

Nonlinear Relationships between Macroeconomic Indicators Shocks and Inflation Rate in Sudan Economy 1970-2019: Evidence Combination between Nardl Model, Svar Approach

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ABSTRACT

This paper integrates the NARDL model and SVAR approach to analyze the long-run and short-run asymmetric effect, Nonlinear Relationships of macroeconomic indicators shocks on Inflation rate in Sudan Economy. We reveal that the demand-side shocks of oil price have a significant impact on the Chinese stock market in both short and long run, but the supply shock is an exception. In terms of asymmetric nature, there is no evidence of asymmetric impact when it refers to the supply shock and the oil-specific demand shock on stock market, and only the aggregate demand shock has asymmetric effect in short run. NARDL model results confirm the presence of long run equilibrium relationship between inflation rate and macroeconomic indicators shocks. Our findings tend to suggest that the long run relationship is asymmetric, while evidence is in support of asymmetrical short-run trade-off between the variables.

Keywords: Macroeconomic indicators shocks; Inflation rate; NARDL model, SVAR approach; Sudan economymarkets; Ghana

INTRODUCTION

Inflation is a purely monetary phenomenon and can be controlled by curbing excessive growth of money supply. The structuralism approach distinguishes between basic or structural inflationary pressures and the propagating mechanisms that transmit such pressures. The identified key structural sources of inflation in these studies include distortionary government policies, foreign exchange bottlenecks, inelastic supply of food, the government budget constraint, and sectional disequilibria. Inflation is an important macroeconomic indicator and is widely discussed in the literature. Both demand and supply side factors including policy variables and expectations affect inflation. Numerous studies on inflation in developing countries draw from the monetarist and structuralism approaches to provide an explanation for inflation [1].

The dynamic interaction between macroeconomic indicators shocks and inflation rate is a major cause of concern in many developing economies. Flexible exchange rate regimes are strongly believed to be independent source of inflation. Some of macroeconomic indicators shocks have a tendency of causing dynamic instability in which the exchange rate constitutes an independent source of inflation although Bilson argued that exchange rates simply respond more rapidly than prices to changes in the underlying economic conditions. Although changes in exchange rates appear to be the cause of subsequent movements in prices and wages, Bilson believed that the ultimate and probable cause of both the exchange rate depreciation and domestic inflation is expansionary monetary policy.

Sudan has in July 2011, the loss of three-quarters of its oil production due to the secession of South Sudan. The oil sector had driven much of Sudan's GDP growth since 1999. For nearly a decade, the economy boomed on the back of rising oil production, high oil prices, and significant inflows of foreign direct investment. Sudan has struggled to stabilize its economy and make up for the loss of foreign exchange earnings. The interruption of oil production in South Sudan. Sudan was subject to comprehensive US sanctions, which were lifted in October 2017. Sudan is attempting to develop non-oil sources of revenues, such as gold mining and agriculture, while carrying out an austerity program to reduce expenditures. The world's largest exporter of gum Arabic [2]. Sudan introduced a new currency, -mail: wdalaweeea1981@gmail.com still called the Sudanese pound, following South Sudan's secession, but the value of the currency has fallen since its introduction. Sudan formally devalued the currency in June 2012, when it passed austerity measures that included gradually repealing fuel subsidies. Sudan also faces high inflation, which reached 47% on an annual basis in November 2012 but fell to about 35% per year in 2017. n the year 2019, inflation rates increase to a rate of 59%. Fischer conceptualizes macroeconomic instability in terms of two types of uncertainty-policy induced uncertainty and temporary uncertainty. Policy-induced macroeconomic uncertainty reduces the efficiency of the price mechanism which affects output. It is associated with high inflation or instability of the budget or current account, which reduce the productivity and its rate of increase. Temporary uncertainty reduces the rate of investment, suggesting that investment would be lower at

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Received: February 04, 2021; Accepted: February 18, 2021; Published: February 25, 2021

Citation: Fadol HTA (2021) Nonlinear Relationships between Macroeconomic Indicators Shocks and Inflation Rate in Sudan Economy 1970-2019: Evidence Combination between Nardl Model, Svar Approach. Int J Account Res 9:199.

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times when uncertainty is high, and its presence should therefore be more noticeable in the time series data.

The Central Bank of Sudan CBS is the monetary authority in Sudan with the mandate of manipulating monetary policy through policy instruments and also uses inflation rate to track the growth rate of the domestic prices. Thus, monetary authorities have often set targets on intermediate variables which include the short term interest rate, growth of money supply and exchange rate in the pursuit of macroeconomic objectives. Some empirical studies have suggested that monetary policy may have asymmetric effects on macroeconomic variables. Therefore, investigating the rate at which an economy responds to the asymmetric effects of monetary policy actions has important implications for macroeconomic management.

Early studies use linear models to check the association between macroeconomic indicators shocks and Inflation rate. This study scrutinized the nonlinear impact of crude macroeconomic indicators shocks and Inflation rate in Sudan. This is first research in SUDAN to scrutinize the asymmetric association between macroeconomic indicators shocks and Inflation rate by applying time series data from 1970 to 2019 to examine the asymmetric association between the study variables by utilizing nonlinear ARDL model, SVAR. Non-linear ARDL model have different advantages as compared to other traditional co-integration model. Asymmetric ARDL model is used when the series of variables are I (0) or I (1) or both of them. To apply nonlinear ARDL model it is compulsory to examine that any variables are not stationary at I (2), otherwise results of the asymmetric ARDL model will be misleading. In nonlinear ARDL model we can use different lag order for variables while the other co-integration method needs the same order of lag. Taking lag of variables helps to remove the problem of endogeneity. Nonlinear ARDL model can be applied for small samples [3].

The main purpose of this study is to contribute to filling this gap by studying the factors driving Nonlinear Relationships between macroeconomic indicators shocks and Inflation rate in Sudan Economy. Hence, we consider the Inflation rate as a major factor and examine the asymmetric linkages between Inflation rate and macroeconomic indicators shocks. Some papers demonstrate that prediction performance might be very poor if traditional statistical and econometric models, such as linear regressions, are employed. This is because traditional statistical and econometric models are built on linear assumptions, which, as a result, fail to capture the nonlinear patterns hidden in the crude Inflation rate series. It is a fact that the Inflation rate may not adjust instantaneously to newly available information. Further, low liquidity and the infrequent trading that occurs under imperfect markets could cause delays in response following the availability of new information, Mihajlović is an early study that drew attention to the nonlinear characteristics of Inflation rate by evaluating them in terms of regime changes in light and Inflation Response to Monetary Policy of SVAR models [4].

After reviewing the previous studies and according to the researcher's knowledge, there is no study that investigates this problem and these methodologies and models. Motivated by these lacunas, it is needed to establish an empirical study to re- investigate the Impact of the macroeconomic indicators shocks on Sudan inflation rate using a multivariate framework. This study differs from the previous studies in at least two dimensions. First, besides the SVAR and NARDL. The remainder of this paper or article is organized and divided as follows. Section 2 will discuss the data, empirical model and econometric methods used in this study. Section 3 will present the empirical findings of this study. Finally, Section 4 will report the concluding remarks of this study.

DATA, MODEL AND METHODS

Data and empirical modeling

Data were collected the annual data for Inflation rate in Sudan and macroeconomic indicators shocks from the International Monetary Fund. Annual sample period from 1970 to 2019. The descriptive statistics show that the standard deviations differ among variables. In addition, at the

5% significance level, we find that all variables are normally distributed (Jarque-Bera, Skewness and Kurtosis statistics).

Accommodations approach (Methodology)

SVAR approach

Sims suggested that VARs are a fruitful way to organize data because they can be used as a sort of battleground for testing alternative theories. Our experience over the past 30 years has confirmed the wisdom of this suggestion. In some respects, VARs represent a natural statistical tool for economists. Economists are accustomed to thinking of economic models in terms of impulses and propagation mechanisms, and VARs are a device for organizing the data precisely into these categories. The methodology used is a structural SVAR that uses restrictions imposed by economic theory to uncover the system [5]. They for, it is needed to have in mind that a SVAR is only a theoretical construct and as Sims said, it is an interpretation of historical data and it is non-observable so it can't be estimated directly.

The vector containing the endogenous variables is a matrix describing the relation among the endogenous variables in time or in other words, the contemporaneous relation or elasticities between them. From the structural form we can multiply in order to obtain the reduced form VAR to be able to estimate the model. The main purpose of SVAR estimation is to obtain non- recursive orthogonalization of the error terms for impulse response analysis. In order to estimate the orthogonal factorization matrices you need to provide additional identifying restrictions [6]. Two types of identifying restrictions: short-run and long-run. For either type, the identifying restrictions can be specified either in text form or by pattern matrices.

Objections to the SVAR methodology

The SVAR methodology has become a popular but controversial tool for the analysis of the monetary transmission mechanism and business cycle fluctuations. The main challenges to the SVAR approach. These can be grouped into three categories: First, many observers have doubts on the role of shocks in SVAR models. Particular in monetary economics it is questionable whether the estimated monetary policy shocks are truly measuring a relevant part of central bank behavior. Second, there is concern that the widespread use of informal restrictions in SVAR models may give rise to undisciplined data mining. This raises the broader question of what can be learned from these models if they reflect, due to the informal restrictions, largely the prejudice of the modeler. Third, the orthogonally restriction is a major source of concern.

EMPIRICAL RESULTS AND DISCUSSION

The starting point is to study the time series properties of the variables under consideration to avoid any spurious relationships between them. If the time series properties of the variables are satisfied, then possible long-term relationships or co-integration are likely to exist, The analytical procedure adopted in this study include: the specification of the empirical models, the concept of SVAR, NARDL. The baseline empirical model is specified to capture the hypothesized relationship among the core variables namely INF_t , MR_t , EX_t , $GDPT$, CPI_t , $BOPT$ in Sudan. The test for the stationary status of all variables to determine their order of integration is necessary before proceeding with the SVAR, NARDL tests, the ADF, PP and KPSS methods are used to determine the stationary of the variables and the results are presented [7].

RESULTS OF NARDL

The null hypothesis of long-run and short run symmetry is clearly rejected at the 1% level. For Model NARDL (1,0,2,0,0,2,1), the null hypothesis of only long run symmetry is clearly rejected at the 1% level. The F-test indicates co- integration in both cases. The models show that the Wald test is unable to reject long-run asymmetry [8]. Therefore, in the long run,

inflation rate will converge toward a symmetric long run relationship between macroeconomic indicators shocks in Sudan.

Macroeconomic indicators shocks in Sudan are more willing to increase inflation rate instantaneously in case of an increase in inflation rate. However, inflation rate exhibit more flexible behavior than Macroeconomic indicators in case of increase and decrease of (MS), (GDP). The important point is that the short-run negative asymmetry is more persistent in Sudan. According to short-run coefficients, an increase in inflation rate is passed through to (MR), (EX). The results show that 1% positive movement in inflation rate will reduce the exchange rate by 0.05%, will reduce the Money supply by 0.08, will reduce the monetary reserves by 0.62 AND will reduce the Real Gross Domestic Product by 0.75 (appreciation) and similar negative movement will increase the exchange rate by 0.81%, will increase Money supply by 0.38, will increase the monetary reserves by 0.52 AND will increase the Real Gross Domestic Product by 0.44 (depreciation) in the short run. This indicates that negative movement has more influence on exchange rate in the short-run. In long-run.

Statistics for the model is greater than the upper bound critical value of 3.89 at 1% significance level. This implies that there is a long run nonlinear relationship between inflation rate and macroeconomic indicators shocks in Sudan [9]. Also, the impulse response functions showed response of money supply, GDP to inflation rate is significant, indicating stable relationship. However, both MS, GDP and (EX) seem to exert a strong negative short run impact on inflation rate levels from period 1 to period 9 and they both peaked around period 10, which implies macroeconomic indicators shocks increases inflation rate in the short run in Sudan economy.

CUMULATIVE ASYMMETRIC ADJUSTMENTS

The asymmetric adjustments from an initial long-run equilibrium to a new long-run equilibrium after a negative or positive unitary shock affecting the inflation rate in Sudan can be learned from the dynamic multipliers. Show the predicted dynamic multipliers for the adjustment of macroeconomic indicators shocks under the four NARDL specifications we consider. The asymmetry curve depicts the linear combination of the dynamic multipliers associated with positive and negative shocks [10]. The positive and negative change curves provide the information about the asymmetric adjustment to positive and negative shocks at a given forecasting horizon respectively. Lower band and upper band for asymmetry indicate the 95% confidence interval.

RESULTS OF SVAR

Coefficient of SVAR approach

A 1% increase in the money supply has an instant positive effect on inflation of 71% at both levels of significance. After one year, the response drops sharply to 13% at both levels of significance, but at the 95 percent interval, the response was insignificant. Further, the response gradually decreases down to the sixth years in the 90 percent interval, and in the 95 percent interval the response does not differ from zero after the second month. also, a 1% increase in the GDP has an instant positive effect on inflation of 31% at both levels of significance. After one years, the response drops sharply to 6% at both levels of significance, but at the 95 percent interval, Further, the response gradually decreases down to the fifth years in the 90 percent interval, and in the 95 percent interval the response does not differ from zero after the 5 years. As for the exchange rate, its response to the change in the inflation rate is only in negative content [11].

The impact of an initial increase of a unit of Inflation rate on all the variables of macroeconomic indicators shocks in Sudan during a period of (10 years). In response to a positive one- standard deviation structural shock to Inflation rate, the Inflation rate gap first increases for some three periods before falling thereafter, inflation increases and is negative for all 10 periods and the exchange rate increases in response to a shock to itself. The positive response of the Inflation rate gap is insignificant throughout, GDP shows a significant response to ff between periods 5 and 9 and the

positive shock of Inflation rate to itself persists from some 9 periods.

CANCELATION

This paper studies the nonlinear Relationships between macroeconomic indicators shocks and Inflation rate in Sudan Economy 1970-2019. However, there are limited econometric evidence to trace the link between macroeconomic indicators shocks and Inflation rate in Sudan Economy. This study used Evidence Combination between NARDL Model, SVAR approach [12]. Foreign money supply, GDP and exchange rate play the prominent role, while CPI, BOP seem not to systematically affect the inflation rate. The macroeconomic indicators controlling measures appear to be used by the Central Bank of Sudan as the policy tools in fighting against inflation that on the domestic prices.

According to short-run coefficients in NARDL model, an increase in inflation rate is passed through to money supply, exchange rate [13]. The results show that 1% positive movement in inflation rate will reduce the exchange rate by 0.05%, will reduce the Money supply by 0.08, will reduce the monetary reserves by 0.62 AND will reduce the Real Gross Domestic Product by 0.75 (appreciation) and similar negative movement will increase the exchange rate by 0.81%, will increase Money supply by 0.38, will increase the monetary reserves by 0.52 AND will increase the Real Gross Domestic Product by 0.44 (depreciation) in the short run. This indicates that negative movement has more influence on exchange rate in the short-run. In long-run. The asymmetry curve depicts the linear combination of the dynamic multipliers associated with positive and negative shocks. The positive and negative change curves provide the information about the asymmetric adjustment to positive and negative shocks at a given forecasting horizon respectively. Lower band and upper band for asymmetry indicate the 95% confidence interval.

CONCLUSION

Also, the impulse response functions showed response of money supply, GDP to inflation rate is significant, indicating stable relationship in SVAR. However, both MS, GDP and (EX) seem to exert a strong negative short run impact on inflation rate levels from period 1 to period 9 and they both peaked around period 10, which implies macroeconomic indicators shocks increases inflation rate in the short run in Sudan economy. A 1% increase in the money supply has an instant positive effect on inflation of 71% at both levels of significance [14]. After one year, the response drops sharply to 13% at both levels of significance, but at the 95 percent interval, the response was insignificant. Further, the response gradually decreases down to the sixth years in the 90 percent interval, and in the 95 percent interval the response does not differ from zero after the second month. Also, a 1% increase in the GDP has an instant positive effect on inflation of 31% at both levels of significance. After one years, the response drops sharply to 6% at both levels of significance, but at the 95 percent interval, Further, the response gradually decreases down to the fifth years in the 90 percent interval, and in the 95 percent interval the response does not differ from zero after the 5 years. As for the exchange rate, its response to the change in the inflation rate is only in negative content. Likewise the Consumer Price Index Index and Balance of Payments Index. However, no causal relationship was found between macroeconomic indicators shocks and Inflation rate in Sudan. Which means performance of macroeconomic indicators shocks cannot be used to predict Inflation rate in Sudan, moreover Inflation rate in Sudan do reflect the macro- economic condition of the country. So, appropriate monetary system should be accelerated to help to reducing inflation rates in Sudan [15]. Not only will it boost the economy, but it will offer more renaissance and social stability.

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