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Using the EGARCH Model to Estimate the Factors Effecting Inflation in Sudan 1992-2018

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Abstract
The study investigated to estimate the effect of inflation factors in Sudan by using the Exponential General Auto-regression Conditional Heteroscedasticity Model (EGARCH M). The study problem was formulated in the following main question: What are the factors affecting inflation in Sudan? The study was built on the following hypothesis: There was a direct relationship between money supply, import prices, budget deficit, financing cost and inflation. The study reached that the increase in the money supply, import price index, budget deficit and the cost of finance lead to increase inflation in Sudan. While devaluing the exchange rate leads to increase inflation. The study recommended the adoption of an effective monetary and financial economic policy and to reduce inflation and achieve economic and monetary stability in Sudan.

Keywords: Inflation Factors, Exchange rate, Money supply, Budget Deficit, EGARCH M.

Introduction

Inflation is a measure of the rate of rising prices of goods and services in an economy. Inflation can occur when prices rise due to increases in production costs, such as raw materials and wages. A surge in demand for products and services can cause inflation as consumers are willing to pay more for the product. Inflation is one of the phenomena affecting the economies of the world. In the nineteenth century, the focus was on one side of the answer is inflation where it is if the increased money supply increased the general level of prices. The economist Keynes Analytics, where he focused on the factors that control the level of national income, cash, especially about the marginal propensity for consumption, the interest rate, and the marginal efficiency of capital. Thus, Keynes concluded that inflation is increasing the size of aggregate demand on the size of the overall width of significant and sustained increase. One of the main types of inflation inherent checks, which means that the increase in aggregate demand is not offset by an increase in production rates, which reflected the impact of higher prices, as well as inflation creeping characterized by this kind of increase slowly in prices, inflation pent-up which is a condition during which prevent prices from rising through policies are put controls and restrictions, and hyperinflation, which is a condition characterized by high inflation rates coupled with high speed in currency trading in the market and may result in this kind**.** The study aims to search for the main factors affecting inflation. The study sought to define the factors of inflation and to identify the important theories explaining inflation, and then estimate the factors affecting inflation in order to reach conclusions and recommendations that would help the decision-maker to reduce inflation in Sudan.

Theories of inflation

In respect to the determinants of inflation, there are various theories proposed by various economists to explain the occurrence of inflationary situations. In this study, the various theories of inflation are grouped basically into two broad theories, the excess–demand theories under the umbrella of expectations-augmented Phillips curve (which comprises the monetarist and the Keynesians theories of inflation) and the cost-push theories which are currently termed structuralisms /institutional theories of inflation.

Excess-demand theories of inflation

The excess-demand theories argued that excess demand for goods and services over supply in an economy is the main source of inflation. This view that was implicitly reflected in the Phillips empirical study in the late 1950s, which showed a trade-off between unemployment and inflation (the Phillips curve), led the monetarists to search for a theory that can explain the existence of excess–demand to propagate inflationary conditions. In their search for the causes of demand in an economy, the monetarists adopted the quantity theory of money as their point of departure. The original quantity theory is expressed by fisher's equation of exchange as ;(Curwen, 1976) $MV = PT$ where (M) is the money stock in the economy, (V) represents the velocity of money circulation, (P) is the average price level and (T) represents the number of transactions in the economy. The classical economists assumed that (V) is constant over time and that the economy is at its full employment level, meaning that (T) is also constant. Under these restrictions, it implies that changes in the money stock (ΔM) directly affect changes in the price level. Also, the monetarists with Milton Friedman (1956) as its chief advocate followed the same line of argument as their predecessors (the classical economists). They only differ in respect to the assumptions on (V) and (T). Friedman, consider that money demand is one of the five main forms of holding wealth (other forms of holding wealth are; equities, bonds, physical goods, and human capital) and that any significant change in any of the other forms of wealth would cause velocity of circulation to vary, but only in the long- run. Based on the fact that velocity of circulation does not change in the short-run but in the long run, Friedman concluded that money supply and velocity of circulation could be treated as existing independently of one another. Considering this as the case, he concluded that, money national income (Y = T in the original quantity theory) could be traced almost exclusively to changes in the money supply. This argument by the monetarists, suggests that in the long run, growth in the money national income could only be achieved through adherence to steady long-term growth in the money supply. Based on this, since velocity of circulation is constant in the short-run, it implies that changes in money national income (Y) must be equal to and move in the same direction as money supply changes if the price level is to remain steady.

This implies that any increases in money supply beyond the increases in money national income will lead to increases in the general price level. Hence when the rate of growth in money supply is greater than that of gross domestic product in the long run, inflation is the ultimate result. Friedman concluded by saying that "inflation is always and everywhere a monetary phenomenon". Johnson (1971) also introduces an international aspect of inflation into the monetarist theory of inflation. He argued that under fixed exchange rate regime when a country expands its domestic demand via increases in the domestic money supply, the excess demand generated will not only be

on domestic products but also imports. Due to this kind of spillover of excess demand, it means that inflationary pressure generated by increases in money supply will be shared between the domestic sector and the foreign sector. However, He pointed out that the extent of the spillover effects depends on the size and the marginal propensity to import by the domestic country where the excess demand originated. This re-enforces Friedman's statement that inflation is always a monetary phenomenon.

The other excess-demand theory of inflation is the Keynesians theory of inflation. Their ideas evolved from Keynes-Smithies' ideas on inflation, basically the inflation gap model. The Keynesians argued that excess demand for goods and services results in inflation which is in line with the monetarist theory, but they differ in respect to what generates the excess demand in the economy. For the Keynesian, excess demand is the result of increases in aggregate demand in the economy rather than just increases in the money supply. They argued that money supply is only one of the components of aggregate demand and therefore cannot solely be responsible for increases in the general price level; rather it is aggregate demand that entirely influences inflationary situations in a country. Keynesians believe that factors that influence aggregate demand in the economy (money supply inclusive) are responsible for the persistent rise in price levels in an economy.

Structuralisms / cost-push theory of inflation

The cost-push theory of inflation is a generic term for Marxists, Structuralisms, and Keynesians theories of inflation that are not based on excess-demand influences in the economy. In this group of theories of inflation, a host of non-monetary supply-oriented factors influencing the price level in the economy are considered. Thus cost-push causes of inflation result when cost of production increases independently on aggregate demand. The Keynesians argued that wage mark-up via trade unions leads to increases in the cost of production. For the affected firms in this regard to maintain their profit margins, they will have to increase prices of their products. The increases in the prices will further put pressure on the trade unions to press for higher wages which will ultimately lead to further increases in prices and the process continue in that circular manner, known as the price-wage spiral. The extent to which price-wage spiral affects the increases in the general price level (inflation) depends on the power of trade unions relative to employer's association.

The Keynesians went on to point out that when firms gain more market power, they will be able to push up prices independently to make profit. This is the case when markets are concentrated and move towards monopoly or oligopoly through mergers. Structuralists' ideas on cost-push causes of inflation can be summarized by J. Laurence views in his article in the 1909 journal of political economy (12, P.178). He started by rejecting the monetarist explanation of inflation. Instead, he proposed that the causes of inflation "must be sought in the (real) forces settling particular prices" Structuralists believe that, conflicts over the distribution of income between capital and labor, between landowners and peasants, between different producers in different sectors, is the main cause of inflation.

This is demand for higher income by one of the following groups (labor, landowners, and different producers in different sectors) their productivity can only be achieved by each of the other groups (firms, peasants, and different producers' different sectors) via increases in prices of their products. The structuralisms also consider currency depreciation as an essential part explaining inflationary situations.

The structuralists' production process, emphasis is placed on capital input. This implies that in countries there is lack of foreign reserves; currency depreciation becomes a serious problem with or without foreign exchange control. The currency depreciation leads to high cost of imported raw materials for production, which are

ultimately passed onto higher prices for goods and services. Besides, Structuralisms such as Pezos (1972), Arida and Andre (1985) also pointed out that inflation is generally caused by inertia. Inflation inertia is a process where the current inflation rate is determined by its history. This is generally caused by inflationary expectations, relative price adjustments, institutional adjustments that support the indexation of wages, financial contracts, monetary and exchange rate policy. From the Keynesian and the structuralism theories of cost-push causes of inflation, the following general factors can be identified as the agents of inflation; wage increases by trade unions, profit motives of firms that gain market power, increase in the prices of raw materials imported from abroad through currency depreciation and price increase in the world commodity market, structure land ownership, inertia, taxes such as value-added tax (VAT)and the presence of external shocks such as a dramatic change in oil prices, crop failure, and war. inflation to the collapse of the national currency.

3. Literature review

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 structuralist approaches to provide an explanation for inflation. According to the monetarist view, given stable demand for money, inflation is a purely monetary phenomenon and can be controlled by curbing excessive growth of money supply. The structuralist 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 (Suleiman, 2012). Studies on the sources of inflation in Sudan differ in their empirical models, sample period, modelled macroeconomic variables and hence their main results. However, there is a broad agreement on the following key factors affecting the rate of inflation: money growth, income growth and exchange developments.

Esat, etal (2021)[1] analyzed the relationship between macroeconomic variables that influence inflation. it used applied panel data such as fixed effects, and Arellano-Bover/Blundell–Bond. The study reached that in the short run, all variables influence the inflation rate, except for foreign direct investment, which has insignificant influence. Moreover, the analyses through the Arellano–Bover/Blundell—Bond estimation reveal that GDP growth, imports, and foreign direct investments have a positive influence on the inflation rate, while, working remittances and exports have a negative influence on the inflation rate. These conclusions provide sufficient information for future debates and examination on macroeconomic variables that potentially affect inflation.

Inim, etal (2020)[2] examined other determinants of inflation in Nigeria using the autoregressive distributed lag (ARDL) method on quarterly data from (January 1999-December 2018). It concluded that poor infrastructural development, exchange rate, political instability, corruption, and double taxation significantly stimulate inflation rather than just money supply. The results showed that a causal relationship between other determining factors and inflation and there is a significant long-short run relationship. It recommended that non-monetary factors of instigating inflation should be controlled and security expenditure should be review along with-related

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[2] Inim, V, Emmanuel Samuel, U, & Ishaku Prince, A (2020) Other Determinants of Inflation in Nigeria. European Journal of Sustainable Development, 9(2), 338.

mechanisms to achieve low inflation at single digits at most and economic growth and development.

Jony (2019)[1] Seek to examine the causal relationship between the exchange rate and the broad growth of money, interest rate, world oil prices and inflation. The Johansson co-integration test for the long-range relationship between variables and the Vector Error Correction Model (VECM) was used. The study found that long-term broad-based monetary growth M2, the parallel market exchange rate, the interest rate, and international oil prices collectively put pressure on commodity prices to varying degrees, causing inflation in South Sudan. The high rate of inflation is due to the influence of external variables. Inflation in Southern Sudan is multidimensional and dynamic, and requires strong stabilization policies. The study recommended adopting strict policies to reduce inflation, such as stabilizing the exchange rate system by building sustainable foreign, domestic currency reserves to counter the trade deficit.

Musa (2018)[2] Tried to Modeling the determinants of inflation in Sudan via GMM method (2000-2017). It focused on Gross Domestic Product (GDP), Government Expenditure(GE), Exchange Rate (EX), Consumer Price Index (CPI), Unemployment Rate (UR) and Money Supply (MS)as they are the most important determinants of inflation in Sudan. It reached that the increase in money supply and Consumer Price Index lead to an increasing inflation rate. The reduction of the exchange rate leads to a high rate of inflation. However, the increasing in Gross Domestic Product, Unemployment Rate, and Government Expenditure lead to decreasing inflation rate in Sudan. The Generalized Method of Moment is the best Method for estimating the determinants of inflation in Sudan. It could be recommended that the state should adopt effective financial and monetary policy for reducing the increasing in inflation rate and increased production for exporting.

IENG (2017)[3] examined the determinants of inflation in Cambodia from (December 2004 to December 2016). Other examined drivers of inflation are narrow money, nominal effective exchange rate, output gap and fiscal revenue and expenditure. Ordinary Least Square (OLS) is used to see the relationship of dependent variables and independent variables. Vector Error Correction Model (VECM) is employed to capture the long- run and short-run relationship of inflation. It reached that food inflation and headline inflation of trading partners have positive impact on food inflation and headline inflation in Cambodia in the long-run. Narrow money interacting with dummy variable, government revenue to GDP, and nominal effective exchange rate also fuel inflation in the long-run based on VECM. In the short-run, the speed of adjustment of food inflation and headline inflation is very fast and has similar coefficient. It implies that the convergence of the explanatory variables in food and headline inflation can adjust quickly to long-run equilibrium.

Rahimov, etal (2016)[4] assessed the main determinants of inflation in Azerbaijan (2003-2015). It using vector auto regression (VAR) analysis. Impulse response and variance decomposition analysis suggest that inflation is mostly explained by foreign inflation, fiscal policy, exchange rate and own shocks. Whereas monetary policy and supply shocks do not play any essential role in explaining inflation. Among these variables inflation expectations, foreign inflation and monetary policy (credit variable) have quick effect on domestic headline inflation, whereas the effect of fiscal variable is relatively slower: it takes two quarters to fully reflect on prices. We also find that appreciation of exchange rate has deflationary effect on domestic inflation.

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[3] Chankreusna IENG (2017) Determinants of Inflation in Cambodia. Google scholar.

[4] Vugar Rahimov, Shaig Adigozalov and Fuad Mammadov (2016) Determinants of Inflation in Azerbaijan, Central Bank of the Republic of Azerbaijan, Working Paper Series No 07.

Lim ,Sek (2015)[1] examined factors affecting inflation in two groups of countries (high inflation group and low inflation group (1970-2011). An Error Correction Model based on the Autoregressive Distributed Lag (ARDL) modeling has been used to explain the short run and long run impacts of each variable on inflation. The results respectively indicate that GDP growth and imports of goods and services have the significant long run impact on inflation in low inflation countries. Results also indicate that money supply, national expenditure and GDP growth are the determinants of inflation which impose long run impact on inflation in high inflation countries. In the short run likewise, none of the variables is found to be significant determinants in high inflation countries. However, money supply, imports of goods and services and GDP growth has significant relationship with inflation in low inflation countries.

Hagos (2014)[2] seek to achieve the stated objective a synthesis model of monetarist and cost-push inflation theories is estimated using vector autoregressive (VAR) models. The estimated models enable to understand the short run and the long run price dynamics in Ethiopia between (2001/02 - 2011/12). It suggests that the determinants of inflation differ between sectors (food and non-food inflation) and the time horizons under consideration. The most important forces behind food inflation in the long run are exchange rate, broad money supply, narrow money supply, food consumption price index, non-food consumption price index, interest rate, real GDP and nominal GDP. The long run determinants of non-food inflation, and also, are exchange rate, broad money supply, narrow money supply, food consumption price index, non-food consumption price index, interest rate, real GDP and nominal GDP are found to be prime sources of inflation. It could be recommended to exercise prudent fiscal and monetary policies. Inflation expectations need to be tackled by way of credible government policies to change public opinion. In this regard it is important to consider targeting of macroeconomic variables and adhere to announced targets.

Taye (2013)[3] examined the determinants of inflation in Botswana (1990-2010) and assess the likelihood that the Bank of Botswana's medium-term objective range of 3 to 6 percent could be achieved in the short to medium-term. It used an Auto Regressive Distributed Lag (ARDL). The study reached the price inertia, real GDP, money supply and South African prices play a dominant role in determining inflation in Botswana; and unless international deflationary environment prevails, the probability that the Bank of Botswana will achieve its medium-term objective range of 3 to 6 percent in the medium-term is very low, according to the policy simulation results in this study.

Suleiman (2012)[4] examined the main determinants of inflation in Sudan, using quarterly data during 1970–2002, by applying Cointegration and error correction modelling. The results reveal that the external sector's disequilibrium matters for price growth. This signifies a strong long-run impact of foreign price and exchange rate on inflation, with slow adjustment to equilibrium. Inflation is also found to be perpetuated by feedback from the short-run nominal exchange rate, foreign price, drought shocks and deterioration in expectations. Money growth does not appear to affect inflation in the long run, but the elasticity of inflation to the short-run money supply is significant and relatively high. The findings suggest that a monetary-cum-exchange rule is more suitable for inflation control while maintaining external

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[3]Haile Kebret Taye (2013) The Determinants of Inflation in Botswana and Bank of Botswana's Medium-Term Objective Range, BOJE: Botswana Journal of Economics.

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competitiveness. Fighting inflation also depends on the ability of policy to reduce the effects of supply shocks emanating from droughts and foreign price movements.

Bandara (2011)[1] investigated the determinants of inflation in Sri Lanka during (1993-2008). It used the Vector auto-regressive (VAR) models to find out appropriate explanations for inflation with accompanied application of Granger Causality Tests. The overall findings of estimated VAR models imply that the money supply, exchange rate and the GDP have information which helps in exploring the behaviour of the inflation in Sri Lanka.

Yol (2010)[2] identified the fundamental determinants of inflation and examine the direction of causality among the variables in Sudan (1970-2008). The study showed that the coefficient of second lag of nominal exchange rate, first lag of real output and first lag of foreign inflation carry the correct signs. The coefficient of the error-correction term is significant at the 1% level and correctly signed, which suggests that about 21% of total disequilibrium in inflation was being corrected in study period. Furthermore, the results of the Granger causality test indicate a bi-directional causal effect between nominal exchange rate and money supply in addition to unidirectional causal effects running from domestic inflation to nominal exchange rate and real money supply, from real output to domestic inflation and nominal exchange rate, and from foreign inflation to domestic inflation, nominal exchange rate, real money supply and real output. Finally, although about 25.72% of forecast error variance in domestic inflation is explained by its own innovation, foreign inflation alone explains approximately half (49%) of total forecast error variance in domestic inflation.

Andersson, etal (2009)[3] analyses the determinants of inflation differentials and price levels across the euro area countries. Dyna mic panel estimations for the period 1999-2006 show that inflation differentials are primarily determined by cyclical positions and inflation persistence. The persistence in inflation differentials appears to be partly explained by administered prices and to some extent by product market regulations. In a cointegrating framework we find that the price level of each euro area country is governed by the levels of GDP per capita.

The study differs from previous studies in the factors affecting inflation, the time period, and its main results. But there is an agreement between the current study and previous studies on the factors that affect inflation, the most important of which is the money supply GDP, exchange rate and economic growth.

Methodology and Data

Inflation INF, Exchange Rate EX, cost of finance FC, and money supply MS data are provided by the Central Bank of Sudan, while the general price level P, and consumer price index CPI, are supplied by Central Bureau of Statistics. Annual data is used and the start date is 1978 when the country shifted from fixed peg to monitored floating exchange rate. Tests of unit roots and Cointegration were carried in addition to the use of EGARCH models to estimate the volatility of the inflation indicators. The phenomenon is quite common (Greene 1990). The ARCH model has become a popular one because its variance specification can capture commonly observed features of the time series of financial variables; in particular, it is useful for modeling volatility and especially changes in volatility over time (Hill, et al 2008) The basic idea of ARCH models is that (a) the mean a_t is serially uncorrelated, but dependent and (b) the dependence of a_t can be described by a simple quadratic function of its lagged values Ruey (2002). Specifically, an ARCH (m) model assumes that

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[2]Marial Awou Yol (2010) Determinants of Inflation in Sudan: An Empirical Analysis Policies, Research and Statistics Department.

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$$a_t = \sigma_t \varepsilon_t; \varepsilon_t \approx iid(0,1); a_0 \succ 0$$
$$a_t{}^2 = \alpha + \alpha_1 a^2{}_{t-1} + \ldots + \alpha_m a^2{}_{t-m}; \alpha 0 \geq 0; \alpha i \succ 0$$

These models suffer from many weaknesses) Ruey 2002): first they assume that positive and negative shocks have the same effects on volatility because it depends on the square of the previous shocks. Second, they are rather restrictive e.g. α_2 of an ARCH (1) model must be in the interval [0, 0.333]. Third, they do not provide any new insight for understanding the source of variations of a financial time series. They only provide a mechanical way to describe the behavior of the conditional variance. It cannot indicate what causes such behavior to occur. Finally, they are likely to over predict the volatility because they respond slowly to isolated shocks to the return series. GARCH (m,s) is the Generalized ARCH by Bollerslev (1986) models are widely used in various branches of econometrics, especially in financial time series analysis.

$$a_t{}^2 = \alpha_0 + \sum_{i=1}^{m} \alpha_i \xi^2{}_{t-1} + \sum_{j=1}^{s} \beta_j \sigma^2{}_{t-j}; \varepsilon_t \to N(0,1); \alpha \succ; \varepsilon_t \geq 0; \beta_j \geq 0$$

The variance equation σ_t^2 is composed of three terms: the mean (long term average) α news about volatility from the previous period (the ARCH term) $\alpha^2_{t-1}$and the GARCH term o^2_{t-j}. It is a weighted average of the variance a (the constant), the ARCH term, and the GARCH term. If there was unexpectedly large move in either the upward or the downward direction, then the forecaster will increase the estimate of the variance for the next period. If the asset return was unexpectedly large in either the upward or the downward direction, then the trader will increase the estimate of the variance for the next period. This model is also consistent with the volatility clustering often seen in financial returns data, where large changes in returns are likely to be followed by further large changes **ω**.

EGRACH Model or Exponential GARCH model was proposed by Nelson (1991). The specification for the conditional variance is as follows:

$$\ln\left(a_t{}^2\right) = \omega + \left|\frac{(\sigma_t(\xi_{t-1})}{\sigma_{t-1}}\right| + \sqrt{\frac{2}{\pi}} + \frac{\gamma \xi_{t-1}}{\sigma_{t-1}} \beta \ln\left(\sigma^2{}_{t-1}\right)$$

The left-hand side is the log of the conditional variance. This implies that the leverage effect Υ is exponential, rather than quadratic, and that forecasts of the conditional variance are guaranteed to be nonnegative. Exchange rate is considered a financial asset. The price of a financial asset is set as the present value of the cash flows expected from the asset. Asset prices change when the expectations of future cash flows change, the uncertainty around them, or the rate at which cash flows are discounted changes. Price change by larger amount or more frequently i.e. become more volatile, the greater

the number of reasons for investors to alter their views on future cash flows greater the fluctuation in the discount rate. This requires news (surprises) or unexpected events. CPI (surprises) news affects inflation uncertainty (the vulnerability or sensitivity of prices to the surprise). In many financial and macro variables volatility responds asymmetrically to past negative and positive return shocks, with negative returns resulting in larger future volatilities i.e. leverage effect (Jan 2005). The presence of leverage effects can be tested by the hypothesis that $\Upsilon < 0$ otherwise the impact is asymmetric if $\Upsilon \neq 0$.

Empirical Evidence

Annex (1) shows Descriptive statistics of inflation rate, exchange rate, import price index, consumer price index and cost of finance. Annex (2) shows the results of unit

root tests based on the ADF and PP Test where the inflation rate and exchange rate, import price index, consumer price index and cost of finance are stationary with an intercept in 1st difference and 2nt difference. Annex (3) shows Johansson Co Integration Test, Trace test indicates 5 cointegrating eqn (s) at the 0.05 level. Annex (4) indicates the presence of four equations among these variables at a 5% significance level i.e. inflation rate (INF), exchange rate (EX), import price index (MP), consumer price index (CPI), and cost of finance (FC). Annex (5) shows the ARCH test indicate variance fixed.

EGARCH Estimation Output

Annex (6) presents:

First: the mean equation

$$\widehat{INF}_t = 27.7540@PCH(EX_t) + 17.5950@PCH(IP) + 49.2556@PCH(MS) + 0.1865CF$$

Z-Stat= 11.62 17.76 29.49 10.78

Second: The Variance Equation

$$\ln(\widehat{a}_t^{\,2}) = 6.12 + 2.004\left|\frac{(\sigma_t(\xi_{t-1})}{\sigma_{t-1}}\right| + 1.16 + \frac{\gamma\xi_{t-1}}{\sigma_{t-1}} 0.26\ln(\sigma^2{}_{t-1})$$

Z-Stat= 7.26 2.77 2.87 32.90

$$R^2 = 0.70 \rightarrow \bar{R}^2 = 0.52 \rightarrow DW = 1.63$$

$$ARCH(F(prob)) = 0.78; ARCH(\chi^2(prob)) = 0.77$$

The estimated coefficients of the mean equation are highly significant. The sign of inflation rate, exchange rate, import price index, consumer price index as expected. An increase in money supply leads to a rise in domestic prices which in turn a considerable change in terms of trade since some countries stop buying the goods and services from the country. Foreign goods become cheaper which leads to capital outflow and a rise the price of foreign currency. The role of news is shown by the variance equation. The leverage effect term (-2.77), denoted as RES/SQR[GARCH](1) in the output, is negative and statistically different from zero, indicating the existence of the leverage effect(positive correlation between inflation rate in future. As the past few years proves highly leveraged financial systems can have crises that increase the.

Discussion

The Descriptive statistics in Annex (1) and (2) show sharp increase in the means, medians and standard deviation of inflation (INF), exchange rate (EX), import price index (MP) consumer price index (CPI), and cost of finance (CF). There is a possibility of a simultaneous feedback relationship between Inflation rate and consumer price index. The main determinants of the Inflation rate are exchange rate (EX), import price index(MP), consumer price index (CPI), and cost of finance (CF); The consumer price index, the index of import prices, and the cost of funding proportional have positive relationship with the rate of inflation in Sudan. The exchange rate is linked to a negative inverse relationship with the rate of inflation in Sudan. The study reached that an increase in the consumer price index, the index of import prices, and the cost of funding to increase in the rate of inflation in Sudan. The reduction in the exchange rate leads to higher inflation. It recommended that the state must adopt an economic policy that will actively work to reduce the rate of inflation and the balance of economic stability.

Conclusion

EGARCH model was used to estimate the factors effecting inflation, the mean equations were found to be determined by exchange rate (EX), import price index(MP), consumer price index (CPI), and cost of finance(CF). So the conditional variance (risk) indicates the existence of the leverage effect in future inflation returns

during the sample period (1992- 2018). The main aim of the study was to establish the factors effecting inflation in Sudan. Based on the regression results, it is clear that the growth rate of Exchange rate and consumer price index are the main factors effecting inflation in Sudan- both in the short-run and the long run, with consumer price index being the key determinant. The coefficient for money supply from the estimated long-run inflation function confirms the theory of inflation in the long run. Base on the estimated result, the independence of the central bank is very important if policymakers want to reduce the effects of consumer price index on inflation. The independence of the Bank of Sudan will help check discretionary monetary practices such as financing of government debt by the central bank via printing of currency. Besides, the success of the current inflation policy known as inflation targeting practiced by countries like United Kingdom and Sweden which places great importance on the independence of the central banker-enforces my point made with regards to the independence of the Bank of Sudan.

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Appendices

Annex (1) Descriptive Statistics

	INF	EX	MP	CPI	CF
Mean	43.12857	43.12857	43.12857	43.12857	43.12857
Median	14.3	2.1715	384565.1	3466710	25.7
Maximum	130.4	2.1715	364565.1	3466710	41.7
Minimum	4.9	0.045	1275	32645	9.7
Std. Dev	46.84668	1.037772	240011	10517577	9.939575
Skewness	0.866227	-0.73466	-0.36725	1.245074	0.24857
Kurtosis	2.045983	1.75562	1.627429	3.403057	1.790096
Jarque-Bera	3.422602	3.243952	2.120519	5.56788	1.497139
Probability	0.180631	0.197509	0.346366	0.061795	0.473043
Observations	27	27	27	27	27

Annex (2) Unit Root Test

Test	Augmented Dickey-Fuller (ADF) Prob.			Phillips- Peron (PP) Prob.		
	level	Ist différence	2nd différence	level	Ist différence	2nd différence
INF	0.6535	0.0000	0.0252	0.4528	0.0000	0.0001
EX	0.8390	0.2394	0.0008	0.9754	0.2394	0.0008
MP	0.2132	0.0000	0.0000	0.0001	0.0001	0.0021
CPI	0.0820	0.0000	0.0000	0.0820	0.0001	0.0001
CF	0.1231	0.0000	0.0000	0.0000	0.0001	0.0000

Annex (3) Johansson Co Integration Test

Date: 12/21/21 Time: 21:14
Sample (adjusted): 1992 2018
Included observations: 27 after adjustments
Trend assumption: No deterministic trend
Series: INF EX MP CPI CF
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

	0.05	Trace		Hypothesized
Prob.**	Critical Value	Statistic	Eigenvalue	No. of CE(s)
0.0001	60.06141	403.9518	0.999853	None *
0.0000	40.17493	165.5859	0.988576	At most 1 *
0.0000	24.27596	44.84044	0.628137	At most 2 *
0.0048	12.32090	18.13123	0.359267	At most 3 *
0.0159	4.129906	6.112381	0.202589	At most 4 *

Annex (4) E GARCH Out put

Dependent Variable: INF
Method: ML – ARCH

Date: 12/20/21 Time: 09:56				
Sample(adjusted): 1992 2018				
Included observations: 27 after adjusting endpoints				
Convergence achieved after 128 iterations				
Bollerslev-Wooldrige robust standard errors & covariance				
Variables	Coefficient	Std. Error	z-Statistic	**Prop.**
EX	27.75399	2.3879	11.62283	0.0000
MP	17.59499	0.9906	17.76195	0.0000
CPI	49.25563	1.6702	29.47048	0.0042
CF	0.186533	0.0173	10.77808	0.0000
Variance Equation				
C	6.126689	0.483589	7.2627	0.0000
|RES|/SQR[GARCH](1)	-2.00442	0.723563	-2.7702	0.0056
RES/SQR[GARCH](1)	1.159994	0.404702	2.8663	0.0000
EGARCH(1)	0.261379	0.007941	32.9018	0.0000
R-squared	0.699086	Mean dependent var		41.915
Adjusted R-squared	0.523553	S.D. dependent var		47.7238
S.E. of regression	32.94132	Akaike info criterion		9.08185
Sum squared resid	13021.64	Schwarz criterion		9.48014
Log likelihood	-82.9185	Durbin-Watson stat		1.62863

Annex (5) ARCH Test

ARCH Test			
F-Statistic	0.781310	Probability	0.018566
Obs*R-squared	0.772024	Probability	0.018566

Annex (6) Study Data

Obs	INF	EX	MP	CPI	FC
1992	120.4	15.1	2422.1	117.6	177774.54
1993	119.3	132	2718.1	101.4	185296.62
1994	101.1	216	9337.5	115.4	87606.509
1995	116.8	315	24462.9	68.4	87606.509
1996	69.5	832	47064.6	132.8	5378.7326
1997	129.2	1460	226608.8	46.7	6044.1118
1998	47.19	1989	356061.7	17.1	5543.3049
1999	17.0	2520	426639.3	16	5911.5002
2000	16.16	2572.3	384565.12	8	4952.6800
2001	8.6	2574	486426.09	4.9	5406.9878
2002	4.8	2584	602546.11	8.3	6226.7053
2003	8.4	2637	326440.93	7.7	8273.5314
2004	7.4	2602	533150.63	8.4	10596.593
2005	78.	2586	607810.13	8.5	9980.2928
2006	8.4	2456	462857.84	7.2	11397.453
2007	7.2	2171	629864.95	8	14633.729
2008	8.1	2016	772645.22	14.3	14415.709
2009	14.3	2091	915425.49	11.2	22384.502
2010	11.2	2325	1058205.8	13.2	22846.052
2011	13	2305	1200986.0	22.1	19849.546
2012	18.1	2660	2893262.4	37.4	16010.656
2013	35.6	3573	29082332	30	22859.886
2014	25.6	4754	32132111	36.9	42577.573
2015	25.7	5200	33343322	16.9	30551.605
2016	12.6	5727	37632222	30.5	32566667
2017	17.6	6025.8	38987667	32.2	35677823
2018	32.4	6391.4	38999991	34.4	43232222