synchronisation which states that government revenue decisions are not made in isolation from government expenditure decisions. The decisions are made concurrently. The causality runs from both directions (bi-directional causality).

Narayan and Narayan (2006) gave three reasons why the nature of the relationship between government expenditure and government revenue is important. The first one states that if the revenue-spend hypothesis holds, budget deficits can be avoided by implementing policies that stimulate government revenue. The second reason states that if the bi-directional causality does not hold, it suggests that government revenue decisions are made independent from government expenditure decisions. This can cause high budget deficits should government expenditure rise faster than government revenue. The third reason is that if the spend-revenue hypothesis holds it suggests that the government spends first and pay for this spending later by raising taxes. This will result in the fear of paying more taxes in the future and encourage the outflow of capital.

The relationship between government expenditure and government revenue has been investigated for a number countries. Studies such as Von Fursterburg, Green and Jeong (1986); Anderson, Wallace and Warner (1986) revealed evidence of causality from government expenditure to government revenue for a number of developed countries. This study was supported by Nararayan and Narayan (2006) for Peru and provided evidence of the spend-revenue hypothesis. Other studies found evidence of causality running from government revenue to government expenditure (such as Manage and Marlow, 1986). Narayan (2006) also found evidence of causality from revenue to expenditure for Mauritius, El Salvador, Haiti, Chile and Venezuela. These studies provided evidence of the revenue-spend hypothesis. A number of Studies found evidence of the fiscal synchronisation hypothesis (such as Owoye, 1995; Li, 2001; Fasano and Wang, 2002; Gounder, Narayan and Prasad, 2007). They found evidence of bi-directional causality between government expenditure and government revenue.

Despite the fact that the relationship between government revenue and government expenditure is important to evaluate how to address fiscal imbalances, empirical research on this issue in Namibia is scarce. The objective of this study is to test the causality between government revenue and government expenditure. It tests the validity of the various hypotheses for the period 1977 to 2007. The rest of the paper is organised as follows. Section 2 discusses the theoretical issue surrounding the causality analysis between government revenue and government expenditure. Section 3 presents the estimation technique and empirical methodology. Section 4 discusses the data and estimation results, while Section 5 concludes.

2. Government Revenue and Government Expenditure: A Granger Causality Analysis

The Granger causality test was developed by Granger (1969). According to Granger and a variable (in this case government revenue) is said to Granger cause another variable (government expenditure) if past and present values of government revenue help to predict government expenditure. To test whether government revenue Granger causes government expenditure, this paper applies the causality test developed by Granger (1969). A simple Granger causality test involving two variables, government revenue and government expenditure is written as:

$$GOVREV_t = \sum_{j=1}^{p} \alpha_j GOVREV_{t-j} + \sum_{j=1}^{p} \beta_j GOVEX_{t-j} + u_t \qquad (1)$$

$$GOVEX_t = \sum_{j=1}^{p} \eta_j GOVREV_{t-j} + \sum_{j=1}^{p} \gamma_j GOVEX_{t-j} + v_t \qquad (2)$$

where $GOVREV$ is government revenue and $GOVEX$ is government expenditure. The null hypotheses to be tested are:

$H_1 : \eta_j = 0,\ j = 1......p,$ this hypothesis means that government revenue does not Granger cause government expenditure.

$H_2 : \beta_j = 0,\ j = 1......p,$ this hypothesis means that government expenditure does not Granger cause government revenue. If none of the hypotheses are rejected, it means that government revenue does not Granger cause government expenditure and government expenditure also does not Granger cause government revenue. It indicates that the two variables are independent of each other. If the first hypothesis is rejected, it shows that government revenue Granger causes government expenditure. Rejection of the second hypothesis means that the causality runs from government expenditure to government revenue. If all hypotheses are rejected, there is bi-directional causality between government revenue and government expenditure.

The traditional Granger causality test uses the simple F-test statistics. Several studies such as Chow (1987), Marin (1992), Pomponio (1996), McCarville and Nnadozie (1995), Darat (1996) have used the traditional (F-test) to test for causality. The use of a simple traditional Granger causality has been identified by several studies (such as Engle and Granger, 1987; Toda and Yamamoto, 1995; Zapata and Rambaldi, 1997; Tsen, 2006; Ahmad and Harnhirun, 1996; Shan and Tian, 1998) as not sufficient if variables are I(1) and cointegrated. If time series included in the analysis are I(1) and cointegrated, the traditional Granger causality test should not be used, and proper statistical inference can be obtained by analysing the causality relationship on the basis of the error correction model (ECM). Many economic time-series are I(1), and when they are cointegrated, the simple F-test statistic does not have a standard distribution. If the variables are I(1) and cointegrated, Granger causality should be done in the ECM and expressed as:

$$\Delta GOVREV_{t-1} = \sum_{j=1}^{p} \alpha_j \Delta GOVREV_{t-j} + \sum_{j=1}^{p} \beta_j \Delta GOVEX_{t-j} + \phi_1 \varepsilon_{1t-1} + u_t \qquad (3)$$

$$\Delta GOVEX_{t-1} = \sum_{j=1}^{p} \eta_j \Delta GOVREV_{t-j} + \sum_{j=1}^{p} \gamma_j \Delta GOVEX_{t-j} + \phi_2 \varepsilon_{2t-1} + v_t \qquad (4)$$

where ε_{1t-1} and ε_{2t-2} are the lagged values of the error term from the following cointegration equations:

$$GOVREV_t = \delta + \varphi GOVEX_t + \varepsilon_{1t} \qquad (5)$$

$$GOVEX_t = a + \psi GOVREV_t + \varepsilon_{2t} \qquad (6)$$

3. Estimation Technique and Empirical Methodology

The first step in the empirical estimation is the univariate characteristics which show whether the variables are stationary or non-stationary. If the variables are non-stationary, their order of integration is tested. This paper uses the Augmented Dickey-Fuller (ADF) and Phillips-Perron statistics to test the stationarity or non-stationarity of the variables and their order of integration. If the variables are I(1), the next step is to test whether they are cointegrated. This is done by using the Johansen (1988; 1995) full information maximum likelihood. This econometric methodology corrects for autocorrelation and endogeneity parametrically using a vector error correction mechanism (VECM) specification. The Johansen procedure is described as follows. Defining a vector x_t of n potentially endogenous variables, it is possible to specify the data generating process and model x_t as an unrestricted vector autoregression (VAR) involving up to k-lags of x_t specified as:

$$x_t = \mu + A_1 x_{t-1} + ...+ A_k x_{t-k} + \varepsilon_t \qquad u_t \sim IN(0, \sum), \qquad (7)$$

where x_t is (*n x 1*) and each of the A_i is an (*n x n*) matrix of parameters. Sims (1980) advocates this type of VAR modelling as a way of estimating dynamic relationships among jointly endogenous variables without imposing strong *a priori* restrictions (see also Harris, 1995). This is a system in reduced form and each variable in x_t is regressed on the lagged values of itself and all the other variables in the system. Equation (7) can be re-specified into a vector error correction model (VECM) as:

$$\Delta x_t = \mu + \Gamma_1 \Delta x_{t-1} + ... + \Gamma_{k-1} \Delta x_{t-k+1} + \Pi x_{t-k} + \varepsilon_t \qquad (8)$$

where $\Gamma_i = -(I - A_1 - ..... - A_i)$, $(i = 1, ..., k-1)$ and $\Pi = -(I - A_i - ...... - A_k)$, I is a unit matrix, and $A_i\,(i = 1, ...p)$ are coefficient vectors, *p* is the number of lags included in the system, ε is the vector of residuals which represents the unexplained changes in the variables or influence of exogenous shocks. The Δ represents variables in differenced form which are I(0) and stationary and μ is a constant term. Harris (1995: 77) states that this way of specifying the system has information on both the short and long-run adjustment to changes in x_t through estimates of Γ_i and Π respectively. In the analysis of VAR, Π is a vector which represents a matrix of long-run coefficients and it is of paramount interest. The long-run coefficients are defined as a multiple of two (*n x r*) vectors, α and β', and hence $\Pi = \alpha\beta'$, where α is a vector of the loading matrices and denotes the speed of adjustment from disequilibrium, while β' is a matrix of long-run coefficients so that the term $\beta' x_{t-1}$ in Equation (8) represents up to (*n-1*) cointegration relationships in the cointegration model. It is responsible for making sure that the x_t converge to their long-run steady-state values. Evidence of the existence of cointegration is the same as evidence of the rank *(r)* for the Π matrix. If it has a full rank, the rank $r = n$ and it is said that there are n cointegrating relationships and that all variable are $I(0)$. If it is assumed that x_t is a vector of nonstationary variables $I(1)$, then all terms in Equation (8) which involves Δx_{t-i} are $I(0)$, and Πx_{t-k} must also be stationary for $\varepsilon_t \sim I(0)$ to be white noise. The cointegrating rank is tested with two statistics, the trace and maximum eigenvalue.

If there is cointegration, it shows evidence of a long-run relationship between the variables and appropriateness of proceeding to test the direction of causality as illustrated in Equations (3) and (4). Cointegrated variables share common stochastic and deterministic trends and tend to move together through time in a stationary manner even though the two variables in this study may be non-stationary. It is important to note that there are three possible cases:

- The rank of Π can be zero. This takes place when all elements in the matrix Π are zero. This means that the sequences are unit root processes and there is no cointegration. The variables do not share common trends or move together over time. In this case, the appropriate model is a VAR in first differences involving no long-run elements.
- The rank of Π could be full (in this study, rank =2). In this case, the system is stationary and the two variables can be modelled by VAR in levels. It represents a convergent system of equations, with all variables being stationary.

- Finally, the rank of Π can be a reduced (in this study, rank =1). In this case, even if all variables are individually I(1), the level-based long-run component would be stationary. In this case, there are *n-1* cointegrating vectors. The appropriate modelling methodology here is a VECM.

4. Data and Estimation Results

4.1 Data

The study uses annual data and covers the period 1977 to 2007. The data were sourced from Cornwell, Leistner and Esterhuysen (1991) and various issues of the budget statement of the Ministry of Finance of Namibia as well as the Bank of Namibia's Annual Report. Total government revenue and total government expenditure are the two variables used in the estimation.

4.2 Univariate Characteristics of the Variables

The first step in the estimation is the univariate characteristics of the variables. It involves test for unit root of the variables to be used in the estimation. The results of unit root test are presented in **TABLE 1**.

TABLE 1. ADF and Phillips-Perron unit root tests

Variable	Model Specification	ADF statistic	Joint test (F-statistic)	Phillips Perron
LnGOVREV	Intercept and trend	-2.456	Φ_3=3.84	-2.321
	Intercept	-1.878	Φ_1=23.850	-4.999***
	None	5.837		5.868
lnGOVEX	Intercept and trend	-3.205	Φ_3=9.836	-3.758**
	Intercept	-3.084**		-8.484***
	None			5.341

*/**/*** significant at 10%/5%/1% level

Critical values for the Φ_3 and Φ_1 are from Dickey and Fuller (1981: 1063).

"General to specific" iterative procedure in Enders (2004: 213) is used for ADF test.

The results of **TABLE 1** show that the two variables are stationary in levels according to Phillips-Perron statistics. The ADF test statistic indicates that government expenditure is stationary in levels but government revenue is not. This study uses rejection of the null hypothesis of unit root at least by one test to assume a verdict of stationarity. Since the variables are stationary, the next step is to use Johansen (1988; 1995) full information maximum likelihood to test for cointegration. Based on the Akaike information criterion, likelihood ratio, final prediction error, Schwartz information criteria, and Hannan-Quinn information criterion, the lag length was set at 3. Cointegration test results are presented in **TABLE 2**.

TABLE 2. Cointegration test results: GDP and exports

Null hypothesis	Alternative hypothesis	Test statistic	0.05 critical value	Probability value[b]
		Trace statistic		
r=0	r=1	49.215[a]	20.262	0.000
r=1	r=2	18.683[a]	9.165	0.000
		Maximum Eigenvalue statistic		
r=0	r>0	30.532[a]	15.892	0.000
r≤1	r>1	18.683[a]	9.165	0.000

[a] Denotes rejection of the null hypothesis at 0.05 level

[b] MacKinnon-Haug-Michelis (1999) p-values

TABLE 2 indicates that there are two cointegrating vectors. It shows that there are two economic equilibrium relationships between government revenue and government expenditure. This a full rank and was expected since the variables are I(0). Since there are two cointegrating vectors or full rank, the appropriate modelling methodology is to test for causality using VAR in levels. There is no need to do a VECM. The long-run results for the two equations specified in Equations (1) and (2) are (standard errors in parentheses):

$$\underset{}{\ln GOVREV} = \underset{(0.291)}{-2.129} + \underset{(0.025)}{1.194} \ln GOVEX \qquad (9)$$

$$\ln GOVEX = \underset{(0.224)}{-1.783} + \underset{(0.019)}{0.838} \ln GOVREV \qquad (10)$$

Equations (9) and (10) indicate a positive relationship between government revenue and government expenditure. The next step is to test the direction of causality between the two variables. The existence of cointegration implies that there must be Granger causality at least in one direction, although it does not indicate the direction of causality among the variables in the estimation. The results are presented in **TABLE 3.**

TABLE 3. Granger causality test results

H_0	Wald test/χ^2	Conclusion
lnGOVREV does not Granger cause lnGOVEX	6.240 (0.044)*	Reject the null hypothesis. There is causality from lnGOVREV to lnGOVEX.
lnGOVEX does not Granger cause lnGOVREV	1.756 (0.416)	Fail to reject the hypothesis. There is no causality from lnGOVEX to lnGOVREV

Note: Probabilities are in parentheses

* Rejection of the null hypothesis

The results of **TABLE 3** show that there is Granger causality running from government revenue to government expenditure. This provides evidence of tax-spend hypothesis in Namibia. Increasing taxes leads to more spending. Budget deficit in Namibia can be eliminated by implementing policies that stimulate government revenue.

4.3 Impulse Responses

Impulse responses introduced by Sims (1980) shows the response of one variable to shocks in another variable (for example response of government expenditure to shocks in government revenue). They are important in the analysis of an estimated structural VAR. They show the dynamic response of a variable to a shock in one of the structural equations. They indicate the response of present and future values of each of the variables to a one-unit increase in the present value of one of the shocks of VAR. The impulse responses are presented in **FIGURE 1**. They are orthogononalised using Cholesky or lower triangular decomposition. The variables are ordered as government expenditure followed by government revenue.

FIGURE 1. Impulse responses

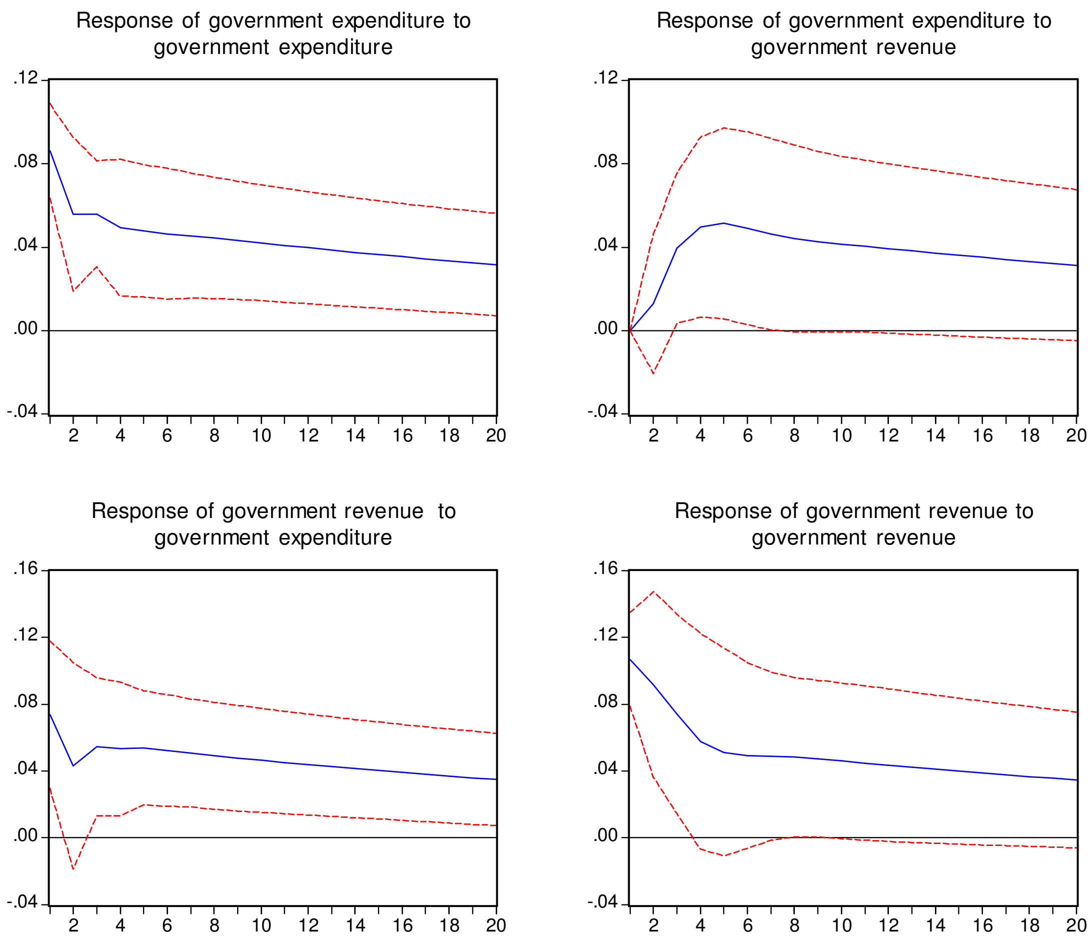

FIGURE 1 shows that government revenue responds positively to shocks on itself and from government expenditure. Government expenditure also responds positively to shocks on itself and from government expenditure.

5. Conclusion

This paper investigates the relation between government expenditure and government revenue in Namibia for the period 1977 to 2007 using the VAR econometric methodology. The ADF and Phillips-Perron statistics were used to test for unit root. Variables are I(0) and hence, VAR was employed in levels. The results show that there is unidirectional causality from revenue to expenditure. The results revealed evidence of the revenue-spend hypothesis for Namibia. This suggests that unsustainable fiscal imbalances (deficit) can be mitigated by policies that stimulate government revenue.

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