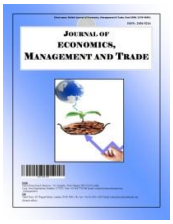

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Estimating the Fiscal Reaction Function for Namibia

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Authors' contributions

This work was carried out in collaboration among all authors. Author EJ designed the study and performed the econometric analysis of the paper. Authors JMN and OKM improved the paper in terms of content, econometric analysis and structured the study. All authors read and approved the final manuscript.

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ABSTRACT

This paper estimates the fiscal reaction function for Namibia with the aim of establishing how the Government of Namibia responds to changes in debt levels. The VECM and the ARDL models were adopted to explore the reactions between the two variables. Both the VECM and ARDL confirmed the long-run relationship between the variables and showed that government increases its primary balance (i.e. reduce its primary deficit) by 0.07 percent and 0.31 percent, respectively, for every 1 percentage increase in debt levels. On one end, the results from VECM indicated that fiscal policy in Namibia is pro-cyclical, reflected in a positive estimated effect of the output gap on the primary balance. On the other end, the ARDL model indicated an insignificant relationship between the output gap and the primary balance. The debt targeting analysis performed provides evidence that it is not enough to only reduce the primary deficit for fiscal sustainability. Instead, it is important to grow the economy and improve the ability of debt repayment so that debt accumulation declines. Thus, the paper recommends that Namibia needs not only a positive, but also a strong economic growth if it is to make significant impacts on the debt level and guarantee both debt and fiscal sustainability.

Keywords: Fiscal reaction; primary balance; debt; sustainability; Namibia.

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1. INTRODUCTION

A fiscal reaction function is generally defined as a rule that helps governments to forecast and prepare against macro-economic shocks. Such a function aims to explore the behaviour of public debt and deficits in response to shocks. Therefore, having the right fiscal reaction function makes fiscal policy and public finance sound and stable [1]. This is mainly so, because governments are aware of how they should respond to shocks under the influence of a reaction function. As detailed in Bohn [2], most fiscal reaction functions originate from the government intertemporal budget constraint. Bohn further asserts that the view behind the intertemporal budget constraint is that the future debt can be projected and defined as: $D_{t+1} = (D_t - S_t)(1 + R_{t-1)})$. This is to say that, the next period's debt (D_{t+1}) is given by the current period's debt (D_t) minus the primary surplus (or primary deficit) (S_t) in the same period, multiplied by the interest payments$(1 + R_{t-1})$.

While fiscal reaction functions have been studied in the literature as tools for assessing fiscal sustainability, most studies have been undertaken for advanced economies. These include the Organisation for Economic Co-operation and Development (OECD) countries [3] and the Euro area (see for example Mencinger & Aristovnik [4] and Stoian & Câmpeanu [5]. The common view towards the estimation of fiscal reaction functions has been to establish the determinants of national fiscal policy directions, by identifying the variables that condition the direction of fiscal policy in a country every [6]. In general terms, estimating fiscal reaction functions is a question of identifying the macroeconomic variables to which the fiscal policy of a government is sensitive to. Since the seminal work of Bohn [1] that used the U.S data to estimate how governments react to the accumulation of debt, there has been an active pool of research on the same subject. Bohn [1] established that the primary balance should be an increasing function of the government debt ratio to ensure debt sustainability for governments. A large part of the literature on fiscal reaction functions agrees with this condition and frequently estimates a positive response of primary balance to change in public debt [6].

For Namibia, apart from the fiscal stimulus such as the Targeted Intervention Program for Employment and Economic Growth (TIPEEG) introduced in 2012, there has not been a fiscal shock. The most notable fiscal shock was only seen in 2015/16 when the government took up a huge debt (Euro Bond) for budget support. This uptake of debt became a precursor to fiscal shocks. Subsequent shocks that followed were coupled with debt uptakes that were geared for development projects with efforts of taking the economy out of recession [7]. Since 2016, Namibia's government borrowing has been increasing (rising from 34 percent to 51 percent by the end of 2019[1]), where debt servicing has also passed its limit (see Fig. 1). These increasing debt figures occurred despite the fiscal consolidation path being undertaken.

Fig. 1 below brings about the sustainability question of fiscal policy in the country since the debt indicators have surpassed their set thresholds. The term debt sustainability is referred to as the level of debt that allows the country to fulfill its present and future obligations without any rescheduling or accumulation of accruals [8]. This implies that the sustainable debt level is the one where the increase in the debt GDP ratio is accompanied by an increase in primary surplus or a reduction in the level of government deficit. This condition is critical so that the resultant debt-servicing cost resulting from increasing debt does not increase at a higher rate than the repayment ability.

The objective of this study is to estimate the fiscal reaction function for Namibia to establish how the Namibian government responds to short-run changes in the public debt stock, as a means to assessing fiscal sustainability in the long-run. This study is particularly important for Namibia, mainly because of Namibia's fiscal policy that of late has been under pressure. The debt levels are projected to reach 69% of GDP by the end of 2020, far above the historical levels of less than the 35% debt threshold. Interest payments are also high at more than 10% of total revenue which is set as the rule on interest payments in the country.

To ensure fiscal sustainability, theoretically, it is argued that the response of the primary balance to higher debt stocks should be immediate. However, literature shows that the response could also be delayed, and the delay may not necessarily imply unsustainable fiscal policy especially that the delay depends on the length of time after which the response occurs [9] and [5]. Barbier-Gauchard & Mazuy [6] presents that

[1] *This does not include guarantees.*

in the fiscal reaction function, the focus is more on the fiscal balance with which its variations can be broken down into three components, namely:

i. A discretionary component, resulting from all the deliberate budgetary measures taken by a government at a given time.
ii. An automatic component, resulting from the play of automatic fiscal stabilizers. The automatic fiscal stabilization corresponds to the mechanism by which the automatic evolution of the budget makes it possible to cushion the effects of cyclical shocks (for instance, a decrease in collected tax revenues and an increase in the unemployment benefits paid in case of economic slowdown).
iii. And lastly, a component related to the burden of public debt itself, which then requires the government to take corrective measures to keep fiscal policy manageable. Failure to respond to debt change during shocks violates the sustainability condition set out in [2] and therefore imply that public debt may explode as opposed to converging to zero over time [10].

Noting the components of the variations in the fiscal balance and levels of some of Namibia's fiscal sustainability indicators which have surpassed the set thresholds, it is imperative to estimate the fiscal reaction function for Namibia. This is done for purposes of establishing how the country should undertake its fiscal policy in response to increasing government debts to ensure fiscal sustainability. This analysis is critical for Namibia mainly because, apart from sustainability concerns, high public debt levels may directly or indirectly harm economic growth. If the debt to GDP ratio increases persistently over time, there comes a possibility that the newly issued bonds can only be absorbed by the market participants if they yield higher real returns. This may result in crowding-out of private investment and therefore, impacts the growth. Additionally, since debt accumulation affects fiscal space, it can also reduce the flexibility of fiscal policy to respond to economic shocks. This was more evident during the 2008/2009 global financial crisis when countries with high debt levels were seen to be more restrictive in their responses to the financial crisis than countries with relatively lower debt levels.

Fiscal policy in Namibia is one dominant tool for policy reactions mainly because monetary policy is less reactive as a result of Namibia's belongingness to the Common Monetary Area. With the debt indicators pointing towards limited fiscal space for Namibia, estimating fiscal reaction for the country becomes critical. This paper is structured as follows: Section 2 provides the empirical literature to the subject and Section 3 presents the model used to estimate the fiscal reaction function for Namibia. Section 4 presents fiscal reaction function estimation results, while Section 5 goes further to estimate the rate of GDP growth and primary balance level that reverse the high debt levels to the country's set threshold. The last section (Section 6) concludes and suggests some policy recommendations.

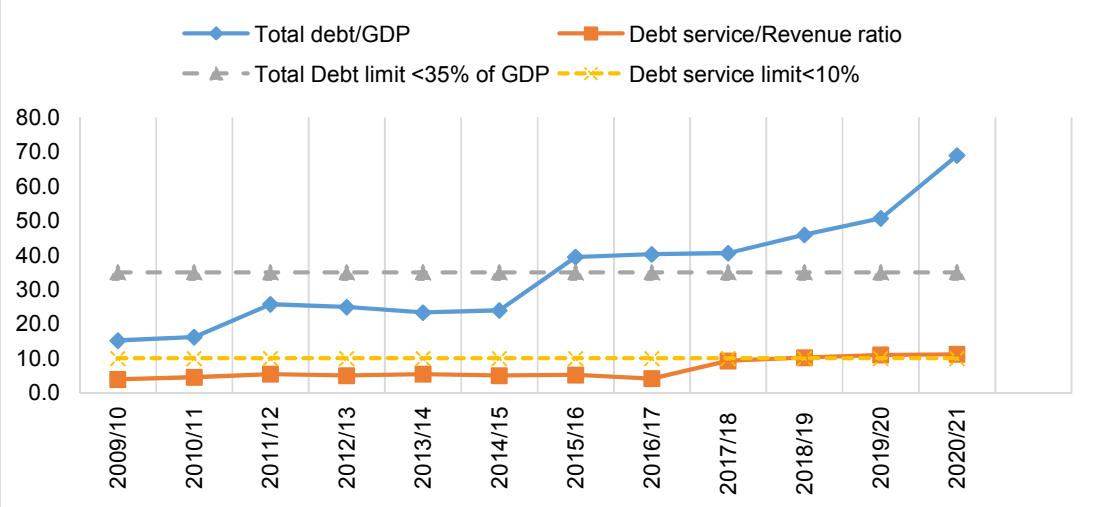

Fig. 1. Debt and interest payments in the last 10 years and beyond

2. LITERATURE REVIEW

Fiscal policy reaction to debt levels has been subject to substantial empirical investigation in the literature. The subject has been investigated both in cross country setup and single country set up using various methodologies. The results differ from one country to another, however, there appears to be a common consensus that, countries that managed to control their debt levels are the ones that responded positively to changes in their countries' debt dynamics. A common approach for the empirical investigation of fiscal sustainability includes testing whether there exists a systematic (positive) linear relationship between primary balance and public debt and provides evidence that fiscal policy that contains a strong enough reaction of the primary surplus to public debt growth is sustainable. The findings of some selected studies are as summarised below.

Jalles and Alfonso [11] used estimated the fiscal reaction function for the OECD countries using a Panel Vector Autoregression (VAR) methodology, the results indicated that on average, governments in the OECD countries have increased their primary balances as a response to higher previous government indebtedness. The results further indicated that these countries have improved (increased) their primary balances to reduce the level of outstanding government debt in the subsequent periods. The results further established a counter-cyclical behaviour of fiscal policy in the OECD, reflected in a positive estimated effect of the output gap on the primary balance.

Estimating fiscal sustainability and the fiscal reaction function for South Africa using a variety of methodologies for robustness reasons, Burger et al (2011) established that the government authorities in South Africa also respond to increasing debt stock by increasing the primary balance. Like [11], Burger et al. [12] also found evidence of counter-cyclical fiscal policy in South Africa. The parameter estimates for the lag of the primary balance to GDP ratio was found to be more than 0.5 for most of the model estimation used, pointing to high degrees of inertia in the government behaviour when it sets its primary balance. The level of inertia is critical as determines whether the primary balance is manageable or not. The existence of inertia in fiscal behaviour reflects a possibility that if a country defaulted in the past, it is more likely to still exhibit fiscal weaknesses in the present [13].

Luporini [14] also estimates a fiscal reaction function to establish how the government's fiscal reaction has changed over time using the Brazilian data over the period, 1991-2011. Using the Johansen cointegration technique, the results also indicate a long-run relationship between the primary surplus and the debt to GDP ratio and that the government of Brazil reacts positively to an increase in government indebtedness, indicating evidence of fiscal sustainability. Accordingly, a one percent increase in debt GDP ratio is followed by a 0.09 percent increase in primary surplus. The error coefficients were found to be negative and statistically significant, an indication that temporary deviations from the long-term surplus-debt relationship are compensated by changes in the primary surplus, and therefore evidence of fiscal sustainability in Brazil. Unlike [11] that established the relationship between the output gap and fiscal policy in the OECD countries, the results for Brazil points to no relationship between fiscal policy and output, as the coefficient on output variations was found to be statistically insignificant. This finding posits limitations of fiscal policy to business cycles.

In Europe, a recent study on fiscal policy reaction function was done by Tashevska, Trpkova-Nestorovska and Trenovski [15], who, using the data for Southeast European countries established that primary balance does not respond to changes in debt levels immediately and therefore contradicts the condition for fiscal sustainability. Fiscal policy was however established to be pro-cyclical in these countries, however only in the first couple of years. These results are not surprising because if fiscal authorities do not react to increases in debt levels, it implies that even when the output gap is positive and the economy is improving, the initial debt increase with no corresponding increase in primary surplus puts an additional burden on the future debt servicing and therefore negative implications on the fiscal policy's ability to respond to changes in the business cycle.

Unlike most studies that focused on investigating the sustainability of fiscal policy, some recent work on Japan, a country with the highest debt to the gross domestic product in all advanced economies, have rather provided a case study using Japan data on what can be tackled when debt levels have constantly increased [16]. The results generally point to the need to rather address policy areas that have impacts on government debt, of which for Japan these areas

were identified to be policies on pension and retirement age, policies guiding expenditure on health and long-term care. The results unveiled that if Japan does not change its current policies, it will continue to run large deficits and the debt to GDP ratio will continue to reach unprecedented highs, with interest payments on the debt becoming increasingly larger, and therefore unsustainability. The findings of [16], brings about an important component in the literature that it is not only about the sustainability condition as depicted by the relationship between primary balance and debt to GDP ratio, but also the ability to change all other policies that have impact on the country's debt.

Vdovychenko [17], in analyzing fiscal policy reaction function and sustainability of fiscal policy in Ukraine emphasized the ability of the fiscal reaction function as a tool to establish whether or not a fiscal policy is "passive" or "active". Accordingly, the passive fiscal policy is the one that is limited by the dynamics of public debt and intertemporal budget consideration such that if a country has a passive fiscal policy, the main objective of fiscal policy would be to maintain or achieve a sustainable level of public debt. In the fiscal reaction function context, a passive or active fiscal policy would be identified by a combination of the coefficients of debt and output. These combinations also allow to determine whether fiscal policy is sustainable, pro-cyclical or counter-cyclical[2] as indicated in Table 1.

3. THE MODEL

To estimate the fiscal reaction function for Namibia, the study follows the model specification set out in [12]. According to [12], the fiscal reaction function specifies the reaction of primary balance/GDP ratio to changes in one period lagged public debt GDP ratio, keeping all other variables constant. By implication, this means that if the debt ratio increases, the government should respond by improving the primary balance to prevent the rise in the debt ratio. The coefficient of the primary balance/GDP ratio is therefore important since it is the one that determines the government's reaction. Accordingly, the primary balance that keeps the debt ratio unchanged is expressed as in equation 1 below:

$$(\mathrm{PB/Y})_t = (\frac{r-g}{1+g})(\frac{D}{Y})_{t-1} \quad (1)$$

Where PB_t is the primary balance, Y_t is output (GDP), r is interest rate[3], g is growth in GDP while $(\frac{D}{Y})_{t-1}$ is the previous year debt/GDP ratio. Equation 1 can therefore be interpreted as a fiscal rule since it provides the required primary balance to keep the Debt target. Replacing $\frac{r-g}{1+g}$ by α, equation 1 can be re-written as:

$$(\mathrm{PB/Y})_t = \alpha(\frac{D}{Y})_{t-1} \quad (2)$$

Since the primary balance is affected by both its lag as well as the lag of the debt ratio and the economic cycles, equation 2 can be extended as:

$$(\mathrm{PB/Y})_t = \alpha_0 + \alpha_1(\mathrm{PB/Y})_{t-1} + \alpha_2(\mathrm{D/Y})_{t-1} + \alpha_3 YGAP_t + \mu_t \quad (3)$$

Where $(\mathrm{PB/Y})_{t-1}$ and $(\mathrm{PB/Y})_t$ are the previous and current years' primary balances and are treated as a percentage of GDP. The alphas (α_0, α_1, α_2 and α_3) are the intercept and slope coefficients, $(\mathrm{D/Y})_{t-1}$ is the government debt/GDP ratio for the previous year, $\mathrm{YGAP}_{t-1}$is the previous year's output gap, and μ_t is the error term. $(\mathrm{PB/Y})_{t-1}$ is included in the model to allow for inertia in government behavior when the government decides on the size of the primary balance. The closer α_1 is to one, the higher the degree of inertia. Mostly, the α_1 value lies above 0.5 [12] while a value above 1 indicates that the primary balance is exploding. The coefficient α_3 on the other hand captures the response of the discretionary fiscal policy to the state of the business cycle. A positive α_3 therefore indicates a countercyclical fiscal policy while a negative α_3 indicates a procyclical fiscal policy.

While most studies estimated the fiscal reaction function as the one in equation 3 above, some also included the variation in expenditure as an explanatory variable. According to [2], if the current change in debt to GDP ratio is negatively

[2] *Procyclical fiscal policy is often referred to when governments choose to increase government spending and reduce taxes during economic booms and reduce spending and increase taxes during recessions. Counter-cyclical fiscal policy on the other hand is the one that counteract the impact of business cycles. When the economy is in recession for example, it would increase spending in order to stimulate the economy. If debt levels of the country is already higher increasing spending during recession may exacerbate debt levels, lending the country's debt into passive-unsustainable column of Table 1.*

[3] *This is an implicit interest rate, defined as a ratio of interest payment at time t to the previous year's debt (D_{t-1})*

Table 1. Possible combinations of coefficients in the reaction function

	Passive			Active			Neutral	Active-Sustainable	Passive-unsustainable
Output Gap	-	0	-	+	0	+	0	+	-
Debt	+	+	0	-	-	0	0	+	-

Source: Vdovychenko [17]
Note: the zero in the Table denotes a statistically insignificant coefficient

related to the previous period debt to GDP ratio and but positively related to government expenditure and output gaps, then fiscal policy is said to be sustainable. This relationship can be specified as follows:

$$\frac{D}{Y}_t = \alpha_0 + \alpha_1(\frac{D}{Y})_{t-1} + \alpha_2 GGAP_t + \alpha_3 YGAP_t + \varepsilon_t \quad (4)$$

Where $GGAP$ is the variation of government spending from its permanent level. Sustainability will therefore require that α_1 in equation 4 is negative while α_2 and α_3 be positive. Since α_1 and α_3 are already part of the fiscal reaction function (equation 3), this function (equation 3) is further extended to include the government expenditure variation like in [2] and [18] to become:

$$(\mathrm{PB/Y})_t = \alpha_0 + \alpha_1(\mathrm{PB/Y})_{t-1} + \alpha_2(\mathrm{D/Y})_{t-1} + \alpha_3 YGAP_t + \alpha_4 GGAP_t + \mu_t \quad (5)$$

From equation 5 above, the coefficient of interest is α_2 since it indicates the reaction of the primary balance to changes in the public debt/GDP ratio and the sustainability position of the debt. The value of α_2 is expected to be positive, an indication of a positive relationship between the primary balance/GDP ratio and the public debt/GDP ratio. A negative α_2 on the other hand indicates an unsustainable public debt/GDP ratio because it implies an increase in the primary deficit for any increase in the public debt/GDP ratio, while its sustainability calls for a positive relationship between the public debt/GDP ratio and the primary balance. Traditionally, sustainability has also been accessed by merely looking at the relationship between the r and g, by establishing the interest rate-growth differential (i.e. $r - g$). When the differential is positive (i.e. a differential above zero), it points to sustainability pressures, mainly because a positive differential implies that interest payments are increasing faster than the GDP growth, thus making it difficult to cover the debts and the related costs. Bohn [19] has however cast doubt on this traditional test indicating that it may only hold in the short-run and not in the long-run, thus it becomes important to make conclusion not solely on the budget constraint sustainability approach but to consider other analytical methodologies. In this paper, the traditional method is supplemented by a debt targeting analysis.

4. EMPIRICAL ANALYSIS

4.1 Data

Annual data from 1980 to 2019 was used for the analysis of this study. The data were sourced from, [20], Namibia Statistics Agency and the Ministry of Finance. Data for potential GDP and potential government spending were obtained using the Hodrick Prescott Filter (HP filter), with the value of lambda set at 100 (i.e. $\lambda = 100$). Therefore, the output gap data and government expenditure gap data were obtained as follows:

$$\hat{y}_t = ((y_t - \bar{y}_t)/y_t)) * 100 \quad \text{and} \quad \hat{g}_t = ((g_t - \bar{g}_t)/g_t)) * 100$$

Where $\hat{y}_t$ and $\hat{g}_t$ are the output and expenditure gaps, y_t and g_t are the actual output (GDP) and expenditure, $\bar{y}_t$ and $\bar{g}_t$ the potential output and expenditure obtained from the HP filter, respectively.

4.2 Unit Root Tests

The variables were first tested for stationarity, to establish whether or not there is unit root present in the series. In assessing the stationarity of the series, two-unit root tests were performed; the Augmented and the Phillip-Peron (PP) test. The null hypothesis for the ADF and PP is that the series has a unit root (non-stationary series). Thus, if the null hypotheses are rejected, then a conclusion of the stationary series is reached. The outcome portrayed mixed results as shown in Table 2 below.

Table 2. Stationarity test

Variables	ADF Test				PP Test			
	5% critical value	10% Critical value	t-statistics	Stationarity	5% critical value	10% Critical value	t-statistics	Stationarity
Primary balance	-2.94	-2.61	-3.39	I(0)	-2.94	-2.61	-3.01	I(0)
Debt to GDP	-2.94	-2.61	-0.28	I(1)	-2.94	-2.61	0.68	I(1)
Expenditure Gap	-2.94	-2.61	-2.51	I(1)	-2.94	-2.61	-3.17	I(0)
Output Gap	-2.94	-2.61	-4.41	I(0)	-2.94	-2.61	-2.58	I(1)

When the variables are integrated, the coefficients may be estimated using a system of equations, the so-called Vector Error Correction Model (VECM), as proposed by [21] or a single equation model. The Johansen´s method departs from a vector auto regression system (VAR) and jointly estimates both the cointegrating vector (the long-run relation between the variables) and the parameters of the error correction vector i.e. the temporary deviations from the long-run relation [14]. These characteristics make the Johansen technique asymptotically more efficient than single equation methods. However, since the Unit root test has only a mix of I(1) and I(0), an Autoregressive Distributed Lag (ARDL) bounds test approach as pioneered by Pesaran, Shin, and Smith's [21] was also estimated to supplement the Johansen's technique. This is particularly done to increase the reliability of the results noting that ARDL has the ability to estimate consistent results when the variables are I(0) even in smaller sample periods, where the Johansen technique cannot [18]. The ARDL test has however also been critiqued in that, the Bounds test, which tests for cointegration of the series is only used in a single equation and on an assumption that there is one cointegrating equation and/or relationship. In this case, the ARDL model becomes less preferred that the Johansen methodology that can be used even for multivariate cointegrating equations [18].

Although the stationarity of the series in Table 2 above portrayed the order of integration, this alone does not guarantee co-integration, a condition that is required for both the estimation of the VECM and the ARDL model. According to [22], the basic steps in estimating a VECM are *Step 1*: Testing for the stationarity of the series, *Step 2*: Determining the Optimal number of lags (p) lags, *Step 3*: perform the Johansen Cointegration test with (p) lags as established in Step 2. In *Step 4*: we estimate the unrestricted Vector Autoregression (VAR) if Step 3 indicated that variables are not cointegration or estimate a VECM with $(p-1)$ lags if variables are integrated. Since the stationarity of the series has already been performed, it means that step one has been done. The results for the next steps are therefore as presented in the sections below.

4.3 Optimal Number of Lags

The optimal number of lags included in the model was obtained using the lag length criteria test. Three criteria were used, namely the Akaike Information Criterion (AIC), the Schwarz Information Criterion (SC) and the Hannan-Quinn Information Criterion (HQ) as indicated in Table 3. The optimal number of lags was established to be 3 lags as indicated by the AIC information criterion (AIC), with the minimum value and therefore points to optimal lags being three lags. However, to save on the degrees of freedom, the number of lags recommended by SC and HQ was used (i.e. 1 lag).

Table 3. Lag order selection criteria

Lag	AIC	SC	HQ
0	23.57046	23.74640	23.63187
1	20.04286	20.92259*	20.34991*
2	20.41515	21.99867	20.96784
3	19.57676*	21.86407	20.37509

**Indicates the lag order selected by the criterion*

4.4 The Johansen Co-integration Test

Johansen co-integration test uses two test criteria namely; the trace statistic and the maximum eigenvalue. The null hypothesis is that there is no cointegration between the series under examination. Therefore, if co-integration test is carried out and the result suggests that the null hypothesis of no co-integration should be rejected, it implies that co-integration exists and as such, there is long-run relationship between the variables in the model. According to [23] and [24], the cointegrating equation is specified as follows:

$$\Delta Z_t = \alpha_0 + \sum_{i,1}^{k} \Gamma_i \, \Delta Z_{t-1} + \Pi Z_{t-1} + \eta_t \qquad (6)$$

Where $\Pi = \sum_{i=1}^{p} A_i - I$ and $\Gamma_i = -\sum_{j=i+1}^{p} A_j$. In equation (6), Π is the rank of a matrix and it represents the number of cointegrating vectors. If $\Pi = 0$, it means that there are no cointegrating vectors and that equation 6 is the usual VAR model in the first difference [25]. However, if $1 < rank(\Pi) < n$, there are r cointegrating vectors and a Vector Error-Correction Model (VECM) can be estimated. Therefore, if variables are cointegrated, vector Π is now defined as a product of two matrices, α and β', i.e. $\Pi = \alpha\beta'$. Where β is the matrix of the cointegrating vectors and α is the matrix of the speed of adjustment [25].

Since this study aims to estimate the fiscal reaction function in Namibia and to discern the relationship between primary balance and debt, the Johnsen cointegration technique estimates the VECM as follows:

$$\Delta(PB/Y)_t = \mu_{10} + \sum_{j=1}^{r} \alpha_{1j}\varepsilon_{t-1,j} + \sum_{i=1}^{p} \gamma_{11,i}\Delta\left(\frac{PB}{Y}\right)_{t-i} + \sum_{i=1}^{p} \gamma_{12,i}\Delta\left(\frac{D}{Y}\right)_{t-i} + \sum_{i=1}^{p} \gamma_{13,i}\Delta YGAP_{t-i} + \sum_{i=1}^{p} \gamma_{14,i} GGAP_{t-i} + \xi_{1t} \qquad (7)$$

$$\Delta(\tfrac{D}{Y})_t = \mu_{20} + \sum_{j=1}^{r} \alpha_{2j}\varepsilon_{t-1,j} + \sum_{i=1}^{p} \gamma_{21,i}\Delta(\tfrac{D}{Y})_{t-i} + \sum_{i=1}^{p} \gamma_{22,i}\Delta(\tfrac{PB}{Y})_{t-i} + \sum_{i=1}^{p} \gamma_{23,i}\Delta YGAP_{t-i} + \sum_{i=1}^{p} \gamma_{24,i}\Delta GGAP_{t-i} + \xi_{2t} \qquad (8)$$

Where, Δ denotes the first difference operator, $\varepsilon_{t-1,j}$ is the lagged error-correction term obtained from cointegrating equating j, ξ_{1t} and ξ_{2t} are serially uncorrelated error terms. α_{1j} and α_{2j} denote the speed of adjustment of the variables PB/Y and D/Y, respectively, to the j-th long-run equilibrium and all other variables are defined as before. A unique advantage of the VECM as compared to other methods such as the Engle-Granger methodology is that it treats each variable (simultaneously) in the system as potentially endogenous and relates each variable to its past values and to past values of all other variables.

The Trace test and the Maximum Eigen values both indicate that there is one cointegrating equation amongst the variables, an indication that a VECM can be estimated (Table 4).

4.5 VECM Estimation Results

Although the selected optimal number of lags would mean that no lags need to be included in the VECM since the lags included in the VECM are $(p-1)$, one lag was included in the estimation since fiscal variables have lagged effects in nature. Before the interpretation of the results, it is important to note that the coefficients in the long-run equation of the VECM are interpreted using the reverse signs, in that, a positive relationship would mean a negative relationship between the explanatory variable and the normalised (dependent variable). Therefore, the debt coefficient in Table 5(a) means a positive coefficient (as expected) and indicates that for everyone percentage increase in the Debt/GDP ratio, the primary balance/GDP ratio increases by 0.07 percent. The coefficient of the output gap is positive, and statistically significant pointing to the procyclical nature of Namibia's fiscal policy. This is to say that the government tends to spend more in good times (during economic booms) and spend less during hard times or economic slowdown, which is intuitively rationale. This has been evident in recent years when the government undertook a fiscal consolidation path over the period of low economic growth.

The results for the short-run effects are presented in Table 5(b) below. The error correction term for the primary balance/GDP ratio is negative and statistically significant. As such, the results established a fiscal response to deviations from the long-run relationship equal to -0.385 (Table 5b). This means that only 39 percent of the variations in the primary balance is corrected in the first period after the deviations have occurred. The error correction term for Debt/GDP ratio is also statistically significant and indicates that more than half of the deviations in debt are corrected one period after the deviation has occurred. These findings imply that

Table 4. Cointegration test results

Null Hypothesis	Alternative Hypothesis	Trace Test		Maximum Eigen Value Test	
		Trace statistics	Probability	Max-Eigen statistics	Probability
r=0	r=1	59.64743[a]	0.0027[b]	35.23223[a]	0.0043[b]
r=1	r=2	24.41520	0.1835	18.65192	0.1074
r=2	r=3	5.763282	0.7233	4.926229	0.7511
r=3	r=4	0.837053	0.3602	0.837053	0.3602

[a] denotes rejection of the null hypothesis at 5% significance level.
[b] MacKinnon-Haug-Michelis (1999) P-values

Table 5a. VECM results – normalisation on primary balance

Cointegrating equation	Coefficients
Primary Balance $(\mathrm{PB/Y})_{t-1}$	1.0000
Government Debt $(\mathrm{D/Y})_{t-1}$	-0.072944
	(0.03834)
	[-1.90247]
Output Gap $(YGAP_t)$	-0.342802
	(0.14738)
	[-2.32594]
Government expenditure Gap $(GGAP_t)$	-0.015279
	(0.03828)
	[-0.39910]
Constant	3.07768

Table 5b. Short run effects

Error correction		
	$\mathbf{D((PB/Y)_t}$	$\mathbf{D(D/Y)_t}$
Coefficients	-0.385121	-0.715271
	(0.16963)	(0.25588)
	[-2.27034]	[-3.16662]
R^2	0.316	0.327
Serial Correlation	0.0634	

Note: Standard errors are presented in the brackets while t-statistics are presented in the parentheses

it is faster to correct deviations in debt than in the primary balance. These findings make sense, especially when looked into the perspective of the Keynesian theory where it indicates that expenditure[4] may be difficult to adjust mainly because some expenditure components are rigid. One such example is the wages, as wage contracts are set for a longer period.

The model was tested for serial correlation and indicated no evidence of serial correlation both at the 1 percent and 5 percentage levels. The VEC Granger test performed indicates that the primary balance/GDP ratio and debt/GDP ratio do no Granger cause each other (Table 6). This is an indication that tackling one variable will not automatically affect the other. This is rather contrary to the theoretical understanding of the relationship between primary deficit and debt that indicates that a lower deficit leads to a lower debt level. The Granger causality test further indicates that the expenditure gap somewhat Granger causes Debt/GDP ratio, which further entails that in order to address debt levels in Namibia, it will be more prudent to address expenditure levels.

4.6 ARDL Estimation Results

The ARDL is one model is recommended in the literature (see for example [25,18] and [1]) when variables are strictly I(0) and I(1), with no mix of I(2), the ARDL can be used. Since the unit root tests performed indicated a mix of I(0) and I(1), an ARDL model was also estimated as

[4] Expenditure is directly linked with the primary balance since primary balance is defined as revenue minus primary spending.

recommended in the literature, to establish whether or not with the model the conclusion on the results will be the same. The ARDL methodology involves just a single-equation set-up, making it simple to implement and interpret. According to [25] the augmented ARDL can be written as follows:

$$\alpha(L,P)y_t = \alpha_0 + \sum_{i=1}^{k}\beta_i(L,q_i)x_{i,t} + \varepsilon_t \ldots . (9)$$

Where α_0 is a constant, y_t denotes the dependent variable, L is a lag operator, $x_{i,t}$ is the vector of regressors (where $i = 1,2,\ldots,k$) and ε_t is the disturbance term. In the long-run the regressand and the regressors are defined as: $y_t = y_{t-1} = \cdots = y_{t-q}$ and $x_{i,t} = x_{i,t-1} = \cdots x_{i,t} - q$. The $x_{i,t}$ denotes the q^{th} lag of the i^{th} variable. The long-run equation of the ARDL which is estimated using the Bounds test in this study, therefore, takes this form:

$$(\mathrm{PB/Y})_t = \alpha_0 + \sum_{i=1}^{k}(\mathrm{PB/Y})_{t-i} + \sum_{i=1}^{k}(\mathrm{D/Y})_{t-i} + \sum_{i=1}^{k} YGAP_{t-i} + \sum_{i=1}^{k} GGAP_{t-i} + \alpha_1(\mathrm{PB/Y})_{t-1} + \alpha_2(\mathrm{D/Y})_{t-1} + \alpha_3 YGAP_t + \alpha_4 GGAP_t + \varepsilon_t \quad (10)$$

The null hypothesis for the bounds test is that there is no long-run relationship while the alternative hypothesis is that there exists a long-run relationship between the variables in the question. The bounds test conducted indicated that variables are cointegrated (i.e. there is a long-run relationship) as reflected in Table 7 below.

Since the bounds test indicates a long-run relationship, the long-run elasticities were also estimated to establish the impact that each variable has on the primary balance. Based on the ARDL results, the main determinant of the primary balance in Namibia is its own lag, the current debt ratio, as well as its one-period lag and the output gap. Such is confirmed from a significant p-value perspective. The output gap was found to have no impact on primary balance indicating that the deviation of output from its potential level does not affect primary balance in Namibia. If these results are anything to go by, they imply that the current economic phase (economic downturn) may not necessarily be blamed for the high deficit but mainly the country's expenditure trajectory and the high deficit level carried over from the previous years. The results are in line with the long-run results obtained from the VECM.

Table 6. VEC granger test

Variables	χ^2	DF	Probability
Dependent Variable: Primary balance			
Government Debt	0.059967	1	0.8070
Output Gap	0.020010	1	0.8875
Expenditure Gap	2.107243	1	0.1466
Dependent Variable: Government Debt			
Primary balance	0.074510	1	0.7849
Output Gap	0.096953	1	0.75555
Expenditure Gap	2.744175	1	0.0976
Dependent Variable: Output Gap			
Primary balance	0.807791	1	0.3688
Government Debt	0.113053	1	0.7367
Expenditure Gap	0.063310	1	0.8013
Dependent Variable: Exp. Gap			
Primary balance	2.888750	1	0.0892
Government Debt	0.072046	1	0.7884
Output Gap	2.237262	1	0.1347

Table 7. The bound test

Test Statistic	Value	Significance level	I(0)	I(1)
F statistics	6.11	10%	2.37	3.20
K	3	5%	2.79	3.67
		1%	3.65	4.66

Table 8. Long-run elasticities

Variables	Coefficient	t-statistics	Probability
Constant	-1.6897		0.0455
Primary balance (-1)	0.4070	2.8834	0.0076
Debt to GDP	-0.2564	-2.2787	0.0308
Debt to GDP (-1)	0.3134	2.6754	0.0125
Output Gap	0.1384	1.0769	0.2910
Expenditure Gap	-0.0737	-1.1999	0.2406
Expenditure Gap(-1)	-0.0228	-03264	0.7467
Expenditure Gap(-2)	-0.0706	-1.0912	0.2848
Expenditure Gap(-3)	0.0994	2.1901	0.0373
Adjusted R-squared	0.619		

Estimating the short-run effects (or the speed of adjustment in returning to their equilibrium level), the results indicate that 59 percent of the deviations are corrected within the first period of occurrence (Table 9). The t-statistic is large (t=5.14, which is further away from zero), implying that the coefficient of 0.59 is significant. These results indicate that shocks to primary balance are not permanent and that Namibia's fiscal reaction is stable. The coefficient of interest in this reaction function remains $((\mathrm{D}/\mathrm{Y})_{\mathrm{t}-1})$ with a positive of 0.3134 (Table 9) as expected. This coefficient implies that debt in Namibia, although high in levels (at 50 percent of GDP by 2019), it is sustainable since the primary balance responds positively to shocks in debt levels.

4.7 Robustness Test for the ARDL

The model was subjected to diagnostic tests to ensure that results are reliable. Both the Breusch-Godfrey Serial Correlation LM Test and the Breush-Pagan-Godfrey Test indicate respectively that the model does not suffer from serial correlation or heteroscedasticity (Table 10), as both probabilities indicate insignificance at all significance levels.

The model was further subjected to the stability tests, namely, the Cumulative Sum of Recursive Residuals (CUSUM) and the Cumulative Sum of Squared Recursive Residuals (CUSUMSQ). As can be observed from Fig. 2, the model is stable, again giving credence to the model results.

5. DEBT TARGETING

Like in monetary policy where there are debates that Central Banks should target inflation or the price level path, the same debate exists in fiscal policy. In the later, policymakers debate on whether they should target deficit or debt. One advantage placed on targeting debt rather than deficit is that it is rather the debt level that matters for fiscal sustainability thus, targeting debt already indirectly forces fiscal authorities to look into how government deficit evolves. It has been argued that there are circumstances where it is good to have large deficits (for as long as they are manageable) and increase the

Table 9. Short-run effects

Variables	Coefficient	t-statistics	Probability
Error correction (-1)	-0.5930	-5.1356	0.0000
D(Debt/GDP)	-0.2563	-2.8110	0.0091
D(EXP Gap)	-0.0737	-1.7141	0.0980
D(Exp Gap(-1))	-0.0287	-0.7000	0.5105
D(Exp Gap (-1)	-0.0994	-2.4263	0.0222

Table 10. Serial correlation and heteroskedasticity test

Breusch-Godfrey Serial Correlation LM test H_0: No serial correlation		Breusch-Pagan-Godfrey Heteroskedasticity test H_0: Homoskedasticity	
	Probability		Probability
Probability F- statistic	0.5353	Probability F- statistic	0.8410
Probability Chi-square	0.4157	Probability Chi-square	0.7897

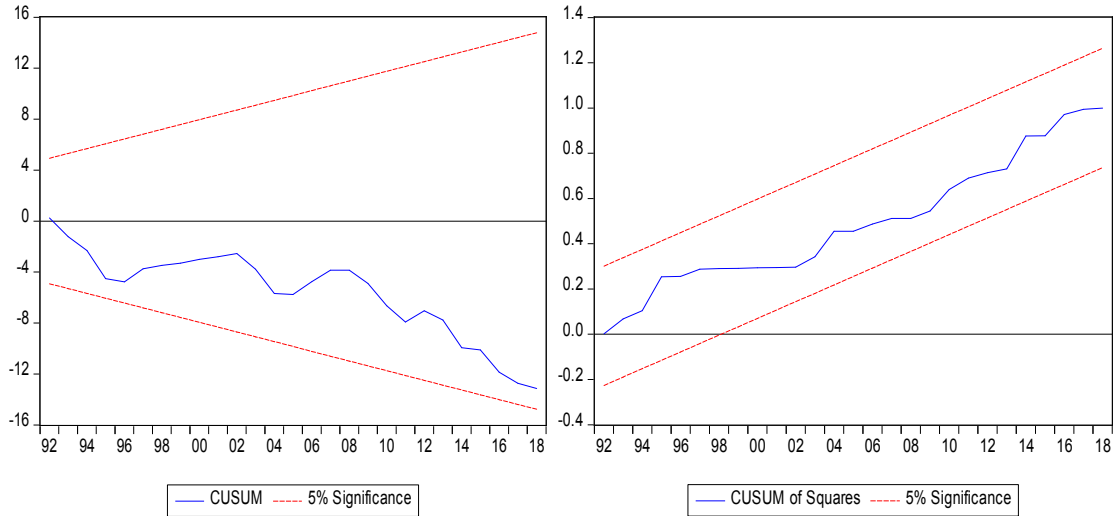

Fig. 2. Stability of the variables

debt/GDP ratio. However, there are also circumstances in which managing a large surplus is good for reducing the debt/GDP ratio [26]. In the 2005/06 budget statement for Namibia, debt and deficit targeting were subsequently revised as indicated in Table 11.

The current (2019) debt level is more than the self-set cap of 35 percent[5], posing a question mark on the sustainability of public debt especially in the current realm of negative economic growth and high expenditure levels (in nominal terms) amidst the fiscal consolidation efforts that the government has put in place. Noting the empirical results obtained from the two models that expenditure is one variable that to a larger extent affects the primary balance and therefore the likelihood of debt levels, the study went further to establish the level of primary balance in Namibia that will keep the debt level at 35 percent. This level of primary balance was calculated using the following assumptions:

i. Baseline debt of end of 2019 (debt level of 56.3 percent of GDP) which is the actual debt data available.
ii. Debt denomination remains as in the past 4 years, where an average of 64 percent of the debt was denominated in domestic currency, whereas the remaining 36 percent is in foreign currency.
iii. The average interest rate on debt: assumed 3.5 percent for foreign debt and 8.9 percent for foreign currency debt, and these numbers are based on the debt interest rates average of 2019.
iv. Assume that inflation remains fairly the same as in the past three years, averaging 4.1 percent.
v. The rate of change in the nominal exchange rate (Rand/US$) will increase (depreciate) by the average rate observed in 2016-2019(5 percent).
vi. Assume that the real GDP growth remains low at its past three years average of 0.1 percent.

These assumptions were simulated using equation 11 below, which calculates the level of primary balance that brings about a debt ratio of <35 percent, which is the debt level in line with Namibia's current debt GDP ratio cap.

$$pb = \frac{\phi^n d_t - \bar{d}_{t+n}}{\sum_{i=0}^{n-1}\phi^i} = \frac{(\phi^n - \sigma)}{\sum_{i=0}^{n-1}\phi^i} d_t = \frac{(\phi-1)(\sigma-\phi^n)}{1-\phi^n} d_t \quad (11)$$

Simulation results for equation 8 indicated that, at the current debt levels, even if GDP was to be in its positive territories (growing at 0.1 percent) annually, where at that GDP growth primary would be at 2.5 percent, debt would become almost unsustainable as it continues with its persistent increase (Table 13), and does not return to its historical values.

[5] *However, when compared to the Southern African Development Community (SADC)'s macroeconomic convergence targets adopted in 2002, Namibia's current level of debt (which stands at 50.3% of GDP by 2019) is lower than 60% target, set for the SADC countries. In terms of deficit as a percentage of GDP, Namibia is however above the SADC convergence target of 3%.*

Table 11. Debt and deficit targeting in Namibia

Variable	Unit of measurement	Cap level in 2005/06	Existing cap level
Deficit	% of GDP	<5%	<5%
Debt	% of GDP	25% - 30%	<35%

Table 12. Debt targeting analysis (scenario 1)

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
d_t	56.3%	57.5%	58.9%	60.3%	61.8%	63.4%	65.2%	67.0%	69.0%	71.1%	73.3%
ϕ	-	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067
Coefficients	r^w	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%
	g	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
	pb	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%

Note: dt is the debt level at time t, phi is the ratio of the weighted interest rate and growth i.e. $(1+r^w)/(1+g)$, r^w is the weighted interest rate, g is real GDP growth and pb is the balance

Table 13. Debt targeting analysis (scenario 2)

Year	2019	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
d_t	56.3%	58.2%	57.7%	57.1%	55.8%	54.1%	52.2%	50.1%	48.0%	45.8%	43.5%
ϕ		1.064	1.051	1.049	1.039	1.032	1.028	1.026	1.026	1.026	1.026
Coefficients	r^w	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
	g	0.5%	1.8%	2.0%	2.9%	3.7%	4.0%	4.2%	4.2%	4.2%	4.2%
	pb	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%

However, should GDP grow steadily, from its current recessionary levels to a growth of 0.5 percent by 2021 and above 2.0 percent from 2023 onwards (Table 13), the debt levels will follow a different trend. At these growth levels, *ceteris paribus*, debt to GDP ratio will significantly reduce to a level less than 45 percent by the year 2030. These results indicate that debt ratio moves towards its historical values and Namibia's self-imposed fiscal rule of debt ratio of 35 percent or less.

6. CONCLUSION

This study aimed at estimating the fiscal reaction function for Namibia to establish how the government of Namibia can respond to changes in debt levels. To achieve this goal, both the VECM and the ARDL models were considered and estimations were performed. The VECM was necessary due to the non-stationarity of variables and given that the variables were found to be cointegrated. However, since the level of integration was a mix of I(0) and I(1), the study also estimated the ARDL model. The use of an ARDL is also vital as literature confirms its appropriateness in estimating consistent results when the variables are I(0) even in smaller sample periods, where the Johansen technique wouldn't be useful. Both models revealed that the government of Namibia is responding to the changes in debt by adjusting its primary balance, a condition that is necessary for a country to ensure debt sustainability. The debt targeting analysis on the other hand brought to light the fact that it is not enough to only reduce the primary balance for debt sustainability. It is rather necessary that the government should generate a primary surplus and devise strategies to achieve positive and stronger economic growth in order to make a significant impact on the debt levels and therefore guarantee both debt and fiscal sustainability. Namibia for example needs to grow its economy at the levels it was six to eight years back when growth was hovering around 4%-5%, if it is to bring back the debt to the set fiscal rule. This by implication means that the Namibia act more swiftly to its pro-growth strategies such as improving the manufacturing sector contribution to GDP as well as the agricultural sector production, which are regarded as game changes for economic growth in its Fifth National Development Plan (NDP5).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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