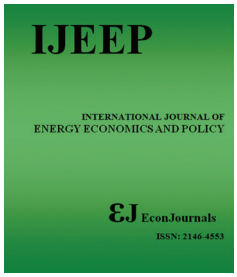

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Impact of Oil Price Shocks on Sudan's Government Budget

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ABSTRACT

There is well established literature on the negative relationship between oil price shocks and aggregate macroeconomic activities for developed economies. However, there is a paucity of similar empirical studies in developing countries. In this respect, Sudan is a prominent example. This paper attempts to address this gap by employing the vector auto-regression model to explore the impact of oil price shocks on the main variables of the Sudan's government budget using quarterly data for the period 2000:q1-2011:q2. The empirical results suggest that oil price decreases significantly influences oil revenues, current expenditure and budget deficit. However, oil price increases do not Granger cause budget variables. Results from the impulse response functions and forecast error variance decomposition analysis suggest that oil price shocks have asymmetric effect on government budget.

Keywords: Vector Auto-regression Model, Oil Price Shocks, Sudan
JEL Classifications: C320, Q430, O55

1. INTRODUCTION

Sudan has shown a tendency of over reliance on oil revenues during the period 2000-2011 (World Bank, 2009). The high dependency on oil revenues is clear from the significant contribution of oil export revenues to the total export proceeds, which reached its peak at 95% in 2008 (Nour, 2011). As can be seen from Figure 1, it also contributed 48.7% on average of the total revenues in the government budget through 2000-2011. This situation had induced the government to increase its public expenditure. However, most of the government spending was directed to non-productive sectors. This is evident from the rapid escalation in the current expenditure compared to the development expenditure as shown in Figure 2. Interestingly, the budget deficit increased despite the surge of oil windfall. This is mainly attributed to the adoption of expansionary fiscal policy and subsidizing oil products for domestic consumption. Moreover, Figure 2 depicts that during the periods 2003-2007 and 2009-2011 budget deficit had worsened. This deficit was financed from domestic and external sources (Abas et al., 2010). The domestic sources were government financial securities, borrowing from the central bank and withdrawals from the oil revenues stabilization account (ORSA). The latter account was established by the government in 2002 to deal with unexpected problems that might affect the economy as a result of oil price fluctuations.

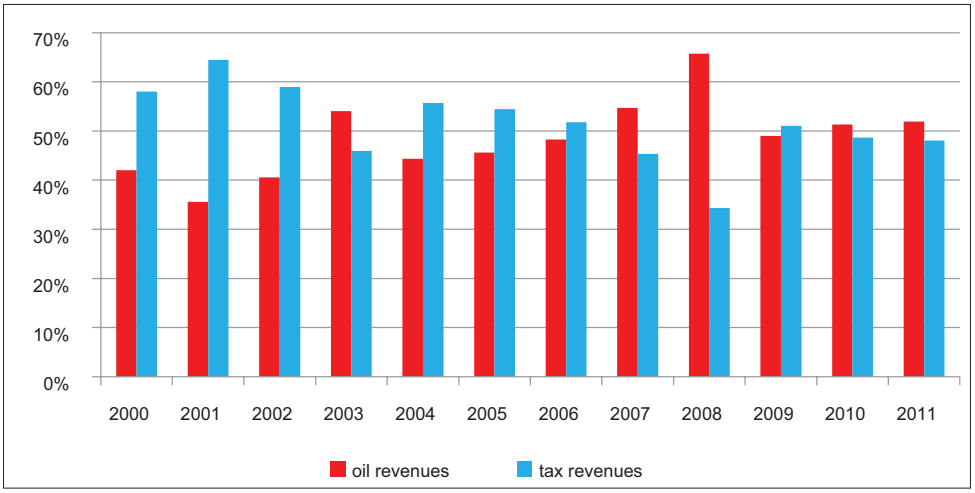
This paper attempts to explore the impact of oil price shocks on the budget variables during the period 2000:q1-2011:q2, that is to say, the period before the separation of the South Sudan in July 2011.

The remainder of this paper is organized as follows. Section 2 discusses the literature review. Section 3 explains data and methodology adopted. Section 4 presents the empirical results and discussion. Section 5 discusses robustness of the findings. Section 6 displays conclusion and policy implications.

2. LITERATURE REVIEW

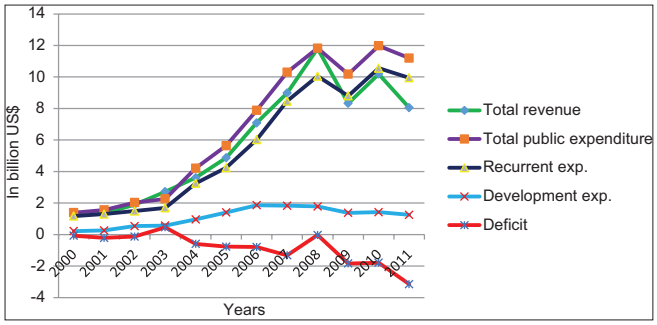
Despite the fact that remarkable attempts of developing other sources of energy, oil by all means is the most important source of energy. Therefore, oil price shocks have spill-over effects on economic activities. Since 1973 many studies have investigated the relationship between oil price changes and macroeconomic variables (Hamilton, 1983; Gisser, 1986; Mork, 1989; Mehrara,

Figure 1: Share of oil and tax revenues in the total government revenues



Source: Ministry of Finance and National Economy, Annual Reports (2000-2011)

Figure 2: Budget variables



Source: Ministry of Finance and National Economy, Annual Reports (2000-2011)

2008; Du et al., 2010; Naccache, 2010). Although there is available literature on the negative relationship between oil price shocks and gross national product for developed countries, the impact on macroeconomic variables in developing countries has not been established yet. This might be attributed, in addition to other triggers, to differences in economic characteristics and the way the fiscal and monetary authorities respond to oil price shocks (Tang, 2010). Numerous empirical studies, among them Hamilton (1983), Mork (1989) and Federer (1996) focused predominantly on the relationship between the oil price shock and the business cycle and some selected macroeconomic variables. But, few studies investigated the impact of oil price shocks on some budget variables, such as those conducted, among others, by Eltony and Al-Awadi (2001) and Farzanegan and Markwardt (2009).

In developing countries, the relationship between oil price shocks and budget variables came up with different conclusions. In Nigeria, Akin and Babajide (2011) report insignificant effect of oil price increases and decreases on government expenditure. However, Oriakhi and Iyoha (2013) claim that oil price volatility has direct significant consequences on real government expenditure in Nigeria. Likewise, in Tunisia, positive and negative oil price shocks have significantly affected government spending (Jbir and Zouari-Ghorbel, 2009). Eltony and Al-Awadi (2001) also claim that oil price shocks Granger causes oil revenues, development expenditure and government current expenditure in Kuwait. This result is supported by Almulali and Che Sab (2013) who suggest that a surge in oil price causes oil revenues to increase in OPEC countries, which in turn impact government expenditure positively. Farzanegan and Markwardt (2009) reported that government expenditure respond negatively to decrease in oil price in Iran. However, in a similar study in Iran, Ebrahim and Mohammad (2012), employing structural vector auto-regression (VAR) model, claim that oil price increase influences government capital expenditure and current expenditure. However negative shocks show greater influence in reducing both government capital expenditure and current expenditure. This is further corroborated by Dizaji (2014) who found that oil revenue (proxy for oil prices) had strong influence on the current and capital expenditure. Also, In Trinidad and Tobago, Lorde and Thomas (2009) stated that increases in oil prices had a positive effect on government revenues and consumption.

3. DATA AND METHODOLOGY

3.1. Data

This research examined the impact of oil price shocks on total government revenue (REV), current expenditure (CUREXP), development expenditure (DEVEXP), tax revenues (TAX), and budget deficit (DEFICIT). These series were obtained from the Ministry of Finance and National Economy, Sudan (Quarterly Budget Performance Reports, 2000:q1-2011:q2). All budget variables are expressed as percentages of gross domestic product. Real oil price is obtained from US Energy Information Administration available online at http://www.eia.gov/. In this research we adopted the non-linear oil price specification proposed by Mork (1989). According to him, oil price change is defined as follows:

$$\text{Positive real oil price (PROILP)} = \begin{cases} O_t \ if \ O_t > 0 \\ 0 \ otherwise \end{cases} \quad (1)$$

$$\text{Negative real oil price (NROILP)} = \begin{cases} O_t \ if \ O_t < 0 \\ 0 \ otherwise \end{cases} \quad (2)$$

Where O_t is the rate of change in real oil price:

3.2. Empirical Methodology

We employed the VAR model, which is widely used in empirical studies that examined the impact of oil price shocks on macroeconomic variables (Hamilton, 1983; Mork, 1989; Jimenez-Rodriguez; 2008, Zhang, 2011). A VAR model composes of a set of variables regressed on their own past values and lagged values of other variables (Guidi, 2009). It treats all variables in the model as endogenous and does not require priori structural identification of variables selecting (Sims, 1980). The general unrestricted VAR model is as follow:

$$Y_t = c + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \ldots + \Phi_p y_{t-p} + \Phi_t \quad (3)$$

Where y_t is (n × 1) vector of endogenous variables; c is (n × 1) vector of constant; Φ_j is (n × n) matrix of autoregressive coefficients for $j = 1, 2, \ldots, p$ where p is lag length; and ϵ_t is (n × 1) vector of white noise term (Hamilton, 1994. p. 257). Generally speaking, researchers use VAR model to analyze Granger causality, impulse response functions (IRFs) and forecast error variance decomposition analysis.

We first test the stationarity and unit root of the series using augmented Dickey and Phillips and Perron and cross-checked by Kwiatkowski, Phillips, Schmidt and Shin. The null hypothesis of the former two tests is existence of unit root, while in the latter series are stationary. Using of the stationarity and unit root tests together is known as "confirmatory data analysis" (Brooks, 2002. p. 379-381). Instead of testing the three equations for stationary (with constant, constant and trend and no constant and no trend), we plotted the data graphically and visually selected the right equation that would be tested. To determine the appropriate lag length we used the information criteria approach. Then we examined the short-run relationships using the Granger causality test (Granger, 1969). Finally, we employed the orthogonalised IRF to determine the dynamic responses of the variables to shocks in oil prices and followed by variance decomposition analysis.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Unit Root and Stationary Tests

Since macroeconomic time series data is characterized by non-stationary, unit root and stationary tests were employed Dicky and Fuller (1979). Table 1 shows the results of the three tests. REV, DEVEXP, CUREXP and DEFICIT variables exhibit non-stationary at level, then become stationary after taking the first difference. NROILP and PROILP and TAX variables are stationary at level.

4.2. Optimal Lag Length

The order of the VAR model was determined by the information criteria: Akaike information criterion (AIC), Hannan-Quinn information criterion (HQ) and Schwarz information criterion. The number of lag that minimizes the value of each of the above mentioned three criteria was chosen as the appropriate VAR order. Table 2 shows that lag one was found to be the optimal lag length of the VAR model as suggested by AIC and HQ criteria.

4.3. Granger Causality Test

Granger causality test determines whether the historical values of one time series is useful in forecasting the values of another series. In this regard, the null hypothesis was set to no causality between variables, if P value is found to be <5% then the null hypothesis would be rejected. Table 3 shows the results of the Granger causality test between the real oil price shocks and the budget variables. It is apparently that oil price decrease Granger causes all budget variables, except tax revenues and development expenditure. Unexpectedly, oil price increase does not Granger cause budget variables. This result is plausible in the case of Sudan, as the price of oil is predetermined (bench mark price) during the preparation of the annual public budget and any increase above the bench price will be deposited into the oil revenues stabilization fund. This result gives an indication to the government to adopt conservative fiscal policy.

4.4. IRFs

The responses of budget variables to real oil price shocks for 10 quarters forecast horizon are presented in Figure 3. The initial response of the tax revenues to oil price increases was positive. While, its response to oil price decrease was negative within the first three quarters, then fluctuated around the zero line and attained equilibrium at quarter seven. For revenues, the oil price increase led to insignificant positive effect, which last for two quarters. Whereas, oil price decreases had significant impact on revenues within quarter two, after that response of revenues hovers around the baseline, then the shock disappears from quarter seven. The current expenditure was boosted as a result of oil price increases within the third quarter. During the fourth and fifth quarters, the response is negative and after that the shock fades away. A significant shrink of current expenditure has been observed as a response to decrease in real oil prices. The response becomes positive within the third and the fourth quarters, then again

Table 1: Unit root and stationary tests

Variables	ADF		PP		KPSS	
	Level	1st difference	Level	1st difference	Level	1st difference
PROILP	0.0000*	-	0.0000*	-	0.3512*	-
NROILP	0.0000*	-	0.0000*	-	0.0582*	-
TAX	0.2513	-	0.0268*	-	0.5306*	-
REV	0.2349	0.5382	0.1120	0.0000*	0.5266*	0.3048*
DEVEXP	0.3380	0.1906	0.0203*	0.0000*	0.0000	0.2936*
CUREXP	0.1881	0.0000*	0.1916	0.0000*	0.12998*	0.5000*
DEFICIT	0.1469	0.0000*	0.1496	0.0000*	0.0689*	0.6002*

*Significance at 5%. ADF: Augmented dickey Fuller, PP: Phillips and Perron, KPSS: Kwiatkowski, Phillips, Schmidt and Shin

negative by the end of quarter five. The development responded positively to oil price increases. It became slightly negative in the following quarter, then positive but close to the base line and fades away thereafter. On the other side of the coin, the development expenditure responded negatively to decrease in real oil prices, followed by a positive effect within quarters three and four. After that it declined during quarter five. The budget deficit shrank within the first and second quarters and then positive during quarters three and four In contrast, the budget deficit worsened as the response to oil price decreases. From Figure 3, it is clear that there was a delay of 2 months for the effect to take place. This result is very plausible in the case of Sudan as the government generally receives its oil revenues 2 months from the date of shipment. Based on the above, the government has to put in place policy measures that sustain the level of oil revenues used in the annual budget and lift oil subsidies to improve the fiscal stance.

Table 2: Optimal lag length

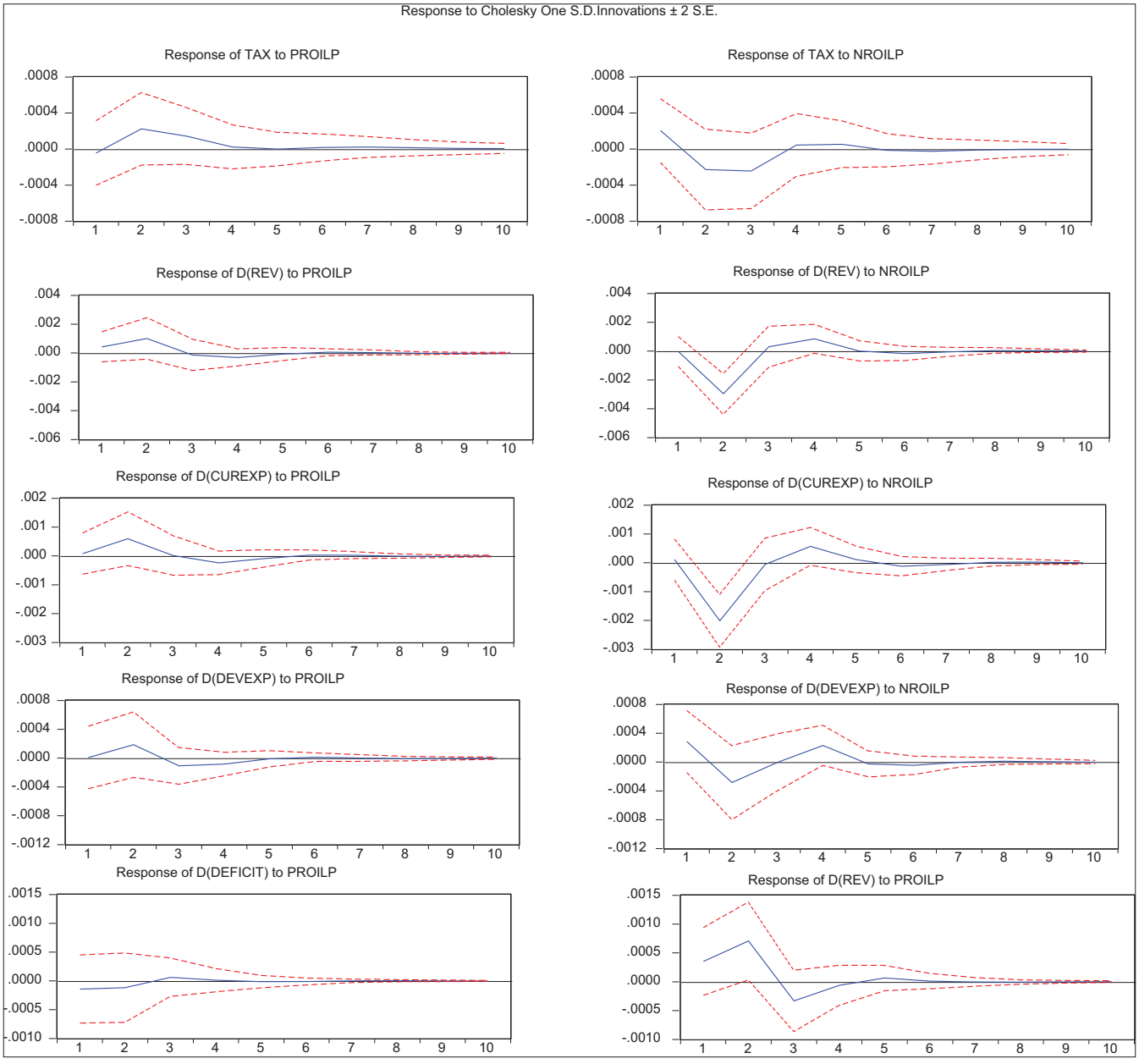
Lag	AIC	SC	HQ
0	−55.20540	−54.91579*	−54.49472
1	−55.34395*	−53.02706	−55.09925*
2	−54.50001	−50.15583	−52.90769
3	−54.33437	−47.96292	−51.99898

*Indicate lag length selected by the criterion. SC: Schwarz information criterion, AIC: Akaike information criterion, HQ: Hannan-Quinn information criterion

4.5. Variance Decomposition

Table 4 shows the forecast error decomposition analysis of the budget variables over 10 quarter time horizon. In general, variance decomposition analysis demonstrates that negative oil prices have greater explanatory power than positive shocks. The decrease in real oil price is the second determinant factor on changes in tax revenues, after the shock of the tax itself, with an

Figure 3: Impulse response functions of shocks to positive and negative real oil prices



average contribution of 5%. Increases in real oil price explain relatively little of the future variations in tax revenues. Looking at the total revenues, oil price increases account for 4.6% of the variation, whereas decreases explain more than 32% through the whole period. Likewise, tax explains the major variation in the total revenue with an average of 36.4%. This result shows that the government depends to a greater extent on the oil revenues and tax as the main sources for financing its budget. Regarding the current expenditure, the major variations are explained by the tax revenue and oil price decreases, with an average contribution of 22.5% and 51%, respectively. The increase in real oil prices accounts on average for 3.6% of current expenditure variability. With regard to development expenditure, positive real oil price marginally contributes to changes in development expenditure. However negative shocks explain on average 6.4% of the variations. Finally, negative shock accounts on average for 14.1% in budget deficit changes, while the positive explains on average 0.76%. The result of the decomposition analysis is consistent with the IRFs results. It is apparent that the effect of increase or decrease in real oil prices on variables in quarter one is marginal, but become greater in the consecutive quarters.

Table 3: Granger causality test

Null hypothesis	P value
Oil price increase does not Granger cause	
Tax revenues	0.1820
Total revenues	0.3977
Current expenditure	0.5684
Development expenditure	0.3635
Budget deficit	0.9250
Oil price decrease does not Granger cause	
Tax revenues	0.1216
Total revenues	0.0000*
Current expenditure	0.0000*
Development expenditure	0.6023
Budget deficit	0.0346*

*Significance at 5% level

5. ROBUSTNESS CHECK OF THE VAR MODEL

We used different ordering of variables to check the robustness of the results. The outcomes are similar to the previous order and no change is observed. To further increase the confidence level in our results, we have carried out four tests to validate the VAR model, namely serial correlation, heteroskedasticity, stability and normality tests. The outcomes are that no serial correlation, no heteroskedasticity and VAR satisfy the stability condition. However, the VAR model fails to pass the normality test using Jarque-Bera test. According to Thadewald and Buning, (2004), Jarque-Bera test suffers from low power when used for small sample, which is the case in this study.

6. CONCLUSION AND POLICY RECOMMENDATIONS

This empirical research employed VAR methodology to examine the effect of oil price shocks on the Sudan's annual public budget over the period 2000:q1 to 2011:q2. Results from the Granger causality test showed that cause running from negative

Table 4: Variance decomposition analysis

Period	PROILP	NROILP	TAX	D (REV)	D (CUREXP)	D (DEVEXP)	D (DEFICIT)
Variance decomposition of TAX							
1	0.136823	2.979993	96.88318	0.000000	0.000000	0.000000	0.000000
4	2.688150	5.709031	75.84189	1.345643	0.374362	0.298185	13.74274
8	2.435207	5.222995	74.40511	1.325299	0.523921	0.288693	15.79877
10	2.415272	5.173560	74.26727	1.329256	0.533242	0.289427	15.99198
Variance decomposition of D (REV)							
1	1.515649	0.003227	41.81589	56.66523	0.000000	0.000000	0.000000
4	4.687229	34.44109	32.51219	26.28807	0.370366	0.982001	0.719053
8	4.694173	34.34028	32.43147	26.21139	0.379104	1.006820	0.936764
10	4.693986	34.33444	32.43304	26.20583	0.379117	1.006832	0.946757
Variance decomposition of D (CUREXP)							
1	0.116343	0.213431	66.71811	2.701869	30.25025	0.000000	0.000000
4	3.566978	36.91806	38.48579	3.173106	14.50402	0.702337	2.649702
8	3.618083	36.85881	38.28576	3.258533	14.40232	0.731230	2.845263
10	3.618486	36.85300	38.28542	3.258558	14.39842	0.731275	2.854843
Variance decomposition of D (DEVEXP)							
1	0.003347	3.932074	57.84686	0.069720	7.277734	30.87027	0.000000
4	1.848247	7.489594	54.88727	1.592769	6.989723	23.61365	3.578751
8	1.836869	7.502837	54.75940	1.667321	6.921875	23.36399	3.947717
10	1.836318	7.497863	54.75755	1.668284	6.917021	23.34524	3.977730
Variance decomposition of D (DEFICIT)							
1	0.521386	3.211899	5.375174	71.33436	2.016172	8.871069	8.669942
4	0.768500	14.92202	9.805129	58.36808	1.784880	7.254032	7.097351
8	0.773830	14.99100	9.805497	58.29984	1.784098	7.246078	7.099654
10	0.773835	14.99058	9.807505	58.29786	1.784111	7.245832	7.100272

oil prices to total revenues, current expenditure and deficit. Positive oil prices failed to Granger caused all budget variables at 5% significance level. This is attributable to the adoption of the benchmark price of oil in the annual budget to limit the use of oil revenues and deposit surpluses above that benchmark price into the ORSA. We concluded that a decrease in oil price significantly affected the budget variables except tax revenue and development expenditure. Likewise, tax revenue significantly influenced all budget variables except budget deficit. Therefore, the government of Sudan has to adopt a conservative approach in determining the oil price that will be used in the budget to avoid persistent withdrawals from the bank and non-bank sources. Also, a prudent tax policy should be put in place to broaden the tax base rather than increase tax rates during the periods of oil price drop. Furthermore, the government has to lift oil subsidies gradually to improve the fiscal balance stance.

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