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Factors affecting the exchange rate in Sudan during the period from 1992 – 2022

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Abstract. The paper aimed to study the factors affecting the exchange rate in Sudan during the period from 1992-2022, and to what extent these factors are considered determinants of the exchange rate in Sudan. Statistically significant between the gross domestic product, the monetary reserve, the value of exports and imports, and the exchange rate. The paper reached results, the most important of which is that the direct relationship between the volume of exports and the decline in the exchange rate of the Sudanese pound did not lead to an increase in the volume of exports and a decrease in the volume of imports, and thus did not contribute to a decrease in the deficit in the trade balance and the balance of payments. The most important recommendations of the paper are: the need to build and diversify foreign exchange reserves to increase the effectiveness of implementing exchange rate policies, and this can only be done through increasing real gross product, reducing imports and increasing exports.

Keywords: exchange rate, foreign exchange reserves, gross domestic product, balance of payments.

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Introduction. Sudan is one of the developing countries that suffers from economic problems that led the country to adopt and implement programs and economic reform supported by the International Monetary Fund since June 1978 , but those policies during the period from 1978 -1990 did not succeed in bringing about economic growth and achieving stability in all sectors Different productivity, as this was accompanied by economic stagnation as a result of internal and external factors, the most prominent of which is the escalation of the internal and external resource gap, as public spending grew at higher rates than public revenues, which led to a deficit in the public budget of more than 13% of the GDP and a rise in inflation rates that reached 70%. On average, the trade balance recorded a large deficit as a result of the weak growth of exports, 1.8%, compared to the large growth in imports, 7% on average. essential in balancing the balance of payments. Also, choosing the appropriate exchange rate with the degree of stability is of great importance in attracting foreign investments, which leads to an increase in the country's foreign exchange earnings.

The paper aims to know the factors affecting the exchange rate during the period from 1992-2022. This is done by answering the following questions:

What are the determinants of exchange rate policies? To what extent are these factors determining the exchange rate in Sudan in the period 1992-2022?. Based on these questions, the study hypotheses can be formulated as follows:

Paper Hypotheses:

There is a relationship between the gross domestic product and the exchange rate.

There is a relationship between foreign reserves and the exchange rate.

There is a relationship between exports and the exchange rate.

There is a relationship between imports and the exchange rate.

Paper methodology:

The paper adopts the descriptive analytical and quantitative approach, using the multiple linear regression model, by building and estimating the exchange rate model as a dependent variable and the independent variables that represent the influencing factors (gross domestic product, foreign exchange reserves, and the value of exports and imports). This is done by studying what was reported from the time series data in some secondary sources of data (bulletins and specialized periodicals in the period from (1992 AD-2022).

The structure:

The paper was divided into four axes as follows. The first axis is the theoretical framework for the exchange rate trends, the second axis is the exchange rate policies in Sudan, then the third axis: factors affecting the exchange rate in Sudan, the fourth axis deals with building an exchange rate model in Sudan by defining The variables and the mathematical form of the model, the evaluation of the estimation results, the examination of the model's ability to anticipate, and finally the results and recommendations.

Previous studies:

Study of Mahasin Othman Muhammad Nour (2019): The impact of the change in the gross domestic product on the exchange rate in Sudan for the period from 2010-2018. The researcher used the descriptive and quantitative approach in estimating the study model. The study reached results, the most important of which is that there is a direct relationship between the gross domestic product and the exchange rate. The study recommended encouraging foreign investment and creating an environment conducive to investment.

The study of Siham Ahmed Dafa Allah Babiker (2014) Determinants of the exchange rate using the co-integration model and error correction for the period from 1978-2010. The study aimed to know the exchange rate and the variables affecting it. The study recommended bridging the gap between the official and parallel exchange rates.

The study of Obaidullah Mahjoub Obaidullah (2013): Measuring the effect of exchange rate fluctuations on the macroeconomic performance in Sudan during the period from 1979-2009 , the researcher used the descriptive analytical standard using the autoregressive model conditional on heterogeneity, and the study reached results, the most important of which is that the exchange rate fluctuation It had a positive impact on the trade balance, and the study recommended managing the exchange rate policy in Sudan.

The study of Haitham Daifallah Abkar (2011): a standard model for the determinants of the exchange rate in Sudan for the period from 1980-2011 . The study aimed to know the determinants of the exchange rate. The study used the descriptive and analytical approach. Exchange The study recommended the need to pay attention to exports as the most important source of foreign exchange.

The first axis: the theoretical framework of the exchange rate trends

What is the exchange rate:

The development of economic relations, the overlapping of interests between countries, and the increase in commercial exchange through import and export, necessitated the existence of an exchange rate between the currencies of countries, or the existence of a price for each country’s currency denominated in other currencies, in order to estimate the prices of goods and services in each country, and this price is called the price foreign exchange.

Concept of Exchange Rate:

The exchange rate is defined as the price through which one currency is exchanged for another, and we conclude from that that the settlement of international transactions requires the existence of a tool for the settlement of these exchanges. The acquisition of a commodity from a country whose value is not paid in the local currency, but rather requires determining the ratio of units in local currencies to foreign currencies. It is also known as the value of one unit of foreign currency estimated in units of the national currency, and we can know it in an inverse way as the value of one unit of a national currency against units of a foreign currency.

Exchange rate regimes:

The intertwining of economic relations and commercial activity between different countries of the world, each of which has a different national currency, indicates the existence of what is called the foreign exchange rate, which is considered one of the most important economic variables that affect international economic transactions, as it reflects the interconnected relations between international economies and expresses the economic status of countries Where the exchange rates are determined like any commodity according to the forces (supply and demand) in terms of the applicable exchange system, which led to the multiplicity of systems interpreting the exchange rate policies according to the development of the global monetary systems witnessed by the global economy throughout history, namely

1- gold standard:

This system began comprehensively and took a global form in 1879 when all industrialized countries joined it at that time. The most important characteristics of this system are as follows:

Fixing an official price for gold, according to which the conversion takes place freely between the local currency and gold.

Freedom of trade in gold and other currencies.

Supporting instruments and banknotes with gold reserves.

However, the state of instability in exchange rates that prevailed during the second half of the thirties of the twentieth century has paved the way for calls for reforming the global monetary system and moving to what is called the gold standard and the paper monetary system together. This is what is known as the fixed exchange rate system, which later developed into the managed floating exchange rate system, and it is the prevailing system until the present time. Below we briefly review this development.

2 - Fixed exchange rate system:

This system was announced in 1945 in the aftermath of World War II, when the Bretton Woods Agreement was reached in the United States of America, which laid the foundations for the new global monetary system, including the agreement to establish the International Monetary Fund, and according to that agreement, every member state of the fund is committed except The United States of America, by determining the exchange rate of its currency in dollars or gold. It also requires countries to intervene in the global exchange market to prevent fluctuations in the exchange rates of their currencies by more than 1% around their declared official rates. One of the results of this agreement was that the dollar base was replaced by the gold standard that prevailed previously.

3 - The floating exchange rate system:

With the growth of US military spending on the Korean War in the fifties and the Vietnamese war in the sixties of the twentieth century, its foreign debts increased, which posed a threat to US gold balances. August 1971 .

On December 18 of the same year, the United States was forced to reduce the exchange rate of the dollar against the currencies of 14 industrialized countries by 12%, then followed it with another reduction in February 1973 by 8%. As a result, the world began the stage of working with the Floating Exchange Rate System, that is, letting exchange rates be determined in the market according to the mechanism of supply and demand.

The second axis: exchange rate policies in Sudan:

The exchange rate policy represents an essential pillar of economic policy, as the exchange rate is nothing but a reflection of all balances or imbalances in the economy, and real economic reform is what ultimately achieves balance in the foreign exchange market. Also, the stability of the currency affects what is more than its value against other currencies, as the effects of its instability ramify to include all economic performance in its wide range, because the exchange rate affects the decision of the domestic and foreign investor alike, and also affects the position of savers and their hiding of available savings vessels and also affects Money market and prices of exports and imports of goods and services.

During the study period, the policies of liberalizing the exchange rate in Sudan went through several stages that can be divided into the following stages:

1 - The policy of liberalizing the exchange rate 1992-1999:

On February 2, 1992, it was announced that the policies of complete liberalization of the Sudanese economy would be pursued, as they included macroeconomic policies and foreign exchange rate policies. The regulations and procedures in the field of exchange rate were as follows

The abolition of the official market system and the free market, and the establishment of a unified market for dealing in foreign exchange.

Evaluating the exchange rate for foreign currencies by a committee of commercial banks according to supply and demand indicators.

The liberalization of the exchange rate in light of the lack of foreign exchange reserves led to a significant decrease in the exchange rate of the pound, reaching in October 1993 to 300 pounds per dollar, and in light of the high rates of inflation, the widening gap in external resources, and the increase in the state budget deficit, which prompted the determination of a new rate by the Central Bank. It is 522 pounds to the dollar. This situation continued until June 1994, when the two-price system was abolished and each commercial bank was allowed to determine the buying and selling prices daily, and the Bank of Sudan calculates a weighted average that is dealt with by the Bank of Sudan. The law regulating dealing in foreign exchange, where the activity of buying and selling foreign exchange was legalized.

The objectives of the exchange rate liberalization policy were as follows

1 - Achieving a rewarding return for exporters that helps to increase and move exports.

2 - Encouraging foreign and Sudanese investors to increase foreign exchange earnings.

3 - Follow a realistic exchange rate policy that reflects the true cost of exports and imports.

Since 1997 , the state has followed a contractionary fiscal policy that coincided with complete control over monetary expansion by the central bank through a contractionary monetary policy, whereby the legal reserve was raised and private sector funding was reduced. It should be noted that this period witnessed large inflows of foreign investment from China, Malaysia and other countries. Countries that invested in Sudanese oil projects, and this led to the availability of foreign exchange, and the difference between the official and parallel exchange rate was reduced and removed by the end of 1999.

2 /Managed flotation 1999-2008:

This period witnessed the stability of the exchange rate in an unprecedented manner as a result of the increase in the flows of oil revenues, which contributed to the provision of estimated resources for the foreign exchange market. The foreign exchange market to correct the course and to manage liquidity in the economy.

3 /Managed flotation and the global financial crisis 2009-2011:

As a result of the repercussions of the global financial crisis in the second wave, the habits of oil have shrunk clearly and the revenues of non-oil exports have become declining, and that is why some pressures began to appear in the foreign exchange market. . The effects of the secession of South Sudan are also the most important reasons that deepened the problem of scarcity of foreign exchange resources, as the country lost 67% of foreign exchange resources and about 65% of the state's general revenues, and the shock

quickly spread to the various productive sectors, and the country witnessed rising inflationary pressures since 2011 AD, the decline in real production in the productive sectors, and the general budget deficit increased, and as a result, the growth of the money supply and the increase in the cost of living accordingly.

4 ./ Managed flotation and scarcity of foreign exchange 2011 -2022 :

As a result of the secession of South Sudan and the loss of oil habits, the problem of scarcity of foreign exchange resources deepened, so the exchange rate policy in 2011 aimed at maintaining the stability of exchange rates, encouraging non-oil exports, rationalizing the demand for foreign peers, and wassuing letters was prevented The guarantee is in foreign currency for beneficiaries inside, with the exception of letters issued in favor of the government and oil companies. The Central Bank continued to follow the policy of the managed monied exchange rate and to pursue a policy of continuous correction in the exchange rate of the pound against foreign currencies in order to reach a stable and balanced exchange rate, as the exchange rates were corrected in 2012 and the exchange rate was reduced by the Central Bank for the transactions of the Ministry of Finance from 2.670 pounds to the dollar to 4.398 EGP by 65%. In contrast, the exchange rate of the pound in the organized market decreased from 2.881 EGP per dollar to 5.600 EGP per dollar, by 94%. Also, in 2013, the exchange rate of the pound in the regulated market was corrected to reflect its real value from 4.4 EGP per dollar to 5.7 EGP per dollar, and the gap reached Between the official rate (6.2) and the parallel rate (8.8) 42% at the end of 2014 , and it jumped to 85% at the end of 2015 , and in 2016 the Central Bank of Sudan took many policies that led to relative stability in the exchange rate, as the gap between the official rate and the parallel rate decreased to Only 5% at the end of 2016 , and the indicative exchange rate of the organized market was also adjusted several times in 2017 in order to reduce the gap between the official and parallel exchange rate, and as a continuation of the efforts of the Central Bank of Sudan to maintain the stability of the exchange rate, the market makers mechanism was established as an independent body to announce the exchange rate Based on market information, and as a result of these measures, the gap between the official price and the parallel price decreased from 202% in December 2017 to 71% in December 2018. Over the past two years, the exchange rate of the pound against the US dollar continued to deteriorate until it reached a value of 250 Sudanese pounds per dollar. One US dollar in the year 2020, as it is believed that 90% of transactions take place at the parallel exchange rate. In order to reduce the gap between the official and parallel exchange rates, the managed exchange rate policy was abandoned and the exchange rate liberalization policy was adopted completely in the year 2021, and the exchange rate jumped to 375 pounds per dollar and the exchange rate continued to decline until the pound exchange rate exceeded 571 pounds per dollar as its highest rate by the end of the year. 2022 .

The third axis: the factors affecting the exchange rate in Sudan:

The Sudanese economy, like any other developing country, has recently been suffering from many economic imbalances, which are represented by the poor performance of macroeconomic indicators, which lead to an imbalance between aggregate demand and supply. Inappropriate economic policies in recent years have played a major role in the instability of exchange rates. And its sharpness has risen for long periods, and the rise in the exchange rate in Sudan in recent years is attributed to structural problems that have been accompanying the Sudanese economy. It is financed by increasing the money supply, which is considered one of the most important sources local price and low exchange rates of the Sudanese pound against other foreign currencies. Recent years have witnessed a steady rise in the growth rates of the money supply in Sudan, due to several factors, the most important of which is the increase in the deficit in financing the general budget, through borrowing from the Central Bank, and as a result of increased government spending and a decrease in the state's general revenues, as the fiscal deficit reached 11% in 2019. of the gross domestic product.

The stability of the performance of macroeconomic indicators is a necessary need, and the mirror reflects the interaction of aggregate supply and aggregate demand. We find that it is represented in the exchange rate, the position of the current account, and the growth rate of the gross domestic product, and therefore the imbalance in the performance of these macroeconomic indicators This results in instability in the exchange rate system and weak ability Exports affect competition in foreign markets, which in turn is reflected in the current account and the balance of payments, which results in the deterioration of infrastructure, a decline in social services and living standards, and an increase in poverty rates in Sudan.

Gross domestic product growth is a primary goal that all countries strive for, as it leads to an increase in real income, savings and investment necessary for economic and social development. On the other hand, it represents more goods and services produced internally, thus reducing dependence on the outside world, and following an appropriate exchange rate policy leads to improving the position of the trade balance by exporting the surplus abroad, bringing more hard currency, increasing foreign exchange reserves, and improving the balance of payments. The gross domestic product also recorded negative growth as a result of the contraction of the Sudanese economy in 2018, and decreased by 8.2% in 2020, as a result of the economic crisis resulting from the outbreak of the Covid-19 epidemic, as the per capita GDP decreased by approximately 62% during the past five years. From 1.910% US dollars in 2015 to 0.730 US dollars in 2020 .

As a result of the increase in government spending, Sudan suffered from a continuous and increasing financial deficit and a shortage in the state's general revenues, as the fiscal deficit reached 11% of the GDP in 2019, while the 2020 budget reflected a deficit of 1.6% billion dollars, and government spending represents 19% of the GDP The total, with the government incurring large costs through providing subsidies, whether apparent subsidies for wheat, fuel, and electricity, or through implicit subsidies through the exaggerated customs dollar exchange rate, set at 55 Sudanese pounds for every one US dollar exaggerated, so a parallel and different exchange rate was set. Over the past two years, the official has reached its current value of 250 Sudanese pounds for every US dollar in 2020, as it is believed that 90% of transactions take place at the parallel exchange rate. The fiscal deficit was further exacerbated by the low tax rate compared to the gross domestic product, as public revenues amounted to only 5.4% of the gross domestic product in 2020.

The balance of payments in Sudan continued to suffer from a continuous deficit over many years caused by difficulties related to the structure of the Sudanese economy, as the balance of payments recorded in 2019 a deficit of 1.9% billion US dollars compared to 1.5% billion US dollars in the previous year, and the trade balance recorded a large deficit as a result of weakness Exports grew by 1.8% compared to the large growth in imports of 7% on average. The large deficit in the balance of payments led to a decrease in foreign exchange reserves, causing intermittent shortages in basic commodities such as fuel, wheat and medicine.

The fourth axis: building the study model

The expression of the economic phenomenon in a mathematical form, and the direction of the relationship between the variables of the study is based on what is provided by economic theory, and the exchange rate here as an economic phenomenon is affected by some variables. From this logic, the model variables are determined. It depends on the values that other variables called independent variables.

Formation of Economic Relations:

Formulating the economic relations under study in a mathematical form that enables measuring their coefficients, identifying variables, and estimating the model of factors influencing the exchange rate. In the foreign trade sector, the exchange rate function in Sudan was formulated in the period (1992-2022). According to the following formula:

OEX = f(GDP, FR, X , M)

whereas:

OEX): official rate of exchange (dependent variable), GDP: gross domestic product, FR: foreign exchange reserves, X: value of exports, value of imports (M), all of which are the independent variables of the exchange rate equation.

Determine the mathematical form:

The mathematical form of the model means the number of equations contained in the model (it may be a linear or non-linear model), and the mathematical form shows that the exchange rate is a function of the gross domestic product, the value of exports, the value of imports, and the foreign exchange reserve.

$OEX = \beta 0 + \beta 1\ GDP + \beta 2\ FR + \beta 3X + \beta 4M + Ut$

Data analysis and processing:

Economic relations usually include explanatory variables that are linked to dependent variables through unknown parameters that are estimated by standard analysis in the presence of random errors resulting from errors in the measurement of these variables. Therefore, the accuracy of the estimates depends mainly on the size and nature of the errors, so the accuracy of the model must be improved. Standard through the primary analysis of the data, especially if the data is related to time series.

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String stability and static test

The time series is a set of observations generated over time and its data is unstable and linked to each other. This instability leads to unreliable predictions. On the practical level, there are many tests that can be applied in time series data, the most important of which are:

1 / Testing the multiple linear correlation problem between the independent:variables:

To discover the problem of the multiple linear correlation between the independent variables, the matrix of linear correlations was used to find out the problem, and the following table shows the test result.

Table 1. Multiple Linear Correlation Matrix

M	X	FR	GDP	
0.2940547378974892	0.06627650771691689	-0.06708202812270982	1	GDP
0.3969577486832864	0.6174327209525824	1	-0.06708202812270982	FR
0.79067360051983	1	0.6174327209525824	0.06627650771691689	X
1	0.79067360051983	0.3969577486832864	0.2940547378974892	M

Source: Prepared by the researcher using (Eviews).

By looking at the multiple linear correlation matrix, we notice that the correlation coefficient between the independent variables is weak in terms of the degree of correlation and is less than one, and this indicates that there is no problem of the multiple linear correlation between the independent explanatory variables. Standard model estimation: using the ordinary least squares method by Eviews software.

Table 2. The results of estimating the linear model of the exchange rate function

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.611631	9.487184	1.013117	0.3203
GDP	0.082972	0.003403	24.38394	0.0000
FR	0.024130	0.011625	2.075637	0.0480
X	0.006691	0.003089	2.165756	0.0397
M	-0.011771	0.002595	-4.535260	0.0001

Source: Prepared by the researcher using (Eviews) program.

R-square = 0.96, Adjusted R-square = 0.95, F-statistic = 155

Prob (F-statistic) = 0.000000, Durbin-Watson stat = 1.57

Estimate the official exchange rate offset

Estimation Command:

LS OEX C GDP FR X M

Estimation Equation:

OEX = C(1) + C(2)*GDP + C(3)*FR + C(4)*X + C(5)*M

Substituted coefficients:

OEX = 9.54857516314 + 0.0830422625534*GDP + 0.0245079872379*FR + 0.00663941629527*X - M*0.0117594247055

Evaluation of the estimation results of the estimated model:

Evaluation of the model according to the economic criterion

The study model is evaluated according to the economic criterion through the references of the estimators of the study model parameters as follows:

1. The sign of the constant is positive in agreement with the economic theory, as the value of the constant represents the average value of the exchange rate when the value of the independent variables becomes zero.
2. The coefficient of gross domestic product is positive, consistent with the economic theory, as raising the productive capacities of the Sudanese economy and the commodities that enter into the production process (improving the value of the official exchange rate).

3. The sign of the foreign cash reserve coefficient is positive, in agreement with the economic theory, and that the increase in the volume of foreign cash reserves has an effect on raising the value of the local currency exchange rate.

4. The sign of the import coefficient is negative, in agreement with the economic theory, as the increase in the exchange rate means a decrease in the value of imports

5. The sign of the export coefficient is positive, in agreement with the economic theory, as the increase in the value of exports means a decrease in the exchange rate.

Evaluation of the model according to the statistical standard:

1. Quality of fit of the estimated equation: This is done by means of the (R-squared) test, which is called the coefficient of determination. about the change in the exploited variables. This means that 96% of the total change in the exchange rate is explained by the variables included in the official exchange rate equation (X, M. FR, GDP,), while 4% of it is due to other variables that were not explicitly included in the equation and fall within the random error limit. 96% of the total change in the official exchange rate (OEX) is explained by the variables included in the official exchange rate formula, which are (X, M. FR, GDP), and an amount of 4% is attributed to other variables that were not included in the equation and fall into error, including psychological factors, speculation, and the dollarization factor It refers to other variables not explicitly included in the equation that fall within the random error limit.

2. Testing the significance of the estimators (testing the dependence of the influence of the independent variables):

The t statistic is used to examine the estimators separately to judge the extent of their statistical dependence (difference from zero). Based on the previous table data, it is noted that the values of all variables of the study model are different from zero, and this appears in all probability values (Prob), which are all less than (0.05), which indicates that they are statistically dependent, and this means that the independent variables each separately have a real impact on the variable Affiliate exchange rate

3. Examining the dependence of the model statistically:

The significance of the overall model: This is done by means of the (F) test and it is compared with the probability value and the level of significance (0.05). The regression is not significant. And from Table No. (2) through the value of Prob(F-statistic), which was (0.000000). The model as a whole is moral. This indicates that the model is statistically dependent, that there is a real effect of the independent variables on the dependent variable, the exchange rate.

4. Evaluation of the model according to the standard:

The problem of self-correlation: to ensure that the coefficients of random errors are not related in time, this is tested by the Durbin-Watson test. If the value of the Durbin-Watson test (1.57), Appendix (2) is equal to the standard value (2) or close This means that the model does not suffer from autocorrelation problem.

But if it is less than (1.5), this means that there is a positive autocorrelation, and if the value is greater than (2.5), this means that there is a negative autocorrelation.

5. Testing the ability of the model to predict:

One of the tests that is used to know the model's ability to predict is the Thiel equality test, and whenever the Thiel coefficient is less than the correct one, the model has the ability to predict future values, and vice versa. 10) It is less than one, and this means that the model has the ability to predict future values.

Results

According to economic theory, there is a direct positive relationship between the gross domestic product, foreign exchange reserves, the volume of exports, and the depreciation of the exchange rate. There is a negative inverse relationship between the devaluation of the exchange rate and the volume of imports, and it can be explained as follows:

The direct relationship between the gross domestic product and the decrease in the exchange rate of the Sudanese pound did not lead to an increase in the growth rate of the gross domestic product and therefore did not lead to an increase in the volume of exports and contribute to reducing the deficit in the trade balance for the following reasons:

Most of the Sudanese exports are agricultural commodities, which means that they are weakly responsive to the exchange rate because they have little cross-elasticity and are affected by natural and internal and external economic factors.

Natural factors represented in climatic conditions and their suitability for the type of commodities, which made many Sudanese exports seasonal.

The economic factors are the dependence of Sudanese exports on production inputs imported from abroad, and the depreciation of the local currency leads to an increase in the cost of production, which hinders its competition in the global markets.

The inverse relationship between the volume of imports and the decline in the exchange rate of the local currency did not lead to a decrease in the volume of imports and an increase in the volume of foreign exchange reserves with the Bank of Sudan, and it did not contribute to a decrease in the deficit in the trade balance and the balance of payments for the following reasons:

Most of Sudan's imports are basic consumer goods, necessary strategic capital goods, and production inputs. This feature makes it weakly flexible regarding changes in the exchange rate.

Accordingly, the policy of decreasing the exchange rate of the local currency against foreign currencies to increase the volume of exports, reduce the volume of imports, and increase the volume of foreign exchange reserves had a weak effect, and thus the balance of payments continued to suffer from a continuous deficit.

Recommendations

In the light of the results of the study, some recommendations can be drawn, the most important of which are:

The need to diversify the sources of income in the local economy through the exploitation of all available agricultural economic resources, both plant, animal and mining, and using them as a major source of financing imports.

And when formulating exchange rate policies, the impact of the GDP on the exchange rate must be taken into account, because it leads to depleting a large part of the income in spending on imports at the expense of domestic production, which may have negative effects on the exchange rate.

Encouraging the production of commodities in which Sudan has a comparative advantage through exemption from taxes is better for the policy of import substitution. Because there are some imported goods that do not respond to the increase in the exchange rate and the import tax.

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Appendix

Table 1. Values are in millions of US dollars

FR	M	X	GDP	OEX	Years
27.5200	820.9000	319.3000	9.056	0.13	1992
37.4300	944.9000	417.3000	9.471	0.22	1993
78.1600	1095.500	523.6000	9.566	0.40	1994
163.3600	1184.600	555.7000	10.140	0.80	1995
106.7800	1504.600	620.2000	11.312	1.46	1996
81.5800	1579.900	594.2000	16.137	1.71	1997
90.6200	1924.200	595.7000	21.935	2.37	1998
188.7400	1414.900	780.1000	27.058	2.58	1999
137.8100	1552.700	1806.780	33.662	2.57	2000
49.74000	1585.500	1698.000	40.658	2.62	2001
248.9400	2446.400	1949.400	42.835	2.66	2002
529.4500	2881.900	2542.200	55.733	2.61	2003
1338.000	4075.000	3777.380	68.721	2.58	2004
1868.590	6756.800	4824.300	83.298	2.44	2005
1659.930	8073.300	5656.600	96.611	2.17	2006
1377.920	8775.400	8879.200	106.527	2.02	2007
1399.040	9351.500	11670.50	124.609	2.09	2008
1094.180	9690.000	7833.700	135.570	2.30	2009
1036.240	10044.00	11404.20	162.203	2.31	2010
192.5300	8127.700	9655.700	182.689	2.67	2011
192.6300	8122.700	4066.00	243.412	3.57	2012
192.9600	8727.900	4789.700	294.630	4.76	2013
181.4600	8105.900	4453.700	447.827	5.74	2014

Table 1 (cont.). Values are in millions of US dollars

173.5200	8367.600	3169.000	505.9374	6.03	2015
168.2800	7491.100	3093.600	605.5140	6.18	2016
177.9300	8220.300	4100.400	815.8554	6.68	2017
144.0000	7065.100	3484.700	1317.000	24.33	2018
124.0000	8290.500	3734.700	1950.100	62.00	2019
318.0000	9834.900	3802.600	3974.000	250.00	2020
115.4900	8470.200	4279.000	5958.000	375.00	2021
880.0000	4940.849	4657.818	5856.893	571.00	2022

Source: Annual reports of the Central Bank of Sudan.

Table 2. The results of estimating the linear model of the exchange rate function

Dependent Variable: OEX
Method: Least Squares
Date: 04/02/23 Time: 13:00
Sample: 1992 2022
Included observations: 31

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.3203	1.013117	9.487184	9.611631	C
0.0000	24.38394	0.003403	0.082972	GDP
0.0480	2.075637	0.011625	0.024130	FR
0.0397	2.165756	0.003089	0.006691	X
0.0001	-4.535260	0.002595	-0.011771	M
43.67742	Mean dependent var		0.959934	R-squared
125.7960	S.D. dependent var		0.953770	Adjusted R-squared
9.579762	Akaike info criterion		27.04758	S.E. of regression
9.811050	Schwarz criterion		19020.85	Sum squared resid
9.655156	Hannan-Quinn criter.		-143.4863	Log likelihood
1.576088	Durbin-Watson stat		155.7328	F-statistic
			0.000000	Prob (F-statistic)

Source: prepared by the author using Eviews.

Table 3. Testing the residual linear correlation problem

	Breusch-Godfrey Serial Correlation LM Test:		
0.1518	Prob. F(2,24)	2.041128	F-statistic
0.1051	Prob. Chi-Square(2)	4.506401	Obs*R-squared

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/02/23 Time: 13:06
Sample: 1992 2022
Included observations: 31
Presample missing value lagged residuals set to zero.

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.8801	-0.152521	9.189562	-1.401605	C
0.4119	0.835032	0.004695	0.003920	GDP
0.5145	0.661640	0.013109	0.008674	FR
0.9217	0.099335	0.002977	0.000296	X
0.6774	-0.421096	0.002702	-0.001138	M
0.9496	-0.063861	0.350896	-0.022409	RESID(-1)
0.0585	1.986400	0.353188	0.701573	RESID(-2)
1.83E-14	Mean dependent var		0.145368	R-squared
25.17992	S.D. dependent var		-0.068290	Adjusted R-squared
9.551710	Akaike info criterion		26.02550	S.E. of regression
9.875514	Schwarz criterion		16255.84	Sum squared resid
9.657262	Hannan-Quinn criter.		-141.0515	Log likelihood
1.700969	Durbin-Watson stat		0.680376	F-statistic
			0.666933	Prob (F-statistic)

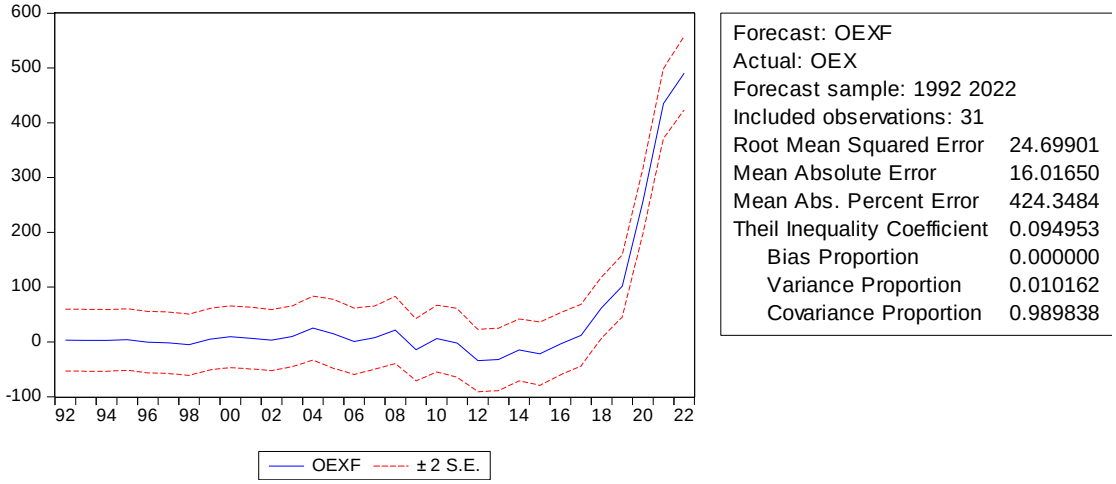

Figure 1. Testing the ability of the model to predict

Source: prepared by the author using Eviews.

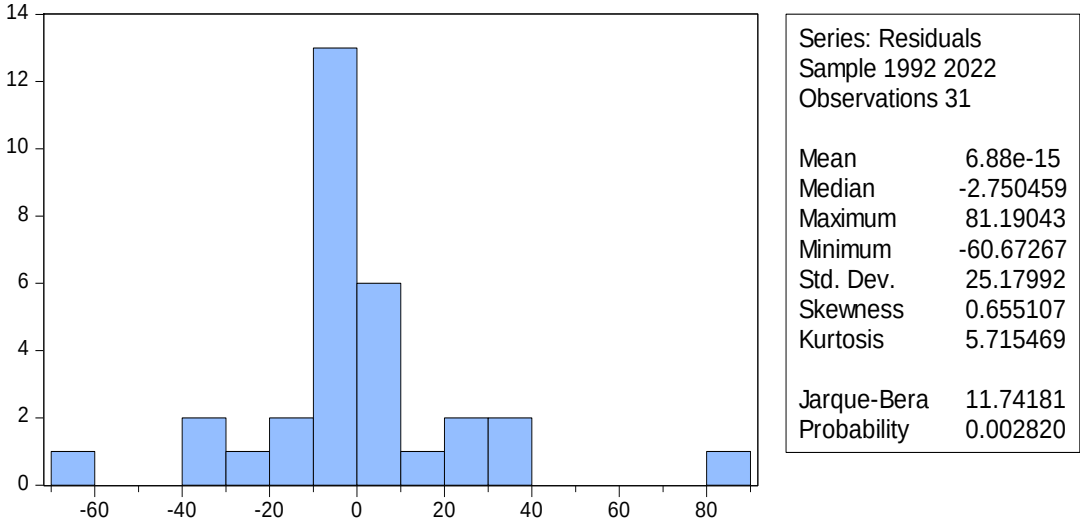

Figure 2. The normal distribution of the residuals

Source: prepared by the author using Eviews.

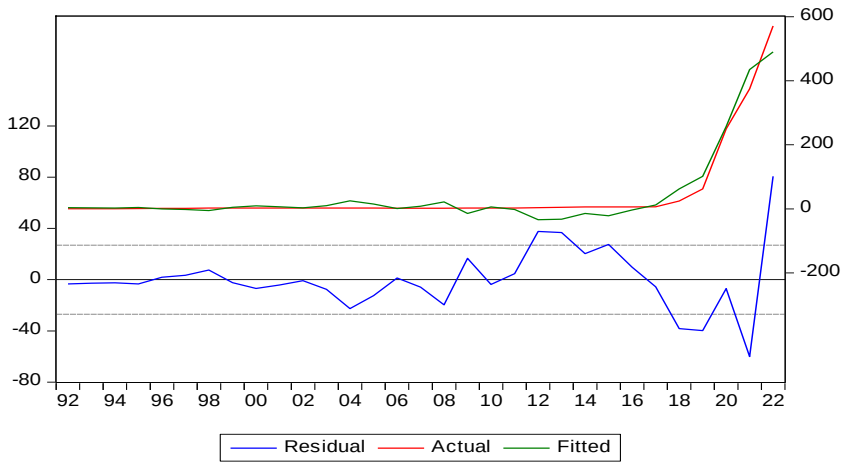

Figure 3. The relationship between the residual & actual & fited model of exchange rate in the periodfrom 1992 - 2022.

Source: prepared by the author using Eviews.

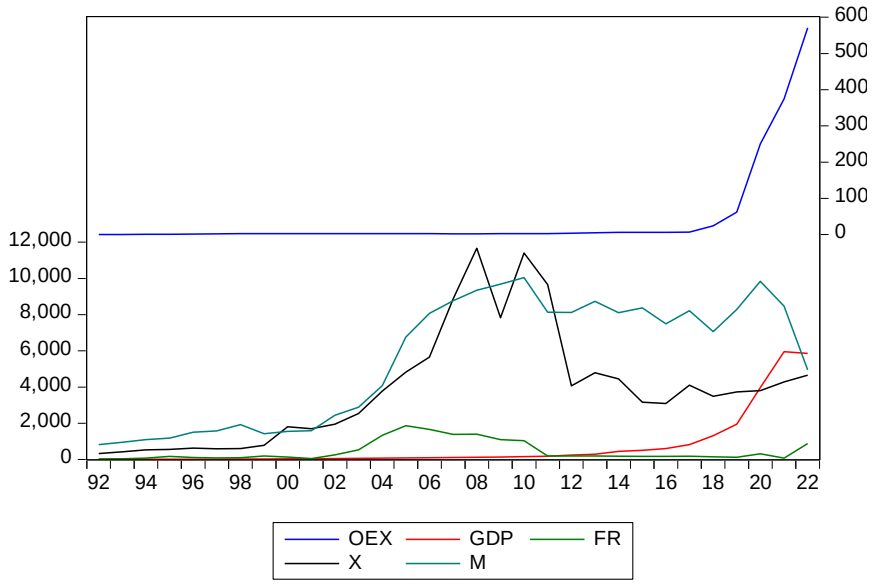

Figure 4. The relationship between the dependent variables and explanatory variables in the period from 1992-202

Source: prepared by the author using Eviews.

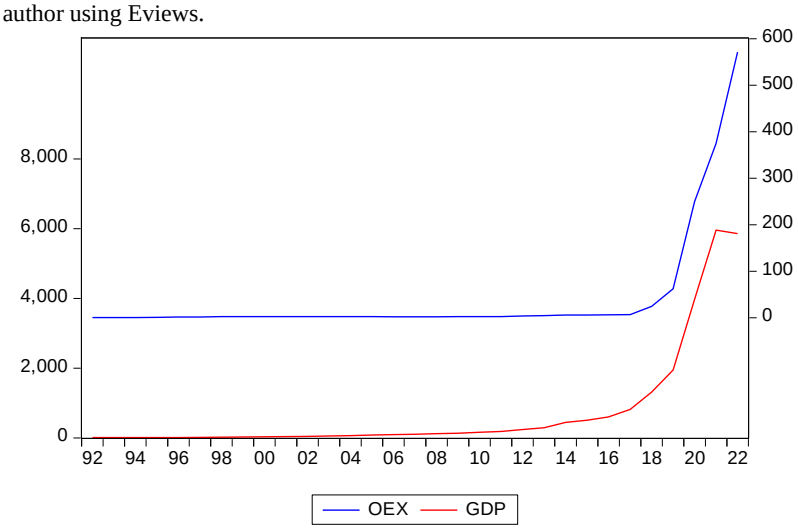

Figure 5. The relationship between the(OEX) and(GDP) in the period from 1992

Source: prepared by the author using Eviews.

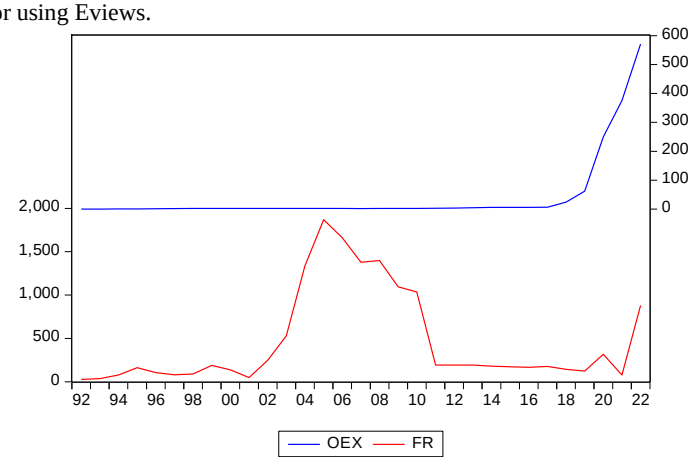

Figure 6. The relationship between the (OEX) and (FR) in the period from 1992-2022

Source: prepared by the author using Eviews.

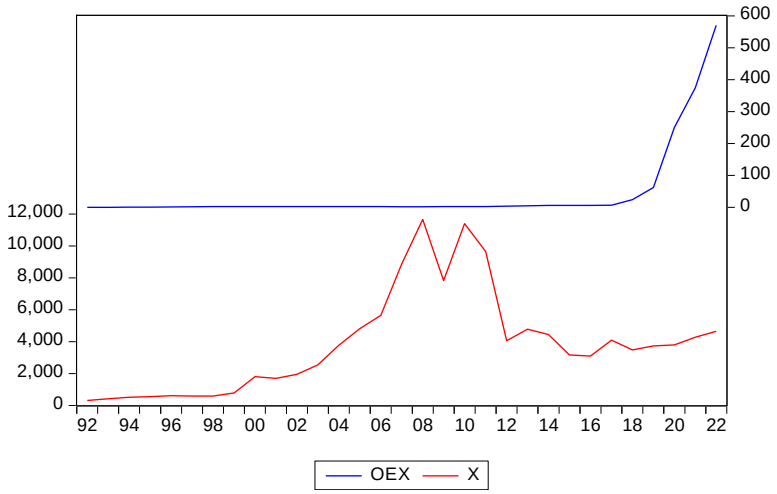

Figure 7. The relationship between the (OEX) and (FR) in the period from 1992-2022

Source: prepared by the author using Eviews.

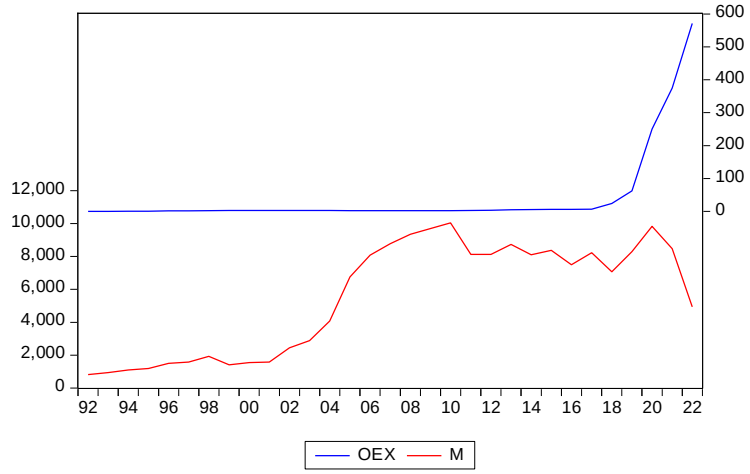

Figure 8. The relationship between the (OEX) and(X) in the period from 1992-2022

Source: prepared by the author using Eviews.