

# An Empirical Analysis of the Relationship between Private Saving and Some Macroeconomic Variables in Sudan

Dr. Elzein Abd Alla Yousif Ahmed\*, Dr. Lena Bedawi Elfadli Almonshid\*\*, Duaa3 Salah Saeed Al Tom\*\*\*

\* Department of Economics, College of Economics and Rural Development University of Gezira, Sudan.

\*\*Department of Finance and investment, College of Business Administration, University of Tabuk, Saudi Arabia.

\*\*\* College of Economics and Rural Development University of Gezira, Sudan.

DOI: 10.29322/IJSRP.12.03.2022.p12309

<http://dx.doi.org/10.29322/IJSRP.12.03.2022.p12309>

Paper Received Date: 10th February 2022

Paper Acceptance Date: 1st March 2022

Paper Publication Date: 6th March 2022

**Abstract-** The objective of the paper is to analyze the relationship between private saving and some variables affecting the macroeconomy in Sudan. For this purpose, the Vector Auto Regression (VAR) model was applied to estimate the interrelationship. The results of the estimated (VAR) model revealed that the coefficient of consumption at first lag is statistically significant to influence the current consumption positively. Also, consumption and investment at first lag are statistically positively associated with current investment. Accordingly, the results showed that consumption and private saving at first lag are statistically positive connected with current private saving and consumption. The results showed that a change in consumption Granger causes a change in private saving, which explains that there is a causal relationship running from consumption to private saving. These results indicate that economic growth could stimulate private saving, and that private savings could accelerate economic growth in the long run. Based on the above results, the study recommends that the government should ensure economic and political stability in order for the country to enjoy the benefits of sustained capital inflows; policy makers should encourage domestic savings through increase in incomes and reduce unnecessary consumption. In addition, investment policy in the country should be revised seriously in order to redirect investment inflows for more productive and more efficient sectors to promote growth of national income, thereby directly increasing private savings.

**Index Terms-** Private Saving, consumption, investment, Economic growth. Sudan

## I. INTRODUCTION

The interrelationships among macroeconomic variables held the attention of researchers to address the importance of these variables and their linkages related to economic growth. Savings is considered a necessary engine for economic growth. Capital formation emerging from savings levels creates economic growth, in turn, and increase rates of savings. These are the approach to

gain increase within the Harrod–Domar model (Jagadeesh, 2015). Dhakal et al (1991) stated that the link between the domestic saving rates and the real production growth rates has received great interest in growth and development literature. The literature has proven that a coverage that encourages the saving and funding is essential to accomplishing sustained economic development, where saving and investment relationship is an essential factor in the Harrod-Domar economic growth model (Poveda, 2013). Jagadeesh (2015) Argued that saving creates capital formation and it, in addition, ends in technical innovation and development improving the economies of large-scale production and will increase specialization, which facilitates boosting up the productiveness of hard work ensuing, in addition, will increase in GDP. Thus, saving ends in fuller usage of scarce assets efficiently to be had; growth within the length of the countrywide output, profits, and employment, thereby fixing the issues of inflation, unemployment, and stability of payments, poverty, inequality. Thus, making the financial system lose from a load of overseas debt and ending in a country of higher welfare. According to Otiwu et al (2018) Saving is defined as a portion of disposable income that is not spent on consumption but is accumulated or invested directly in capital equipment, the payment of a home mortgage, or the purchase of securities. Saving denotes the decision not to spend money. Retirement, precaution, and bequest are three key motivators that lead to such a decision. There is also a goal of saving for the purchase of tangible assets. The two motives for saving are not mutually exclusive. Private savings are important in both developed and developing countries because they enable households to smooth consumption in the face of volatile incomes while also supporting investments in human and physical capital. Domestic savings, as is well known, encourage greater investment and, as a result, higher growth rates. Domestic savings are an important resource for developing countries, but they are extremely vulnerable to external shocks. A low per capita income is one of the characteristics shared by developing countries, making it difficult to fund investments. In terms of macroeconomic indicators, one of the most important

subjects in developing countries is the savings-investment gap. (Gocer et al, 2016).

Mixture saving and investment in any financial system depend on a number of interdependent variables. For monetary making plans functions, it's far vital that monetary planners have a true and honest concept about the quantum of saving and investment, the behavior of humans closer to saving and investment, and the technique by using which financial savings can be stepped forward for funding decisions. historically, nations that have completed and preserved excessive increase rates over long durations are the ones that have been capable of preserving high home financial savings, taking into consideration the sturdy and sustained domestic investment. (Otiwu et al, 2018). In addition, saving contributes to economic development as it expands capacities and enriches people's lives and encourages lively creative individuals and communities in addition, it is considered a significant source of investment financing in any country and a tool for achieving macroeconomic stabilization. (Abdelmawla and Yousif, 2016).

The Sudanese economy has experienced a number of difficulties such as rigidity of supply, internal and external imbalances, higher inflation rates, all of which have contributed in one way or another to the low rates of savings in the economy. (Abdelmawla and Yousif, 2016). The country has suffered greatly from its low level of domestic resource mobilization due to the lack of adequate incentives to encourage savings. It depends on tax revenues, especially indirect taxes, which have overburdened the poor and deepened poverty. Lack of domestic resources to finance recurrent and development expenditures have forced the country to resort to loans and foreign aid to fill the resource gap. conditions and thus exacerbating the pressure to depend on foreign finance and aid, the imbalances and deficits in the budget and the external sector in the 1970s caused Sudan to seek foreign aid at all costs to finance expenditure. essential currents, which were mostly unproductive (Ahmed, 2008).

## 1.2 The Study Organization

Section 2 discusses the theoretical framework, Section 3 illustrates the methodology and data used in the research, and Section 4 discusses the empirical results. Finally, section (4) concludes the study with final remarks and policy implications.

## II. LITERATURE REVIEW

Saving is defined as the portion of income that is not spent by economic units. Saving is defined by Samuelson (1998) as income less consumption. savings or accumulated savings Personal savings refer to the portion of disposable income that is not spent, whereas corporate savings refer to the portion of a company's profits that is not distributed to shareholders as dividends. Thus, a country's total savings supply is simply the sum of domestic and foreign savings. Domestic savings, on the other hand, can be divided into two components: public sector or public sector savings and private foreign savings. (Otiwu et al, 2018).

The importance of savings for investment has received a considerable attention in growth theory. According to Todaro (1977) One of the primary 'tricks' of development required for any take-off is the mobilization of domestic and foreign savings to generate enough investment to accelerate economic growth. Every

economy must save a portion of its national income, even if it is only to replace capital goods. (Mualley, 2011).

As a result, while investment helps to raise overall wealth, funding cannot rise without increasing the amount of money saved. As a result, financial savings play a critical role in supplying the country's capacity for funding and production, as well as having an impact on the capacity for financial growth. Low saving rates are a significant stumbling block to a long-term financial boom. According to popular belief, rising diversified financial savings contribute to better funding and lead to faster GDP growth in the short term. It means that improved saving rates lead to reduced consumption, which could result in a huge amount of capital funding. (Rasmidatta, 2011).

## 2.1 Saving, Investment and Consumption in Sudan

Sudan is a developing country with abundant natural resources. The total area suitable for cultivation is 300,000 square kilometers, of which only 60,000 are used, with forests and pasture accounting for one-third of the used area. According to the 1959 water sharing treaty with Egypt, the White and Blue Niles, as well as the Atbara, Rahad, Dindir, and Sitait rivers, carry 93 billion cubic meters of water annually, with Sudan's share being 18.6 cubic meters. Traditional agriculture provides the primary source of income for 80 percent of the population. However, the first shipment of Sudanese oil arrived in the fourth quarter of 1999. (Arabi, 2014).

### 2.1.1 Saving

The average saving rate in Sudan as a developing country is below ambitions. Lack of adequate domestic finance is a major obstacle to development in the country. Based on data collected from the Central Bureau of Statistics, the Sudan average saving ratios during the periods (1990-1994) and (1995-1999) were estimated at 4% and 5.5%, respectively. The situation improved after the oil exploration in 1999, where the saving rate reached 23% during the period (2000-2004), while it dropped since then to reach 20.6%, 17.6%, and 21.07% during the sub-periods (2005-2009), (2009-2013), and (2014-2018), respectively.

The Central Bank of Sudan (CBOS) coordination with the Ministry of Finance and National Economy and the rest of the economic and social sector of the financial and social sector ministries to set policies for the yr 2012 these guidelines are primarily based on the hints and desires of the 3 years software (2012-2014), which has been designed and tailored to address the poor effects on the Sudan economic system attributable to the go out of sources of the oil produced in South Sudan after the secession, which turned into then on progress. The 3 years software (2012-2014) has recognized 4 pillars for the economic, monetary, financial, and social regulations which might achieve, on the quit of the duration, recovery of the inner and outside equilibrium of the financial system and hence resumption of sustainable financial boom beneath stability. the pillars are: the monetary policies, the financial regulations, the actual region guidelines, the social balance rules

### 2.1.2 Consumption

Consumption is a fundamental concept in economics and other social sciences. Economists are particularly intrigued by the

relationship between consumption and income, which serves as a model of the consumption function.

According to Badour (2016) in the period (1990-2008), there was an increase in real GDP from SDG 1.20 billion in 2000 to 2.55 billion by the end of 2008 with an annual average growth rate of 9.2% between (2000-2008). This increased real consumption from SDG 1.28 billion in 2000 to SDG 2.23 billion at the end of 2008 with an annual average growth rate of 7.6% during the period (2000-2008). The per capita real consumption increased from 4.4% to 5.8% between the years 2000 and 2008 as a direct result of oil production and export. The average growth rate of per capita real consumption ranged at 3.6% during the years (2000-2008). In addition, the growth rate of per capita real consumption was estimated at 3.6% between (1990-2008); real consumption grew at 5.6%, which is apparently less than the real GDP growth rate estimated at 6.7% for the whole period, which may be attributed to population increasing and civil war. The growth rate of per capita real consumption estimated at 3.9% between (2008-2013); real consumption grew at 5.4%, which is apparently less than the real GDP growth rate estimate at 6.6% for the period. Finally, we notice that gross or overall real consumption increased from SDG 0.75 billion in 1990 to 2.23 billion at the end of 2008 with an annual average growth rate of 5.6% between (1990-2008). This is justified by the increase in real income from SDG 0.82 billion in 1990 to SDG 2.55 billion at the end of 2008 with an annual average growth rate 6.7% during (1990-2008) and during (2008-2013) 6.6% this is justified by lack of exports of petroleum (Badour, 2016). According to the Central Bank of Sudan (2018), the consumption growth rate declined from 40.8% in 2014 to 8% in 2016, while in 2017 it increased to 19.6%; and increased more rapidly to reach 54.2% in 2018, which attributed to the rising inflation rate in 2018.

### 2.1.3 Investment

Sudan is wealthy with its ample sources, which are represented in enormous regions of land, and diverse climates. Its miles are special with its fertile agricultural lands, a massive quantity of fresh water, and a variety of animal assets. The extraction of petroleum gave Sudan a crucial economic measurement. This is except the distinguished geographic location of Sudan which makes it Sudan a passage to different African countries. This qualifies the country as one of the industrial and funding inlets of those nations (Abdulrahman, 2015).

Abdelmawlal and Siddig (2011) After studying the characteristics of real GDP and real domestic financing, Granger's bivariate causality examines between financial increase and internal financing and the effects of financing tax and degree of openness to change on the financial increase in Sudan over the course of time (1990-2009). the use of ordinary least squares (OLS) and Granger causality takes a look. The (OLS) explains that real GDP and real financing in Sudan have shown huge real stretches for the considered duration, with projected annual joint incremental costs of 7.4% and 9.5%, respectively. While Granger's causal analysis confirmed that actual funding justifies the financial increase along with the financial increase, this is not always due to actual funding. Moreover, the results show that each of the coefficients of the financing load and the openness to change stimulate the financial increase. Based at the Central Financial Institution of Sudan (2018), the burden of increasing funding

decreased in duration (2014-2016) from 34.2% in 2014 to 30.5% in 2016, after which it is significantly reduced to 1.3% in 2017 while increasing rapidly. in 2018 to reach 72.3% this due to the growth of the inflation rate in 2018t.

## III. METHODOLOGY, DATA AND EMPIRICAL RESULTS

This chapter focuses on research methodology, analysis, and discussion of empirical results. The examination makes use causality technique to observe the relationship between, investment, consumption, and private saving in Sudan using the VAR version framework utilizing annual data. The data was collected from the Central Bureau of Statistics covering the period (1980-2018). For this purpose, the stationarity test, the Granger Causality/Block Exogeneity, and the Wald Test were applied for analysis of the data. The Ordinary Least Squares (OLS) technique has been used to estimate the VAR model. Also, Wald test has been used to examine the significance of the explanatory variables in the model. While, the Variance Decomposition technique is used to explain where there is a shock or change in one of the variables and the effect of this shock on the variable itself and other variables.

### 3.1 Stationarity Test

Stationary tests can be used to determine whether or not a series is stationary. There are two approaches: stationary tests like the Kwiatkowski Phillips Schmidt Shin (KPSS) test, which considers the null hypothesis "Ho" that the series is stationary, and unit root tests like the Dickey-Fuller and Philips Z-test. In the field of statistics, The Dickey-Fuller test determines whether or not a unit root exists in an autoregressive model. The alternative hypothesis varies depending on the version of the test used, but it is typically stationary or trend stationary. It was created by statisticians David Dickey and Wayne Fuller, who named it after them (1979). It is based on the regression of the observed variable on its one-period lagged value, which may or may not include an intercept and time trend. The Augmented Dickey-Fuller (ADF) test is a significant extension of the Dickey-Fuller t-test for a unit root. The Augmented Dickey Fuller model is used in this study (ADF).

### 3.2 The VAR Model

Sims (1980) was the first to propose Vector Autoregression (VAR) models as an alternative to large-scale macroeconomic models. Since then, the methodology has grown in popularity in applied macroeconomic research. (Bjornland, 2000). The VAR model is a time series dynamic multivariate extension of the univariate autoregressive model. The VAR model has several advantages, including the fact that it is the most successful, flexible, and straightforward model for analyzing multivariate time series. The VAR model has been demonstrated to be especially useful for describing the dynamic behavior of economic and financial time series, as well as forecasting. Forecasts from univariate time series models and complex theory-based simultaneous equations models are frequently outperformed. (Zivot and Wang, 2006).

The VAR model is a multi-equation system with all variables having endogenous variables. As a result, each variable has its own dependent regress equation, with lagged values for all

of the included variables, including the dependent variable, as dependent variables. Because no contemporaneous variables are included as explanatory, right-hand side variables, the model is simplified. As a result, because the right-hand side variables are the same, all equations have the same form. (Olanrewaju et al, 2015).

The VAR model is the most appropriate model with the sample size used in this research, which reaches 38 observations from 1980 to 2018. To estimate the VAR system, the simple regression model for the variables under consideration formulated as follows:

$$S = f \quad (\text{CO, I}) \quad (1)$$

Where:

CO: consumption, I: investment, and S stand for savings

Equation (1) can be rewritten in econometrics form as follows:

$$S_t = \alpha + \beta_1 CO_t + \beta_2 I_t + U_t \quad (2)$$

An econometrics model can be formulated in the VAR system form to examine the causality relationship among saving, Investment and consumption in the following way:

$$CO_t = \alpha + \sum_{i=1}^n \varphi_i CO_{t-i} + \sum_{j=1}^m \beta_j I_{t-j} + \sum_{g=1}^k \phi_g S_{t-g} + \mu_{1t} \quad (3)$$

$$I_t = \sigma + \sum_{i=1}^n \varphi_i CO_{t-i} + \sum_{j=1}^m \beta_j I_{t-j} + \sum_{g=1}^k \phi_g S_{t-g} + \mu_{2t} \quad (4)$$

$$S_t = \delta + \sum_{i=1}^n \varphi_i CO_{t-i} + \sum_{j=1}^m \beta_j I_{t-j} + \sum_{g=1}^k \phi_g S_{t-g} + \mu_{3t} \quad (5)$$

$n$ ,  $m$ , and  $k$  are the lag lengths which will be determined by lag criterions.  $\mu_{1t}$ ,  $\mu_{2t}$ , and  $\mu_{3t}$  are uncorrelated error terms. To investigate the causality relationship between the variables listed above VAR system model first we apply the ADF test to check the stationarity of the data under the hypothesis that:

The null hypothesis indicates that all variables have unit roots, as opposed to the alternative hypothesis that all variables do not have unit roots. It is also necessary to determine the ideal lag length. Thus, the VAR lag order criteria test will be applied to the optimal lags. The VAR system is then estimated using the ordinary least squares (OLS) method. Following the preceding steps, the Wald test should be performed to determine the combined impact of the independent variables on the dependent variable. In addition, to test the causality of the variables, The VAR Granger Causality/Block Exogeneity Wald test was used in the study. The variance decomposition approach is used to demonstrate the percent of variation in the dependent variables by measuring the shock of any independent variable. Finally, autocorrelations with a standard deviation of two. The AR Characteristic Polynomial Bounds and Inverse Roots are used to determine the stability of the estimated coefficients.

### 3.3 Empirical Results and Discussion

To accomplish the purpose of this research. First, the variables under study should not be integrated of order I (2). To ensure that the data is stationary and to avoid its being integrated of order I (2), the Augmented Dickey-Fuller test for unit root was applied, the result of which is reported in table (1) below:

**Table. 1. Unit Root Test Results (ADF): Null Hypothesis: the variable has a unit root**

		At Level		
		CO	I	S
With Constant	t-Statistic	-1.3881	-1.6975	-1.8449
	Prob.	0.5772	0.4244	0.3539
With Constant & Trend	t-Statistic	-2.4653	-2.8872	-5.0407***
	Prob.	0.3423	0.1796	0.0014
Without Constant & Trend	t-Statistic	0.2900	-0.4826	-1.1178
	Prob.	0.7642	0.5001	0.2348
		At First Difference		
		d(CO)	d(I)	d(S)
With Constant	t-Statistic	-5.1360***	-6.2331***	-4.3905***
	Prob.	0.0002	0.0000	0.0015
With Constant & Trend	t-Statistic	-5.1224***	-6.1984***	-4.0909**
	Prob.	0.0010	0.0000	0.0154
Without Constant & Trend	t-Statistic	-5.0858***	-6.2682***	-4.2325***
	Prob.	0.0000	0.0000	0.0001

Source: Authors' calculations

Note: (\*) Significant at the 10%; (\*\*) Significant at the 5%; and (\*\*\*) Significant at the 1%.

The results in table (1) illustrate that consumption and investment variables are stationary at first difference, while the private savings series is stationary at level.

Consequently, once the results of ADF confirm that all the variables are stationary, the next step is to determine the optimal

lag length. Thus, the vector autoregressive (VAR) lag order selection criteria test was conducted. The results of the lag selection criterion are reported in table (2) below:

**Table (2): The optimum lag order selection criteria**

Lag	LogL	LR	FPE	AI C	SC	HQ
1	-542.6791	NA	9.86e+09*	31.52452*	31.92447*	31.66258*
2	-535.5160	11.87022	1.11e+10	31.62949	32.42938	31.90561
3	-528.7301	10.08194	1.29e+10	31.75601	32.95585	32.17019
4	-516.2710	16.37483	1.11 e+10	31.55834	33.15813	32.11059

Source: Authors' calculations

\* denotes the lag order chosen by the criterion, FPE: Final prediction error, LR: sequential modified LR test statistic (each test at 5% level), AIC stands for Akaike information criterion, SC stands for Schwarz information criterion, and HQ stands for Hannan-Quinn information criterion.

Results of the lag criteria in table (2) above, show that most of the criteria (FPE, AIC, SC, and HQ) confirm that the first lag is proper for estimating VAR at 5% significance level.

The next step is to estimate the VAR system using the OLS method. Thus, the VAR system was formulated in the following equations:

$$CO = C(1)*CO(-1) + C(2)*I(-1) + C(3)*S(-1) \tag{6}$$

$$I = C(4)*CO(-1) + C(5)*I(-1) + C(6)*S(-1) \tag{7}$$

$$S = C(7)*CO(-1) + C(8)*I(-1) + C(9)*S(-1) \tag{8}$$

The ordinary least squares (OLS) method is applied to estimate the VAR system. Table (3) below shows the results.

**Table (3): Results of the estimated VAR system**

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.956693	0.059134	16.17831	0.0000
C(2)	0.347716	0.332933	1.044405	0.2987
C(3)	-0.217695	0.300082	-0.725452	0.4698
C(4)	0.065079	0.029798	2.184019	0.0312
C(5)	0.705408	0.167764	4.204757	0.0001
C(6)	-0.038241	0.151211	-0.252899	0.8008
C(7)	0.095161	0.045602	2.086760	0.0393
C(8)	-0.302983	0.256746	-1.180085	0.2406
C(9)	0.732376	0.231413	3.164797	0.0020
<b>Equation: CO = C(1)*CO(-1) + C(2)*I(-1) + C(3)*S(-1)</b>				
R-squared	0.924140	Mean dependent var	607.8071	
Adjusted R-squared	0.919805	S.D. dependent var	238.2073	
S.E. of regression	67.45718	Sum squared resid	159266.5	
Durbin-Watson stat	1.744306			
<b>Equation: I = C(4)*CO(-1) + C(5)*I(-1) + C(6)*S(-1)</b>				
R-squared	0.789367	Mean dependent var	119.2489	
Adjusted R-squared	0.777331	S.D. dependent var	72.03464	
S.E. of regression	33.99155	Sum squared resid	40439.89	
Durbin-Watson stat	1.745474			
<b>Equation: S = C(7)*CO(-1) + C(8)*I(-1) + C(9)*S(-1)</b>				

R-squared	0.419209	Mean dependent var	40.49895
Adjusted R-squared	0.386020	S.D. dependent var	66.38947
S.E. of regression	52.02070	Sum squared resid	94715.36
Durbin-Watson stat	1.686410		

Source: Authors' calculations

The results in table (3) represent the estimated VAR system through applying (OLS). For equation (6): The results reveal that the coefficient of consumption C(1) at the first lag is statistically significant to influence the current consumption positively at 1% level as indicated by t-statistic. While the coefficients of investment C(2) and private savings C(3) show insignificant impact on current consumption as indicated by the corresponding t-statistic. Also, the coefficient of determination R<sup>2</sup> suggests that 92% of variation in current consumption is explained by the variations in consumption, investment, and private savings at the first lag. The Durbin-Watson test result illustrates non-existence of serial correlation in the model. Based on the average value of the variable, the elasticities of the consumption function have been calculated. The results showed that the elasticity of previous consumption CO(-1) is 0.96 indicating that a positive increment of 1% in previous consumption CO(-1), will increase current consumption (CO) by 96%. This indicates the fact that people prefer current consumption to future consumption. Meanwhile, the elasticity of previous investment I(-1) is 0.068, which indicates that an increase in previous investment I(-1) by 1% will lead to an increase current consumption CO(-1) by 6.8%. As for the elasticity of previous private saving S(-1), which is -0.0122 showed that an increase in previous private saving by 1% will decrease current consumption (CO) by -1.22%.

Moving on to equation (7) it's clear that consumption C(4) and investment C(5) at first lag are statistically significant and positively associated with current investment at 5% and 1% significant level respectively as indicated by t-statistic. While, private savings C(6) at the first lag show insignificant negative effect on current investment. due to the behavior of the economy showing that consumption is more than saving, which mean that the marginal propensity to consume is very high. There for the finance of investment is sought for foreign resources. The coefficient of determination R<sup>2</sup> suggests that 78% of the variation in current investment is explained by variations in consumption, investment, and private savings at the first lag. The Durbin-

Watson test result suggests that there is no serial correlation in the model. On based of the average of the variable, the elasticities of Investment function have been calculated. The results showed that the elasticity of previous consumption CO(-1) is 0.33%, which indicates an increase in the previous consumption CO(-1) by 1% will lead to an increase current investment(I) by 33%. Meanwhile the elasticity of previous investment I(-1) is 0.71, which indicates that an increase in previous investment I(-1) by 1% will increase current investment I(1) by 71%. As for the elasticity of previous private saving S(-1), which is -0.011 showed that an increase in the previous private saving by 1% decrease current investment (I) by -1.11%.

Finally, the results in equation (8) clarify that consumption C(7) and private savings C(9) at first lag are statistically significant to positively connect with current private savings at 5% and 1% significant level respectively as indicated by t-statistic. Whereas, investment C(8) at the first lag demonstrate insignificant negative influence on current private savings. The coefficient of determination R<sup>2</sup> suggests that 41% of the variation in current private savings is explained by the variations in consumption, investment, and private savings at the first lag. Durbin-Watson statistics indicates non-existence of serial correlation in the model. based on the average of the variable, the elasticities of investment function have been calculated. The results showed that the elasticity of previous saving S(-1) is 1.52, which indicates that an increase in the previous consumption(CO(-1)) by 1% will increase current private savings (S) by 152%. Meanwhile, the elasticity of previous investment I(-1) is - 0.94, which indicates that an increase in the previous investment I(-1) by 1% will decrease current private saving(S) by -94%. As for the elasticity of previous private saving S(-1), which is equal to 0.65, it shows that a positive increment in the previous private saving by 1% will increase current private saving (S) by 65%.

Thereafter, the Wald test has been applied to check the joint impact of independent variables on the dependent variable. The results of Wald test presented in table 4 below:

**Table 4. Wald test results equation (6)**

Test Statistic	Value	Df	Probability
Chi-square	1.092066	2	0.5792
Null Hypothesis: C(2)=C(3)=0, Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value		Std. Err.
C(2)	0.347716		0.332933
C(3)	-0.217695		0.300082

Source: Authors' calculations

The result in table (4) illustrates the joint impact for equation (6). This result reveals that there is no significant joint impact from investment C(2) and private saving C(3) on consumption as explained by probability of Chi-square which is more than 5%.

**Table 5. Wald test results equation (7)**

Test Statistic	Value	Df	Probability
Chi-square	6.630146	2	0.0363
Null Hypothesis: C(4)=C(6)=0, Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(4)		0.065079	0.029798
C(6)		-0.038241	0.151211

Source: Authors' calculations

The result in table (5) illustrates that the joint impact for equation (7). This result indicates that there is significant joint impact from consumption C(4) and private saving C(6) on investment as explained by probability of Chi-square which is less than 5%.

**Table 6. Wald test results equation (8)**

Test Statistic	Value	Df	Probability
Chi-square	8.420829	2	0.0148
Null Hypothesis: C(7)=C(8)=0, Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(7)		0.095161	0.045602
C(8)		-0.302983	0.256746

Source: Authors' calculations

Table 6 illustrate the joint impact for equation (8). This result indicates that there is significant joint effect from consumption C(7) and investment C(8) on private savings as explained by probability of Chi-square which is less than 5%. To test the causality between the variables, this study applied the Wald test - VAR Granger Causality/Block Exogeneity. The results are provided in table (7) below. The null hypothesis  $H_0$ : Lagged coefficients = 0 is tested against the alternative hypothesis  $H_1$ : Lagged coefficients  $\neq$  0.

**Table 7. (VAR) Granger causality/block exogeneity Wald tests**

<b>Dependent variable: CO</b>				
Excluded	Chi-sq	Df	Prob.	Decision
I	1.090781	1	0.2963	Cannot be rejected
S	0.526281	1	0.4682	Cannot be rejected
All	1.092066	2	0.5792	Cannot be rejected
<b>Dependent variable: I</b>				
Excluded	Chi-sq	Df	Prob.	Decision
CO	4.769939	1	0.0290	Rejected
S	0.063958	1	0.8003	Cannot be rejected
All	6.630146	2	0.0363	Rejected
<b>Dependent variable: S</b>				
Excluded	Chi-sq	Df	Prob.	Decision
CO	4.354565	1	0.0369	Rejected
I	1.392600	1	0.2380	Cannot be rejected
All	8.420829	2	0.0148	Rejected

Source: Authors' calculations

The results in Table (7) represent the VAR Granger Causality/Wald test. According to results in (7) change in investment and private saving does not Granger causes change in consumption. The null hypothesis has been accepted meaning the absence of a causal relationship from investment and private savings to consumption; as indicated by the probability value of Chi-square, which is more than 5%. Whereas, a change in consumption Granger causes a change in investment, as confirmed by non-acceptance of the null hypothesis, indicating a causal relationship running from consumption to investment as illustrated by the probability (0.0290) of Chi-square which less than 5%. In contrast, a change in private saving does not Granger cause a change in investment. In addition, a change in investment does not Granger cause a change in private savings, which means that there is no causal relationship between private saving and investment. Finally, a change in consumption Granger causes a change in private savings, hence there is a causal relationship running from consumption to private savings as illustrated by the probability value (0.0369) of Chi-square which is less than 5%.

To measure the percentage contribution of any independent variable in demonstrating the variation in the dependent variables, the variance decomposition approach has been used. The results are reported in tables (8) (9) and (10) below:

**Table 8. Variance Decomposition (CO)**

Period	S.E.	CO	I	S
1	67.45718	100.0000	0.000000	0.000000
2	97.08570	98.58955	0.434942	0.975511
3	121.2631	96.13539	1.324019	2.540592
4	142.8289	93.27669	2.482626	4.240681
5	162.7427	90.38704	3.754482	5.858478
6	181.4226	87.66094	5.031575	7.307480
7	199.0848	85.18400	6.249085	8.566917
8	215.8609	82.98059	7.373557	9.645856
9	231.8445	81.04334	8.391868	10.56480
10	247.1101	79.35015	9.302999	11.34685

Source: Authors' calculations

**Table 9. Variance Decomposition (I)**

Period	S.E.	CO	I	S
1	33.99155	1.614009	98.38599	0.000000
2	41.75243	4.679564	95.15768	0.162758
3	46.05726	8.794188	90.63471	0.571106
4	49.26183	13.34850	85.44979	1.201705
5	52.07105	17.85766	80.15213	1.990204
6	54.71888	22.03839	75.09594	2.865666
7	57.28335	25.77088	70.45975	3.769374
8	59.78909	29.03534	66.30481	4.659854
9	62.24268	31.86245	62.62642	5.511131
10	64.64510	34.30311	59.38793	6.308962

Source: Authors' calculations

**Table 10. Variance Decomposition (S)**

Period	S.E.	CO	I	S
1	52.02070	6.228842	22.07545	71.69570
2	61.84839	4.912163	17.16125	77.92659
3	66.07498	4.323599	15.04673	80.62967
4	68.32532	4.421183	14.45748	81.12134
5	69.68766	5.036429	14.44396	80.51961
6	70.59497	5.994439	14.51717	79.48839
7	71.26565	7.156286	14.50295	78.34076
8	71.82625	8.422379	14.38351	77.19411
9	72.35191	9.725007	14.19742	76.07757
10	72.88475	11.02024	13.99067	74.98909

Source: Authors' calculations

From the results of variance decomposition analysis in tables (8), (9) and (10). First, table (8) indicates that investment and private savings variables are explaining 9.30% and 11.34% of consumption respectively in the long run. But, at the first period consumption is completely explained by itself. Second, table 9 illustrates that consumption and private savings explain 34.30% and 6.30% of investment respectively in the long run. While, at the first investment explained by consumption (1.61%) and itself (98.38%). Finally, table 10 indicates that consumption and investment variables are explaining 11.02% and 13.99% of private savings respectively in the long run. Whereas, at the first period 6.22% and 22.07% of private savings have been explained by consumption and investment respectively. To accomplish the purpose of this research, the diagnostic test of Autocorrelations with 2 St. Err. Bounds and Inverse Roots of AR Characteristic Polynomial have been taken to test parameters stability. Figure (1) and Figure (2) show the related results, respectively. From figure (1), it is clear that all the points fall within the circle indicating that VAR model coefficients are stable.

Inverse Roots of AR Characteristic Polynomial

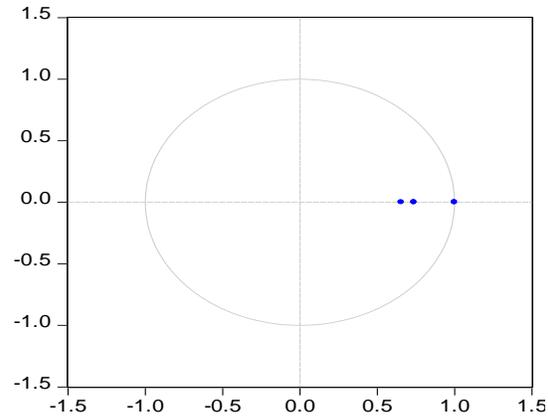


Figure (1): Inverse Roots of AR Characteristic Polynomial

Furthermore, figure (2) indicates that most of the residual patterns fall with the dotted negative and positive straight-line of Autocorrelation with two Std. Err. Bounds, meaning that the residuals are completely random and confirm the absence Autocorrelation problem.

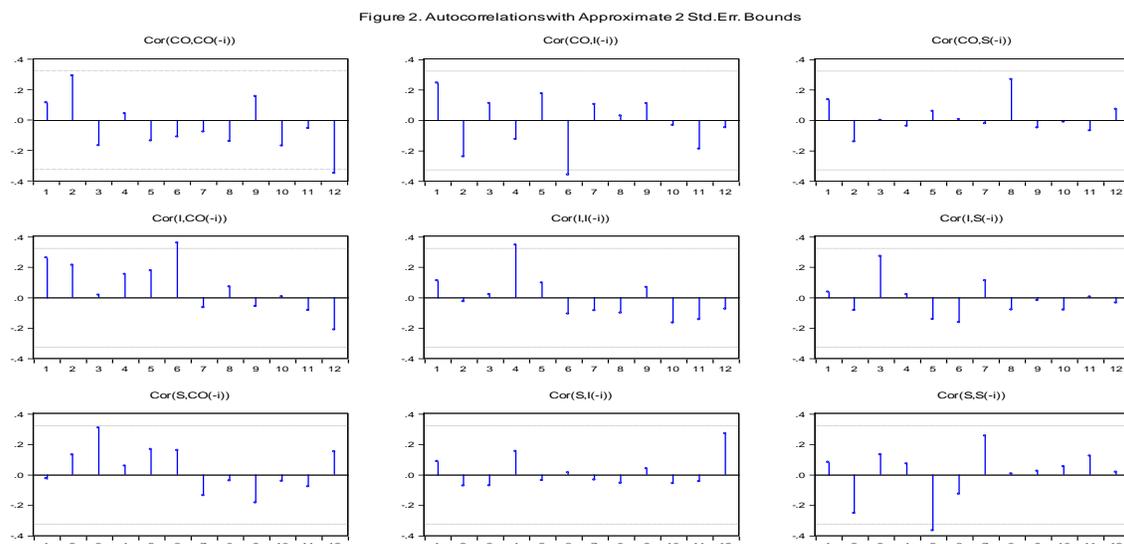


Figure (2): Autocorrelations with two St. Err. Bounds

#### IV. CONCLUSION AND RECOMMENDATIONS

The research paper aims to examine the interrelationship and causality relationship among private saving, investment and consumption in Sudan over the period (1980-2018). For this purpose, the vector autoregressive (VAR) approach has been applied. The data was collected from the Central Bureau of Statistics. Results of the unit root test, using the so-called Augmented Dickey Fuller (ADF), indicate that the variables under study are stationary at first difference; and lag criteria (FPE, AIC, SC, and HQ) confirmed that the first lag is appropriate for estimating the VAR system. The results of the estimated VAR system through applying (OLS) reveal that the coefficient of consumption C(1) is statistically significant at first lag to influence current consumption positively. While, the coefficients of investment C(2) and private savings C(3) show insignificant impact. Also, empirical results illustrate that consumption C(4) and investment C(5) at first lag are statistically positively associated with current investment. Whereas, private savings C(5)

at the first lag show insignificant negative effect on the current investment. Accordingly, the results show that consumption C(7) and private savings C(9) at first lag are statistically positively connected with current private savings. The Wald test result reveals that there is no significant joint impact from investment C(2) and private saving C(3) on consumption. But, there is a significant joint impact from consumption C(4) and private saving C(6) on investment. Similarly, there is a significant joint effect from consumption C(7) and investment C(8) on private savings. Results of the Granger Causality (VAR) indicate that the change in investment and private saving does not Granger cause change in consumption. Whereas, change in consumption Granger causes a change in investment as confirmed by non-acceptance of the null hypothesis. In contrast, private saving does not Granger cause a change in investment. Also, a change in investment does not Granger cause a change in private saving. Finally, a change in consumption Granger causes a change in private savings, which indicates that a causal relationship running from consumption to private savings. The results of the variance decomposition reveal

that consumption is explained by 9.30% and 11.34% of investment and private savings variables, respectively. Whereas, consumption and private savings explain 34.30% and 6.30% of an investment, respectively. Along the same line, consumption and investment variables are explaining 11.02% and 13.99% of private saving, respectively. Lastly, the results of the diagnostic test results (for autocorrelation with two Std. Err Bounds and Inverse Roots of AR Characteristic Polynomial) confirm the stability of the VAR model coefficients.

Building on the above results, the study raises some policy implications as follows:

Policy makers should use policy tools to encourage domestic savings through increases in incomes and reduction of unnecessary consumption.

Investment policy in the country should be revised seriously in order to redirect investment inflows for more productive and more efficient sectors, which leads to growth of national income thereby directly increasing private saving.

The government should ensure stability both economically and politically stability in order for the country to enjoy the benefits of sustained capital inflows. It is to be emphasized that some efforts need to be exerted to help solve the real economy problem such as improving infrastructure and productivity. The exchange rate needs to be stabilized to encourage investment, which enhances economic growth.

This is an important and comprehensive contribution to the existing literature that could help policymakers and academics design future research and policy decisions to make Sudan sectors that are more productive and efficient in order to boost national income growth.

#### REFERENCES

- [1] Abdelmawla, M.A. and Yousif, O.A., (2016). "Determinants of Saving Rate in Sudan: An Empirical Investigation: 1990-2013". Khartoum University. *Journal of Management Studies*, Vol.10, Issue.1.
- [2] Abdelmawla, M.A. and Siddig, K.H.A., (2011) Investment and Economic Growth in Sudan: Trends and Causal Relationships (1990-2009). Farming and Rural Systems Economics. In Issues and Challenges in Rural Development: Compendium of Approaches for Socio-Economic and Ecological Development in Developing Countries. Vol, III, Chapter 2, pp, 75-85.
- [3] Agbetsiafa, D., (2002). Capital Mobility, Saving and Investment link: Evidence from Sub-Saharan Africa. *Journal of African Development*, 5(2), pp.1-19.
- [4] Ahmed, M.M., (2008). "External Debts, Growth and Peace in the Sudan. Some Serious Challenges Facing the Country in the Post-Conflict Era", University of Khartoum, available at: <http://ssrn.com/abstract=1651802>.
- [5] Aka, B.F., (2008). The Saving-Investment Relationships: A Markov Switching Causality Analysis of Cote D'Ivoire and Ghana. *Applied Econometrics and International Development*, Vol.7-2(2007).
- [6] Al-Afeef. M. A., and Al-Qudah.A.A . (2015). The Causal Relationship between Savings and Investment in Jordan (A prospective study for the period 1980-2013). *Journal of Economics and Sustainable Development*, Vol.6, No.10.
- [7] Anoruo, E., (2001). Saving-Investment Connection: Evidence from the ASEAN Countries. *The American Economist*, 45(1), pp.46-53.
- [8] Arabi, K.A.M., (2014). Sustainability and Genuine Saving: Empirical Evidence from Sudan Economy. *Journal of Economics*, 2(4), pp.211-222.
- [9] Badour, S. M. E. (2016), Estimation of Consumption Demand Function of Gezira State, Sudan: An Empirical investigation, Crater Wad Medani Locality (2016). Unpublished M.Sc. Dissertation, Department of Economics, Faculty of Economic and Rural Development, University of Gezira, Wad Medani, Sudan.
- [10] Bjornland, H.C., (2000). VAR Models in Macroeconomic Research. *Statistics Norway*, 14, pp.1-29.
- [11] Central Bank of Sudan (2018). Annual Reports.
- [12] Dhakal, D., Grabowski, R., & Shields, M. P. (1991). The Role of Savings in Economic Development: the US and Japanese Experiences. *Japan and the World Economy*, 3(4), 331-340.
- [13] Dritsaki, C., (2015). The long-Run Relationship Between Saving and Investment in Greece. *International Journal of Economics and Finance*, 7(9), p.178.
- [14] Ezzo, L.J. and Kehu, Y., (2010). The Savings-Investment Relationship: Co Integration and Causality Evidence from Uemoa Countries. *International Journal of Economics and Finance*, 2(1), pp.174-181.
- [15] Gebeyehu, W., (2010). Causal Links Among Saving, Investment and Growth and Determinants of Saving in Sub-Saharan Africa: Evidence from Ethiopia. *Ethiopian Journal of Economics*, 19(2), pp.1-34.
- [16] Gocer, I., Akin, T. and Alatas, S., (2016). "The Effects of Saving-Investment Gap on Economic Growth in Developing Countries: A clustering and Panel Data Analysis". *Theoretical & Applied Economics*, Volume XXIII (2016), No. 2(607), Summer, pp. 157-172.
- [17] Investopedia.(2019). Investment. Reviewed by James Chen., <https://www.investopedia.com/terms/i/investment.asp>.
- [18] Jagadeesh, D. (2015). The Impact of Savings in Economic Growth: An Empirical Study Based on Botswana. *International Journal of Research in Business Studies and Management* Volume 2, Issue 9, September 2015, PP 10-21
- [19] Mualley, S.M.A., (2011). Determinants of Savings: An Empirical Evidence from African Countries, (1990-1999). *Volume*, 9, pp.21-30.
- [20] Mualley, S.M.A., (2011). Determinants of Savings: An Empirical Evidence from African Countries, (1990-1999). *Volume*, 9, pp.21-30.
- [21] Nasir, S., Khalid, M. and Mahmood, A., (2004). Saving-Investment Behavior in Pakistan: An Empirical Investigation [with Comments]. *The Pakistan Development Review*, pp.665-682.
- [22] Nindi, A. and Odhiambo, N.M., (2014). Savings and Investment in Malawi: A Causality Test. *Investment Management and Financial Innovations*, 11 (4), pp.77-84.
- [23] Ogbokor, C.A. and Musilika, O.A., (2014). Investigating the Relationship Between Aggregate Savings and Investment in Namibia: A Causality Analysis. *Research Journal of Finance and Accounting* Vol.5, No.6.
- [24] OLANREWaju, S.O. OGUNTADE, E.S. ZUBAIR, M.A.( 2015). An Application of Vector Autoregressive Model on Investments and Savings in Nigeria. *Journal of Economics and Sustainable Development*, Vol.6, No.21.
- [25] Onafowara, O.A., Owoye, O. and Huart, F., (2011). The Temporal Relationship Between Saving and Investment: Evidence from Advanced EU Countries. *International Journal of Business and Social Science*, 2(2).
- [26] Otiwu, K., Okere, P.A. and Uzowuru, L.N., (2018). "Determinants of Private Domestic Savings in Nigeria (1981-2015)". *International Journal for Innovation Education and Research*, No 6(2), pp.21-40.
- [27] Pata, U.K., (2018). The Feldstein Horioka puzzle in E7 Countries: Evidence from Panel co-Integration and Asymmetric Causality Analysis. *The Journal of International Trade & Economic Development*, 27(8), pp.968-984.
- [28] Poveda, A. C. (2013). The Relationship Between Development, Investments, Insecurity and Social Conditions in Colombia: A dynamic Approach. *Quality & quantity*, 47(5), 2769-2783.
- [29] Rasmidatta, P., (2011). The Relationship Between Domestic Saving and Economic Growth and Convergence Hypothesis: Case Study of Thailand.
- [30] Reham Mohamed, (2017): Interrelationship between Economic Growth and some Economic Variables in Sudan (1990-2013): A Vector Auto Regressive Analysis <http://repo.uofg.edu.sd/handle/123456789/806>
- [31] Sekantsi, L.P. and Kalebe, K.M., (2015). Savings, Investment and Economic Growth in Lesotho: An Empirical Analysis. *Journal of Economics and International Finance*, 7(10), pp.213-221.
- [32] Yadav, I.S., Goyari, P. and Mishra, R.K., (2016). Saving, Investment and Growth in India: Evidence from Co Integration and Causality Tests. *Economic Alternatives*, 1, pp.55-68.
- [33] Yousif, G. Elmonshid, L (2020): The Impact of Export and Financial Development on Economic Growth in Saudi Arabia: An Empirical Analysis (1980-2018). *Journal of Solid State Technology*, 63 (1).

[34] Zivot, E. and Wang, J., (2006). Vector Autoregressive Models for Multivariate Time Series. *Modeling Financial Time Series with S-Plus®*, pp.385-429.

**Third Author** – DuaaSalah Saeed Al Tom ,College of Economics and Rural Development University of Gezira, Sudan. <mailto:duaasalah610@gmail.com>.

#### AUTHORS

**First Author** – Dr. Elzein Abd Alla Yousif Ahmed, Associate professor, College of Economics and Rural Development University of Gezira, Sudan. <mailto:elzeinaay@gmail.com>.

**Second Author** – Dr. Lena Bedawi Elfadli Almonshid, Associate professor ,College of Business Administration, University of Tabuk, Saudi Arabia. [lenamonshid@gmail.com](mailto:lenamonshid@gmail.com).

**Correspondence Author** – Dr. Elzein Abd Alla Yousif Ahmed, Associate professor, College of Economics and Rural Development University of Gezira, Sudan. <mailto:elzeinaay@gmail.com>