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Article

Asymmetric effects of public debt on economic growth: Evidence from emerging and frontier SADC economies

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DEVELOPMENT ECONOMICS | RESEARCH ARTICLE

Asymmetric effects of public debt on economic growth: Evidence from emerging and frontier SADC economies

Bongumusa Prince Makhoba*, Irrshad Kaseeram and Lorraine Greyling

Abstract: This study interrogates asymmetric effect of public debt on economic growth among selected emerging and frontier SADC economies. The study estimates a smooth transition regression (STAR) to analyse asymmetric relationship between public debt and economic growth using time series data from 2000 to 2018, extracted from the World Development Indicators. The findings indicate a strong evidence of a significant asymmetric relationship between public debt among emerging and frontier SADC members under consideration. The results revealed the inverted U-Shape effect of public debt on growth in South Africa. While the results for Botswana, Namibia, Zambia and Zimbabwe indicate that there is a U-Shape relationship between public debt and economic growth. The study suggest that policymakers ought to consider curbing public debt level within a sustainable threshold target in order to reduce accompanying debt serving costs, and efficiently use public finances consistent with sustainable economic expansion.



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PUBLIC INTEREST STATEMENT

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Over the years, the majority of African economies have recorded unsatisfactory levels of economic growth including SADC members. One of the major causes of such an unpleasant economic climate is the lack of well-coordinated public finances and fiscal indiscipline. The primary focus of this research paper is to analyse dynamic asymmetric effects of public debt on economic arowth among selected emerging and frontier SADC economies. This paper allows us to analyse the net effect of the low-debt regime and highdebt regime on economic growth through the estimation of a Smooth Transition Regression approach. The empirical findings of the study indicate that there is an inverted U-Shape effect of public debt on growth in South Africa while Botswana, Namibia, Zambia, and Zimbabwe exerted a U-Shape relationship between public debt and economic growth. The study advocate for a regulated common debt threshold target for SADC members to promote healthy public finances consistent with sustainable regional economic integration and development.





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Subjects: Development Economics; Social Sciences; Development Studies; Economics and Development; Economics; Finance; Business & Conomics; Finance

Keywords: Public debt; Economic growth; Smooth Transition Regression; SADC

1. Introduction

Over the years, several SADC economies have constantly recorded a rapid rise in government spending growing at a much faster and devastating pace compared to government revenues, which have subsequently resulted in a growing fiscal deficit and public indebtedness. This considerable growth of public debt in the SADC region over the years is primarily due to expansionary policy measures adopted by these countries, such as infrastructure investment, technology and development, of SMME's among others. A drastic rise in public debt among these developing economies has become a concern for policymakers as to whether such an increase in government debt enhances or deters long-term economic prospects. Several conventional theories contend that a reasonable level of debt for developing countries would enhance economic growth through effective fiscal policy that aims to accelerate the development of growth-stimulating sectors, such as infrastructure, education and technology (Lee and Ng, 2015).

This study estimates a STAR approach to discriminate against contradictive theoretical and empirical perspectives on asymmetric effects between public debt and economic growth to provide robust SADC-specific empirical evidence. The macroeconomic variables used for empirical investigation include the gross domestic product (GDP), public debt, employment, gross fixed capital formation and government expenditure. A study conducted by Baaziz et al., (2015) in South Africa found nonlinearity from the threshold of 31.37% debt to GDP ratio using variables such as real GDP, public debt, inflation and trade openness. Reinhart and Rogoff (2010) discovered a positive influence of debt on growth up to a threshold of 90%. However, it is critical to note that the unprecedented level of public debt may still jeopardise the pursuit of crucial macroeconomic reforms across different countries.

The current study primarily focused on public debt dynamics and fiscal policy by incorporating fiscal variables and applying recent datasets to determine the rigorous asymmetric effects of public debt on long-term growth among selected emerging and frontier SADC economies. According to the S&P Dow Jones Index Country Classification 2020, South Africa is considered an emerging market, while Botswana, Namibia, Zambia, Malawi and Zimbabwe are classified as frontier economies. These classifications of countries are based on the level of stock market developments and general conditions of the macroeconomic environment (S&P Dow Jones Indices, 2020). The empirical enquiry that incorporates emerging (South Africa) and frontier (Botswana, Namibia, Zambia, Malawi and Zimbabwe) markets allow us to understand dynamic asymmetric effects of public debt dynamics towards sustainable economic growth among SADC economies. An ideal sustainable economy within the context of the study would be one where SADC members enjoy desired economic prosperity with stable public finances.

Several previous studies, such as Reinhart and Rogoff (2010); Checherita and Rother (2012); Herndon et al., (2014) and Baaziz et al., (2015) reported mixed findings on the effect of public debt on economic growth across different global economies. The existing literature provides some considerable ambiguous and contradictive findings on the general impact of public debt on economic growth. Studies conducted by Reinhart and Rogoff (2010), Baum et al. (2013), and Burhanudin et al. (2017) found a positive relationship between public debt and economic growth. While Atique and Malik (2012); Teles and Mussolini (2014); and Lee and Ng (2015) discovered an adverse effect of public debt on sustainable economic growth.

A study carried out by Perlo-Freeman and Webber (2009) pointed out that government debt would bring a positive influence on economic growth if the expenditures are utilised towards productive sectors, such as infrastructure, education and healthcare. The argument of this paper lies in the fact that the impact of debt on growth may be nonlinear in the sense that low debt can lead to growth while excessive debt may hinder growth. This study contributes to the body of knowledge through estimating sophisticated STAR methodology to examine the dynamic asymmetric relationships between public debt on economic growth among selected emerging and frontier SADC economies. This study attempt to fill the gap in the literature by providing new insight supported by rigorous empirical evidence to disseminate a better understanding of asymmetric effects of public debt on economic growth using cutting-edge estimation techniques for selected emerging and frontier SADC economies. SADC economies.

2. Review of literature

Romer (1986), Lucas (1988) and Barro's (1990) pioneered the "Endogenous growth model" which advocates that public debt would bring positive influence on growth prospects but this depends on the nature of public investments financed through public debt. The neoclassical school of thought argue for a robust fiscal policy to drive healthy macroeconomic conditions that would promote sustainable economic activities. The neoclassical theory describes the loosening of fiscal policy as detrimental to output growth through crowding out of private investment. The loosening of fiscal policy does not only lead to higher interest rates but also stifle business activities since the government usually focuses on unproductive spending that has little scope for continuous improvement of macroeconomic conditions consistent with long-term economic prospects (Furceri & Sousa, 2011;; Bardaka et al., 2021). Krugman (1988) advocates for the debt overhang hypothesis which simply implies that debt overhang occurs when the expected repayment of debt falls short of the initial contractual debt. Empirical analysis of asymmetric effects of public debt on growth has received limited scholarly attention particularly from the SADC perspective, among others, these include Reinhart and Rogoff (2010), Antonakakis (2014), and Baaziz et al., (2015).

Several existing macroeconomic theories contend that public debt has a significant negative influence on long-term economic prospects. On the other hand, previous empirical studies yields mixed findings on the nexus between public debt and economic growth. Perlo-Freeman and Webber (2009) postulated that public debt would have a positive impact on long-term growth if public expenditures are directed toward productive sectors, such as education and healthcare. Investing in education and health would directly benefit the society through educational programs which would lead to a significant rise in their ability to self-start and stimulate productivity, and subsequently enhance output growth. A persistent increase of public debt has drawn considerable attention from both scholars and policymakers in addressing fiscal challenges brought by souring fiscal deficit and public indebtedness through the provision of empirical insights supported by conventional theories.

A study carried out by Teles and Mussolini (2014) posited that the impact of public debt would be detrimental to long-term economic growth if the majority of government spending is channelled toward unproductive expenditures and non-stimulating sectors, such as social security and aids. Empirical analysis of asymmetric relationships between public debt and economic growth has attracted the interest of several scholars, yielding inconsistent empirical results from one study to another. A study conducted by Baaziz et al., (2015) investigated the nonlinear effect of public debt on real economic growth in South Africa from the period 1980–2014. Their study revealed that the effect of public debt becomes negative on economic growth when the debt level approaches the threshold of 31.37% debt to GDP ratio.

Reinhart and Rogoff (2010) investigated the nonlinear effect of public debt on economic growth in 20 advanced economies over the period 1946–2009. The study found that government debt becomes detrimental to economic growth when the debt to GDP ratio reaches the 90% threshold. The work of Reinhart and Rogoff (2010) was among the first empirical studies to investigate and discover the threshold effect of public debt on economic growth for advanced economies. However, the work of Reinhart and Rogoff (2010) was later criticised by Herndon et al., (2014) on the accuracy of the 90% debt threshold, arguing that the 90% threshold cannot be defended that debt level of 90% would consistently deteriorate long-term economic growth. Herndon et al. (2013) corrected several methodological flaws on the same dataset used by Reinhart and Rogoff (2010) and discovered that the impact of public debt on economic growth varies substantially from one country to another over time. Herndon et al. (2013) found that a debt threshold of 30% hinders economic growth among these advanced economies.

A study carried out by Checherita and Rother (2012) assessed the nonlinear relationship between public debt and economic growth in 12 European countries over the period 1990–2008. The study revealed that a debt threshold of 90% to 100% stifle economic growth. Another study conducted by Baum et al. (2013) examined the nonlinear effect of public debt on economic growth from 1990 to 2010, using the same set of countries employed by Checherita and Rother (2012), applying a dynamic panel threshold model. The findings of their study showed a significant positive impact of public debt on economic growth for the debt-to-GDP ratio below the threshold of 67%. Moreover, a negative impact of debt was observed when public debt reaches the threshold 95% debt to GDP ratio.

A study conducted by Antonakakis (2014) used both dynamic and non-dynamic panel data analyses to examine the relationship between sovereign debt and economic growth in 12-euro area countries over the period 1970–2013. The study found that non-sustainable debt to ratio above and below 60% threshold have a detrimental effect on economic growth in the short-run while sustainable debt to GDP ratio below 90% threshold exerts a positive influence on economic growth in the short-run. Moreover, the long-run estimate indicates that both non-sustainable and sustainable debt to GDP ratios above the 90% threshold, and non-sustainable debt to GDP ratios below 60% deteriorates long-term real economic growth.

Another study by Lee and Ng (2015) investigated the contribution of public debt on economic growth in Malaysia using quarterly data over the period 1991–2013. The findings of the study revealed that there exists a negative association between government debt and economic growth. The results further found that economic variables, which include the budget deficit, government consumption and external debt service are a decreasing function of real economic growth. Eberhardt and Presbitero (2015) applied a common correlated effects (CCE) estimator to analyse the debt-growth nexus among 118 developing, emerging and advanced economies over the period 1960 to 2012. The study found a negative relationship between public debt and long-run growth across countries, but there was no evidence to conclude on debt threshold within countries.

A recent study by Burhanudin et al. (2017) investigated the effect of government debt on sustainable economic growth in Malaysia for the period 1970–2015. The study estimated the ARDL approach to analyse the dynamic relationship between government debt and economic growth. The findings of the study revealed a significant positive relationship between government debt and economic growth. The results indicated a unidirectional causality from government debt to economic growth. The study claimed that government debt is an important macroeconomic component to stimulate economic activities consistent with sustainable economic growth. The study found no evidence to conclude on the threshold effect at which government debt deters sustainable economic growth.

Bardaka et al. (2021) estimated a panel vector autoregressive to assess the influence of fiscal consolidation on total factor productivity (TFP) among 26 OECD countries from 1980 to 2016. The results found fiscal consolidation to be more harmful TFP of low debt countries in the short run. The study recommended that spending-driven fiscal consolidation is unnecessary as such consolidation would undermine the capacity due to the importance of government spending in shaping productive capital. This section presented evidence of disparity among empirical results reported by previous studies on the relationship under examination. Therefore, the current study intends to shed more light on the body of literature using advanced time series techniques to address the inconsistency of previous studies on asymmetric relationships between public debt and growth. The following section outlines the methodological framework employed during the estimation process to critically analyse asymmetric effects of public debt on economic growth and discriminate against contradicting literature, and thereby provide rigorous empirical evidence specifically for SADC economies.

3. Data and methodology

This section outlines the applicable research methodological procedure employed for empirical investigation. As mentioned earlier, this study estimates a STAR methodology to analyse the asymmetric effects of public debt on economic growth among selected emerging and frontier SADC economies. These countries include South Africa, Botswana, Namibia, Malawi, Zambia and Zimbabwe. According to the S&P Dow Jones Index Country Classification 2020, South Africa is classified as an emerging market while Botswana, Namibia, Zambia, Malawi and Zimbabwe are classified as frontier economies. This combination of both emerging and frontier markets enables us to analyse the asymmetric effects of public debt dynamics towards sustainable growth among emerging and frontier SADC economies.

The specific macroeconomic variables employed throughout the estimation process are gross domestic product (GDP), public debt, gross fixed capital formation, employment and government expenditure. The economic modelling of variables in the model specification is supported by a conventional theoretical framework such as Endogenous growth, Solow model, Production functions, etc., which underpins the relationship under investigation. The time-series data covering the period 2000–2018 were extracted from the World Development Indicators (WDI), Federal Reserve Economic Data (FRED) and Quantec EasyData through online database facilities.

3.1. Smooth transition regression (star) model

This study adopted a STAR approach proposed by Teräsvirta (1998) to examine dynamic asymmetric effects of public debt on economic growth among selected SADC economies. A STAR is the most appealing time series technique to study asymmetric relationships among variables due to its ability to analyse dynamic coefficients during different regimes while allowing coefficients to vary smoothly over time. Unlike other nonlinear methods, such as Nonlinear ARDL, a STAR does not only analyse asymmetries but also threshold effects among variables. Baaziz et al., (2015) contend that a STAR method is the most appropriate approach that captures asymmetric, heterogeneity and time-varying effect within time series analysis. Following Teräsvirta (1998), the standard STAR with two extreme regimes and a single transition function for asymmetric relationships between public debt and economic growth can be written as the following equation:

$$Y_t = \alpha + \beta_0(X_t) + \beta_1(X_t)g(q_t; \gamma, c) + \varepsilon_t$$
(1)

Where Yt represent the endogenous variable (GDP), X_{it} represent a vector of time-varying exogenous variables (PD, EMP, GFCF and GOE). t = 1..., T, represents the time dimension. α is the coefficient of the intercept, and ε_{it} represent idiosyncratic errors in the system. The transition function $g(q_t; \gamma, c)$ in the above equation 1 is a continuous function of the observed threshold variable q_t (public debt) and is normalised to be bounded between zero and one. γ is the slope parameter that drives the smoothness of the transition from the low-debt regime to a high-debt regime, and *c* is the threshold parameter (public debt-GDP threshold). The value of transition variable q_{it} determines the value of $g(q_t; \gamma, c)$ and thus effective regression coefficients $\beta_0 + \beta_1 g(q_t; \gamma, c)$ at time. β_0 measures the effect of public debt on growth when q_t is expected to be below the threshold level q_t . On the other hand, β_1 measures the effect of public debt on economic growth when q_t is greater than the threshold value *c*. If $\beta_0 = \beta_1$ the STAR fails heterogeneity and become a linear regression model. The work of Teräsvirta (1998) modelled the logistic transition function for the time series STAR in the following equation

$$g(q_t;\gamma,c) = \left(1 + \exp\left(-\lambda \prod_{j=1}^m (q_t - c_j)\right)\right)^{-1} \text{with } \gamma > 0$$
(2)

Where, c is a vector of location parameters, and the slope parameter γ determines the smoothness of the transition. This study proceeds to estimate the STAR model as follows

$$Y_t = \alpha_0 + \beta_0 (q_t + EMP_t + GFCF_t + GOE_t) + \beta_1 (q_t + EMP_t + GFCF_t + GOE_t) * g(q_t; \gamma, c) + \varepsilon_t$$
(3)

Where, q_t represents a transition variable (PD_t) followed by other explanatory variables (EMP_t , $GFCF_t$, GOE_t). Teräsvirta (1998) formulated a testing procedure for a STAR model to ascertain the stability and robustness of the model. The stability diagnostic tests include testing for homogeneity, testing no remaining nonlinearity and evaluation parameter constancy. The linearity test is conducted to determine the appropriate transition variable q_t and the most suitable form of the transition function within the STAR. Teräsvirta (1998) suggested the null hypothesis for linearity test H_0 : $\beta_1 = 0$ and we use the LM-type test to test for this null hypothesis. For a STAR model to be applied, the null hypothesis of linearity must be rejected. The STAR is further subjected to conventional several post-diagnostic inspection tests, such as testing for serial correlation, heteroscedasticity, and normality of the residuals. Testing for a number of transition functions examines the null hypothesis of no remaining heterogeneity in the transition function H_0 : ? = 0 If the null hypothesis of no remaining heterogeneity is accepted, then the STAR model confirms the nonlinear relationship between two variables under investigation, that is, public debt and growth, and thus the results of the estimated STAR model would be trustworthy.

4. Empirical results analysis

This section provides a detailed discussion and interpretation of the empirical results of the study. As previously stated, empirical investigation was conducted through the estimation of a STAR methodology pioneered by Teräsvirta (1998) to critically analyse dynamic asymmetric relationships between public debt and economic growth among selected SADC economies.

4.1. Smooth transition regression model (star) estimates

As mentioned earlier, a STAR requires one to test for homogeneity to determine whether indeed the relationship under investigation is nonlinear using Terasvirta Sequential tests. The Terasvirta Sequential test examines the null hypothesis which states that the model is linear against the alternative of nonlinearity. The null hypothesis would be rejected if the F-statistic is insignificant, implying that the relationship is asymmetric. The homogeneity test results based on the Terasvirta Sequential tests revealed that the null hypothesis of a linear model is rejected in favour of nonlinearity at the conventional level [See: Table 1]. This result implies that the relationship between public debt and economic growth is indeed asymmetric.

Terasvirta Sequential test results further pointed to a nonlinear relationship between public debt and growth for Botswana, Namibia, Zambia, Malawi and Zimbabwe. These results are not displayed for the sake of brevity, however, they are available upon request. Therefore, the study proceeded

| Table 1. Linearity test results for South Africa | | | | | |
|--|-------------|---------|---------|--|--|
| Teräsvirta Sequential Tests | | | | | |
| Null Hypothesis | F-statistic | d.f. | p-value | | |
| H3: b3 = 0 | 0.020012 | (1, 47) | 0.8881 | | |
| H2: b2 = 0 b3 = 0 | 2.210034 | (2, 48) | 0.1207 | | |
| H1: b1 = 0 b2 = b3 = 0 | 10.67550 | (2, 50) | 0.0001 | | |

Note: The results for Botswana, Namibia, Zambia, Malawi and Zimbabwe are available upon request.

with the estimation of a STAR to detect the asymmetric relationships between public debt and growth among selected emerging and frontier SADC members.

As previously mentioned, the study estimated a STAR for individual countries to analyse the asymmetric relationships between public debt and economic growth among selected SADC economies. The purpose of this analysis is to provide rigorous evidence-based empirical insight on the asymmetric effects of public debt on economic growth and identify lessons that these SADC member countries can learn from one another. Table 2 provides a summary of the empirical results obtained from a STAR estimated for selected SADC members (South Africa, Botswana, Namibia, Zambia, Malawi and Zimbabwe). The results provide robust empirical evidence of a significant asymmetric relationship between public debt and growth among SADC members under consideration, except for Malawi which carries positive coefficients during both low-debt and high-debt regimes. Findings of a significant, nonlinear effect of public debt on economic growth among selected SADC economies is theoretically plausible and consistent with numerous empirical studies, such as Reinhart and Rogoff (2010), Baum et al. (2013), and Checherita-Westphal et al. (2014) for advanced economies.

The results reveal the inverted U-Shape effect of public debt on economic growth for South Africa. This implies that debt has a significant positive impact on economic growth during the low-debt regime while the effect is positive during a high-debt period, which implies the contraction of the economy. The elasticity coefficient for public debt suggests that if debt increases by 1%, the economy would expand by 0.17% during the low-debt regime significant at the conventional level, ceteris paribus. However, once the threshold is reached, i.e., the economy transits into a high-debt regime, hence a 1% rise in public debt would lead to a 0.014% contraction in South Africa's economy. The finding of a concave relationship between public debt and economic growth in South Africa is theoretically plausible and supported by

| Table 2. STAR estimates for SADC economies | | | | | | |
|--|-----------------|------------------|---------------------------------|----------|-------------------------|----------|
| Variables | Emer SADC Ec | rging onomies | Middle-Income SADC Economies | | Frontier SADC Economies | |
| | South Africa | Botswana | Namibia | Zambia | Malawi | Zimbabwe |
| PD_LOW DEBT REGIME | 0.17*** | -0.58 | -1.5*** | -0.37*** | 0.04 | -0.27* |
| PD_HIGH DEBT REGIME | -0.014*** | 1.28* | 1.29*** | 0.37** | 0.22** | 0.28*** |
| ЕМР | -0.08* | 0.90 | 1.89 | -0.08 | 5.65*** | 0.56 |
| GFCF | 0.36*** | 0.44 | -0.48 | -1.03 | 0.69* | 0.68* |
| GOE | -0.31** | -0.71* | 0.89 | 1.73 | 0.26 | 0.45 |

Note: Asterisks ***, **, and * indicates the significance level at 1%, 5%, and 10%, respectively.

several empirical studies, such as Reinhart and Rogoff (2010), Checherita-Westphal and Rother (2014) and Baaziz et al. (2015), among others. In the case of South Africa, this suggests that public debt below the threshold realises maximum benefits to the economy, while debt beyond the threshold leads to the government perhaps crowding out private investment and engaging in sub-optimal expenditure that causes negative growth.

Conversely, the STAR results for Botswana, Namibia, Zambia and Zimbabwe indicate that there exists a U-shape relationship between public debt and economic growth. The elasticity coefficient for public debt indicates that if public debt increases by 1% in the low debt regime, the respective economies Botswana, Namibia, Zambia and Zimbabwe would decrease by 0.58% (statistically insignificant), 1.5%, 0.3% and 0.27% (statistically significant at conventional level) for Botswana, Namibia, Zambia and Zimbabwe, respectively. In the high debt regime, the growth rate for Botswana and Namibia is a staggering 128% and 129%, respectively. This may indicate that the governments of these economies are highly efficient with the potential to appropriately allocate and manage infrastructural funds to stimulate high growth rates for their economies, given their endowments at their offshores. Alternatively, there is an impressive 37% and 28% for Zambia and Zimbabwe, respectively. This performance is better than that of Malawi at 22%, under a high-debt regime. However, relative to the results of Botswana and Namibia, the governments of these economies appear to be less efficient in appropriately allocating infrastructural funds, given their endowments.

The results for these four SADC members are contrary to the results found for South Africa, indicating that public debt has a significant positive impact during the high-debt regime. It also shows that, during the low-debt regime, public debt has a significant negative effect on economic growth in these countries. The empirical results of a U-shape relationship are unexpected for SADC economies but interesting. It suggests that, for these economies to grow on a sustainable level, public debt must be higher than the debt threshold level. This is perhaps an indication of the lack of diversity and robustness of these economies to attract sufficient private investment for sustainable growth. It may also indicate that government expenditure below the threshold level goes toward consumption expenditure and only beyond the threshold level contributes to infrastructural investment. The group of frontier economies may need to adopt some public finance management policies and strategies from emerging markets (South Africa). This may include appropriate allocation of expenditure towards growth-stimulating sectors such as infrastructure investment, SMME's development, technology and education, which would subsequently enhance economic activities.

Additionally, the STAR estimates for Botswana, Namibia, Zambia and Zimbabwe are somewhat different to that of Malawi concerning the relationship between public debt and growth, before the threshold (low-debt regime). Malawi might exhibit an S-shaped phenomenon, where a 1% rise in debt causes a 0,04% growth in GDP in the low debt regime, although this coefficient is not statistically significant. However, after transitioning to a high debt regime, the impact is at 0.22%. This may indicate a marginally higher efficiency in the allocation of government spending in the Malawian economy towards productive investment under a low debt regime compared to the mentioned countries. While this shows higher returns on growth for Malawi under the high debt regime, the performance of its four counterparts is much better.

The EMP estimate for South Africa indicates that a 1% rise in employment would lead to a 0.08% contraction in the economy. This result is unexpected since, as the number of people employed increases, a complementary growth in output level would be expected. However, the magnitude of this coefficient is too small to exert a major influence on the economy. In addition, this result might indicate that the policy choices that the government (with its alliance to trade unions) has made in favouring high wage labour (thus high marginal product) over low wage unskilled/semi-skilled labour, has meant that additions to the employed labour force that is not highly productive

would cause a drop in productivity on average. Hence, indicating that we might be in stage three of the production process, despite having a high unemployment rate, which largely comprises unskilled and semi-skilled labour.

Alternatively, the EMP coefficient for Malawi posits that if employment increases by 1%, the economy would grow by 5.65%, significant at the conventional level. This finding is plausible as employment growth is expected to correlate with output growth. The EMP estimates for Botswana, Namibia, Zambia and Zimbabwe were found statistically insignificant to influence economic activities. These results may verify the validity of jobless growth among the majority of SADC members, implying that the number of jobs that are created does not contribute significantly to long-term economic growth as expected.

The elasticity coefficient for GFCF indicates that if gross fixed capital formation increases by 1%, the economy would expand by 0.36%, 0.69% and 0.68% for South Africa, Malawi and Zimbabwe, respectively. Moreover, South Africa's economy, being a more diversified and sophisticated economy compared to its SADC counterparts, sees lower returns on investment as expected. The finding of a significant positive influence of gross capital formation on growth is theoretically plausible as supported by the Solow growth model as well as several previous studies, such as Ocran (2011); and Bi et al. (2014), to mention a few. The GFCF estimates for Botswana, Namibia and Zambia were found statistically insignificant. The coefficient for GOE suggests that a 1% increase in government spending would lead to the economy contracting by 0.31% and 0.71% for South Africa and Botswana, respectively. This finding is supported by Perlo-Freeman and Webber (2009) and Teles and Mussolini (2014), who postulated that the impact of government spending would be positive if large a large expenditure is channelled toward growth-stimulating sectors, such as infrastructure investment, education, health, technology, etc. Therefore, this finding may suggest that more expenditure is allocated to sectors that are not stimulative to economic activities, such as social consumption. The GOE coefficients for Namibia, Zambia, Malawi and Zimbabwe were found to be statistically insignificant.

Interestingly, the public debt threshold coefficients carry plausible coefficient signs across all SADC members under investigation. The results reveal a debt threshold of approximately 70% debt-to-GDP ratio in absolute value for South Africa since we are dealing with log-linear equations. The threshold for Malawi and Zimbabwe is 41% and 47% significant at a 1% level of significance. The debt threshold for Botswana, Namibia and Zambia are 58%, 53% and 48%, respectively. However, the threshold coefficient for these three member countries was statistically insignificant. The application of a small dataset became the major limitation of the study during the estimation process of the STAR model, which could explain the divergence of the empirical results on the asymmetries among SADC members that contradict conventional theoretical foundations.

The threshold results among selected SADC members are plausible and strongly support nonlinearity coefficients across selected countries. The high threshold for South Africa indicates that South Africa remains the most advanced economy among SADC countries with the highest debt threshold, sequentially followed by Botswana, Namibia, Zambia, Zimbabwe and Malawi. These findings suggest that frontier SADC economies need to take lessons from emerging economies in terms of redirecting public debt expenditure towards growth-stimulating sectors, such as infrastructure, SMMEs development, technology and education, which are all instrumental to achieving worthwhile regional integration and economic development among SADC economies as enshrined in the SADC treaty. All SADC members under consideration remain well within the threshold of a 60% macroeconomic convergence target as stipulated in the SADC treaty, except for South Africa. This further indicates that South Africa remains the most advanced emerging market among SADC economies. This suggests that South Africa must focus more on private sector involvement, while other SADC members need to focus more on state involvement, such as

| Table 3. No remaining nonlinearity test | | | | |
|--|-------------|---------|---------|--|
| Smooth Threshold Remaining Nonlinearity Tests | | | | |
| Additive nonlinearity tests using PD(-1) as the threshold variable | | | | |
| Taylor series alternatives: b0 + b1*s [+ b2*s^2 + b3*s^3 + b4*s^4] | | | | |
| Teräsvirta Sequential Tests | | | | |
| Null Hypothesis | F-statistic | d.f. | p-value | |
| H3: b3 = 0 | NA | (0, 45) | NA | |
| H2: b2 = 0 b3 = 0 | 5.991204 | (1, 45) | 0.0183 | |
| H1: b1 = 0 b2 = b3 = 0 | 2.388623 | (2, 46) | 0.1030 | |

Note: The results for Botswana, Namibia, Zambia, Malawi and Zimbabwe are available upon request.

attracting foreign direct investment and borrowings, from financial institutions such as the IMF, World Bank, BRICS Bank and the African Development Bank, among others.

The current study opted for a STAR approach for numerous advantageous reasons. The STAR technique is robust and superior in time series asymmetric analysis because it enables us to analyse regime-switching behaviour while capturing the rich asymmetric dynamics among variables during the low-debt and high-debt regimes. Teräsvirta (1998) formulated a STAR model to scrutinise dynamic asymmetric relationships between two or more variables during different extreme regimes. Baaziz et al., (2015) noted that a STAR is the most appropriate model to capture rich asymmetric relationships between variables while allowing for parameter coefficients to vary smoothly over time.

5.1.1. Stability diagnostic inspection

The STAR was subjected to no remaining nonlinearity test to ascertain the stability and robustness of the model. The results of no remaining nonlinearity through the Terasvirta Sequential tests indicated strong evidence that the null hypothesis of no remaining nonlinearity (r = 1) cannot be rejected [See: Table 3]. Therefore, we can conclude that the test for no remaining nonlinearity reveal that there is no remaining nonlinearity in the estimated STAR, implying that there is a single transition function separating the low-debt regime from the high-debt regime on the asymmetric relationship between public debt and economic growth among selected SADC members.

This section provides no remaining nonlinearity results for South Africa, for the sake of brevity. However, the results for other countries under investigation were also tested and found to be similar to these findings, indicating no remaining nonlinearity. Moreover, the study further examined the parameter adequacy of a STAR by applying misspecification tests for parameter constancy. The results showed the null hypothesis that STAR parameters are constant and adequate cannot be rejected. Therefore, this implies that a STAR approach has constant and statistically trustworthy parameters. These results were not reported due to brevity; however, they are available upon request.

4.1.2. Post-diagnostic inspection of residuals

The results for serial correlation conducted using the Breusch-Godfrey Serial Correlation LM test indicated that residuals of a STAR model are not serially correlated. Furthermore, the results of heteroscedasticity tested through the Breusch-Pagan-Godfrey test indicated that residuals of a STAR are homoscedastic. The normality test carried out using the Jarque-Bera test found that residuals are normally distributed. The post-diagnostic test of the residuals indicated that a STAR carries independent and identical residuals.

5. Conclusion

This study provides rigorous empirical evidence of an asymmetric relationship between public debt and economic growth among selected SADC economies. The empirical results revealed the inverted U-Shape effect of public debt on growth in South Africa. While the estimates for Botswana, Namibia, Zambia and Zimbabwe indicated a U-Shape relationship between public debt and growth. On the other hand, Malawi exhibited an S-shaped phenomenon on the relationship between public debt and economic growth.

The findings provide valuable input to policymakers on the importance of monitoring sustainable public finances among SADC members. This study suggests that public debt ought to be allocated towards productive and growth-stimulating sectors that would directly contribute towards long-term prosperous economic growth. These growth-stimulating sectors may include infrastructure investment, education, training and skills development, technology and innovation, and development SMMEs, which would directly contribute to employment opportunities and equip the majority of citizens with relevant skills required in the labour market, and subsequently enhance economic activities.

Furthermore, fiscal policymakers ought to avoid the adoption of unconventional fiscal policies that may lead to excessive public indebtedness that would destabilise the macroeconomy. Moreover, policymakers may consider formulating sound fiscal strategies that aim to ensure that the accumulated public debt remains manageable within a reasonable and sustainable threshold. Furthermore, policymakers must improve the effective use of both fiscal and monetary policy in the most efficient approach that aims to reduce the reliance on public debt by the national fiscus as a stabiliser for public finances if SADC members are resolute on achieving sustainable regional economic integration and development.

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