

## AN ASSESSMENT OF INFLATION ON MONEY SUPPLY IN SOUTH SUDAN FROM 2010 TO 2021

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### Abstract

*This article analyzes the effects of inflation on money supply in South Sudan from 2010 to 2021. The article uses monthly secondary data from the Bank of South Sudan (BOSS) and the South Sudan National Bureau of Statistics (SSNBS) for the period extending from 2010 to 2021. In the analysis, Multiple regression, Stationarity test, Co-integration test, Vector error correction model (VECM), and Granger causality test were applied to observe actual data set and link to it with economic conditions in South Sudan. The co-integration test depicted a long-term relationship among the study variables. In addition, the vector error correction model showed no long-run relationship between money supply and inflation. However, there is a short-run causality of inflation rate, exchange rate and food price in money supply. The findings further revealed a unidirectional causal relationship between money supply and inflation rate; that is, money supply is granger caused by inflation rate, exchange rate and food prices as well as bidirectional causality from money supply to exchange rate in a short-run. The study findings stress that inflation is affected by many factors positively or negatively and, it can as well serve as a standpoint in positively forecasting money supply in the long run. To put it bluntly, inflation rate, exchange rate and food prices play a great role toward changes in money supply within the area under the study due to their causal long-running relationship. The study directs that, policy makers in the Ministry of Agriculture and Food Security should embark on food production. Furthermore, the Ministry of Mining and Petroleum should plan for crude oil refinery in the country to reduce the high inflation rate caused by the variables, namely food prices and fuel prices imports to the country.*

**Keywords:** *Inflation, Money Supply, Exchange Rate, Food Prices, Fuel Prices, South Sudan.*

### 1.0 Introduction

Inflation is often defined as the continued increase in the general level of prices of goods and services in an economy (Parkin, 1993). According to Lerner in Gunawan (1995), inflation is where there is a general excess demand for goods and services in an economy. Economists define inflation as a continuous rise in prices. Generally speaking, inflation depicts an economic situation where there is a general rise in the prices of goods and services continuously. It can also be defined as an ongoing rise in prices as measured by an index such as the consumer price index (CPI) or by the implicit price deflator for Gross National Product (GNP). It is normally described as a state where too much money is used in purchasing very few goods and services. When there is inflation, the currency loses purchasing power (London Oxford Economic Dictionary, 2009).

The word general or aggregate implies that the rise in prices upon which inflation is constituted must cover the entire basket of goods in the economy as distinct from an isolated rise in the prices of a single commodity or group of commodities. The aggregate price level must show a tendency of a sustained and continuous rise at varying times. This must be separated from a situation of a one-off rise in the price level (Bernanke, 2021). Inflation can bring bad influence on the structure of production costs and the level of welfare (Yolanda, 2017). The wider effects of inflation include political instability, declining of

economic growth, declined market competitiveness, high interest rates, uneven income distribution, and unemployment; and these are tremendously increasing. Countries like Zimbabwe and Sudan, which experienced hyperinflation of 557.2% and 150.3% respectively in 2020, corroborate the findings that unregulated inflation can lead to social and political instability which, in turn, impedes economic growth (Sukirno, 2004).

Global inflation has been recorded to be on the rise; and the highest was recorded in the last decade, when the economy immensely suffered the global financial crisis of 2008, with an increase of more than 6.4% in comparison to the global inflation rate in 2007. Inflation had globally reached its highest peak of 4.8% in 2010, and its lowest peak of 1.4% in 2015. It also reached 3.4% in 2021 compared to 1.9% for the previous year 2020 (World Bank, 2022). In his research, O'Neill (2022) stresses that, global inflation could approximately even reach 3.23 percent in 2020 compared to 3.51% for the previous year 2019. The projections of 4.71% and 7.4% are calculated for 2021 and 2022 respectively (Statista.com; O'Neill, 2022).

According to DeSilver (2022), inflation in the United States of America (USA) reached 5.3%, Argentina 51.9% and Turkey 19.3% while Japan had negative 0.2%. This shows that USA had the biggest inflation in the world that varied between the third quarter of 2019 and third quarter of 2021. This has been the eighth-highest annual inflation rate of USA ever experienced among the 46 countries examined, USA included. Factors that have contributed to global inflation include: increase in commodity prices (food prices) and rising global demand, global supply changes in both developed and developing countries as result of high transport costs, and currency depreciation in developing countries where exchange rate easily affects prices stability. Other factors are dwindling labour market in developed countries and high energy prices (oil, gas and electricity) due to less wind and drought in the United Kingdom and Brazil respectively (Carmen & Clement, 2022).

In sub-Saharan Africa, inflation came to its peak in 2012 by 6.6%; and went down to 3.6% in 2015 before turning again to 5.3% in the years 2017 and 2021 (World Bank, 2022). The factors affecting inflation in Sub-Saharan Africa include shocks of global community markets, fluctuated exchange rate due to high global interest rates and increased uncertainty in food prices with 40% increase in consumer regions (Choi, 2021). Social and political turmoil are yet other existing factors that add to high inflation in Sub-Saharan Africa (Zawya, 2022).

As slightly hinted earlier, the factors that have contributed to inflation in South Sudan include exogenous factors like oil, food and fuel prices; structural factors like domestic production shocks (floods, drought, pests, diseases) and policy variables like monetary, fiscal and exchange rates. Some factors that seem to intensify inflation in South Sudan are money supply, exchange rates, as well as food and fuel prices. Money supply is an indicator that affects inflation due to the fact that, demand for more money results in an increase in the circulation of money which, in turn, lowers the value of local currency (South Sudanese pounds) as result of financial authority's nonproductive stabilization of the economy. Fuel prices have a direct impact on world oil prices in the economy. The increase in world oil prices, directly affects domestic fuel prices leading to increase in commodity prices, production costs and job layoffs, hence unemployment. Increase in fuel prices affects all sectors of the economy. Such an increase, likewise, caused the exchange rate in South Sudan in terms of dollar to depreciate, reaching 412.67 per US dollar in December 2021.

Inflation can be in different types according to magnitude, one of which being Creeping Inflation. This occurs when the rise in price is very low, reaching less than 3% per annum. It is regarded as safe and essential for economic growth. Another one is called Walking Inflation, which occurs when prices rise moderately and, annual inflation rate is a single digit ranging from 3 to less than 10%. This serves as a warning to governments for it becomes a Running Inflation if kept unchecked. As a third type, Running Inflation occurs when prices rise rapidly at the rate of 10% to 20% per annum. It has adverse effects on economically poor and middle class population. Curbing it requires strong fiscal measures. Hyperinflation adds to another type of inflation that occurs when prices rise very fast at double or triple-digit rates. This may lead to a situation where the inflation is absolutely uncontrollable if kept rising unabated. Such a situation brings a total collapse of the monetary system because of the unceasing fall in the purchasing power of money (Amadeo, 2022). The three major types of inflation according to cause are cost push, demand pull and built-in inflation. The Cost Push Inflation in an economy may arise from an overall increase in the cost of production. Demand Pull Inflation is an increase in an aggregate demand over the available output, leading to a rise in the price level. Built-in Inflation is caused by people's expectation of the existing inflation rates to continue in the future. As the price of goods and services rises, workers and other community groups surmise that it will keep rising in the future at similar rate; hence demanding more costs to earn their living. Their enlarged wages lead to higher prices of goods and services. This wage price spiral that continues as a factor ultimately induces the other and vice-versa (Fernando Investopedia, 2022).

On the contrary, the fundamental concept of economics stresses that inflation has been caused primarily by an excess of money supply and increase of credits associated with the government's decision to mint more money to finance its deficit budget. This is because such a trend causes imbalance between money supply and goods supply, resulting in the rise of prices of goods. Monetary policies initiated have unceasingly been pushing to inflation rise and monetarists have argued that the government budget and credits should be controlled for the better. This is because when the supply of money is very high; inflation adversely manifests effects on the value of monetary unit namely: rising of living costs, wiping out the value of earlier savings, discouraging future savings and redistributing wealth and income wants only. The move eventually reduces the economic growth (Mbongo, 2014).

In South Sudan, inflation since independence has been on rise and unstable time after time. For example, inflation was 1.7% in 2010; 46.85% in 2011; 45.53% in 2012, and -0.06% in 2013. It also recorded 1.67% in 2014, 52.76% in 2015; 380% in 2016; 187.85% in 2017; 83.5% in 2018; 87.24% in 2019; 29.68% in 2020 and 10.52% in 2021. High inflation in South Sudan has made food prices unaffordable for the poor, reaching the peak of 380.0% in 2016. It has been nevertheless steadily decreasing with intensity, remaining above 10%, which yet adversely affects the economy. The Central Bank announced an inflation target of 8%, with a tolerance of 1% on either way in a statement of its policy for the Year 2022. This still remains unachieved. Therefore, the study looks into inflation and how harmful it is on money supply in South Sudan.

### **Theoretical perspective**

According to Friedman (1969), who uses monetarist model based on the quantity theory of money, in economics, excess supply of money in an economy leads to domestic inflation and that inflation is always a monetary phenomenon where changes in general price level are brought by changes in the money supply or monetary stock. This implies that an increase in money supply by a certain percentage is likely to affect the price level; precisely stating, the price embraces an increase by the same

percentage. The theory also states that inflation rate is caused by rise in money supply although it does not conform to an increase of output in the economy.

It is possible to theoretically examine the relationship between money supply and price level. This relationship is implied in the refined quantity theory of money as explicitly put forth by Friedman through the following equation:

$$MV = PY$$

Where; M = Money supply or quantity of money, V = Velocity of money circulation, P = Price level, Y = Real national income (output growth rate).

The above equation is sometimes referred to as “equation of exchange”. The equation shows that, the total value of payments (MV) equals to money value of national output (PY). “V” is assumed to be constant while, any change in M is to produce a similar change in either price level or real national income. The theory assumes that, the economy is operating at full employment level of output, and then changes in Y are to be so difficult.

Therefore, every change in M causes P to change. On the other hand, if the economy operates at less than full employment level of output, the change in M is reflected more in Y than in P. As a result, an excessive increase in money supply leads to excessive increase in prices, which influences inflation. Also, the changes that take place in stock of money affect the price level and real national income in an economy, regarding the movement in the velocity of money. Stability of the velocity of money in other words means stability of the demand for money as both are inversely related. This, therefore, yet authenticates the theory which solely focuses on analyzing inflation and its effects on money supply in South Sudan.

### **Empirical evidence**

Oliha (2017) examined macroeconomic determinants of inflation in South Sudan using co-integration approach. Results revealed that in the long run, Real GDP growth rate, food and fuel prices highly influence inflation; there is increase in inflation associated with real GDP growth rate and, increase in food and fuel prices. Furthermore, money supply, exchange rate and government expenditure culminate in inflation declines. Rabiul et al. (2017) examined determinant factors that influenced inflation in Malaysia using quantitative method and econometric model. The paper was categorized into two models, namely mathematical model and econometric model. In this paper, autocorrelation, multicollinearity and heteroscedasticity have been discussed. The results show that high inflation may cause negative impact on a particular country. Ayubu (2013) examined the degree to which inflation is a result of monetary phenomena in the case of Tanzania economy using impulse response function on SVAR and VECM econometric models; and empirical results suggest that inflation in Tanzania is more of an output factor than a monetary phenomenon. The World Bank (2012) used regression analysis, and results showed that external factors such as global food and fuel prices were only marginally responsible for the very high price inflation in South Sudan.

Madesha, Chidoko and Zivanomoyo (2013) looked into the empirical relationship between exchange rate and inflation in Zimbabwe using Granger Causality test; and estimated results revealed that both exchange rate and inflation have a long-running relationship. Furthermore, inflation and exchange rate are found to Granger-cause relationship, influencing each other during the period under consideration. Ofori (2017) examined the impact of money supply on inflation in Ghana using ordinary least square;



and results showed a long-running positive relationship between money supply and inflation. Saleem and Ahmad (2015) examined the impact of crude oil prices on inflation in Pakistan to ascertain the existence and intensity of relationship between crude oil price and inflation using Johansen Co-integration techniques. The study concluded that money supply, crude oil price, exchange rate, interest rate and indirect taxes had a positive impact while real GDP had a negative impact on inflation during the study period. Mbongo (2014) examined the effects of money supply and other selected variables on inflation in Tanzania using secondary data and the OLS, VAR and ECM techniques. The OLS and ECM results showed that money supply and exchange rates have a significant impact on inflation in the short and long-runs. Trisha, Sukono, Kalfin and Abdul (2020) examined the effects of inflation, interest rates and foreign exchange reserves on money supply in Indonesia. The Ordinary Least Square (OLS) method results showed that foreign exchange reserve, interest rate and exchange rate variables simultaneously had a positive and significant effect on money supply, with the probability values of 0.0048 and 0.0000. It was further revealed that, the inflation rate variable had no significant effects on money supply in this country, with a probability value of 0.0645. Ifionu and Akinpelumi (2015) reviewed the effects and implication of selected macroeconomic variables on money supply (M2) in Nigeria using econometric techniques such as O.L.S, causality test and co-integration. The results revealed long-running relationships between the variables employed and, inflation had an inverse significance with money supply (M2) and exchange rate (EXR). All other variables such as Gross Domestic Product (GDP) were found to have a positive impact on money supply. Yugang (2017) examined the relationship between money supply and macroeconomic variables in China using vector auto regression (VAR) model techniques. The empirical analysis and conclusions obtained showed that an increase in the real GDP resulted in an increase in money supply. It can thus be substantiated that, an increase in an inflation rate can lead to an increase in money supply; conversely, an increase in interest rate can cause a decrease in money supply.

Kesavarajah and Amirthalingam (2012) examined the nexus between money supply and inflation in Sri Lanka over the period of 1978 to 2010 using Johanson and Juseliues multivariate co-integration test and Granger causality test techniques. The results revealed the presence of long-running relationship among the variables while Granger causality test indicated a significant causality from money supply to inflation and exchange rate to inflation while the causality from budget deficit to inflation was insignificant. Furthermore, the analysis indicated that inflation was mainly attributed to monetary expansion in Sri Lanka during the post liberalization period. Lado (2015) also did a study to identify the relationship between exchange rate and consumer price index (as a measure of inflation) in South Sudan using Granger-causality approach. The results revealed that there has been a unidirectional link running from exchange rate to consumer price index in the country. Denbel (2016) examined the existing causal relationship between inflation and money supply; and between inflation and economic growth in Ethiopia. Results of Johansen co-integration test indicated the presence of a co-integrating vector and the VECM demonstrated the existence of a long-running bi-directional causality between inflation and money supply and a unidirectional causality from economic growth to inflation. In the short run one way, causality was found from money supply and economic growth to inflation. Therefore, the key findings of the study assert that inflation is a monetary phenomenon in Ethiopia and, inflation is negatively and significantly affected by economic growth. Joshi (2021) conducted a study to explore long and short-running relationships between money supply and inflation in Nepal using Economic Survey data of Nepal from 1964/65 to 2018/19. The ARDL Bounds Test technique was used to show the relationship between the two phenomena and, the results revealed long-running co-integration

relationship and the error correction term was found to be negative (-0.98) and significant ( $p = 0.02$ ) between the variables.

## 2.0 Methods and materials

### Description and Justification of Area of Study

The study area is the Republic of South Sudan, which covers an area of 619,745 square kilometres, with a population of 13,249,924 million people as per 2020 projections from 2008 census (SSNBS). South Sudan is the newest country in Africa that attained its independence on 9<sup>th</sup> July 2011, and became a member of the EAC in April 2016. It is bordered by Sudan to the north, Ethiopia to the east, Kenya to the southeast, Uganda to the south, the Democratic Republic of Congo to the southwest, and the Central African Republic to the west. The area is strategically located within the great lakes region and East African community; and thus the country needs to alleviate inflation rate in order to attract investors to the country.

### Research Design

The study used a longitudinal research design based on time series data of inflation rate, money supply, exchange rate, food prices and fuel prices from 2010 to 2021. Therefore, quantitative data was used in the analysis.

### Study Population and Sample Size

The study population involved the whole of South Sudan and the variables of the study included inflation rate, money supply, exchange rate, food prices and fuel prices which are macro-economic indicators of an economy; be it developed or developing economies where South Sudan is among them. The study used a sample of monthly data for the period of twelve (12) years from 2010 to 2021, making 144 observations for the above macro-economic variables. This is because South Sudan got independence in 2011 and there are no available data for previous years, thus grounding the study sample on monthly data for the study variables.

### Types and Data Sources

The study used secondary time series monthly data from 2010 to 2021; and the data were collected from the South Sudan National Bureau of Statistics and Bank of South Sudan as the government official institutions entrusted with secondary sources of data for public use in the government of this very country under the study.

### Model Specification

The study used the multiple linear regression model. The objective was to analyze the effect or the relationship between dependent and independent variables. Regarding this study, the dependent variable was money supply and the independent or explanatory variables were inflation rate, exchange rates, food prices and fuel prices. The data was analyzed using Stata 15 statistical software computer programme that is widely used for statistical and econometric analysis of time-series data.

The model for the study was built basing on Mbongo (2014):

$$M2_t = f(\beta_0 + \beta_1 INFR_t + \beta_2 EXR_t + \beta_3 FP_t + \beta_4 F\_P_t + \epsilon_t) \dots\dots\dots(1)$$

$$INFR_t = f(\beta_0 + \beta_5 M2_t + \epsilon_t) \dots\dots\dots(2)$$

Where:  $INFR_t$  = Inflation Rate,  $M2_t$  = Money Supply,  $EXR_t$  = Exchange Rate,  $FP_t$  = Food Prices,  $F\_P_t$  = Fuel Prices,  $\beta_0$  = constant of the model,  $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$  are coefficients of the model,  $\epsilon_t$  = error term or stochastic

The models were rewritten in regression form as:

$$M2_t = \beta_0 + \beta_1 INFR_t + \beta_2 EXR_t + \beta_3 FP_t + \beta_4 F\_P_t + \epsilon_t \dots\dots\dots (3)$$

$$INFR_t = \beta_0 + \beta_5 M2_t + \epsilon_t \dots\dots\dots (4)$$

From equation (3) above, the variables were transformed into econometric model, using log to reduce the heteroscedasticity before comparison with standard regressions (Gujarati and Porter, 2009). The log model provides coefficients of the elasticity of inflation against the independent variables. A log model is used to fulfill OLS conditions in analyzing the inflation. Natural log was used to transform data for assurance of normality, stability and reducing skewedness and kurtosis (Apeh Kenneth, 2019).

The equation (3) was transformed into econometric model as:

$$\ln M2_t = \beta_0 + \beta_1 \ln INFR_t + \beta_2 \ln EXR_t + \beta_3 \ln FP_t + \beta_4 \ln F\_P_t + \epsilon_t \dots\dots\dots (5)$$

$$\ln INFR_t = \beta_0 + \beta_5 \ln M2_t + \epsilon_t \dots\dots\dots (6)$$

Where: ln is a natural log

### Testing for unit root

The Augmented Dickey-Fuller test was applied to test the presence of a unit root to test whether the variables are stationary of order I (1) or non-stationary I (0) before proceeding to the co-integration tests. This test was used with the assumption that the error term may be correlated. The lagged values for the dependent variable were included. It was important to use Augmented Dickey-Fuller test because of its ability to include enough terms so that the error term becomes uncorrelated. The model is expressed as illustrated by Hussain (2016), Gujarati (2003) and Mbongo (2014).

$$\Delta \ln M2_t = \beta_1 + \beta_2 t + \delta \ln M2_{t-1} + \sum_{i=1}^p \alpha_i \Delta \ln M2_{t-i} + \epsilon_t \dots\dots\dots (7)$$

Where: t is a trend and  $\Delta \ln M2_{t-1} = (\ln M2_{t-1} - \ln M2_{t-2})$  is number of lags.

### Testing for Co-integration

Co-integration has gained remarkable considerations in analyzing time series data in order to avoid spurious regression. It was used to test if variables are said to be co-integrated and if they have a long-term, or long-run equilibrium in the relationship between them. In this case, where the individual variable exhibits stochastic process, the technique is appropriate for choosing coefficient to be stationary. In this study, when the unit root was analyzed, subject to research, the stationary is denoted by I (0) and the individual variable is represented by I (1). In this sense, the linear combination cancels out the stochastic trend in the model. With this assumption, stochastic variable in the model generates meaningful results and correspond to the long-running equilibrium relationship (Mbongo, 2014).

$$\mu_t = \ln M2_t - \beta_0 - \beta_1 \ln INFR_t - \beta_2 \ln EXR_t - \beta_3 \ln PF_t - \beta_4 \ln F\_P_t \dots\dots\dots (8)$$

### Vector Autoregressive Model (VAR)

VAR model works like the Autoregressive Moving Average (ARIMA) model only that the VAR model can analyze vectors with more than one variable. It works better if there is no distinction between the endogenous or exogenous variables and true simultaneity among variables. The study was grounded on the assumption that the model contains p number of lagged values for each variable and predetermined lagged value of variables is uncorrelated with the error term. These assumptions allow the use of OLS in estimating the VAR (Mbongo, 2014). However, VAR can only be applied to test long run relation where there is no co-integration equation among the variables but in case of such, error correction model overtakes.

$$\ln M2_t =$$

$$\alpha_0 + \sum_{i=1}^p \beta_1 \ln M2_t - i + \sum_{j=1}^p \alpha_1 \ln INFR_t - j + \sum_{k=1}^p \delta_1 \ln EXR_t - k + \sum_{m=1}^p \sigma_1 \ln F_P t - m + \sum_{y=1}^p \sigma_1 \ln F_P t - y + \mu_1 t \dots (9)$$

**Error Correction Model (ECM)**

Although long-running equilibrium can be achieved using the proposed model, there might be disequilibrium in the short run. ECM corrects disequilibrium in the short run by presenting variables in the linear trend and transforming variables to structures related to co-integration in the long run. In addition, the error term produced is termed as equilibrium error. The ECM model is presented as:

$$\Delta \ln M2_t = \alpha_0 + \sum_{i=1}^{p-1} \beta_1 \Delta \ln M2_t - i + \sum_{j=1}^{p-1} \alpha_1 \Delta \ln INFR_t - j + \sum_{k=1}^{p-1} \delta_1 \Delta \ln EXR_t - k + \sum_{m=1}^{p-1} \sigma_1 \Delta \ln F_P t - m + \sum_{y=1}^{p-1} \sigma_1 \Delta \ln F_P t - y + \mu_1 t \dots (10)$$

Or as (Mbongo, 2014):

$$\mu_t = \ln M2_t - \beta_0 - \beta_1 \ln INFR_t - \beta_2 \ln EXR_t - \beta_3 \ln F_P t - \beta_4 \ln F_P t + \beta_5 t \dots (11)$$

Consider the following model

$$\Delta \ln M2_t = \alpha_0 + \alpha_1 \Delta \ln INFR_t + \alpha_2 \Delta \ln EXR_t + \alpha_3 \Delta \ln F_P t + \alpha_4 \Delta \ln F_P t + \alpha_5 \Delta \mu_{t-1} + \varepsilon_t \dots (12)$$

$\varepsilon_t$  is the white noise disturbance and  $\mu_{t-1}$  is the lagged value of the error term in the previous model. When the equilibrium error is non-zero, the model is disequilibrium. The absolute value of  $\alpha_5$  shows how quick the equilibrium converges.

**Granger Causality Test**

The study used the Granger Causality test to identify the direction of influence between money supply and inflation rate. From the work of Ndanshau (2011) and the theory presented by Mankiw (2008), there is a close relationship between money supply and inflation, but none of them proves the existence of causality. Causality test is important for policy makers to identify the source of influence and the outcomes after implementation of the policy.

The Granger causality test was expressed as:

$$\ln M2_t = \sum_{i=1}^p \alpha_1 \ln INFR_t - i + \sum_{i=1}^p \beta_1 \ln M2_t - i + \sum_{i=1}^p \delta_1 \ln EXR_t - i + \sum_{i=1}^p \sigma_1 \ln F_P t - i + \sum_{i=1}^p \sigma_1 \ln F_P t - i + \mu_1 t \dots (13)$$

$$\ln INFR_t = \sum_{i=1}^p \alpha_1 \ln INFR_t - i + \sum_{i=1}^p \beta_1 \ln M2_t - i + \sum_{i=1}^p \delta_1 \ln EXR_t - i + \sum_{i=1}^p \sigma_1 \ln F_P t - i + \sum_{i=1}^p \sigma_1 \ln F_P t - i + \mu_1 t \dots (14)$$

Where;  $\ln$  denotes natural logarithm,  $p$  is the maximum lag length,  $\mu_t$  is stochastic error terms (normally distributed with zero mean and constant variance)

The causality test is tested using the following formula:



$$F = \frac{(RSSR - RSSUR) / m}{RSSUR / (n - k)}$$

Where:  $RSS_R$  restricted sum of squares  $RSS_{UR}$  is the unrestricted sum of squares and  $m$  is the lag length of  $M_2$ .

### 3.0 Findings and Discussion

#### Analysis of the Unit Root Test

As shown in Table 1 below, the unit root test using Augmented Dickey-Fuller test was non stationary at level as shown by the non-significant p-values of 0.9471 and 0.9953 for the natural log of money supply and exchange rates respectively. This calls for differencing of variables at first difference.

**Table 1: Shows the Augmented Dickey-Fuller Test at Level**

Variable Names	At Level		
	ADF Test	5% Critical Value	P-Value for Z (t)
lnINFR_RATE	-5.271	-2.887	0.0000
lnM_SUPPLY	-0.123	-2.887	0.9471
lnEX_RATE	1.109	-2.887	0.9953
lnF_PRICE	-5.453	-2.887	0.0000
lnFUEL_PRICE	-7.294	-2.887	0.0000

**Source:** Authors Computation with Stata (2022)

The results presented in Table 2 below, show that all variables became stationary at their first difference using Augmented Dickey Fuller test at the significance level of 1% for all the variables, which is less than 5% significance level for the test statistics. This helps in meeting the assumption that the error term may be correlated.

**Table 2: Results of ADF Test at First Difference**

Variable Names	At First Difference Level		
	ADF Test	5% Critical Value	P-Value for Z (t)
lnINFR_RATE	-10.361	-2.887	0.0000
lnM_SUPPLY	-8.479	-2.887	0.0000
lnEX_RATE	-6.369	-2.887	0.0000
lnF_PRICE	-10.366	-2.887	0.0000
lnFUEL_PRICE	-11.478	-2.887	0.0000

**Source:** Authors Computation with Stata (2022)

#### Analysis of Co integration

Basing on the results in Table 3 below, if the trace statistics is greater than critical value, statistically the null hypothesis is accepted and if trace statistics is lower than critical value at 5%, the alternative hypothesis is accepted. Therefore, since 5.3 trace statistics is lower than 15.41 critical value at 5% level, the alternative hypothesis is accepted by rejecting the null hypothesis. Hence, the existence of 3 or less co-integrating equations indicates a long-running relationship between inflation rate, money supply, exchange rate, food prices and fuel prices variables.

**Table 3: Results of Johansen Tests for Co-Integration.**

Max rank value	LL	Parms	Eigenvalue	Trace Statistic	5% Critical
0	80	-2567.2	.	159.7	68.52
1	89	-2533.2	0.385	91.6	47.21

2	96	-2508.3	0.299	41.8	29.68
3	101	-2490.0	0.229	5.3*	15.41
4	104	-2487.8	0.031	0.9	3.76
5	105	-2487.4	0.006		

**Source:** Authors Computation with Stata (2022)

**Note:** \* Indicates Number of Co-Integration Equations at 5%

These findings are similar to Joshi (2021), whose results revealed long-running co-integration relationship and the error correction term was found to be negative (-0.98) and significant (p=0.02) between the variables.

### The relationship between money supply and inflation rate

**Table 4: Output of Vector Error-correction Model for D\_InM\_SUPPLY**

	Coefficient.	Std. Err	Z	P>z
D_InM_SUPPLY				
_ce1	-0.04544	0.04122	-1.10	0.270
L1.				
_ce2	0.01126	0.01732	0.65	0.516
L1.				
_ce3	0.00080	0.00070	1.14	0.252
L1.				
lnM_SUPPLY				
LD.	-0.85621	0.13247	-6.46	0.000
L2D.	-0.80537	0.14370	-5.60	0.000
L3D.	0.30104	0.13289	2.27	0.023
INF_RATE				
LD.	-0.02061	0.01384	-1.49	0.137
L2D.	-0.02066	0.01042	-1.98	0.048
L3D.	-0.00085	0.00680	-0.13	0.901
EX_RATE				
LD.	-0.00547	0.00183	-2.99	0.003
L2D.	0.00170	0.00176	0.96	0.336
L3D.	-0.00559	0.00172	-3.25	0.001
F_PRICE				
LD.	0.01439	0.01276	1.13	0.259
L2D.	0.01862	0.00920	2.02	0.043
L3D.	0.00329	0.00553	0.59	0.552
FUEL_PRICE				
LD.	-0.00011	0.00159	-0.07	0.947
L2D.	-0.00068	0.00117	-0.58	0.559
L3D.	-0.00057	0.00071	-0.79	0.429
_cons	0.03712	0.04545	0.82	0.414

**Source:** Authors computation with Stata (2022)

As shown in Table 4 above, the results show that the coefficient of error correction term (speed of adjustment for co-integration) in the first co-integrating equation is negative 0.045 and statistically

insignificant at the 5% level. In the second co-integration equation, the results show that the error correction term is positive 0.011 and insignificant at 5% level. In the third co-integration equation, the results show that the error correction term is positive 0.0008 and insignificant at 5% level. Since the value of coefficient should be negative and significant at 5% level, the results show that, all equations have no significant p values though co-integration equation has a negative value. This means that the two conditions are missing, and the VECM do not show any long-term causality between difference of natural log of money supply and the remaining variables inflation rate, exchange rate, food price and fuel price.

The findings reveal that, there is insignificant positive relationship between money supply and inflation rate in the long run. These findings are similar to Trisha, Sukono, Kalfin, and Abdul (2020), whose findings indicated that inflation rate variable had no significant effects on money supply, with a probability value of 0.0645. Furthermore, these results differ from Ifionu and Akinpelumi (2015), whose findings revealed that, there exist long-running relationships between the variables employed and, inflation has an inverse significance with money supply (M2) and exchange rate (EXR) in Nigeria. Also, Ofori (2017) showed a long-running positive relationship between money supply and inflation in Ghana.

The short term causality for difference in natural log of money supply between variables is examined by looking at individual lag coefficients and p-values for each independent variable as indicated in Table 4 above. This part shows the lagged values of inflation rate, exchange rate, food price and fuel price for difference of natural log of money supply. The results show that the 2<sup>nd</sup> lag of inflation rate is significant with (p-value is 0.048), 1<sup>st</sup> and 2<sup>nd</sup> lags of exchange rate is significant with (p-value is 0.003 and 0.001 respectively), and the 2<sup>nd</sup> lag of food price is significant with (p-value is 0.043). This means the indicated lags have a short-term causality with difference in the natural log of money supply.

**Table 5 Results for Long-run Cointegration Equations of Johansen Normalization Restrictions Imposed**

beta	Coefficient	Std. Err.	z	P>z
_ce1				
lnM_SUPPLY	1	.	.	.
F_PRICE	0.4334	.1236542	3.51	0.000
FUEL_PRICE	-0.3026	.0360307	-8.40	0.000
_cons	-8.5211	.	.	.

**Source:** Authors computation using Stata (2022)

In the long run, food price has a positive effect while fuel price has a negative effect on natural log of money supply. The coefficients are statistically significant at 1% level. Food price and fuel price have a symmetric effect on natural log of money supply in the long run average ceteris paribus.

#### 4.0 Conclusion and recommendations

Conclusively, the study shows that inflation is positively or negatively affected by many factors, and money supply and inflation rate have no long run causal relationship. However, there is a short-run causality from inflation rate, exchange rate and food price to money supply. This means inflation rate, exchange rate and food prices have information about changes in money supply in South Sudan; and the other way round for exchange rate due to their causal long-running relationship. Thus, the article recommends the following:-

- i. The Bank of South Sudan should strengthen the monetary policy to protect the currency from depreciation through interest rates and reserve requirements and getting rid of government deficit financing by minting more money which increases money supply in circulation;
- ii. There is a need for the government to embark on investing capital in the Agriculture sector to raise food productivity in the country, and hence lowering food prices, importation and reducing inflation rate in the country; and
- iii. There is a need for the government to build more crude oil refineries in the country to reduce fuel prices by discouraging imported oil. This will help in boosting production; simplifying transportation of raw materials, goods and services from areas of low demand to areas of high demand, hence reducing inflation rates.

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