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# The Response of Macroeconomic Variables to Government Spending Shocks in the Sudanese Economy 1989-2019: Comparing the Structural Shocks (DSGE Approach) and Impulse Response (SVAR Model)

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## Abstract

The importance that different (approaches and models) to modeling the macroeconomy place on theoretical coherence compared to their capacity to match the data and the quality of the econometric model description varies. Dynamic stochastic general equilibrium (DSGE) models are more theoretical, whereas vector autoregression (SVAR) models provide a better match to the data. For developed economies, there are well-established publications on measuring the response of economic indicators to government spending shocks and aggregate macroeconomic activity. In addition, such empirical studies in emerging nations are scarce. This research seeks to fill this void by utilizing the DSGE model and the SVAR approach to investigate the influence of the response of macroeconomic variables to government spending shocks in the Sudanese economy from 1989 to 2019. The findings indicate that the influence of government expenditure shocks on the Sudanese economy is inconsistent with Keynesian principles, as some selected macroeconomic indicators do not respond positively to government expenditure shocks. The non- responsiveness of the inflation rate and exchange rate to government expenditure shocks is demonstrated; this finding may indicate the monetary authority's weakness in managing monetary variables in the Sudanese economy. In most situations, fiscal and monetary policies were in sync, and "double expansionary" and "double contractionary" policy coordination may be the proper approach; and also create tools that fit the Sudanese economy's structure.

**Keywords:** Government spending shocks; Macroeconomic variables; Sudanese economy; Structural vector-autoregressive model; DSGE model

**JEL Classification Code:** C01; C11; C32; B22; E61; F41

## Introduction

Sudan is located on the Red Sea, at the crossroads of Sub-Saharan Africa and the Middle East. Its neighbours include Libya, Egypt, Chad, the Central African Republic, South Sudan, Ethiopia, and Eritrea. The White and Blue Niles join in Khartoum, the country's capital, to form the Nile River, which flows to the Mediterranean via Egypt. Sudan features a Sahelian belt with desert in the extreme north, lush territory in the Nile valleys and the Gezira region, and farming and cattle land throughout the rest of the nation, from Darfur to Kassala via the states of Blue Nile and Kordofan. For the majority of its independent history, the country has endured significant internal conflict, undermining its capacity to play a leadership role in the region. This includes two of Africa's longest-running civil wars, as well as hostilities in Darfur, South Kordofan, and the Blue Nile. South Sudan seceded from Sudan in 2011 under the terms of the Comprehensive Peace Agreement signed in 2005, becoming Africa's 54th independent state. The independence of

South Sudan resulted in a number of economic shocks, including the loss of oil money, which had previously accounted for more than half of Sudan's revenue and 95% of its exports. This has slowed economic growth and resulted in double-digit consumer price inflation, which, along with higher fuel prices, sparked violent protests in December 2019. Sudan began producing oil in the late 1990s, with oil exports fast growing to a peak of US$ 11.1 billion in 2008, accounting for 95.1 percent of total exports. As a result, the Sudanese economy saw a decade of tremendous growth, with GDP increasing from US$ 10 billion in 1998 to more than US$ 60 billion in 2008. Then, in 2011, South Sudan seceded, removing 75% of the oil reserves. This caused a significant irreversible fiscal and external shock to an economy whose spending patterns had been modelled after a 10-year oil boom. The GDP shrank by a total of 20% from 2011 and 2012. Sudan's economy recovered in the mid-2010s, but declined again in 2018-2020 before increasing by 0.5 percent in 2021 [1]. The macroeconomic impacts of changes in government expenditure shocks have gotten a lot of attention in the economics profession, especially since the Great Recession began in 2007. Following in the footsteps of, a large body of literature has used Structural Vector Autoregressive (SVAR) models to characterize the empirical effects of government spending shocks on GDP, inflation, and a variety of other macroeconomic variables [2,3]. Fiscal policy must strike a balance between the requirement to enhance capital formation and the marginal propensity to save by lowering consumption levels and the need to reallocate resources through transfer payments in order to achieve an equitable income and wealth distribution system. The second need may be met at the expense of the former [4].

The main findings show that an unexpected government spending shock has an immediate expansionary effect on real GDP and a sudden positive effect on inflation (WPI) and exchange rate stability, and that the impact is permanent and away from zero in both the small VAR and 'augmented' SVAR models. The findings suggest that pro-cyclical policies targeted at increasing the tax base during periods of recession and stagflation may assist overcome the situation by achieving stability and balance in specific macroeconomic variables. A government spending shock increases real GDP in the short term but stabilizes along the negative axis in the long run, showing that the government must ensure that its spending improves the economy's productive capacity and is channelled in the appropriate direction. The responsiveness of the inflation rate to a government expenditure shock suggests that the government should design fiscal consolidation initiatives to address the rising fiscal imbalance and high inflation. Sudan exhibited an over-reliance on oil earnings during the Sudanese National Congress Party's second term of administration from 2000 to 2011 [5]. The enormous contribution of oil export profits to overall export receipts, which peaked at 95% in 2008, demonstrates the country's reliance on oil revenues. The goal of this study is to quantify the reaction of macroeconomic variables to government spending shocks in the Sudanese economy from 1989 to 2019 using the DSGE model and the SVAR technique. The rest of this study will go as follows. Section 2 examines and contrasts theoretical frameworks and research approaches in this subfield of macroeconomics to identify the DSGE model and SVAR methodology as superior while reviewing the literature on the interaction between macroeconomic variables and government spending shocks. Section 3 describes how the SVAR method and DSGE models are employed in this study, including a description of the sample selection procedure and the determination of essential variables. Section 4 discusses the empirical analysis's main findings. Section 5 calculates the impact and reaction multipliers. Finally, section 6 provides conclusions.

## Theoretical Framework

According to Keynesian theory (1936), which emphasizes the demand side, the economy may not spontaneously recover to full employment during a recession and that the government must intervene and use government expenditure to boost economic growth. In the short run, the aggregate supply schedule is upward-sloping under the Keynesian model of sticky wages, and hence an expansionary fiscal policy would cause real GDP to rise [6]. Macroeconomists are still divided about the quantitative effects of fiscal policy. This uncertainty stems not just from standard errors in empirical estimation, but also from differing perspectives on the appropriate theoretical framework and econometric approach [7]. There is no agreement on how macroeconomic variables - real GDP, consumption, exchange rate, and inflation rate—react to macroeconomics. The behaviour is primarily determined by the econometrics model used. Thus, the dispute over the reaction of macroeconomic variables to government spending shocks in light of growing foreign indebtedness is about more than just the amount of the effect, and there is significant disagreement concerning the underlying direction of the effects [8].

## Literature Survey

### Effects of government spending shocks: what do we know?

The empirical literature frequently yields highly disparate results when it comes to the responses of specific variables to government spending shocks, and the estimated multipliers vary in size between nations and time periods. Existing empirical research are mostly classified into two categories: the Structural Vector Auto regression (SVAR) technique and the narrative approach. The

estimated response changes between the two procedures and is critical to the identifying method used.

### Macroeconomic variables management in Sudan

A detailed examination of the Sudanese economy during the last three decades (the period of leadership of the Sudanese National Congress regime) reveals that it has altered significantly, transitioning from comparatively prosperous times in the 1980s and 1990s to significant volatility in subsequent decades. Overall, Sudan's macroeconomic performance has been weak and unstable, with low or negative growth, severe budgetary imbalances, a volatile and unpredictable exchange rate, a high and unpredictable inflation rate, high unemployment, severe poverty, and underlying external adjustment problems [9,10].

## Data and Econometrics Methods

### Data sources and description

The analysis made use of annual data from 1989 to 2019. The information was gathered from a variety of sources, including the IMF's International Financial Statistics (IFS), the Government Financial Statistics (GFS), and the Central Bank of Sudan. World Development Indicators and the Ministry of Finance and National Economy's Department of Statistics webpage. All variables were converted to a log format. (Figures 1, 2, 3, and 4 demonstrate that the Sudanese economy, as well as the macroeconomic indicators included in the study, are unstable. (Government spending) (GEX) and RGDP, (inflation rate) (INF), and (exchange rate) (EXE) are all mentioned. (Figures 1-4).

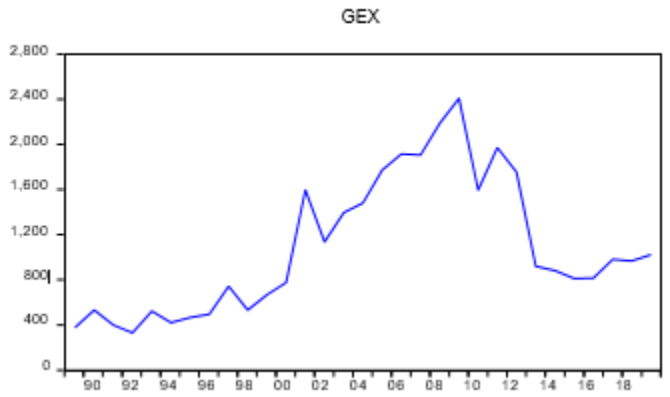


***Figure 1:*** *GEX.*

Government spending remained high since 2000 until it fell due to the south's secession in 2011, and then steadied between 2014 and 2019. The inflation rate was constant from the start of the study period until 2010, and it rose after 2011 due to the transfer of the government's share of oil revenues to the state of South Sudan, and it rose insanely during the popular movement until the study's time series ended in 2019.

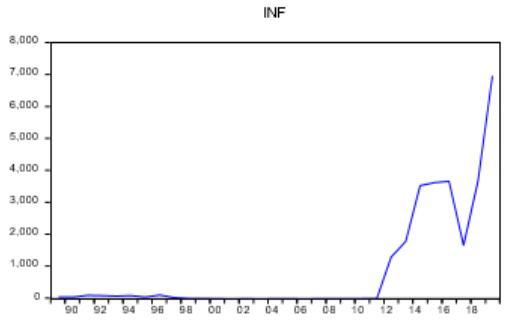


***Figure 2:*** *INF.*

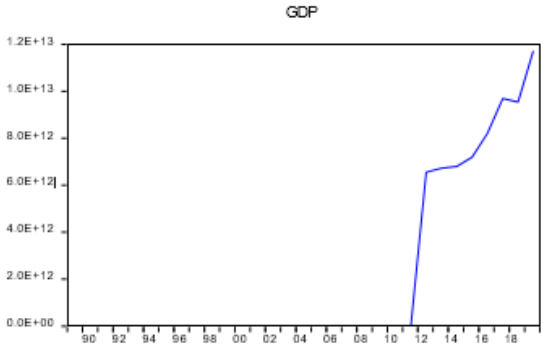


***Figure 3:*** *RGDP.*

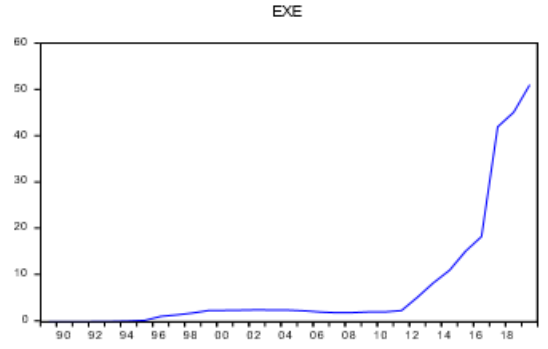


***Figure 4:*** *EXE.*

The data clearly shows that overall consumer spending is increasing till it approaches the conclusion of the time series at very high rates. Similarly, the real GDP variable increased following South Sudan's independence from Sudan. The exchange rate variable was nearly steady throughout the period when Sudan implemented its economic liberalization strategy in 1992. Following South Sudan's secession, the exchange rate variable rose significantly to levels that were difficult for the Sudanese economy to control.

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### Key variables and descriptive statistics

The variables in this study are limited by the SVAR model. An SVAR model with two equations integrating three key variables is articulated in that study: government expenditure shocks (GEXt) and RGDPt, inflation rate (INFt), and exchange rate (EXEt) of the shocks on the economy directly.

### Empirical methodology

Two empirical SVAR models are estimated by using a non-recursive, unbiased identification technique to identify government spending shocks in the Sudanese economy. I evaluate two identification approaches based on macroeconomic variable simultaneity to investigate if the RGDPt, inflation rate, and exchange rate provide information relevant for identifying government spending shocks. First, I present the estimating approach, and then I describe the identification strategy and results. Choosing the best policy for those outcomes.

### Identification in SVAR models

The identificationstrategy in SVAR models is intended to circumvent the challenges encountered in dynamic simultaneous equation models, which frequently result in 'extraordinary' identifying constraints, as Sims puts it [11]. The difficulty of obtaining really exogenous variables that may be utilized as instruments is one of the primary challenges with the traditional approach to identification. This is especially true in monetary economics, where virtually every variable in the monetary/financial sector is endogenously determined given well-established financial markets and rational expectations. Furthermore, for the same reasons, it is difficult to justify a priori that one variable does not influence another. That is, there are few compelling identifying constraints. To address these issues, SVAR models assume all variables as endogenous. VAR models are used to model the sampling information in the data, which models each variable as a function of all other variables. In terms of defining constraints, SVAR models first deconstruct all variables into expected and unexpected components. The identifying constraints are therefore imposed only on the unexpected segment, where credible identifying constraints are more easily found. In terms of monetary policy, the SVAR method recognizes that the policy instrument is mostly endogenously driven, preventing it from being treated as an exogenous variable. After modelling the model's reduced form with a VAR system, the SVAR analysis proceeds to identify the model. A'reaction function in surprises' is modelled to represent unexpected changes in the policy instrument as a function of unexpected changes in the non-policy variable and monetary policy shocks.

### Baseline (VAR) identification scheme

A VAR is an equation, n variable linear model in which each variable is explained by its own lagged value as well as the present and previous values of the remaining n-1 variable. The Blanchard and Perotti approach is used to alter the structural form of an n variable-VAR model. SVAR's major goal is to produce non-recursive orthogonalization of error terms for impulse response analysis. This necessitates imposing sufficient theoretically based constraints to determine the orthogonal (structural) components of the error terms. Taking a look at a simple vector autoregression (VAR) specification:

$$Y_t = A_0 + B\,(L,q)\,Y_{t-1} + U_t$$

Where Yt is the K-dimensional vector of endogenous variables at time t (government spending, GDP, inflation rate, consumption, and exchange rate). Yt-1 is a (K) dimensional vector of lagged endogenous variables; A0 is a K dimensional vector of constants; and B(L,q) is a polynomial lag operator L of order q that permits the coefficients at each lag to rely on the quarter q that indexes the dependent variable. Ut is a vector of innovations that may be contemporaneously linked with their own lagged values while being uncorrelated with all right-hand side variables. Because only lag values of the endogenous variables appear on the right side of the equations, simultaneity is not a concern, and the ordinary least squares OLS approach can produce consistent estimates. Furthermore, even if the innovations Ut are contemporaneously correlated, the OLS approach is efficient and equal to GLS because all equations have the same regressors (Eviews9 User's Guide II, 2015). Based on this, the OLS model for the simplified form VAR model stated below can be computed.

$$Z_t = a + (L,q)_{t-1} + u_t$$

Where $a = A^{-1}A_0$, $D(L,q) = A^{-1}D(L,q)$ and $u_t = A^{-1}U_t$

Because the structure cannot be obtained from the reduced form, the impulse response function (IRF), that is, the dynamic responses of endogenous variables to unit shocks of some of the variables in the system, has no meaningful economic interpretation because reduced form innovations have no direct economic context because they are linear combinations of structural innovations. Furthermore, knowing that u Ik (unit matrix of order k) is frequently correlated in time t complicates the understanding of the reduced form of shocks [12]. Exogenous (nonsample) constraints must be imposed to extract the structure from the reduced form. Explored the influence of fiscal policy shocks on GDP, interest rates, and inflation using pattern matrices to specify the constraints defining limits [13].

## DSGE Model and SVAR Approach

### DSGE-SVAR: the idea

The structural shocks and impulse-response functions obtained by estimation-calibration of the DSGE with those obtained in a Structural Vector Autoregressions (SVAR) identified using some of the DSGE restrictions is a popular validation procedure for Dynamic Stochastic General Equilibrium (DSGE) models [14]. Del Negro and Schorfheide propose a weighted average of a reduced-form VAR and a fully structured DSGE model in their DSGE-SVAR approach [15]. This approach is beneficial for estimating SVAR because it permits eliciting priors for many reduced-form SVAR parameters from priors for a small number of structural parameters in a DSGE model. Because structural parameters often have an obvious interpretation, eliciting priors in the DSGE model is simpler. The DSGE-SVAR can also be used to determine whether the structural DSGE model adequately describes the economy. Based on the reduced-form statistical features of VARs, comparing the DSGE model fit to that of the SVAR offers a relevant metric of misspecification. Formally, the more the weight placed on the DSGE model by the best-fitting DSGE-VAR, the smaller the risk about misspecification [16].

### The mapping between the DSGE and VAR model

It is useful to investigate the mapping between form SVAR and DSGE models in order to see the connections between the two. To be more specific, we will look at the class of structural models known as DSGE models, which are often based on an agent's optimization behaviour and rational expectation construction. In general, the following state-space description can summarize the solution of a linearized DSGE model: [17,18].

$$X_t = B(\theta)\, X_{t-1} + \Gamma(\theta)\, \eta_t$$

$$Y_t = A(\theta)\, X_t$$

Where Xt denotes a n 1 vector of state variables, Yt denotes a m 1 vector of variables observed by an econometrician, and t denotes a k 1 vector of economic shocks such that E(t) = 0 and E(t tr) = I.5 The matrices A(), B(), and () are all functions of the underlying structural equation. Uhlig (2005) proposes an alternate strategy employing the 'penalty function' in addition to the pure sign limitation approach. The procedure's goal is to discover a set of orthogonal shocks that minimizes a given penalty function. However, the choice of the penalty function remains arbitrary and difficult to justify economically. The identification procedure discussed here essentially takes the 'penalty-function' approach and applies it to a more formal framework. To construct the penalty function, we use the previously established mapping between the DSGE and the VAR model. This is appealing because it gives a theoretically consistent method of identifying structural VAR shocks, and the identifying assumptions are motivated by DSGE model constraints. Furthermore, the process can aid in the integration of the two separate approaches to macroeconomic modelling. According to the work of Fernandez-Villaverde, Rubio-Ramirez, Sargent, and Watson, Christiano and Ravenna, the state-space representation of the DSGE model described above has an infinite order VAR process representation, VAR(), if and only if the eigenvalues of the following matrix are equal to one [19-21].

$$M = (In - \Gamma\,(A\Gamma)^{-1}\, A)\, B$$

In absolute terms, are less than one, and the number of shocks corresponds to the number of observable variables, ie: m = k. This is referred to as the 'Poor Man's invertibility condition' or simply the 'invertibility condition' by Fernandez-Villaverde.

## Empirical Results and Discussion

In the first, we look at how macroeconomic variables react to changes in government spending. To do this, the effects and responses of changes in aggregate, current, and capital expenditures, as well as economic stability, are examined. However, two distinct SVAR models are developed to verify that all of the models estimated are stable. The findings are detailed below. Pay note here: the SVAR shocks are not "made of" the relevant structural shocks plus measurement and description mistakes.

### Preliminary analysis

Table 1 displays a variety of descriptive statistics. It is worth noticing that there is a considerable link between the log of real GDP and the log of government spending for all variables.1 Source: shows a time series plot of the four variables, and the graph shows that, with the exception of EXE, the variables have a long-run relationship.

### Unit root and cointegration tests

Verifying the stationarity of the econometric series as a preparatory step before modelling is critical to ensure relevance and validity criteria. The response of Sudanese economic activity to budgetary shocks is illuminated using structural vector auto regression modelling, which provides insight into how these shocks spread through the economy. As a result of the impact and response on Sudanese macroeconomic factors. Visual inspection indicates that the levels of all four series considered in the analysis are non-stationary. The results of the standard augmented Dicky Fuller and Phillips-Perron unit-root tests are shown in (Table 1,2). The test included both an intercept and a linear trend. The results reveal the existence of unit roots in taxes, but they are substantial, implying the rejection of a null hypothesis of a unit root at a 5% level for spending and RGDP. When series are represented by initial differences, the null hypothesis of a unit root can be disproved using ADF, PP, and KPSS tests. This is not the case with GDP, which appears to have a unit root. However, when the Phillips-Perron test is performed, the exchange rate and RGDP have a unit

root in levels, although the hypothesis of a unit root in initial differences can be rejected at 1% significance. Because unit root tests reveal the presence of a unit root in our time series, the next step in testing for time series attributes was a co-integration test. Table 3 summarizes the findings. The Johansen co-integration test results indicate a single long-run relationship between the variables. As a result, a structural vector error correction model that takes the cointegration relationship into account might be estimated. However, this is outside the scope of this work. Blanchard and Perotti also find no significant variation in findings when the cointegration relationship among the variables is imposed. As a result, the SVAR model and DSGE technique used in this analysis are stated in terms of levels and rank.

Table 3 shows the results of a co-integration test that suggests two co-integration vectors. The estimated coefficients of the two co-integration vectors are largely significant in the system, implying that deviations from the long-run relationship have an effect on government expenditure shocks (Table 3). The elasticities of government expenditure shocks to inflation and exchange rates based on impulse responses based on the projected VEC system are 0.32 and -0.57 for two years, 0.43 and -0.98 for three years, and 0.49 and -0.99 for four years, respectively. These findings are consistent with those in table 4 based on the structural VAR with three delays. The lag duration is determined using the Akaike Information Criterion (AIC) and the Schwartz Information Criterion (SIC) (Table 4,5). The computed structural VAR provides the impulse responses of Government expenditure shocks to RGDPt and the inflation rate (INFt), as well as the exchange rate (EXEt). The first stage in model estimation is to explain the long-term features of the data series (that is, to confirm the presence of cointegration relationships between model variables). According to the Akaike parameter (AIC), the time series utilized in this study was unstable for all variables except government expenditure. This suggests that non-stationary level variables should be shifted to the first difference. The tests show that three lags are the optimal amount of delays for our model, which differs from the literature, where lags ranged from four to five periods. However, the Schwarz indicator (SC) indicates that a lag of zero is ideal.

## Empirical approach selection and construction to measure impact and response

According to the Akaike parameter (AIC), the time series utilized in this study was unstable for all variables except government expenditure. This means that non-stationary variations exist. The autocorrelation of macrovariable time series data is high. The vector autoregressive model (VAR model) and the structural vector autoregressive model (SVAR model) can handle time series of macroeconomic data more effectively. In comparison to the VAR model, SVAR identified the relationship that was previously buried in the random disturbance term of the VAR model by introducing the synchronization relationship matrix A. The five variables have a clear contemporaneous link. As a result, this paper abandons the VAR model in favour of building the SVAR model [22-26].

## Effect of Aggregate Government Expenditure

Figure 5 depicts the responses of macroeconomic variables to government expenditure shocks. Initially, there was no response to government spending shocks in Sudan's exchange rate variable during the time, and the figure shows that the response is close to zero (Figure 5). Following this phase, the exchange rate begins to display a good bullish trend that will last until the fourth quarter. The results reveal that aggregate expenditure shocks have a nearly three-quarter lag before their influence on the currency rate. In general, aggregate expenditure shocks have long-term impacts, although their impact on the Sudanese exchange rate is limited. The same is true for the inflation rate's reaction to government spending shocks. We can see from the graph that inflation rates in Sudan did not respond to government spending shocks during the time due to the weakness of monetary policy and its adaptability to the requirements of economic policies. The indication is stable and does not move, as we can see. In the second and third quarters, RGDP responded positively to aggregate expenditure shocks; in the first quarter, the response was weak or non-existent. The level of reaction remained constant in the fourth quarter. This is because the Sudanese economy was unstable throughout the first time of the ruling regime (the National Conference), and the shocks to government spending were obvious during the period when oil was exploited. This discovery contradicts the Furthermore, it contradicts studies such as Blanchard and Perotti [27,28]. This finding contradicts Keynes' argument about the effectiveness of increased aggregate expenditure as an expansionary policy; it also contradicts studies such as Blanchard and Perotti.

## Effects of Economic Stability (Stability of the exchange rate of the Sudanese pound)

A change in the exchange rate of the US dollar versus the Sudanese pound will have an immediate and long-term impact on the balance of the state's general budget and government spending. This is mostly owing to the Sudanese economy's close link to gasoline sales income during the study period. The central bank's expansionary monetary policy has been in place since One of the studied years 2010-2014, which had a more than 16% rise in the money supply, higher inflation, and a high and volatile exchange rate for the Sudanese pound. Thus, coordination of fiscal and monetary policy could pave the road for Sudan to reduce exchange rate volatility. Controlling government spending, increasing

savings, and lowering trade barriers could all benefit the currency. Similarly, gold purchases by the Central Bank of Sudan should be undertaken at the current market exchange rate, not at a higher rate.

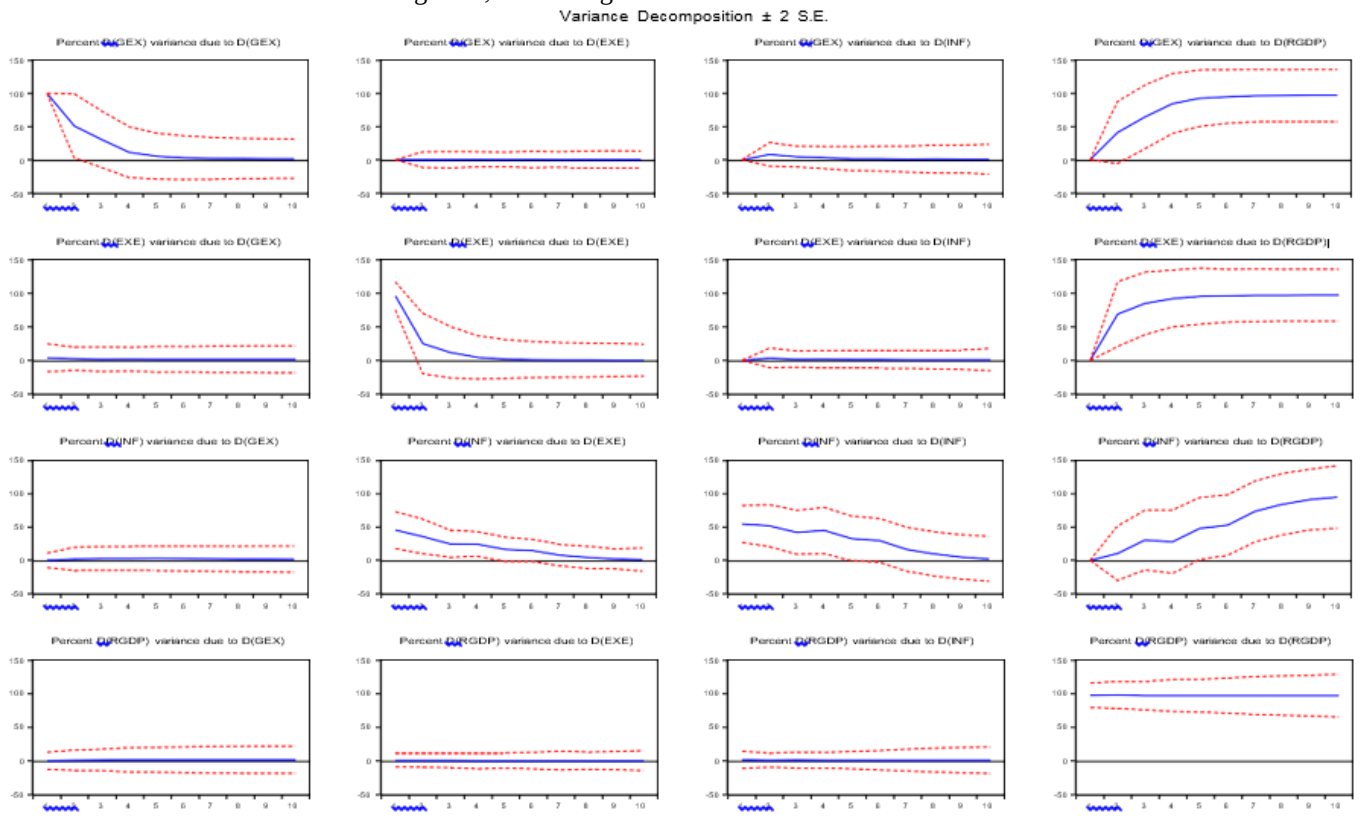


***Figure 5:*** *Impulse Responses to Aggregate Government Expenditure.*

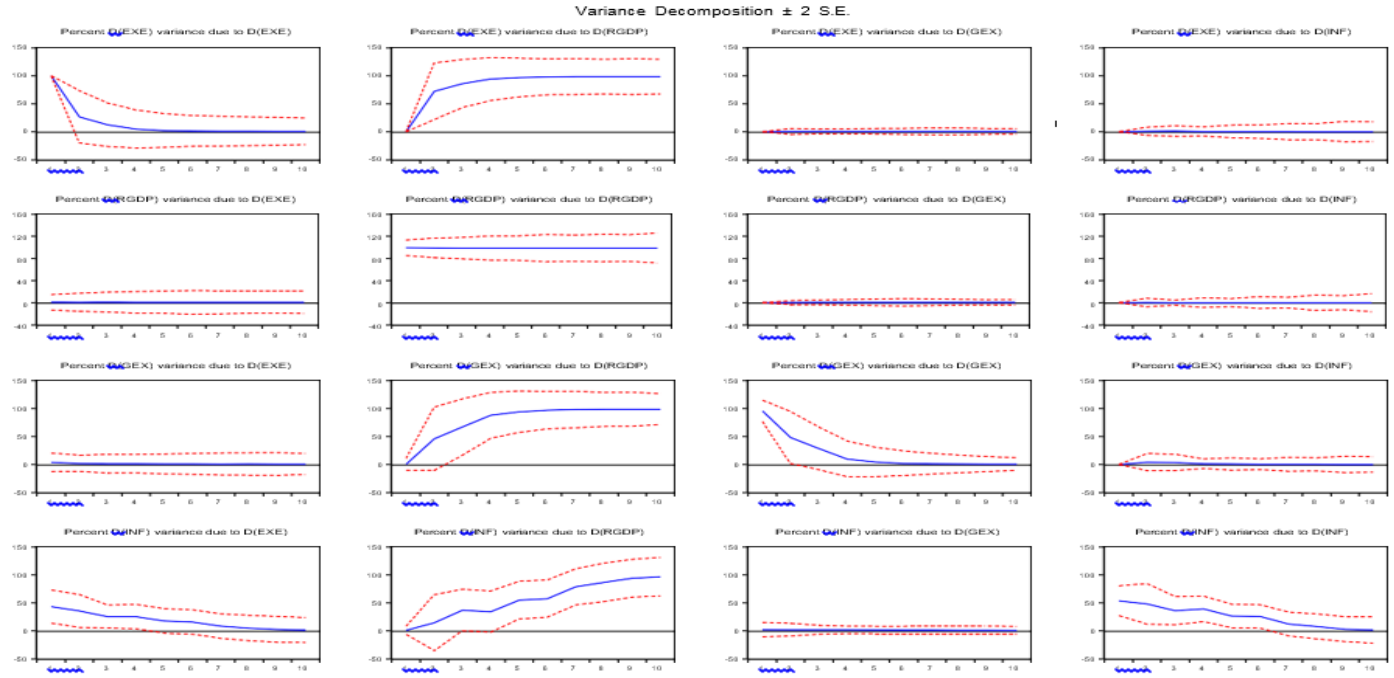


***Figure 6:*** *Impulse Responses to Economic Stability (Stability of the exchange rate of the Sudanese pound).*

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***Table 1:*** *Descriptive statistics.*

| | GEXt | RGDPt | INFt | EXEt |
|---|---|---|---|---|
| **Mean** | 1092.037 | 7346.584 | 884.3227 | 7.572665 |
| **Median** | 921.9192 | 9057.000 | 67.40000 | 2.435800 |
| **Maximum** | 2409.554 | 17335.00 | 6996.754 | 51.25000 |
| | **GEXt** | **RGDPt** | **INFt** | **EXEt** |
| **Minimum** | 333.5026 | -196.772 | 4.900000 | 0.045000 |
| **Std. Dev.** | 607.6726 | 5839.770 | 1692.745 | 13.63368 |
| **Skewness** | 0.565209 | -0.10456 | 2.100037 | 2.344171 |
| **Kurtosis** | 2.073439 | 1.659643 | 6.892949 | 7.148401 |
| **Jarque–Bera** | 2.759467 | 2.377046 | 42.36108 | 50.62013 |
| **Probability** | 0.251646 | 0.304671 | 0.000000 | 0.000000 |
| **Observations** | **31** | **31** | **31** | **31** |
| Source: Prepared by the researcher from the outputs of the E-views13 package. | | | | |

***Table 2:*** *Unit-root test.*

| **ADF Test** ***HO*****: Variable Has a Unit Root Level** | | **P.P Test** ***HO*****: Variable Has a Unit Root Level** | | **KPSS Test** ***HO*****: Variable Is Stationary Level** | |
|---|---|---|---|---|---|
| **Intercept** | **Intercept and Trend** | **Intercept** | **Intercept and Trend** | **Intercept** | **Intercept and Trend** |
| 1.92 (0.99) | −0.18(0.92) | 3.27 (0.99) | 3.49 (0.98) | −4.15** (0.00) | −4.15** (0.00) |
| −0.66 (0.83) | −1.402192 (0.8388) | 4.88 (0.99) | 1.12 (0.99) | 4.61 ($p < 0.01$) | −8.18 *** ($p < 0.01$) |
| −0.77 (0.81) | −5.54* (0.00) | −5.41*** (0.00) | −5.83*** (0.00) | 0.81*** ($p < 0.01$) | 0.27*** ($p < 0.01$) |
| −1.69 (0.42) | −6.69* (0.00) | −01.36 (0.20) | −4. 05* (0.01) | 1.06*** ($p < 0.01$) | 0.17** (0.04) |
| *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. p- values are shown in parentheses. Source: Prepared by the researcher from the outputs of the E-views13 package. | | | | | |

***Table 3:*** *Co-integration test.*

| **Hypothesized No. of CE(s)** | **Eigenvalue** | **Trace Statistic** | **0.05 Critical Value** | **Prob.**** |
|---|---|---|---|---|
| None * | 0.984138 | 214.6437 | 69.81889 | 0.0000 |
| At most 1 * | 0.887123 | 94.47323 | 47.85613 | 0.0000 |
| At most 2 * | 0.494483 | 31.21098 | 29.79707 | 0.0342 |
| At most 3 | 0.314824 | 11.42794 | 15.49471 | 0.1865 |
| At most 4 | 0.015860 | 0.463621 | 3.841466 | 0.4959 |
| Source: Prepared by the researcher from the outputs of the E-views13 package. | | | | |

***Table 4:*** *Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC).*

| Lag | AIC | SC |
|---|---|---|
| **0** | 110.4389 | 110.6869 |
| **1** | 103.4584 | 104.9462 |
| **2** | 95.42835 | 98.15595 |
| **3** | 92.29624* | 96.26367* |
| Source: Prepared by the researcher from the outputs of the E-views13 package. | | |

***Table 5:*** *Accumulated bias for misspecified models (DSGE) and the SVAR model.*

| Mu | DSGE | Period 1SVAR Lag one | Ratio | DSGE | Periods 2SVAR Lage two | Ratio | DSGE | Periods 3SVAR Lage three |
|---|---|---|---|---|---|---|---|---|
| $M0$ | 0.5 | 0.6 | 0.9 | 2.5 | 3.7 | 0.7 | 18.2 | 12.4 |
| $M1$ | 1.1 | 0.9 | 1.0 | 4.3 | 7.5 | 1.1 | 12.9 | 17.8 |
| $M2$ | 2.1 | 1.9 | 1.1 | 4.3 | 4.4 | 1.4 | 17.1 | 21.7 |
| $M3$ | 3.2 | 2.0 | 1.8 | 5.8 | 7.9 | 1.2 | 21.2 | 23.4 |
| $M4$ | 3.7 | 2.4 | 2.0 | 7.3 | 6.3 | 1.2 | 22.7 | 25.9 |
| Source: Prepared by the researcher from the outputs of the E-views13 package. | | | | | | | | |

The constant degradation and fluctuation of the exchange rate across the study period suggests that the exchange rate system used has no effect on the exchange rate's stability. The central bank's many interventions and swings between alternative monetary and fiscal policies, which aim, among other things, to stabilize the currency rate, have failed. To reduce exchange rate volatility, central banks must intervene in exchange rate- determining variables. The model of impulse responses (Figure 6) depicts large inflation responses to simultaneous changes in the exchange rate. When the exchange rate rises by one percentage point, the Sudanese inflation rate rises by 0.39 percentage point. Although the impulse response to an exchange rate shock is usually minor, the lagged cumulative effect is significant in all study periods and thereafter becomes trivial. Despite the fact that the impulse response to an exchange rate shock is small most of the time across all study periods.

- The accumulated bias is calculated as the sum (across different numbers of periods) of the absolute percentage difference between the estimated DSGE model and the SVAR impulse responses with the DSGE.
- The ratio measure is simply the bias of the estimated DSGE model relative to that of the SVAR model.

These findings emphasize a significant distinction between the two models: the SVAR suggests that real shocks, such as inflation rate and RGDP shocks, are more important than nominal shocks (government spending shocks and exchange rate stability) for real economic variables. The aggregate of real shocks is responsible for 23% of RGDP, 7% of inflation, and 3.9% of the exchange rate. The DSGE model, on the other hand, suggests that both real and nominal shocks are equally important. However, it is extremely vulnerable to shocks. Another intriguing finding is that the DSGE model identifies inflation rate mark-up shocks as the primary contributor to the unconditional variation of the exchange rate, RGDP, and government spending, whereas.

## Robustness Check of the SVAR Approach

To test the robustness of the results, we used several variable orderings. The results are identical to the prior order, with no discernible difference. To boost our confidence in our findings, we ran four tests to validate the SVAR approach: serial correlation, heteroskedasticity, stability, and normalcy testing. The results show that there is no serial correlation, no heteroskedasticity, and SVAR meets the stability criteria. The VAR model, however, fails the normalcy test using the Jarque-Bera test. According to Thad Ewald and Buning, the Jarque-Bera test has poor power when applied to small sample size, as was the case in this investigation [29-33].

### Robustness checking

In this study, different approaches for robustness checking were investigated, such as the use of a model without monetary policy.

### Model without monetary policy and fiscal policy

The monetary policy variable was employed in the baseline model. Because the primary goal of this research is to examine the impact of macroeconomic variables' responses to government spending shocks, it is assumed that the model does not include a monetary policy variable. According to the findings of the analysis, the impulse response function of the influence of fiscal policy in the baseline model is nearly identical. Overall, the impulse response function was found to be resilient with baseline constraints.

## Concoction

To improve budgetary balance, the government must gradually reduce oil subsidies. In terms of policy recommendations, it is implied that government spending shock convergence can be achieved by rationalizing spending and developing monetary and financial policy tools that are compatible with the structure of the Sudanese economy, though the latter is more effective in terms of magnitude. As government spending shock convergence across countries is a sign of welfare enhancement, and establishing economic stability and full employment of resources through these policies, the results in this article demonstrate that it is possible. In general, the newly estimated models' results did not differ much from those reported in the preceding part or theoretical section, and they did not agree with the theoretical model's conclusions. In other words, a shock to macroeconomic variables resulted in rising inflation, an unstabilized exchange rate, labour accumulation, and, lastly, a low growth rate. It is critical to stress that the primary contributions of this work to public finances can be stated in two complimentary elements. For starters, by developing an indicator of government spending shocks, it gives inputs for decision-making in both the current and future scenarios. Second, by investigating and highlighting the effects of increased inflation rate and exchange rate on the real and fiscal variables of the economy in a structural model, it is demonstrated that increased government spending shocks negatively affect both economic activity and public accounts, and that the adoption of a fiscal rule can mitigate the adverse effects of increased government spending shocks on public accounts and all macroeconomic variables. Taken as a whole, this conversation can have a positive impact by promoting better fiscal policy planning and consolidation during times of increased government spending shocks. According to the policy, model, and strategy implications, the government should carefully study and identify the sectors or components that have better potential, capacity, and importance in generating sustainable economic growth and rationalizing public spending. The findings shed light on the potential and specific future issues confronting the Sudanese economy. Sudan faces numerous problems, including urgent humanitarian and economic needs, guaranteeing security, justice, and respect for human rights, peacekeeping, and advancing the democratic transition. Fiscal reforms to increase domestic revenue mobilization, reduce subsidies, and strengthen the social safety net; solidifying the transition to a flexible exchange rate and reserve money targeting regime; strengthening the financial sector by transitioning to a dual banking system and reforming the resolution regime; strengthening governance and transparency, particularly in the SOE sector; and creating a more enabling environment for private sector growth.

## Disclaimer

The author's views, results, opinions, and conclusions or recommendations in this scholarly Paper are solely his or her own. They do not necessarily represent the Sudanese government's viewpoint. The Sudanese government accepts no responsibility for any errors or omissions in these scientific publications or for the accuracy of the material included within them.

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