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41/2023

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Impact of Monetary Policy and its Transmission Mechanism in Sudan

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Abstract. The current paper investigates the impact of monetary policy and its transmission mechanism in Sudan, using the structural vector autoregressive (SVAR) model utilizing monthly data from Jan 2000 to the end of 2021. The findings show that Sudan's monetary transmission mechanism for credit and exchange rate channels performs poorly due to the salient features of the Sudanese economy and the financial and banking sector. The policy implication arising from this finding is; the role of the conduct approach for monetary policy should be clearly defined. Moreover, it is necessary to restore the credibility and reliability of the Central Bank of Sudan (CBOS) for conducting monetary policy. Sudan's monetary and credit policies must rely on indirect instruments, and the exchange rate should be determined by the market. The banking sector should be subjected to a program of reform and recapitalization. Other financial institutions, such as insurance companies and pension funds, must play a greater role in the economy.

Keywords. Banking sector, credit & exchange rate channel, transmission

1. Introduction:

Sudan is a diversified economy and enjoys huge potential resources, historically the economy was driven by agriculture. Sudan became one of the countries producing and exporting crude oil in 1998. Crude oil has been the main driving force of the economy and attained investment in transportation, construction, infrastructure development, and social services. The pattern of economic development in Sudan is imbalanced, this situation amplifies the equal access to financial services among normal citizens and complicates the meeting of the financial inclusion objectives, but the available potential resources indicate that the country hosts a huge idle resource that can be activated in any time to achieve the setout macroeconomic objectives.

The economic performance showed a variety and volatile nature, low economic performance before 1985, which can be attributed to many reasons especially the political instability and the civil war in Southern Sudan. The country had witnessed many events that affected its economic performance throughout the period (1984 – 1985), in 1989, the National

Salvation regime took the power. In the early 1990s, the economy witnessed many transformations attributed to the structural policies that adopted and switched the economy towards free market policy, Ebaidalla (2014). The period 1992- 1997 witnessed the imposition of strong measures including the adoption of privatization and liberalization and the launching of economic structural reform programs.

The successive periods witnessed a considerable improvement and extremely various episodes in the economic performance especially after 1999; which showed strong economic performance. The improvement was supported by the large foreign direct investment and capital inflow for establishing the required infrastructure to run the oil production process. This period witnessed the resumption of Sudan's relationships with the IMF under the Staff Monitoring Program (SMP). In 2011, the Sudanese economy witnessed a major shock represented by the secession of South Sudan, Abdalla (2017). However, after 20 years of US economic and financial sanction, in October 2017 the sanction was revoked due to the progress made in the cessation of hostilities in internal conflict, improving the cooperation on regional stability, and improving humanitarian aid access. Nevertheless, Sudan remained on the US list of State Sponsoring Terrorism (SSTL), which blocked the country from access to debt relief initiatives; and access to the international financial market.

Given the foregoing, Sudan has achieved a low-ranked position in terms of access to credit, trade across borders, investment protection, enforcement of contracts, and some other important measures. The governments have recorded low-ranked scores in terms of institutions, bureaucracy, effectiveness, governance, and security. The continuous deterioration ended up in a change of regime in April 2019; followed by a period of insecurity, political instability, economic crisis, and social unrest. Politically, the power-sharing agreement was signed between the military force, political parties, and civil societies in August 2019. This agreement led to the form of the transitional government of Sudan. The new government faced legacy challenges and difficulties related to shrinking the economy due to large fiscal and external imbalances, high inflation rates, and difficult humanitarian situations.

Consistently, at present, the economy faces many distortions; the prolonged twin deficit of the public budget and trade deficit, the inflation rate rising to hyperinflation. In May 2020, three digits were recorded and caused by the monetary expansion through the successive financing deficit to the government. Therefore, the exchange rate fluctuations dominated, and the country faced what is the so-called Multiple Currency Practice (MCP). Due to this distortion, it is crucial to look for a unified exchange rate which is critical for restoring macro stability and strengthening investment and economic growth. Furthermore, Sudan remains in debt distress and the country is eligible for debt relief under the HIPC initiative, this situation requires a comprehensive effort with the international community to secure support for debt relief.

Principally, a healthy economic environment and a well-functioning financial system that perform the intermediation role is a prerequisite condition for the proper allocation and mobilizing the resources. In such a situation, the transmission mechanism has the advantage of increasing understanding of the effectiveness of the monetary policy, and the purpose of conducting appropriate monetary policy, the policy makers need clearly to understand the propagation mechanism of the monetary policy shocks and the relative importance of the various channels. It is also important for monetary policy to understand the feedback mechanism between different channels to avoid adopting an excessive expansionary or contractionary monetary policy. The main objective of the current paper is to figure out the structure and the salient features of the Sudanese financial system and explore its impact on the

monetary policy implementation, through an investigation of the monetary transmission mechanism in Sudan.

The paper will be structured as follows; section one introduces, and section two concentrates on the Sudanese financial system. Moreover, it covers the previous works on the Sudanese financial system its main features, and the obstacles. While section three covers the monetary policy transmission mechanism and overviews the MTM in Sudan. Whereas, section four undertakes the empirical works, and the data and pick up the suitable model to figure out the MTM and use the model to overcome the problem, whereas section five presents the conclusion and the policy implication.

2. The Sudanese Financial System

The well-functioning financial markets and financial intermediaries are crucial for economic growth. The financial markets perform the essential function of channeling funds from households, firms, and governments that have surplus funds to those who have exposed a shortage of funds and wish to spend more. The financial system covers each of the financial institutions, financial markets, and the infrastructure that facilitates financial operations. The aforementioned three components of finance represent the financial environment; the balanced financial environment would achieve financial stability. More importantly, financial stability refers to the ability of the financial system to facilitate the allocation of resources, valuation, pricing, control financial risks and finally maintain the functions, (the CBOS Financial Stability Report, 2016). The country's financial stability is crucial for a robust and reliable monetary policy transmission mechanism which ultimately leads to sustainable economic growth and equitable distribution of resources among the population.

The financial system in Sudan is comprised of commercial and specialized banks, insurance companies, pension funds, Ijara companies, brokerage firms, exchange companies, microfinance institutions, and financial transfer companies. There about three main regulatory bodies that supervise these institutions such as the Central Bank of Sudan, the Insurance Supervisory Board, and the Khartoum Stock Exchange (KSE). The Central Bank of Sudan is responsible for supervising (38 commercial banks), exchange bureaus (19 exchange companies), money transfer companies (18 money transfer companies), microfinance institutions (47 companies), and Ijara companies (two companies), while KSE is supervising the financial brokerage companies, and the Insurance Supervisory Board is responsible for supervising the insurance companies, (CBOS Annual Report 2021).

Table (1) the structure of the Sudanese Banking Sector:

Ownerships	1990	2000	2005	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
State-owned	5	2	2	1	1	1	1	1	1	1	1	1	1	1
Joint Banks	12	16	20	23	23	24	24	22	24	24	24	24	23	23
Foreign Banks	6	3	3	4	6	7	7	8	7	7	7	7	9	9
Specialized Banks	4	3	3	5	5	5	5	6	5	5	5	5	5	5
Investment Banks	1	1	1	0	0	0	0	0	0	0	0	0	0	0
T. No. of Banks	28	25	29	33	35	37	37	37	37	37	37	37	38	38

T. No. of Branches	589	629	655	650	679	732	778	984	828	846	865
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Table (1) shows that by 2021 the number of banks operating in Sudan amounted to 38 banks with 865 branches, (the CBOS 2021 annual report). The other financial corporation includes institutions that perform part of banks' functions such as; accepting some sorts of deposits. They include insurance companies, pension funds, financing companies, and other institutions. Furthermore, the Central Bank of Sudan gave microfinance great interest and relies on it as a mechanism for economic empowerment and a tool for reaching and achieving sustainable development goals (SDGs). Hence, microfinance is primarily used for combating extreme poverty, and helping the poor to diversify their income. The small loans can help the normal citizen to reach his economic potential and end up breaking the cycle of poverty.

The Sudanese banking sector adopts a full Islamic financial system. In such a system, all operations and transactions must comply with the Islamic laws (Shariya) that govern Muslims life, El Qorchi, (2005). The interest rate is forbidden by Islamic rules, and earnings generated by an exchange of money for money are also immoral. Moreover, all financial transactions should be based on real economic activities, and investment is completely prohibited in sectors such as tobacco, alcohol, gambling, and armament. The prohibition is extended to paying and receiving the interest rate, and it is not implied that prohibition is against making money or encouraging reverting to cash or barter economy, but encourages all investors to engage in financial transactions, and share the risk and profit or loss of the venture.

Kireyev (2001), discussed that Sudan introduced Islamic banking in 1984, and enforced it for the entire financial system in 1992. Therefore, the financial system in Sudan is characterized by cumbersome guidelines for credit allocation, historically the economic sectors were subdivided into priority and non-priority sectors; and some sectors are prohibited from performing banking finance. The guidelines are based on maximum and minimum limits of lending and restrictions on financing some commodities. The Sudanese financial sector generally and the banking sector specifically have unique characteristics due to, their operation under the full-Islamic banking sector to indicate that the interest rate tool is forbidden. The financial system in Sudan is dominated by the banking sector, which represents more than 90% of total assets, while other financial corporations (Insurance companies and pension funds) represent less than 10% of total assets, IMF Mission to Sudan Report (2014).

Accordingly, Elhiraika and Ismaeil (2000), demonstrated that the Sudanese financial sector was not lived-up to play a major role in financing the economic development of the economy, especially in terms of setting up institutions and policies that would widen poor access to credit and micro-entrepreneurs. The financial system's role in channeling the credit to different sectors with strong potential resources especially financing agriculture where the majority of the Sudanese poor are concentrated is questionable. The financial sector was dominated by small banks compared to regional and international standards. These banks are based in a few big cities and focused on commercial lending operations. The sectors with a high growth rate were agriculture, followed by manufacturing, mining, and construction. Domestic products mainly rely on imported capital goods. The main source of foreign currency is a handful of primary agricultural exports, such as cotton and Arabic gum, beside livestock.

Table (2) Some macroeconomic indicators of Sudan for the period 2005 – 2021.

Indicator	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Real GDP %	7.5	3.5	(0.02)	0.7	6.8	7.0	4.0	3.6	4.7	2.8	(1.3)	(1.6)	(1.9)
M2 %	44.7	25.4	17.9	40.2	13.3	17.0	20.7	28.9	68.2	111.7	60.1	88.8	153.2
Inflation (Ave.)	8.5	13.0	18.1	35.6	36.5	36.9	16.9	17.8	32.4	63.3	51.0	163.3	359.1
End of Period Inflation	5.6	15.4	18.9	44.5	41.9	25.7	12.6	30.5	25.2	72.9	57.0	269.3	318.2
Velocity	4.6	4.3	4.4	3.8	4.6	5.8	5.4	5.0	4.0	3.1	2.8	3.1	3.5
Current account / GDP	(1.72)	(0.34)	(0.94)	(0.77)	(0.41)	(0.83)	(1.10)	(0.65)	(0.57)	(0.39)	(0.25)	(0.15)	(0.04)

Table (2), outlines the performance of some selected macroeconomic indicators during the period (2005 - 2021). The monetary expansion that emerged recently, which was due to the involvement in the economic reform with the IMF and unifying the exchange rate, has great impact on the slowdown of the economic performance, in which the economy witnessed successive negative growth rates throughout the period 2019 – 2021, this was accompanied with unprecedented monetary expansion 153.2% in 2021, that resulted in recording 359.1% average inflation rate for the year 2021.

Figure (1), the financial and agriculture sectors' contributions to the GDP

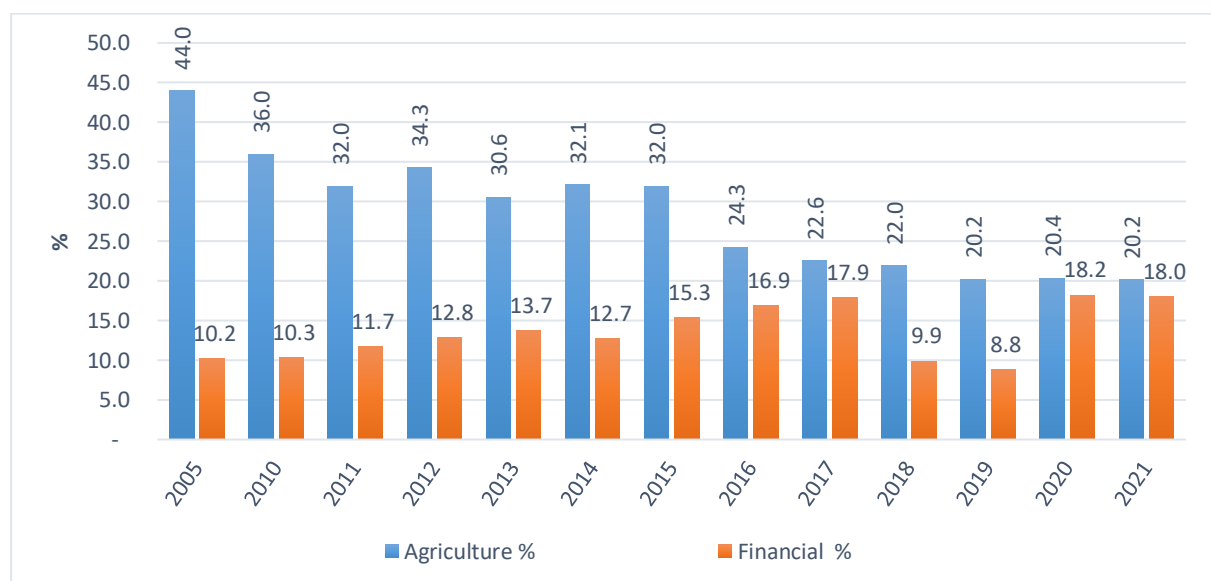
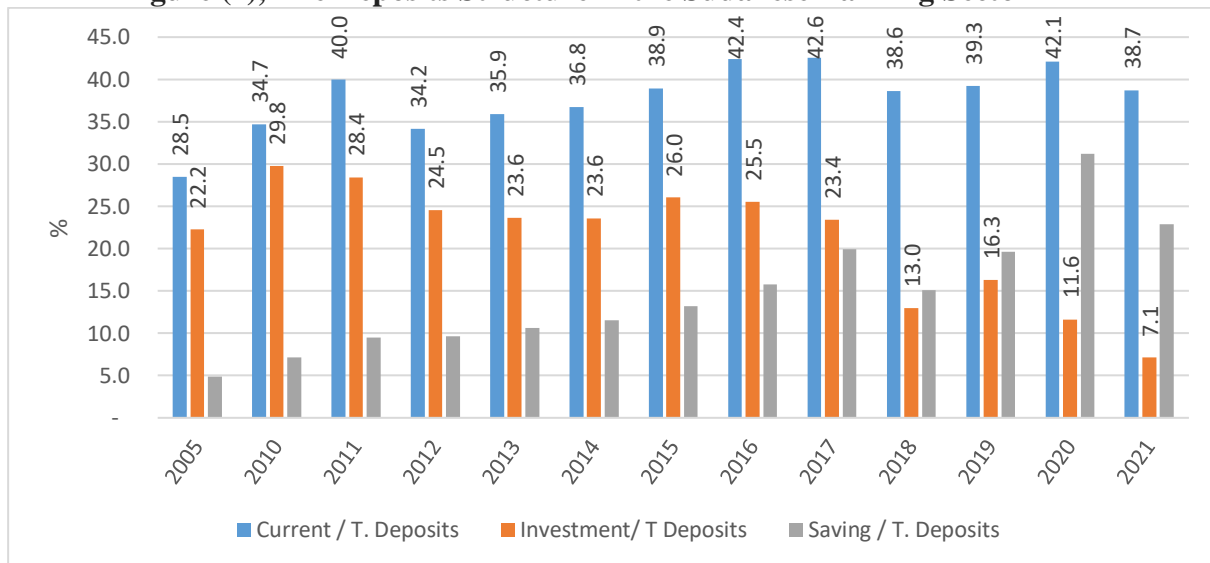


Figure (1) depicts the development of agriculture and the financial sectors and their contribution to economic performance throughout the period (2005 - 2021), in which the

average contribution of the agriculture sector reached 28.5%, while the average contribution of the financial sector reached 13.6% for the same period, this explains how the agriculture sector dominates the Sudanese economy, but recently there is a shift in the sector contributions coincided with the slowdown of the economy, the share of other sectors compared to agricultural is increasing, in the year 2021 the share of the agricultural sector was 20.2%, while the share of the financial sector was 18.0%.

Figure (2), The Deposits Structure in the Sudanese Banking Sector



The demand deposits dominate the structure of the deposit with a share of over 38.7%, which reflects the cash nature of the Sudanese economy, where the bank's clients prefer to have quick and unconditional access to their deposits and know that the demand deposits cannot be used for long-term and development loans without authorization from the depositors. The investment and saving deposits remain small, which is not the case for the deposit structure of most Islamic banks in other countries. The deposits base and the total assets of the Sudanese banks remained small, compared to other similar Islamic banks in the region and the world. The total amount of deposits in the banking system is very low compared to the deposits in Islamic banks and they are far below international standards. The same story can be applied to the capital and total assets; thus, we can say that the international standards apply to Islamic banks whereas Sudanese banks are extremely very small.

Table (3), the contribution of the credit to the GDP (Cre/GDP) for the period 2005 – 2021.

Indicator	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Private Credit/T. Cred	88.3	70.5	68.4	72.2	74.0	70.2	67.3	67.4	62.2	66.9	73.7	86.9	87.6
Credit to Gov./T. Cred %	11.4	19.8	23.3	21.3	18.9	20.1	20.5	19.7	18.6	18.1	15.8	15.0	13.4
Credit/GDP %	11.9	16.9	15.9	17.0	14.9	11.9	12.8	13.2	14.8	14.4	12.9	7.7	9.0

Due to the fiscal dominance, the credit to the government is the largest identified source of the reserve money, this means that the monetary policy in Sudan is still determined

by the borrowing needs of the government, while the experiences of other countries have shown that the independence central bank produces a sound monetary policy and hence, better control of the reserve money, and the government financing needs should be covered by the borrowing from the financial market. Relatedly, the conduct of the monetary policy in Sudan has not yet been completely divorced from the political process, meaning that the CBOS has to subordinate its objectives to accommodate government financing needs.

Relatedly, using open market operations OMO as tools to control the reserve money is inefficient, because the instruments used are too small to mitigate the large fluctuations of the liquidity effectively. Moreover, the government absorbed a noticeable amount of commercial banks' resources causing what is known as crowding out of the private sector from the credit market, this situation affects negatively the role of the private sector in mobilizing resources and contributed positively to the growth and the development process.

Table (4), Some Monetary Ratios of Sudan for the Period 2005 – 2021.

Indicator	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
M2 %	44.7	25.4	17.9	40.2	13.3	17.0	20.7	28.9	68.2	111.7	60.1	88.8	153.2
Reserve %	61.7	17.2	27.8	46.7	20.3	16.0	22.1	27.4	63.6	170.2	77.4	100.3	160.9
Currency_O_B / Deposits	38.5	41.1	48.8	44.8	45.8	46.4	45.9	51.2	46.6	37.3	80.4	87.5	47.4
Multiplier	2.3	2.2	2.0	1.9	1.8	1.8	1.8	1.8	1.9	1.5	1.3	1.3	1.2
Velocity	4.6	4.3	4.4	3.8	4.6	5.8	5.4	5.0	4.0	3.1	2.8	3.1	3.5
Currency_Circ. / M2		28.4	30.7	28.6	28.9	30.0	29.3	32.0	30.2	26.2	40.8	43.0	27.5
Currency_Cir / Reserve		62.3	62.2	55.3	52.6	55.2	53.2	58.8	57.1	38.8	54.5	54.2	33.6
Private Cred / T. Credit	92.9	88.3	70.5	68.4	72.2	74.0	70.2	67.3	67.4	62.2	66.9	73.7	86.9
Foreign Dep / T. Deposits		9.5	10.5	8.4	10.9	9.0	17.2	14.6	9.4	4.2	3.7	3.3	4.9

Figure (3); The relationships between the money supply and the reserve money during the period 2005 - 2021.

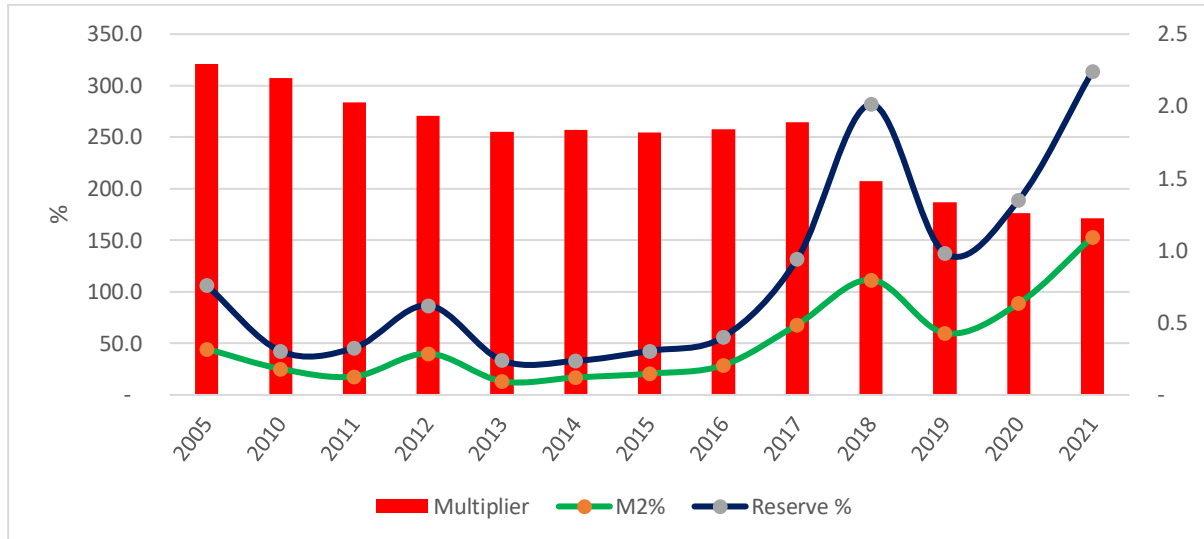


Figure (3) shows the relationships between the multiplier and the reserve money growth are unique, recently the multiplier was the factor that accelerate the money supply, while the swings of the multiplier reflect the shift in the demand for cash stemming from both confidence and the seasonality effect and the change in the CBOS policies toward the credit allocation. In addition to the cash shortage problem that faces the Sudanese banking sector recently. In this connection, the degree of the CBOS control of the reserve money is crucial for the monetary policy to be conducive in achieving long-term growth and inflationary targets. The movement in the broad money supply should be tied to the movement in reserve money, reflecting the growth rates of the nominal stocks of the broad money compared with the growth rates of its components, the reserve money, and the monetary multiplier. The explanation of the variation in the growth of the broad money recently is due to the growth in the reserve money.

Similarly, Davoodi, et al., (2013), have outlined that the stability of the money multiplier implies that the second building block of monetary targeting under the reserve targeting monetary policy works well in the country. The large shifts in currency in circulation, the entry of the new banks, and the bank's branching make the implementation of the reserve money monetary policy much more challenging. Thus, the stability of the velocity and the multiplier imply that both steps of the reserve targeting monetary policy program may not work ex-ante but could work ex-post adjustment. The NGDP, M2, and reserve money are used to summarize the movement in the velocity and the money multiplier. By assuming that the reserve monetary policy works ex-ante we expect to see stability or constancy of the velocity and the money multiplier, in addition to their predictability which is very important.

The Historical Development of Monetary and Credit Policy in Sudan

Throughout the period 1983 -1985, the Central Bank of Sudan adopted several measures and instructions that aimed at managing banking finance, while in 1985 the credit ceiling policy for the first time was initiated. In 1987, Sudan's economy witnessed the combination of sub-sector ceilings related to exports and industry sectors and adopted one ceiling for the priority sectors, and finance was provided to the priority sectors and activities by not less than 80% of the designated ceiling for each bank by the first of January 1988. Whereas,

the year 1989, showed the providing of privilege financing and purchasing the Sorghum to the agricultural bank, in addition to the adoption of some measures concerning the financing in general and financing the exports. While in 1990 the regulations stated that agriculture financing should not be less than 40% of the specified ceiling for each bank, and the regulations imposed some penalties.

In the years 1991 – 1992, Sudan adopted the economic liberalization policy that included the removal of all banking restrictions in monetary and financing policies. Moreover, the policy showed for the first-time clear objectives for financing. In the year 1998, the new objectives that stipulated the credit policy such as; raising the importance of the supply side economy, supporting the economic privatization policy, and imposing the application of Islamic sharia-based accounting standards. In addition to, many regulations concerning the credit policy, and the adoption of some measures related to credit provided to domestic trade. The year 1999, showed the issuance of monetary and credit policy coincided with the issuance of comprehensive banking policy for the period (1999 - 2002).

The aim was to restructure the banking system to cope with international development based on economic liberalization policy and the outcome of the Basel Committee and economic globalization. In the year 2000, the monetary policy settled the legal reserve to 20% while at the beginning of the year accounted for 15%. In May 2000, the local currency deposit accounted for 10% and the foreign currency deposit was set at 15%. In the same context, Kireyev (2001), stated that for purposes of strengthening monetary management and analysis in 1998, the CBOS established a monetary policy committee. In addition, to develop a short-term information system to monitor key items of the balance sheet every week (the weekly flash report).

Currently, the Central Bank of Sudan adopts monetary aggregate targeting as a monetary policy regime, using the monetary base or reserves as operational tools, and hence the money supply as a medium target to achieve the final target which is the prices and exchange rate stability. The CBOS uses a combination of monetary policy instruments. These instruments include open market operations (OMOs), and legal reserve requirements, and concentrate on targeting the reserve requirement affecting the volume of reserve money and the multiplier through the reserve/deposit ratio, and the depositor's preference for cash or deposits reflected in the currency/deposit ratio. The bank's decision on how much reserve to keep for a given level of deposits is revealed through the excess reserve/deposit ratio. Furthermore, the CBOS often provides various incentives to banks in the context of moral suasion to induce desired responses in certain policy-related issues.

The central bank of Sudan conducts its monetary policy under a full-Islamic banking system. Under such a monetary framework, the debt-based monetary policy instrument such as the interest rate is forbidden. However, equity-based securities can be traded in the open market, with trading values reflecting market expectations. Therefore, the CBOS relied on Islamic modes of finance and equity-based instrument issued by the government and the Central Bank to provide interbank and credit facilities. The reserve requirement was a vital instrument in conducting monetary policy, and in the absence of conventional policy instruments, the legal reserve ratios are applied to both local and foreign currency deposits. The monetary policy implementation has shown a significant development represented by the introduction of The Real Time Gross Settlement Systems (RTGS) in 2011, and the inauguration of the interbank Liquidity Management Fund in 2014.

In this connection, the monetary policy in Sudan relied heavily on direct or non-market instruments such instrument includes credit guidelines and reserve requirements. More importantly, the market in which it operates is ineffective, and a lack of depth and liquidity is

necessary for the adoption of a market-oriented monetary policy. The underdevelopment of the financial market is reflected in the degree of market segmentation, lack of securities at longer maturities, or lack of depth and liquidity in the financial market. Poor liquidity can induce large changes in market prices and complicates the conduct of monetary policy due to its impact on financial stability, and requires government intervention to keep the market functioning. In the same way, the existing interbank market in Sudan did not carry any interest rate which constrained the effectiveness of the interbank channel in Sudan.

However, the current situation of monetary expansion, fiscal dominance, high inflation rate, and depreciated exchange rate make the monetary targeting monetary policy regime ineffective and neutralized the role of monetary policy in favor of the fiscal policy. This is why there is a serious consensus on a new nominal anchor for monetary policy that will be adopted alongside the exchange rate reforms. In this connection, the authorities planning to adopt the reserve targeting monetary policy framework as transitional towards adopting inflation targeting as an ultimate objective for monetary policy.

In more extensive, Kireyev (2001) demonstrated that the financial intermediation in Sudan was still low, and the banking system remained also weak and largely undercapitalized. This situation was due to a combination of economic and social factors that included years of financial instability, high inflation, rapid nominal exchange rate depreciation, weak financial infrastructure, excessive centralization of economic power within the government, and widespread poverty. The social factors that appeared include the large geographical size of Sudan, poor infrastructure, political instability, and religious constraints. In this regard, Rodrik (1999), demonstrated empirically that, the social conflicts were diminishing the productivity of the society's resources which were utilized in several ways, such as delaying adjustments needed in fiscal and key relative prices (real exchange rate and real wages) and diverting activities from productive and entrepreneurial spheres to the political sphere.

Bearing that in mind, Acemoglu, et al., (2003) stated that the countries that have distortionary macroeconomic policies, including high inflation, large budget deficits, and misaligned exchange rates appeared to be suffered more macroeconomic volatilities, and more slowly economic growth during the postwar period. Consequently, the countries that pursue poor macroeconomic policies and weak institutions including political institutions, ineffective enforcement of property rights for investors, widespread corruption, and a high degree of political instability. The distortionary macroeconomic policies reflected institutional problems such as lack of law enforcement, transfer of resources from agriculture to urban interest through the overvalued exchange rate; the influence of interest groups on the political decisions in an institutionally weak society, and prevalent corruption.

While, Arabi (2015), has stated that financial stability entailed the efficient allocation of resources, assessment, and management of financial risk, maintaining the employment levels closer to the economy's natural rate, and eliminating relative price movements of real and financial assets. The stable financial system absorbed shocks, therefore, economic growth was required as a medium for most real transactions.

3. **The Monetary Policy Transmission Mechanism (MTM)**

The monetary transmission mechanism refers to the channels through which the monetary policy actions influence aggregate demand and inflation and ended up in achieving the designated economic growth objectives of the country. In other words, the monetary transmission mechanism is a sequence of events with changes in the value of monetary policy instruments that ended in a change in real output and inflation. The monetary transmission mechanism indicates what policy instruments are used, the channels through which the changes

in the instruments are transmitted into changes in real GDP and inflation, and the relative importance of each channel.

Mugume (2009), has outlined that the main issue concerning the monetary transmission mechanism is associated with the absence of short-term real effect, either due to asymmetric information or adjustment costs, or price stickiness in the key markets. The actions of monetary authorities have a real effect in the short term. The investigation of the monetary transmission mechanism is so important that the recognition of the economic environment is incomplete, and the existence of considerable time lag before monetary policy actions have an impact on the economy. Meanwhile, Cecchetti (1995), has mentioned that one way of posing the fundamental question associated with understanding the monetary transmission mechanism is to ask how trivial changes in the supply of an outside asset can create large shifts in the gross quantity of assets that in zero net supply. How is a small movement in the monetary base (or nonborrowed reserves) translate into large changes in demand deposits, loans, bonds, and other securities, thereby affecting aggregate investment and output?

An understanding of the monetary transmission mechanism is a prerequisite for conducting monetary policy. Davoodi, Dixit, and Pinter (2013) have found that most empirical literature on monetary transmission mechanisms primarily focusing on developed countries, more specifically, the most distinctive features of the monetary transmission mechanism in developed countries are the prices (interest rates, exchange rates, and other assets prices). In contrast, the focus in developing countries is on quantities (money, credit, base money, bonds, foreign assets, etc.).

An overview of the Monetary Transmission Mechanism:

There is some sort of consensus in the economic literature on the ability of the central banks to control the supply of assets (outside money) that is demanded by financial institutions. Generally, monetary policy actions begin when the central banks change the monetary base or sell securities to reduce the monetary base. The central bank affects the liquidity of the banking system and interest rate, and the prices of a variety of domestic and foreign assets. Berg, et al., (2013), have stated that the actions of monetary authority may proceed through the following channels to affect the economy's prices and output. These channels can be grouped into the following categories: The interest rate channel; exchange rate channel; credit channel; expectations channel; assets prices channel; and risk-taking channel. Hereby an outline of the most important channels that characterize the monetary transmission mechanism, the forthcoming channels represent the most widely known monetary transmission channels.

A. The Interest Channel

It is one of the traditional channels of monetary policy, an expansionary monetary policy leads to a fall in the real interest rate, thereby reducing the cost of capital and stimulating investment, leading to increase aggregate demand and output. The vital factor linking the monetary base with the real interest rate and determining the effectiveness of the interest rate channel is the slow adjustment of the price level (price stickiness) which causes the movements in the monetary policy rate to mark the short-term interest rate. The rational expectations hypothesis stipulated that the long-term real interest rate is determined by expectations about the future short-term real interest rate. Together with price stickiness and rational expectations, the long-term real interest rate is affected and influenced the demand for a broad range of capital goods. According to Keynesian analysis, the deviations of aggregate demand from the potential output of the economy (output gap) would result in inflationary pressure. On the other hand, the

tightening of the monetary policy stance translates into a higher interest rate, slow aggregate demand, and falling inflationary pressure.

B. Exchange Rate Channel

The exchange rate channel is one of the most important monetary policy channels, which means that the monetary policy affects the exchange rate movements and is influenced by the theory of purchasing power parity (PPP). In addition to uncovered interest parity (UIP) suggests that the expected future changes in nominal exchange rates are related to the differences between domestic and foreign interest rates. The UIP enables a monetary authority to influence the exchange rate, which in turn affects the relative prices of domestic and foreign goods affecting the net exports and thus output. Hence, the effectiveness of the exchange rate channel is determined by the UIP condition.

To a large extent, Mugume (2009), has pointed out that the exchange rate was a very important element in the macroeconomic model of an open economy. The chain of transmission functions from the interest rate to the exchange rate via the uncovered interest parity conditions relating the interest rate differentials to expected exchange rate movements. Hence, under floating exchange rates and perfect capital mobility, the arbitrage between domestic and short-term government securities causes initial capital flows, which change the equilibrium value of the exchange rate required to sustain the uncovered interest parity. In sticky prices, these changes would be reflected in the real exchange rate depreciation that induced expenditure switching between domestic and foreign goods.

In practice, Basci, Ozel, & Sarikaya (2008), have discussed that the monetary policy in an open economy operates through the exchange rate, under the main assumption underpinned by the uncovered interest parity. When the exchange rate is floating, a policy-induced cut in the interest rate leads to capital outflows and nominal exchange rate appreciation. The sticky prices together with the exchange rate would lead to a real depreciation and an increase in the prices of tradable relative to non-tradable. In the same manner, Berg, et al., (2013), asserted that capital mobility, arbitrage opportunities, and changes in the real interest rate would affect the exchange rate so that the increase in local interest rate would tend to appreciate the currency. The movements in the exchange rate would directly affect inflation by changing the cost of imports and moving the real exchange rate which affects the net exports and aggregate demand.

C. The Assets Prices Channel

There are two major routes through which higher asset prices can increase demand. First, the higher asset prices would boost household wealth and the permanent desired consumption would increase. The increases in wealth can be used as collateral to allow intertemporal substitutions. Second, the higher asset prices lift the mark value of firms about the replacement cost of capital. In particular, the arbitrage between long-term bonds on one hand, and equities and real estate on other hand, would affect stock market values and real estate prices, which in turn affect household wealth and consumer spending. The present value of any assets or durable goods is inversely related to the long-term real interest rate.

D. The Credit Channel

Economists usually differentiate between two types of credit channels, the bank lending channel and the balance sheet channel, with that in mind Berg, et al., (2013), have noted that several mechanisms in the credit channel outline the role of symmetric knowledge in

financial markets and its implications for the transfer of the monetary policy to the rest of economy (the bank lending channel, the balance sheet channel, and the cash flow channel). By assuming monetary contractions in the bank lending channel, the banks' reserves and deposits would decrease the quality of available bank loans.

The two channels, the bank lending channel, and the balance-sheet channel can be understood as a complementary mechanism that would be used to explain whenever asymmetric information problems exist such as the influence of financial factors on the effect of monetary policy. The credit channel tells us that there would be a greater impact on those agents for whom the cost of funds is more sensitive to the collateral offered. In general, the existence of a balance-sheet channel seems well established, but the bank lending channel is more controversial due to the institutional changes during the past decades.

1. **The bank Lending Channel**

The bank lending channel postulates that as long as banks cannot perfectly substitute deposits with other sources of funds, changes in monetary policy would be translated into changes in the number of banks' reserves and deposits, thus, altering their ability and willingness to lend. However, the tightening monetary policy would result in slow aggregate demand, low credit availability, and inflation. The credit market frictions imply that some borrowers only have access to external funds through bank credit, while others must pay a premium over the risk free rate which depends on their net worth. The credit channel captures the dual effects so that the changes of the supply in the reserves of the banking system exert aggregate demand through changes in terms of which bank customers have access to loans, as well as changes in the external finance premium.

2. **The Balance Sheet Channel**

The balance channel is related to the effects of monetary policy on the net worth of the business and the household by altering the value of the collateral that can be pledged for credit. The increase in interest rate translates into lower values of collateral and tighter access to credit, resulting in low aggregate demand and inflation. Monetary policy affects firms' balance sheets in several ways, contractionary monetary policy leads to a decline in assets prices particularly equities prices which lower the net worth of the firms, and it can also affect firms' balance sheets through cash flows, the difference between cash receipt and the cash expenditure raises the interest rates and the firm's interest payment and leads to pushing the cash flow to fall. Hence, the firms tend towards external financing which is exposed to asymmetric information problems, and external financing premium which boosts the cost of capital that is reflected in lending, investment, and economic activity.

E. **The Expectations Channel**

Modern economic analysis is based on rational economic agents and forward-looking behavior, accordingly, the expectation channel affects the working of all channels, and the expectation channel works properly in developed countries. The monetary policy can also guide economic agents' expectations of future inflation, and influence price developments. The expectations are crucial because they would influence the level of the real interest rate and nominal interest rate. Because they influence prices and money wages would set out behavior and feedback into the actual inflation. Likewise, Berg, et al. (2013), found that the strength of different channels was determined by the expectation of the private sector for future policy decisions, which can be viewed as a separate channel of transmission. The Expectation of the

future matter greatly for exchange rate determination and inflation behavior, which is the ultimate concern of monetary policy. While, Mugume (2009), has asserted that expectations are central to monetary transmission.

The market responses to the expectations would depend on the external and internal environments and the policy regime. The uncertain impact of policy change on the economy enhances the need for a credible and transparent regime. The credible inflation target monetary policy would allow agents to generate clearer and less erratic expectations of future policy behavior, and exchange rate and diminish the impact of monetary disturbances that are likely to reserve in the future. The market infers future policy actions by looking at currently available information. In the same context, Basci, et al. (2008), have discussed the expectations in terms of considerable significance for the effectiveness of all other channels of transmission. The operation of expectation depends on many factors such as; the degree of credibility of the central bank, the degree of predictability of the central bank's actions, and the higher degree of commitment by the central bank.

Monetary Transmission in Low-income Countries

Some prerequisites must be satisfied to build solid and well-functioning monetary transmission in low-income countries. The monetary transmission mechanism is weaker in low-income countries compared to that in developed countries. The financial structure of low-income countries implies that the bank lending channel is the dominant channel of monetary transmission, and its effectiveness depends on the domestic institutional context, the structure of the banking system, and the stability of the domestic macroeconomic environment which is problematic in such countries. The integration of the informal (shadow) economy into the formal economy and there is a need to deepen financial intermediation. The placing primary responsibility for domestic macroeconomic stabilization on the central bank is misguided. For instance, Mishra and Montiel (2013), claimed that the central bank policy instruments in low-income countries must be effective to implement effective monetary policy, but unfortunately, the link between monetary policy instruments and aggregate demand is not strong.

Mishra, et al. (2010), outlined that the monetary transmission in developing countries was different from those in developed and emerging countries based on the structure of the financial system. Many developing countries are characterized by the absence of a well-functioning market for fixed-income securities, equity, and real estate, with limited connections to the international private capital markets and heavy central bank intervention in foreign exchange markets. This situation leaves little room for the functioning of the conventional interest rate channel, the assets channel, or the exchange rate channel, and the other channels would be weak. Banks are dominating financial intermediaries in such countries. The bank lending channel is likely to be the dominant channel of monetary transmission, and the balance-sheet channel is operating as a financial accelerator, indicating that it is the factor that magnifies the effect of the bank lending channel and increases the external finance premium when banks credit is plentiful and reducing it when such credit is scarce.

In the same context, Mishra, et al. (2010), postulated that the different economies shared some common features of monetary transmission mechanisms, which depend on their financial structure. The monetary transmission in developing countries is more different than those of developed countries. It is likely to be dominated by bank lending channels, because of the low level of financial development and the combination of institutional differences that restrict bank lending as well as a high level of banks concentration which shows that the transmission from the monetary policy actions to the bank lending rates both weak and

unreliable. Similarly, Basic, Ozel, & Sarikaya (2008), have demonstrated that the past decades witnessed a fundamental change in monetary policy structure within the financial environment. In such a way, the central bank sets a key short-term interest rate and allows the markets to determine another interest rate in the economy and the flexible exchange rate opens up an additional channel of monetary transmission, and if monetary policy is credible, there would be the major implication for the transmission of monetary shocks.

Broadly speaking, the bank lending channel is likely to be the dominant channel for monetary transmission in developing countries. Next, the effectiveness and reliability of monetary transmission in such countries depend on the properties of the specific channel. The properties concern the link and the causal chains from monetary policy actions to aggregate demand. The link is between monetary policy actions and the availability and cost of banks' credit and aggregate demand. When the financial sector is small, the links are likely to be weak which may be due to either; the lending industry being non-competitive or changes in the bank's financing cost may be reflected in the bank's profit margins, rather than in the lending of the banks. The poor institutional environment raises the cost of lending to banks and it can restrict lending activities in a manner that weakens the effect of monetary policy actions on loan supply.

These features of developing countries lower the functioning of the conventional interest rate channel. Mishra and Montiel (2013), have specified the dominant channel for monetary transmission mechanism in low-income countries. The bank lending channel is accompanied by a derivatives balance sheet channel operating as a financial accelerator. While, Peiris and Saxegaard (2010), have demonstrated the use of monetary policy to stabilize macroeconomic conditions and analyze the sources of inflation in low-income countries, particularly Sub-Saharan African countries which exposed many challenges; the trade-off between alternative monetary policy rules where the characteristics of the economy and monetary policy setting are quite different. The commercial banks in these countries are at the center of the formal financial system, and the conduct of monetary policy focuses primarily on the supply and demand for the monetary base. While, Demirgüç-Kunt and Detragiache (1998), showed that when the macroeconomic environment is weak the banking crisis tends to erupt, particularly when growth is low and inflation is high. High real interest rates are associated with systematic banking sector problems. Moreover, the balance of payments is subject to a vulnerability crisis.

The requirements needed to be satisfied to have well-functioning monetary transmission in developing countries are; the monetary transmission environment should be closer to those in developed countries, besides the size of the formal financial sector and the informal sector should not play a dominant role in financial intermediation, in addition to central bank independence similar to that in developed countries, the quality of institutional and regulatory environment related to political instability, poor accounting, and disclosure standards, weak regulatory environment, poorly functioning of the legal system, and the prevalence of corruption that amplifies and causes a high cost of financial intermediation.

Stylized Facts about MTM in Sudan:

The Sudanese financial system shares some common features of low-income countries, its financial system is dominated by private banks. More precisely, the Sudanese banking sector has dominated the financial system (IMF Mission 2014), where the total assets of other financial corporations accounted for less than 10% of total financial assets. In addition, the financial sector is operating only through the Islamic banking system; indicating that the interest rate is forbidden in the Sudanese banking system associated with Islamic Shariaa. This fact raised

many difficulties and challenges to the functioning and practicing of banking businesses in Sudan, ultimately leading to great challenges in tracking the monetary transmission mechanism.

In the same context, Feizi (2008), has argued that the prohibition of interest rates in the Islamic economies framework has created some problematic challenges to macroeconomic modeling and the execution of monetary policy mechanisms. He introduced the exchange rate as an alternative monetary policy instrument to the Islamic economies. On other hand, the impossible trinity provides a conclusion that with fixed exchange rates the effectiveness of monetary policy decreases as the degree of integration between domestic and foreign financial assets increases. In line with perfect integration monetary policy does not affect aggregate demand.

In general, Sudan lacks large secondary markets, and the stock market is very small; it means that the monetary policy effect would be channeled only to the bank lending channel. However, the cost of credit in the economy is albeit high. Some well-known monetary transmission channels are found in Sudan; while others are not applicable in Sudan at this stage; for instance, an interest rate channel does not exist in the Sudanese economy due to the adopted financial system. Relatedly, Benes, et al. (2012), demonstrated that the monetary transmission mechanism in low-income countries (LICs) was considered very different because of a large proportion of the population without access to financial services. Banks dominate the financial system and the secondary market for government securities is often missed; the interest rate might not reflect the domestic financial situation. In such a situation, the market-determined exchange rate will be the most possible candidate for replacing the interest rate and channeling the monetary policy actions to the rest of the economy.

4. **The Empirical Works:**

Analysis of Transmission Mechanism in Sudan:

Based on the seminal work of Sim (1980), the VAR become a workhorse in empirical macroeconomic analysis. The VAR takes into account the interactions between macroeconomic variables over time. Because there is one equation for each variable, all variables in the system are treated as potential endogenous, and each variable is explained by its lags and the lag values of other variables. The VAR models treat the economy as a black box and try to identify the linkages between some key inputs and key outputs of interest. This means that the model allows the data to speak freely about the empirical contents of the model.

$$Z_t = A_0 + A_1 Z_{t-1} + \varepsilon_t \dots\dots\dots(1)$$

Each variable is expressed as a linear function of their past values (own lags) and the past values (lags) of other variables plus the white noise residuals, so all regressors are predetermined (all variables are endogenous). The traditional VAR is of limited use and has been a subject of Lucas's critique (Lucas, 1972), for the lack of knowledge of the complete structural economic structure, and prone to spurious regression problems when data are non-stationary.

Set up the Monetary Transmission SVAR Model:

In the SVAR models, the economic theory is used to inform the construction of the model. Freeing-up econometrics modeling from the constraints applied by economic theory. Because the shocks are not always orthogonal due to the contemporaneous correlation between variables. Therefore, we have to add structure to the evolution of the shock processes into the VAR to achieve contemporaneity, in which the value of the variable depends on the

contemporaneous values of other variables, as opposed to a variable depending solely on the past values of other variables. The SVAR ensures that the shocks have economic meaning.

SVAR Identification:

We start by fitting the reduced form VAR, then proposed the SVAR whose structural equation errors are taken to be structural economic shocks, then estimate the parameters of the structural equation by utilizing the information in the estimated reduced form VAR.

By putting the

$$Y_t = FY_{t-1} + \varepsilon_t \dots \dots \dots (2)$$

Then the SVAR is of the form

$$AY_t = C(L)Y_{t-1} + BU_t \dots \dots \dots (3)$$

$$Y_t = A^{-1}C(L)Y_{t-1} + A^{-1}BU_t \dots \dots \dots (4)$$

$U_t \sim N(0, \Sigma)$ where:

Σ specified as a diagonal matrix, because the structural shocks are assumed to originate from independent sources, and are frequently normalized such that $E(U_t U_t') = \Sigma = I_n$. The assumptions underlying U_t are that there are as many structural shocks as there are variables in the model and that shocks are mutually uncorrelated, which means that the Σ is diagonal. Then if Y_t is a vector of variables; contemporaneous relations among variables, the recovered structural shocks from the reduced form shocks are contained in matrix A, and B a matrix of reduced form shocks.

The matrices A and B, are not separately observable from the estimated variance-covariance matrix $E(\sum_t \sum_t') = \Omega$, of the reduced form shocks, \sum_t . So the equation cannot be estimated directly, it must be recovered from the restricted VAR. we need to find the VAR, then by imposing economic theory-informed restrictions on the unrestricted VAR to identify the underline structure embedded in the data. The EViews allows two types of restrictions; short and long-run restrictions.

Imposing Short-run Identification

From $\sum_t = A^{-1}BU_t$ or $A\sum_t = BU_t$

The EViews will follow the AB model

$$E(\sum_t \sum_t') = E(A^{-1}BU_t U_t' B' (A^{-1})')$$

$$= A^{-1}BE(U_t U_t')B' (A^{-1})'$$

$$= A^{-1}BB' (A^{-1})'; E(U_t U_t') = I_n$$

$$\Omega = A^{-1}BB' (A^{-1})'; E(\sum_t \sum_t') = \Omega$$

Which shows the relationships between the coefficient of the structural and the reduced form equations. The Ω is a symmetric matrix, with $k(k+1)/2$ different elements, and plays a key role in the identification scheme. Then we need to identify the elements in A and B from Ω . A necessary condition in the identification scheme is the fulfillment of the requirements that the number of equations in the system should be equal to the number of unknown variables. The sufficient condition to facilitate the identification process is that the equations should not be a linear combination of each another. Note, that the identification can be recursive or non-recursive.

The recursive Identification

The recursive identification makes use of the Cholesky decomposition approach and imposes restrictions on the matrix so that it is a lower triangular, and the structural shocks are uncorrelated. The Cholesky decomposition is

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{pmatrix} \dots\dots\dots(5)$$

$$B = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} \end{pmatrix} \dots\dots\dots(6)$$

Then we impose the restrictions in our estimated reduced form VAR to obtain the SVAR. Then we proceed with our analysis.

For purposes of detecting the monetary transmission mechanism in the context of the Sudanese economy, the study built the SVAR model; utilizing the variables of the nominal GDP, the money supply (m2); the nominal exchange rate (nexr); the consumer price index (cpi); the total credit (tcred); the reserve money (resm), and the international oil prices (oprice) as an exogenous variable; then imposing the designated restrictions and obtaining the impulse response functions and the variance decomposition analysis to track the monetary policy transmission mechanism in the context of the Sudanese economy.

The analysis proceeded as follows:

First, the variables subjected to seasonality analysis, hopefully, we avoid incorrectly characterizing cyclical behavior and spurious regression. So first, we apply X12 procedure for seasonality adjustment on the monthly series assuming the seasonality is present, then all variables were taken in the logarithm.

The unit-roots test result:

To avoid spurious regression, the paper conducted unit root tests to specify the stationarity of the variables.

Table (5) the stationarity test result

Variable	Notation	Level		First difference		Comment
		ADF	PP	ADF	PP	
Log GDP	NGDP	2.237	4.798	0.447	-3.314**	I(1)
Log CPI	CPI	5.863	7.885	-4.206***	-15.024***	I(1)
Log M2	M2	5.543	3.825	-4.865***	-17.387***	I(1)
Log Exchange r.	Nexr	3.639	3.794	-8.104***	-12.160***	I(1)
Log Res. Money	Rmoney	5.188	4.558	-5.739***	-19.249***	I(1)
Log T. Cred	Tcred	4.604	7.274	-2.920***	-13.479***	I(1)
Log I. oil price	Oil	-2.323	-2.068	-13.679***	-13.575***	I(1)

Note: ***, **, and * indicate significance at 1%, 5%, and 10% levels of significance.

Then we started the analysis by building reduced form VAR, to determine the optimum lags, then apply the VAR order selection criteria test, and obtained the following result.

Table (6) the VAR lag order Determination
VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1100.388	NA	4.26e-14	-16.59678	-16.48759	-16.55241
1	1267.382	318.8080	4.96e-15	-18.74822	-18.09303	-18.48198
2	1343.837	140.1661	2.28e-15*	-19.52783	-18.32666*	-19.03973*
3	1368.893	44.03811*	2.29e-15	-19.52868*	-17.78152	-18.81871
4	1388.531	33.02799	2.50e-15	-19.44744	-17.15430	-18.51561
5	1405.161	26.70855	2.87e-15	-19.32062	-16.48150	-18.16693

* indicates lag order selected by the criterion

Table (6) shows that the lags order 2 & 3 were chosen by lag order determination criteria, then to judge which lag to be chosen we need to check the residual autocorrelation test.

Table (7) the residual autocorrelation LM test.

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	31.59425	25	0.1701	1.276873	(25, 399.0)	0.1704
2	39.36325	25	0.0339	1.606200	(25, 399.0)	0.0340
3	33.59070	25	0.1170	1.360909	(25, 399.0)	0.1172
4	34.64757	25	0.0948	1.405560	(25, 399.0)	0.0950

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	31.59425	25	0.1701	1.276873	(25, 399.0)	0.1704
2	60.67693	50	0.1433	1.228525	(50, 468.6)	0.1444
3	73.78444	75	0.5180	0.982733	(75, 468.8)	0.5224
4	92.15909	100	0.6992	0.912878	(100, 453.5)	0.7067

*Edgeworth expansion corrected likelihood ratio statistic.

The paper decided to use lag order 3 because it overcome the residual autocorrelation problem based on VAR Residual Serial Correlation LM Test

The Impulse Response Analysis:

The impulse response function traces the effect of a one-time shock on one of the innovations on the current and future values of the endogenous variables.

Figure (4), Inflation Shocks:

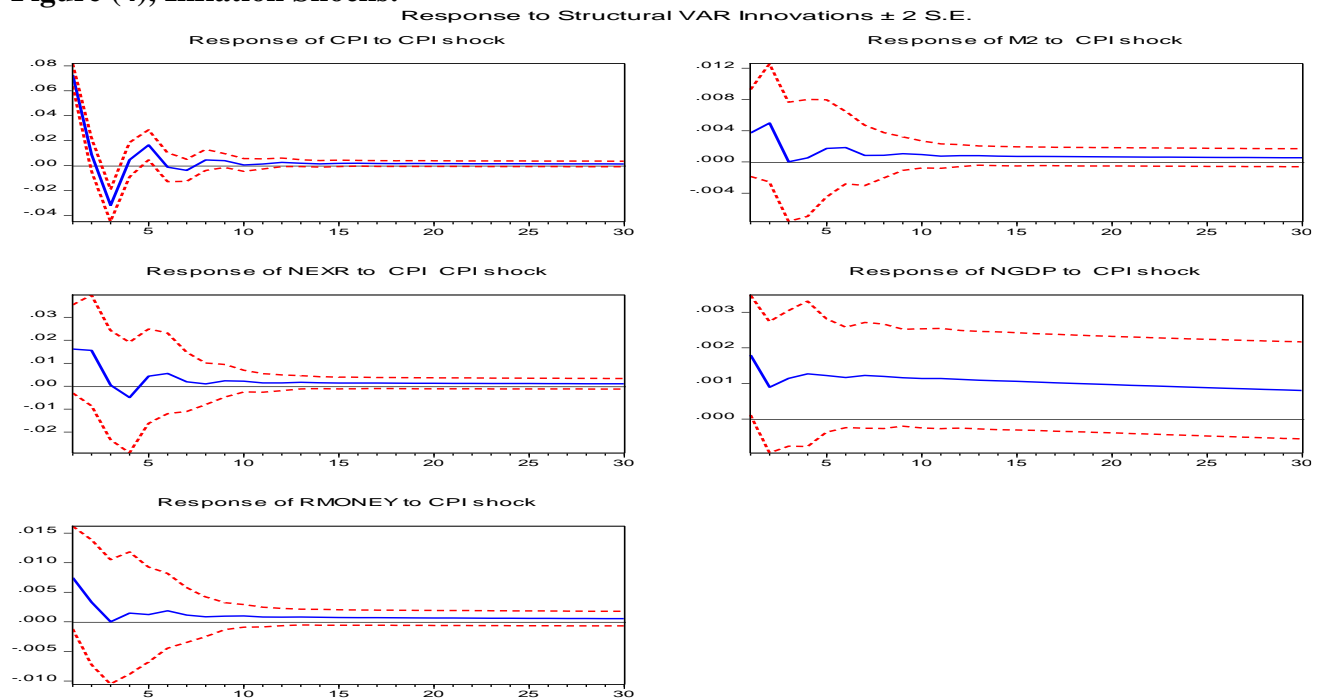


Figure (4) shows the estimated impulse response to a one percent increase in inflation shocks, 1% increase in inflation has a positive impact on itself by 8% and will continue for a two-time horizon to return to its steady state, while the impact of inflation shocks on the money supply, the 1% increase in inflation increases the money supply by 4% and sustained only for two months and become insignificant. The exchange rate increases by 1.5%, while the reserve money also increases and returns to its steady state after a 2-time horizon. While the estimated responses of the output to inflation shocks are insignificant.

Figure (5): Money Supply Shock:

Response to Structural VAR Innovations ± 2 S.E.

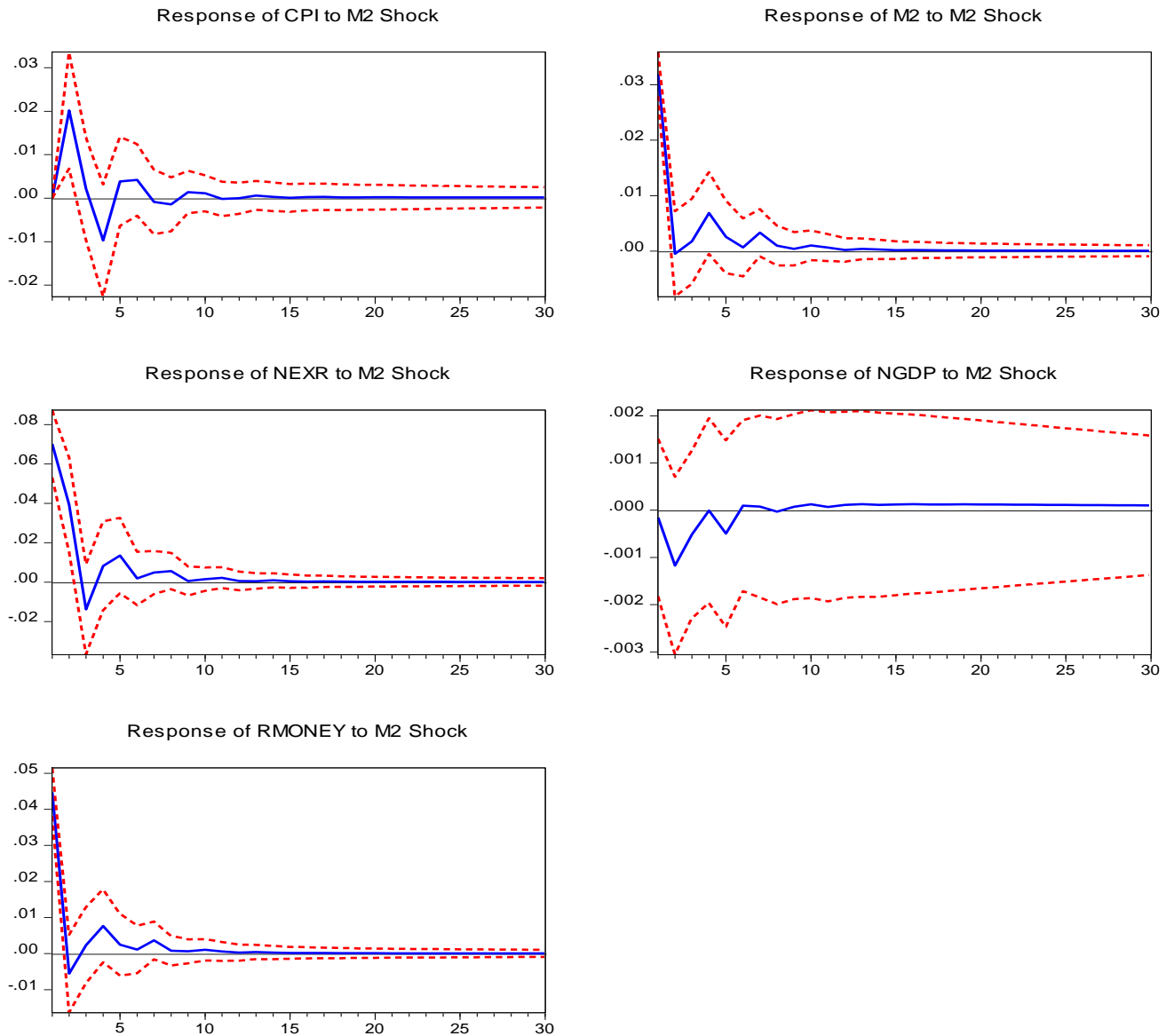


Figure (5) analyses the estimated impulse response to a one percent increase in money supply shocks, 1% increase in money supply has a positive impact on itself by 3%, and the impact dropped quickly and return to its steady state after two months, the responses of the CPI increase immediately and reach its peak at 2% after two months then it dropped quickly and become insignificant after three months. The responses of the exchange rate to money supply shocks increase immediately by 6% and dropped quickly to return to its steady after 3 months. Similarly, the response of reserve money to money supply shocks increase immediately by 4% and dropped quickly to return to a steady state 3 months after the shocks.

Figure (6) The Exchange rate Shock:

Response to Structural VAR Innovations ± 2 S.E.

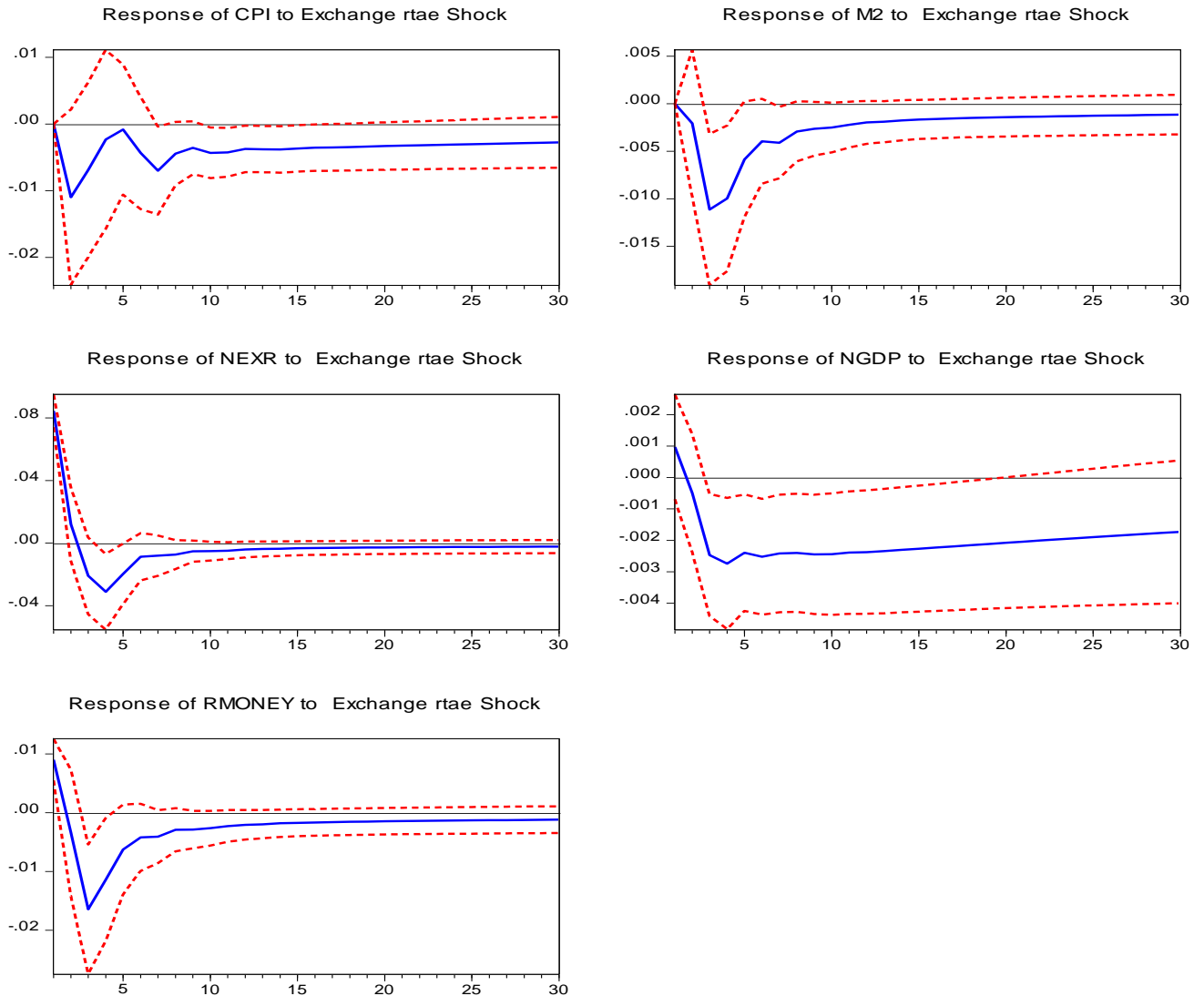


Figure (6) analyses the estimated impulse response to a one percent increase in nominal exchange rate shocks, 1% increase in the nominal exchange rate has a positive impact on itself by 0.08 basis points, and the exchange rate depreciated by that amount, the impact dropped quickly and return to its steady state after three months, the responses of the CPI that is the inflation and money supply dropped by -0.01 basis points, and it takes longer time horizon to return to its steady state. Similarly, the reserve money and the output behave in the same manner. While the responses of the variables to exchange rate shocks are unclear; it is reflected in the problems and challenges related to the monetary transmission mechanism and the efficiency of monetary policy in Sudan.

Figure (7), The Output Shock:

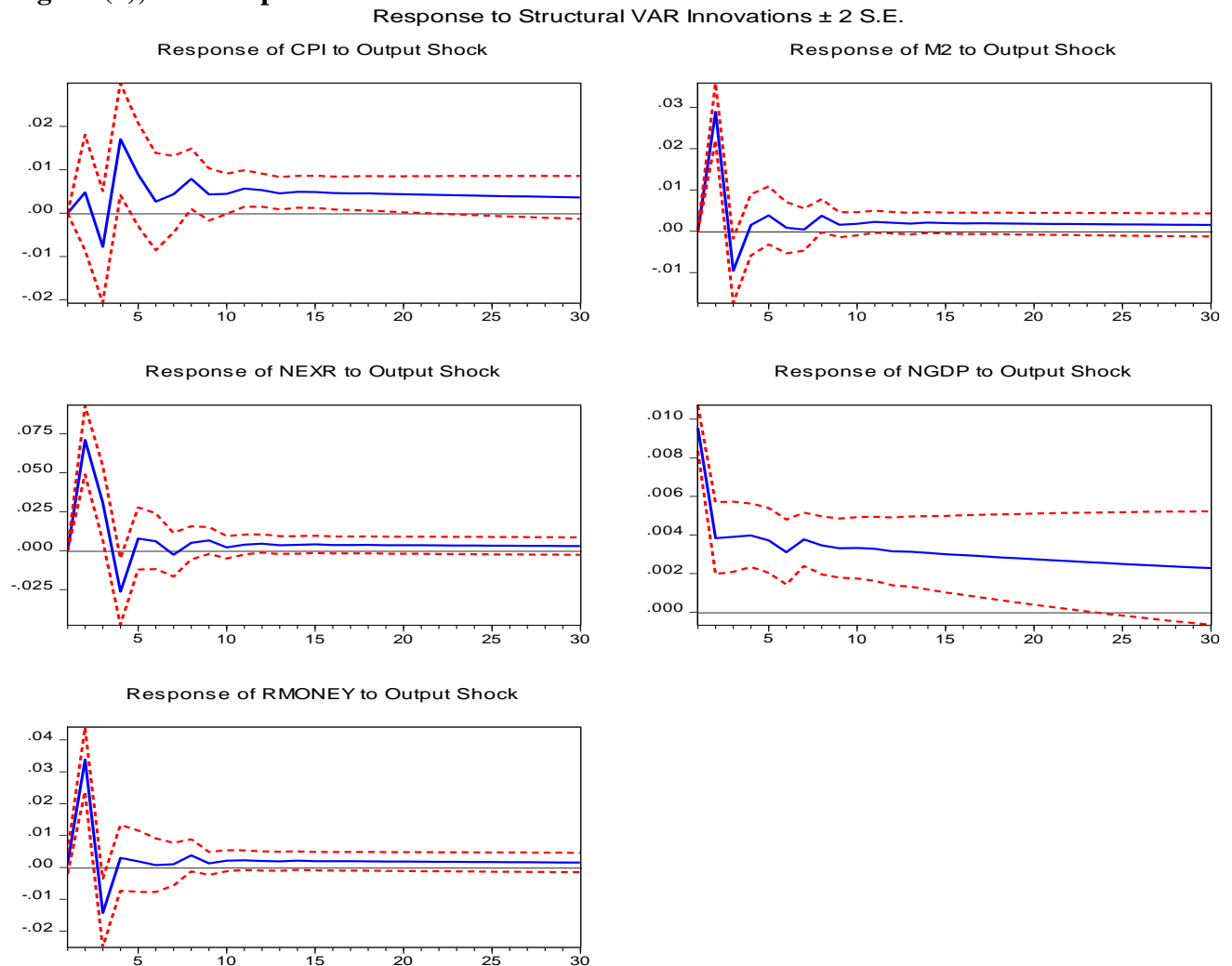


Figure (7) depicts the estimated impulse response to a one percent increase in output shocks, 1% increase in output has a positive impact on itself by 0.01 basis points, then the impact dropped quickly and reach 0.01 basis points after two months of the shocks, then the shocks sustain and take a longer time to return to its steady state. The responses of other variables in the model to the output shock have a similar fashion, increase immediately and reach the peak then dropped quickly and return to their steady state. While the responses of inflation and exchange rate are unclear; it is reflected in the problems and challenges related to the monetary transmission mechanism and the efficiency of monetary policy in Sudan. More investigations and research needed to be conducted to find out the causes of the weak nature of the transmission mechanism in Sudan. The role of the conduct approach for monetary policy should be clear. It is also necessary to restore the credibility and reliability of the CBOS for conducting monetary policy.

The Variance Decomposition Analysis:

The variance decomposition analysis shows the relative importance of different shocks for a particular variable fluctuation. More importantly, the impact of the shocks on the macroeconomic variables is analyzed through the variance decomposition of the forecast errors

based on the SVAR model. It provides the percent of the variation in the major macroeconomic aggregates that can be explained by shocks to other economic variables in the SVAR system.

Table (8), The Variance Decomposition Analysis:

Variance Decomposition of CPI:

Period	S.E.	CPI	M2	Exch. r	GDP	Rmoney
1	0.072664	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.076880	90.67057	6.891908	2.039343	0.388572	0.009610
3	0.083941	90.55860	5.848211	2.382416	1.183261	0.027517
6	0.088912	84.47042	6.813247	2.436193	5.811943	0.468197
9	0.090279	82.54878	6.667102	3.359164	6.867761	0.557189
12	0.091087	81.18811	6.564624	3.911929	7.711413	0.623929

Variance Decomposition of M2:

Period	S.E.	CPI	M2	Exch. r	GDP	Rmoney
1	0.032125	1.329252	98.67075	0.000000	0.000000	0.000000
2	0.043767	2.014237	53.16892	0.220382	43.58801	1.008447
3	0.046367	1.794726	47.52115	5.958072	43.08548	1.640577
6	0.048955	1.887203	44.88208	11.57222	39.38997	2.268525
9	0.049651	1.938402	44.12489	12.55733	38.97136	2.408017
12	0.049990	1.996323	43.58820	12.99007	38.95375	2.471660

Variance Decomposition of NEXR:

Period	S.E.	CPI	M2	Exch. r	GDP	Rmoney
1	0.111016	2.129100	39.91650	57.95440	0.000000	0.000000
2	0.139131	2.609739	33.37963	37.64482	26.12345	0.242362
3	0.144676	2.414664	31.77081	36.91296	28.67611	0.225464
6	0.153745	2.451472	29.20996	38.74285	28.73885	0.856866
9	0.154811	2.460266	29.04663	38.81981	28.65562	1.017678
12	0.155255	2.483082	28.91258	38.88002	28.65929	1.065027

Variance Decomposition of NGDP:

Period	S.E.	CPI	M2	Exch. r	GDP	Rmoney
1	0.009756	3.393900	0.025280	0.995272	95.58555	0.000000
2	0.010639	3.561126	1.233525	1.053210	93.34188	0.810259
3	0.011691	3.905897	1.215195	5.338190	88.47442	1.066300
6	0.014232	4.841713	0.944936	13.29795	79.10291	1.812490
9	0.016250	5.338590	0.729580	16.86351	74.75059	2.317724
12	0.017873	5.616341	0.613808	19.36120	71.73691	2.671740

Variance Decomposition of RMONEY:

Period	S.E.	CPI	M2	Exch. r	GDP	Rmoney
1	0.050133	2.225137	79.76862	3.242575	0.071878	14.69179
2	0.060973	1.803609	54.74108	2.497249	30.92809	10.02998

3	0.064858	1.594011	48.50968	8.597613	32.16456	9.134139
6	0.067160	1.646963	46.70890	12.14286	30.29172	9.209549
9	0.067703	1.686221	46.27835	12.67251	30.18146	9.181470
12	0.067969	1.723065	45.94978	12.92223	30.23987	9.165051

Factorization: Structural

Table (8) shows the percent variation in the model variables that can be explained by the shocks to the other variables in the SVAR model. The decomposition values for the 1st, 2nd, 3rd ... 12th, horizons into the future are displayed in the table. The table demonstrates that the variation in the general price level is largely explained by the forecast error variance of its innovations at all horizons, which account for 90.67% at the second horizon and declined to 81.19% at the 12th. Furthermore, the result shows that much of the fluctuations in the general price level can be explained by the shocks in the money supply, the nominal exchange rate, and the output. Specifically, the money supply contributes by 6.9% in the second horizon, while the exchange rate contributes by 2.1% in the second horizon and less contribution by the output. And the variation in the reserve money accounted only for 0.6% at the 12th time horizon, which indicates that the reserve money fluctuation has a limited effect on the general price level.

The empirical result explains that the variation in money supply is largely explained by the forecast error variance of its variation which accounted for 98.7% at the first horizon and declined to 43.6% at the 12th horizon. The result also suggests that apart from their shocks, much of the money supply fluctuations can be explained by the shocks in the nominal exchange rate, output, and lesser extent by reserve money shocks. The contribution of exchange rate shock is about 0.2% in the second horizon and gradually increases in the subsequent horizons, whereas the contribution of innovations in the output accounting for the forecast errors variance of the money supply is about 43.6% in the second horizon decreases to 38.9% in the 12th horizons. Similarly, the variation in the nominal exchange rate is largely explained by its innovation accounting for more than 57.9% in the shorter period and about 38.9% in the long run. Whereas, the variation in the output is largely explained by its innovations accounting for more than 95.6% in the shorter horizon and about 71.7% in the 12th horizon.

5. The Conclusion and Policy Implication:

The Sudanese banking sector adopts a full Islamic financial system. The interest rate is forbidden by Islamic rules. The Central Bank of Sudan relied on Islamic modes of finance and equity-based instrument issued by the government and the CBOS to provide interbank and credit facilities. The features of the Sudanese economy, the fragile economic situation, the weak performance of the economy, and the weak performance of the financial and banking system and the monetary and credit policy which relied heavily on direct or non-market instruments, the monetary expansion, fiscal dominance, high inflation rate, and depreciated exchange rate make the monetary targeting monetary policy regime is ineffective and neutralized the role of monetary policy in favor of the fiscal policy. resulted in the weak performance of the monetary transmission mechanism.

The demand deposits dominate the structure of the deposit with a share of over 38.7%, and the investment and saving deposits remain small, which is not the case for the deposit structure of most Islamic banks in other countries. The deposits base and the total assets of the Sudanese banks remained small, compared to other similar Islamic banks in the region and the

world. Throughout the period (2005 - 2021), the average contribution of the agriculture sector reached 28.5%, while the average contribution of the financial sector reached 13.6%, the share of other sectors compared to agricultural increased, in the year 2021 the share of the agricultural sector was 20.2%, while the share of the financial sector was 18.0%. The involvement in the economic reform with the IMF, and unifying the exchange rate, has had a great impact on the economy, the economy witnessed successive negative growth rates throughout the period 2019 – 2021, this was accompanied by the unprecedented monetary expansion of 153.2% in 2021, that resulted in recording 359.1% average inflation rate for the year 2021.

The performance of the exchange rate channel demonstrates the exchange rate is not a market-based determined exchange rate. Moreover, the market in which it operates is ineffective, and the lack of depth and liquidity, which are necessary for the adoption of a market-oriented monetary policy. While the responses of the variables to exchange rate shocks are unclear; it is reflected in the problems and challenges related to the monetary transmission mechanism and the efficiency of monetary policy in Sudan. The variance decomposition analysis shows that the reserve money fluctuation has a limited effect on the general price level. More investigations and research needed to be conducted to find out the causes of the weak nature of the transmission mechanism in Sudan.

In conclusion, the salient features of the Sudanese economy, the financial and banking sector contributed negatively to the performance of monetary and credit policy, which is reflected in the weak performance of the monetary transmission mechanism in Sudan. As result, the role of monetary and credit policy and the banking sector in economic development is questionable. To overcome this situation, the role of the conduct approach for monetary policy should be clear. Moreover, it is necessary to restore the credibility and reliability of the CBOS for conducting monetary policy. The monetary and credit policy in Sudan has to rely on indirect instruments, the exchange rate should be the market-determined exchange rate. The banking sector should be subjected to strict reform and recapitalization programs. Moreover, it is crucial to improve the role of other financial institutions such as insurance companies and pension funds in the economy.

Bibliography:

1. Abdalla, S. Z. S. (2016). Modeling the Sources and Impact of Macroeconomic Fluctuations in Sudan. V. R. F. Series No. 495, INSTITUTE OF DEVELOPING ECONOMIES, JAPAN EXTERNAL TRADE ORGANIZATION.
2. Abdalla, S.Z.S., 2017. Understanding Stock Market Fluctuations: Evidence from Sudan. *Journal of Economic Cooperation & Development*, 38(3), pp.1-43.
3. Acemoglu, D., Johnson S., Robinson, J., &Thaicharoen, Y. (2003), Institutional causes, Macroeconomic Symptoms: Volatility Crises and Growth. *Journal of Monetary Economics*, 50 (1) 49 – 123.
4. Andrle, M., Berg, M.A., Morales, M.R.A., Portillo, R. and Vlcek, M.J., 2013. Forecasting and monetary policy analysis in low-income countries: Food and non-food Inflation in Kenya (No. 13-61). International Monetary Fund.
5. Arabi, K. A. M., 2015, Factors Affect Economic Growth Empirical Evidence from Sudan Economy, *IJRSS*, Volume 5, Issue 1 ISSN:2249-2496.
6. Arabi, K. A. M., 2015, Macroeconomic Uncertainty and Growth: Empirical Evidence from Sudan Economy, *IJMT*, Volume 5, Issue 5 ISSN: 2249 – 1058.

7. Arabi, K. A. M., 2019, Impact of macroeconomic policies on Sudanese economic growth: Empirical evidence via switching regression, *European Scientific Journal*, edition vol. 15.
8. Başçı, E, Ö Özel and Ç Sarıkaya (2008): “The monetary transmission mechanism in Turkey: new developments”, BIS Papers, no 35, Bank for International Settlements.
9. Başçı, E, Ö Özel and Ç Sarıkaya (2008): “The monetary transmission mechanism in Turkey: new developments”, BIS Papers, no 35, Bank for International Settlements.
10. Benes, J., Berg, M.A., Portillo, R., Dao, M. and Baldini, M.A., 2012. Monetary policy in low-income countries in the face of the global crisis: The case of Zambia (No. 12-94). International Monetary Fund.
11. Bernanke, B.S. and Gertler, M., 1995. Inside the black box: the credit channel of monetary policy transmission. *Journal of Economic Perspectives*, 9(4), pp.27-48.
12. Biljanovska, N. and Meyer-Cirkel, A., 2016. Testing Shock Transmission Channels to Low-Income Developing Countries. International Monetary Fund.
13. Bwire, T., Anguyo, F. L., & Opolot, J. (2013). Exchange rate pass-through to domestic prices in Uganda: evidence from a Structural Vector Auto-Regression (SVAR). *Journal of Statistical and Econometric Methods*, 2(4), 41-68.
14. Cecchetti, S.G., 1995. Distinguishing theories of the monetary transmission mechanism. *Review-Federal Reserve Bank of Saint Louis*, 77, pp.83-83.
15. Davoodi, M., H., R., Dixit, M., S., and Pinter, G., 2013. Monetary Transmission Mechanism in the East African Community: an Empirical Investigation (No. 13-39) International Monetary Fund.
16. Davoodi, M.H.R., Dixit, M.S. and Pinter, G., 2013. Monetary transmission mechanism in the East African Community: An empirical investigation (No. 13-39). International Monetary Fund.
17. Demirgüç-Kunt, A. and Detragiache, E., 1998. The determinants of banking crises in developing and developed countries. *Staff Papers*, 45(1), pp.81-109.
18. Ebaidalla, E. (2014) “Impact of Exchange Rate Volatility on Macroeconomic Performance in Sudan”, *Journal of Development and Economic Policies*, Vol. 16. No. 1, pp. 73-105.
19. El Qorchi, M., 2005. *Islamic Finance Gears up*, Finance and Development December 2005. IMF Publication.
20. Elhiraika, A., B., and Ismaeil, K., A., 2000, Financial sector policy and poverty reduction in Sudan. *Economic research forum*.
21. Feizi, M., 2008, December. A new Keynesian small open economy DSGE model in Islamic economic framework: the case of Iran. In *Conference on Iran’s Economy at University of Illinois at Urban Champaign* (pp. 11-13).
22. Hernando, I., 1998. The credit channel in the transmission of monetary policy: the case of Spain. *Topics in monetary policy modeling*, 1998:257-75.
23. International Monetary Fund’s monetary and financial statistics mission to Sudan report, (2014).
24. Kireyev, A., 2001, *Financial Reform in Sudan: Streamlining Bank Intermediation*, IMF working paper, WP/01/53.
25. Lucas, R. E. 1976. “Econometric Policy Evaluation: A Critique.” *Carnegie-Rochester Conference Series on Public Policy* 1: 19–46.

26. Mengesgha, L., G., and Holmes, M., J., (2013), Monetary Policy and its Transmission Mechanisms in Eritrea. *Journal of Policy Modeling* 35 (2013), 766 – 780.
27. Mishkin, F., S., 2007. *The economics of Money, Banking, and Financial Markets*. Pearson education.
28. Mishra, P. and Montiel, P., 2013. How effective is monetary transmission in low-income countries? A survey of the empirical evidence. *Economic Systems*, 37(2), pp.187-216.
29. Mishra, P. and P. Montiel and A. Spilimbergo. 2010. —Monetary Transmission in Low-Income Countries, IMF Working Paper, No. 10/223.
30. Montiel, P.J., 2013. *The monetary transmission mechanism in Uganda*. International Growth Center, London School of Economics and Political Science.
31. Mugume, A., 2009. *Monetary transmission mechanisms in Uganda*. Editorial Board.
32. Mugume, A., 2009. *Monetary transmission mechanisms in Uganda*. Editorial Board.
33. Opolot, J. and Nampewo, D., 2014. Bank Lending Channel of the Monetary Policy Transmission Mechanism in Uganda: Evidence from Disaggregated Bank-level Data. *Journal of Applied Finance and Banking*, 4(1), p.47.
34. Osman, Abdelwahab. 2001. *Methodology of Economic Reform in Sudan*, (in Arabic), Khartoum: Sudan Currency Printing Press.
35. Peiris, S.J. and M. Saxegaard (2010) ‘An Estimated Dynamic Stochastic General Equilibrium Model for Monetary Policy Analysis in Mozambique. Washington, DC: International Monetary Fund. Vol. 57, No. 1.
36. Rodrik, D., (1999). Where did all the Growth go? External Shocks, Social Conflict, and Growth Collapses, *Journal of economic growth*, 4(4) 385 – 412.
37. Saches, J., Tornell, A., and Velasco, A., 1996. *Financial Crises in Emerging Markets: the lessons from 1995*, (No. W 5576), National Bureau of Economic Research.
38. Sims, C. 1980. “Macroeconomics and Reality.” *Econometrica* 48, no. 1: 1–48.
39. Velasco, A., and Cheng R., 1998. *Financial Crises in Emerging Markets. A canonical Model*, Federal Reserve Bank of Atlanta Working Paper, PP. (10 - 98).
40. Central Bank of Sudan Annual Report, different versions.
41. Central Bank of Sudan Financial Stability Report (2016).

Appendixes:

Appendix (1) the reduced form VAR(3) result.

Vector Autoregression Estimates

Date: 02/09/23 Time: 08:39

Sample: 2011M01 2021M12

Included observations: 132

Standard errors in () & t-statistics in []

	CPI	M2	NEXR	NGDP	RMONEY
CPI(-1)	0.093299 (0.08802) [1.05993]	-0.003445 (0.03892) [-0.08854]	-0.046570 (0.13448) [-0.34628]	0.004505 (0.01182) [0.38117]	-0.026706 (0.06073) [-0.43974]
CPI(-2)	-0.430810 (0.07854) [-5.48529]	0.020940 (0.03472) [0.60307]	-0.036853 (0.11999) [-0.30713]	0.007627 (0.01054) [0.72335]	0.035063 (0.05419) [0.64708]
CPI(-3)	0.095308 (0.08814) [1.08133]	-0.028567 (0.03897) [-0.73311]	-0.111798 (0.13466) [-0.83023]	0.005431 (0.01183) [0.45892]	-0.032608 (0.06081) [-0.53623]
M2(-1)	0.979178 (0.48960) [1.99995]	-0.138158 (0.21645) [-0.63828]	0.724987 (0.74802) [0.96921]	-0.070157 (0.06573) [-1.06730]	-0.093717 (0.33779) [-0.27744]
M2(-2)	0.322267 (0.46638) [0.69099]	0.347542 (0.20619) [1.68556]	0.864974 (0.71255) [1.21392]	0.045307 (0.06262) [0.72357]	0.585901 (0.32178) [1.82084]
M2(-3)	0.136977 (0.42597) [0.32157]	0.195827 (0.18832) [1.03986]	0.024816 (0.65080) [0.03813]	0.094114 (0.05719) [1.64565]	0.228040 (0.29389) [0.77593]
NEXR(-1)	-0.131567 (0.08449) [-1.55716]	-0.083260 (0.03735) [-2.22898]	0.018830 (0.12909) [0.14587]	-0.015726 (0.01134) [-1.38631]	-0.091181 (0.05829) [-1.56418]
NEXR(-2)	0.022261 (0.08574) [0.25964]	-0.084415 (0.03790) [-2.22703]	-0.085140 (0.13099) [-0.64997]	-0.032174 (0.01151) [-2.79508]	-0.140150 (0.05915) [-2.36925]
NEXR(-3)	-0.002250 (0.06191) [-0.03635]	-0.008899 (0.02737) [-0.32515]	0.029360 (0.09458) [0.31043]	-0.014652 (0.00831) [-1.76295]	-0.025356 (0.04271) [-0.59368]

NGDP(-1)	0.507981 (0.69966) [0.72604]	2.997327 (0.30932) [9.69015]	7.405404 (1.06894) [6.92780]	0.394770 (0.09393) [4.20262]	3.538396 (0.48272) [7.33015]
NGDP(-2)	-2.893225 (0.96372) [-3.00214]	-1.991376 (0.42606) [-4.67393]	-3.253674 (1.47238) [-2.20980]	0.396516 (0.12939) [3.06457]	-2.297012 (0.66491) [-3.45464]
NGDP(-3)	3.752223 (0.95236) [3.93994]	-0.585541 (0.42103) [-1.39072]	-3.350039 (1.45502) [-2.30241]	0.127843 (0.12786) [0.99986]	-0.798863 (0.65706) [-1.21581]
RMONEY(-1)	-0.039221 (0.34783) [-0.11276]	0.228724 (0.15378) [1.48738]	0.356444 (0.53142) [0.67074]	0.049838 (0.04670) [1.06721]	0.099088 (0.23998) [0.41290]
RMONEY(-2)	-0.133906 (0.35145) [-0.38101]	0.096950 (0.15538) [0.62398]	-0.551367 (0.53695) [-1.02686]	0.035465 (0.04718) [0.75161]	0.042022 (0.24248) [0.17330]
RMONEY(-3)	-0.287526 (0.30960) [-0.92871]	0.056039 (0.13687) [0.40942]	0.102683 (0.47301) [0.21709]	-0.004172 (0.04157) [-0.10036]	0.116749 (0.21360) [0.54657]
C	-0.017363 (0.01267) [-1.37039]	-0.001648 (0.00560) [-0.29424]	-0.032816 (0.01936) [-1.69521]	-0.000516 (0.00170) [-0.30312]	-0.000401 (0.00874) [-0.04591]
R-squared	0.415272	0.605568	0.494045	0.847435	0.467764
Adj. R-squared	0.339661	0.554564	0.428619	0.827707	0.398940
Sum sq. resids	0.612483	0.119710	1.429654	0.011040	0.291549
S.E. equation	0.072664	0.032125	0.111016	0.009756	0.050133
F-statistic	5.492188	11.87293	7.551285	42.95553	6.796553
Log-likelihood	167.3205	275.0619	111.3745	432.3755	216.3132
Akaike AIC	-2.292735	-3.925181	-1.445068	-6.308720	-3.035048
Schwarz SC	-1.943304	-3.575750	-1.095638	-5.959290	-2.685618
Mean dependent	0.041351	0.034583	0.040465	0.032487	0.039123
S.D. dependent	0.089420	0.048133	0.146867	0.023503	0.064665
Determinant resid covariance (dof adj.)		1.29E-15			
Determinant resid covariance		6.76E-16			
Log-likelihood		1368.893			
Akaike information criterion		-19.52868			
Schwarz criterion		-17.78152			
Number of coefficients		80			

Appendix (2) the VAR(3) stability test.

Roots of Characteristic Polynomial

Endogenous variables: CPI M2 NEXR NGDP
RMONEY

Exogenous variables: C

Lag specification: 1 3

Date: 02/09/23 Time: 08:41

Root	Modulus
0.981725	0.981725
0.728948	0.728948
-0.286011 - 0.596832i	0.661824
-0.286011 + 0.596832i	0.661824
-0.097613 - 0.646061i	0.653393
-0.097613 + 0.646061i	0.653393
-0.613570	0.613570
0.302079 - 0.385123i	0.489461
0.302079 + 0.385123i	0.489461
-0.303283 - 0.323000i	0.443068
-0.303283 + 0.323000i	0.443068
-0.060616 - 0.357198i	0.362305
-0.060616 + 0.357198i	0.362305
0.307211	0.307211
-0.045597	0.045597

No root lies outside the unit circle.

VAR satisfies the stability condition.

Appendix (3) the SVAR estimation result.

Structural VAR Estimates

Date: 02/09/23 Time: 08:39

Sample: 2011M01 2021M12

Included observations: 132

Estimation method: Maximum likelihood via Newton-Raphson
(analytic

derivatives)

Convergence achieved after 9 iterations

Structural VAR is just-identified

Model: $Ae = Bu$ where $E[uu'] = I$

A =

1	0	0	0	0
C(1)	1	0	0	0
C(2)	C(5)	1	0	0
C(3)	C(6)	C(8)	1	0
C(4)	C(7)	C(9)	C(10)	1

B =

C(11)	0	0	0	0
0	C(12)	0	0	0
0	0	C(13)	0	0
0	0	0	C(14)	0
0	0	0	0	C(15)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.050971	0.038223	-1.333510	0.1824
C(2)	-0.110894	0.101913	-1.088120	0.2765
C(3)	-0.023704	0.011553	-2.051804	0.0402
C(4)	-0.016210	0.023644	-0.685589	0.4930
C(5)	-2.198020	0.230522	-9.534984	0.0000
C(6)	0.030173	0.033808	0.892486	0.3721
C(7)	-1.172640	0.068318	-17.16440	0.0000
C(8)	-0.011516	0.009823	-1.172362	0.2411
C(9)	-0.105195	0.019893	-5.288064	0.0000
C(10)	-0.140919	0.175357	-0.803614	0.4216
C(11)	0.072664	0.004472	16.24807	0.0000
C(12)	0.031910	0.001964	16.24808	0.0000
C(13)	0.084514	0.005201	16.24807	0.0000
C(14)	0.009538	0.000587	16.24808	0.0000
C(15)	0.019216	0.001183	16.24807	0.0000

Log-likelihood 1326.253

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000
-0.050971	1.000000	0.000000	0.000000	0.000000
-0.110894	-2.198020	1.000000	0.000000	0.000000
-0.023704	0.030173	-0.011516	1.000000	0.000000
-0.016210	-1.172640	-0.105195	-0.140919	1.000000

Estimated B matrix:

0.072664	0.000000	0.000000	0.000000	0.000000
0.000000	0.031910	0.000000	0.000000	0.000000
0.000000	0.000000	0.084514	0.000000	0.000000
0.000000	0.000000	0.000000	0.009538	0.000000
0.000000	0.000000	0.000000	0.000000	0.019216

Estimated S matrix:

0.072664	0.000000	0.000000	0.000000	0.000000
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0.003704	0.031910	0.000000	0.000000	0.000000
0.016199	0.070140	0.084514	0.000000	0.000000
0.001797	-0.000155	0.000973	0.009538	0.000000
0.007478	0.044776	0.009028	0.001344	0.019216
Estimated F matrix:				
0.173705	0.033473	-0.258811	0.328579	0.091270
0.058135	0.055939	-0.136376	0.150353	0.055366
0.125636	0.147086	-0.188617	0.327952	0.107653
0.074617	0.005846	-0.153607	0.219103	0.058499
0.061857	0.066139	-0.138081	0.154202	0.074288
