The Impact of Broad money, Exchange rate and Interest rate on Inflation in Egypt, Nigeria, South Africa for the period of 1982- 2020

تأثير النقد الواسع وسعر الصرف على التضخم في مصر ونيجيريا وجنوب إفريقيا للفترة ١٩٨٢-٢٠٢٠

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Abstract:

Standard studies on the relationship between broad money[1], exchange rate (FX), interest rate, and inflation showed a spectrum of varying results. The first strand of research documented a positive causal relationship where broad money and the exchange rate directly stimulate inflation by increasing purchasing power and aggregate demand. The second reported a negative association where broad money and exchange rate were harmful to inflation because the wide money and exchange diverted resources leading to more productive government spending. The third showed a sequential causal relationship indicating an impact of broad money on exchange rate causing an increase on inflation and subsequently leading to an increase in money abroad and exchange rate, while the fourth strand indicated a two-way causal relationship between broad money, exchange rate and inflation.

This study investigates the impact of broad money, exchange rate, and interest rate on inflation in Egypt, Nigeria and South Africa since they showed the highest levels of gross domestic product (GDP) among African countries during the research period of interest. These countries experienced a negative relationship between real interest rate and inflation where increased rates of real interest led to inflation rates decrease.

The results of the standard model showed a positive correlation between broad money, exchange rate and inflation in Egypt, Nigeria and South Africa.

Key words: inflation, Broad money, interest rate.

[1] Broad money is a category for measuring the amount of money circulating in an economy. It is defined as the most inclusive method of calculating a given country's money supply, and includes narrow money along with other assets that can be easily converted into cash to buy goods and services.

المستخلص:

أظهرت الدراسات القياسية المتعددة حول العلاقة بين كلٍ من النقد الواسع، سعر الصرف، سعر الفائدة، والتضخم تبايناً فى نتائجها والتى تراوحت بين إتجاهاتٍ مختلفة. حيث أشار الاتجاه البحثى الأول علاقة سببية إيجابية بين النقد الواسع، سعر الصرف، والتضخم بتحفيز كلٍ من النقد الواسع وسعر الصرف لمعدلات التضخم مباشرةً عن طريق زيادة القوة الشرائية والطلب الكلى. فى حين رصدت المجموعة البحثية الثانية علاقةٍ سلبية بين النقد الواسع، سعر الصرف، سعر الفائدة، والتضخم، حيث أثبتت أن النقد الواسع وسعر الصرف ضاران بالتضخم لأن اتساع النقد والتبادل سيؤديان إلى تحويل الموارد إلى إنفاق حكومي أكثر إنتاجية مثل الزراعة والصناعة. وسجلت دراسات الاتجاه الثالث لعلاقة السبب والأثر بين النقد الواسع، سعر الصرف، والتضخم ، حيث يؤدى النقد الواسع لارتفاع سعر الصرف مما يتسبب فى زيادة التضخم، وبالتبعية يؤدى التضخم إلى زيادة النقود في الخارج، وسعر الصرف. كما أشارت مجموعة بحثية أخرى إلى العلاقة السببية ذات الاتجاهين بين كلٍ من النقد الواسع، سعر الصرف، والتضخم.

ومن ثَمَ، تسعى الدراسة الحالية إلى التحقق من أثر النقد الواسع وسعر الصرف على التضخم فى كلٍ من مصر، نيجيريا، وجنوب افريقيا. حيث سجلت هذه الدول لأعلى معدلات من الناتج المحلى الإجمالى ما بين دول القارة الإفريقية، وتوافقاً مع النظرية الاقتصادية فقد سجلت علاقة سلبية بين سعر الفائدة الحقيقي والتضخم ، حيث إرتفاع سعر الفائدة الحقيقي إلى إنخفاض معدلات التضخم. وعلى الرغم من ذلك، فلا يشعر مواطنى تلك الدول بمعدلات الناتج المحلى الإجمالى المرتفعة عن سائر القارة بسبب إرتفاع معدلات التضخم.

وبناءاً عليه، كان الحافز لاجراء الدراسة الحالية بهدف التحقق من الأسباب المؤدية إلى تحقيق هذه الدول لتلك المعدلات المرتفعة من التضخم و من ثَمَ العمل على خفضها. واستخدمت الدراسة البيانات المقطعية لهذه الدول للتغلب على أي انحرافات في قيم المتغيرات في ضوء الظروف غير المستقرة للدول الأفريقية. وأظهرت نتائج النموذج القياسي المستخدم في هذه الدراسة أن هناك علاقة ارتباط موجبة بين النقد الواسع، سعر الصرف، والتضخم في كلٍ من مصر، نيجيريا، وجنوب إفريقيا.

الكلمات المفتاحية: التضخم، النمو النقدي الواسع، نمو نصيب الفرد من الناتج المحلي الإجمالي، الإنفاق الاستهلاكي النهائي للحكومة العامة، سعر الفائدة الحقيقي، سعر الصرف الرسمي، مصر، نيجيريا، جنوب إفريقيا.

1. Introduction

In light of turbulent regional economic conditions in Africa, Egypt, Nigeria, South Africa seek to reduce inflation by utilizing appropriate monetary policy tools. The surrounding risks and external economic completion, gave rise to an academia interest in investigating broad money, FX rate, interest rate and inflation. Nevertheless, since inflation may cause deteriorations multiple economic activities that accelerate the pace of economic growth and keep its rates stable.

Achieving low rates of inflation by controlling broad money and FX rate positively affects the process of economic growth through encouraging and attracting investments. On the other hand, high inflation rates increase interest rates which discourage investments ultimately negatively affecting economic growth.

The effect of broad money on inflation has become an important issue for academics and policymakers. Theoretical and empirical research on this topic has been evolving for the past thirty years. In theory, many researchers have tried to identify the channels through which broad money affects inflation, by focusing on the effects of total supply and demand, and the methodology used in this field varied. Multiple econometric models have been used; cross-sectional analysis for a group of countries (used in this study) versus time series analysis for a single country. Simultaneous equation models; using large samples or dividing the sample according to economic and non-economic structural features, and testing whether there is a cause for inflation.

2- Literature review:

Multiple and varying results were documented in the related literature on the associations between broad money, FX rate, interest rate, and inflation. Mishkin (1992) and Ghazali (2003) concluded the absence of interest rate-inflation rate association. McCandless & Weber (1995) examined data for 110 countries over a period of 30 years where a high (almost unity) correlation between money supply rate of growth and the rate of inflation in long term was concluded. Lardic & Mignon (2003) have studied the relationship between interest rate and inflation rate in G-7 countries using Engel-Granger co-integration method concluding a long-term interest rate-inflation rate relationship.

Shelley & Wallace (2005) investigated supply money growth/CPI US Inflation Rate correlation using annual data collected during the period 1900-1960. A strong negative association was found between filtered money growth and CPI inflation rate at all frequencies examined. Nassar (2005) used a two-segment model to estimate the relationship between prices, money, and the FX rate for quarterly data in Madagascar over the period 1982-2004. The results showed a

significant positive impact of money supply on inflation. Pelipas (2006) studied money demand and inflation in Belarus on a quarterly data basis for the period 1992-2003. By using the integrated VAR model and equilibrium correction, the study indicated a positive money supply-inflation has relationship.

Okhiria and Saliu (2008) used Dickey-Fuller augment to perform the unit root test in co-integration with the Johansen test to study the effect of FX rate on inflation and the relationship that exists among government expenditure, money supply FX rate, oil revenues, and inflation in Nigeria. The study concluded that the measures used by the government to reduce the amount of money supply and government spending and measures to control the FX rate can lead to poor productivity in the country. The study recommended that policy makers should try to mitigate the impact of inflation on the economy when needed, so that the rise in the FX rate does not lead to inflationary pressures in the short term.

Moreover, Hossain (2010) investigated the behavior of broad money demand in Bangladesh using annual data from 1973 to 2008 using the Johansen cointegration test and error-corrected model. Results indicated a causal relationship between the growth of money supply and inflation. Anjum (2013) showed the major role of money supply (M2) on the GDP of Pakistan. Excessive money supply (M2) by the SBP (State Bank of Pakistan) to run the state necessitates a high rate of inflation. The study clarified the relationship, as the greater the money supply in the economy, the higher the inflation rate where CPI and the interest rate have a significant impact on the GDP and inflation rate has a small impact on the GDP.

Kirimi (2014), investigated inflation determinants in Kenya for 1970-2013 using ordinary least squares. The study showed that central bank rates and the GDP growth rate are important determinants of the inflation rate during the period. According to that finding, food prices, GDP growth rate, and perception of corruption had a negative relationship with inflation, and money supply (M2) and FX rate had a positive relationship with inflation. Moreover, Alavinasab (2014) studied the factors affecting the inflation rate in Iran, using annual time series data between the periods 1965-2012 using augmented Dickey-Fuller (ADF) and Johansen co-integration test. Result showed a long-term co-integration between money supply, GDP, and inflation. In addition, positive money supply– inflation association and a negative GDP-inflation relationship.

According to Nguyen (2015), a high sustainable growth rate of GDP at a low inflation rate is one of the main objectives of the majority of macroeconomic policies. The study examined the effects of the fiscal deficit and the broad M2 money supply on inflation in the Asian countries, namely Bangladesh, Cambodia, Indonesia, Malaysia, Pakistan, the Philippines, Sri Lanka, Thailand and Vietnam for the period 1985-2012. The study concluded a significant positive effect of wide supply money on inflation only through a method that prepares PMG

estimates of the deficit Fiscal. On the other hand, Ofori-Frimpon et al. (2017) studied the effect of money supply on inflation rate in Ghana using annual data from 1967 to 2015 to test the model. The research was restricted to use money supply on inflation rate. Results showed a long-term positive association between money supply and inflation rate based on an Ordinary Least Square (OLS) method.

Zhang (2017) showed a long-term positive relationship between money supply and inflation on an ordinary least squares basis in Ghana for the period of 1967-2015. While Chaudhary (2018) studied the determinants of inflation in Nepal where money supply, CPI, Indian prices and real GDP are taken as determinants that significantly affect inflation in Nepal and it is concluded that money supply and Indian prices cause inflation in the long run.

Lowe (2019) investigated the relationship between the FX rate regime and the sources of inflation for the period 1978-2016 in Gambia using the Augmented Dickey Fuller (ADF) the Johansen co-integration test. Results indicated fixed levels of inflation-interest rates and unstable levels of FX-GDP. Moreover, results showed that a unit increase in the interest rate leads to a decrease in inflation. There was also a positive relationship between the FX rate and the interest rate. A unit increase in the FX rate leads to an increase in the rate of inflation. It also showed that there is a negative relationship between GDP and the level of inflation.

In addition, Huyen (2020) used VAR model to examine the relationship between FX rates and output, as well as the relationship between FX rates and inflation in Vietnam. An increase in FX rates does not help economic growth and may even have the opposite effect. Moreover, the FX rate has a negative impact on the inflation control policy. Joshi (2021) illustrated the relationship between money supply and inflation in Nepal for the period 1964-2019 using ARDL Bounds test. The results showed a long-term co-integration between research variables.

According to Dekkiche (2022), used VECM regression model to assess the relationship between money supply and inflation in Egypt for 1990- 2019. The model includes four independent variables: money supply, imports, GDP and FX rate. The Johansen-Juselius co-integration test and the Vector Error correction model were used to determine the presence of long-run and short-run associations. The results showed that there are co-integration links between the variables. All independent factors had a positive effect on the inflation rate.

Mohamed (2023) analyzed the effects of both FX rates and interest rates together on selected indicators of macroeconomic performance in Egypt during 1991-2020. The Engle Granger two-step co-integration model was applied to estimate short- and long-term relationships between variables. It turned out that although the interest rate and the FX rate, each in the presence of the other had an impact on the inflation rate in the long run. And only the rate of interest, in the presence of the FX rate, had an effect on the rate of inflation.

Conversely, a negative relationship between GDP per capita growth and inflation might be inferred from reviewing the above literature. Anjum (2013) argued that the inflation rate has a small impact on the GDP, Alavinasab, Kirimi (2014) and Lowe, (2019) are According to that finding, GDP growth rate, had a negative relationship with the level of inflation. Dekkiche showed (2022) a positive relationship between GDP and inflation. These studies revealed a negative relationship between Real interest rate and inflation, Lowe, 2019, used to search for a long-run relationship between series showing that a unit increase in the interest rate leads to a decrease in inflation.

Lardic & Mignon (2003) studied interest rate and inflation rate association in G-7 countries. A long run relationship between interest rate and inflation rate but not directional. Mohamed, (2023) analyzed the effects of interest rates. It turned out that the interest rate, had an impact on the inflation rate in the long run. However, Mishkin (1992) and Ghazali (2003) have concluded that there is no strong relationship between interest rate and inflation rate.

Consequently, a positive relationship between FX rate and inflation might be inferred from reviewing the above literature. Kirimi (2014) and Lowe, (2019) indicated that FX rate had a positive relationship with inflation. Okhiria and Saliu (2008) demonstrated the effect of the FX rate on the rate of inflation that the rise in the FX rate does not lead to inflationary pressures in the short term. Dekkiche (2022) and Mohamed (2023) pointed out that the FX rate had an effect on the rate of inflation. However, Huyen (2020) indicated that FX rate has a negative impact on the inflation control policy.

A positive relationship between Broad money growth and inflation, might be inferred from reviewing the above literature where McCandless and Weber (1995) showed that there is a high (almost unity) correlation between the rate of growth of the money supply and the rate of inflation in long term. Moreover, Nassar (2005) and pelipas (2006) indicated that the money supply has a positive relationship with inflation.

Moreover, Hossain (2010) results indicated a causal relationship between the growth of money supply and inflation. Alavinasab and Kirimi (2014) showed that there is a long-run co-integration relationship between money supply, GDP, and inflation, and a positive relationship between money supply and inflation, Nguyen (2015), came to the conclusion that the wide supply of money M2 has a significant positive effect on inflation.

According to Zhang, Ofori-Frimpon et al. (2017) a long-run positive relationship exists between money supply and inflation on an ordinary least squares basis. Chaudhary (2018), it is concluded that money supply and Indian prices cause inflation in the long run. Joshi (2021), illustrated the relationship between money supply and inflation where long-run co-integration between variables reveals a

long-run relationship between money supply and inflation. Dekkiche (2022) indicated a positive effect on the inflation rate. However, Shelley and Wallace (2005) concluded a negative association between filtered money growth and CPI inflation rate at all frequencies examined.

These contradictory findings triggered the researcher's motivation to conduct the current study, since there is no research work (according to the best of the researcher's knowledge) was found studying these variables empirically on the Egyptian economy.

3- Research Model:

This study utilizes panel data for Egypt, Nigeria, South Africa from 1982 to 2020 in measuring the relationship between broad money, FX rate and inflation. Broad money growth, GDP per capita growth, General government final consumption expenditure, Real interest rate, Official FX rate were used as an independent variable in the study so that it can be measured the effect of broad money in the absence of it as an independent variable in the study.

The study model was built on the foundations of economic theory which indicates that inflation is affected by (monetary policy, financial policy, and other economic activity) Broad money growth (monetary policy) GDP per capita growth, General government final consumption expenditure (financial policy), Real interest rate(monetary policy), Official FX rate and thus there has become an accurate theoretical explanation and a basis compatible with economic theory in choosing the model used for this study and formulating the model used In this study, the following equation is based, according to economic theory:

$$INF = C + C_{(1)} X BM2 + C_{(2)} X ER + C_{(3)} X GDP + C_{(4)} X GE + C_{(5)} X IR$$

INF = inflation.

BM2 = Broad money growth.

ER = Official FX rate.

GDP = GDP per capita growth.

GE = General government final consumption expenditure.

IR = Real interest rate.

C= Constant

$C_{(1)}$, $C_{(2)}$, $C_{(3)}$, $C_{(4)}$, $C_{(5)}$, is parameter

The Eviews9 statistical program was used to estimate and select the appropriate model.

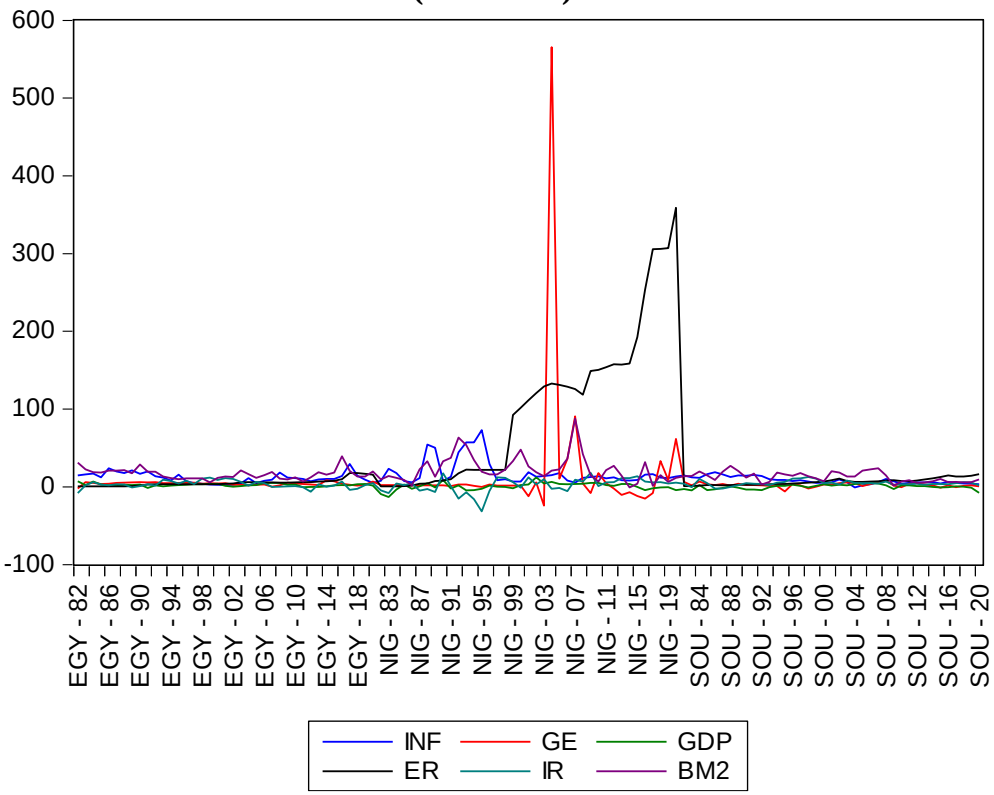
The following table highlights the research variables where the dependent variable is INF and the independent variable are BM2, ER, GDP, GE, IR, data were extracted from the World Bank database.

Table No (1): Description of data for the study variables and their source (1982-2020):

Variable	Definition	Data source	Variable
INF	Inflation	World Bank	Dependent
BM2	Broad money growth	World Bank	Independent
ER	Official FX rate	World Bank	Independent
GDP	GDP per capita growth	World Bank	Independent
GE	General government final consumption expenditure.	World Bank	Independent
IR	Real interest rate	World Bank	Independent

Data source: From World Bank database.

figure No. (1): Data for the study variables and their source as graph (1982-2020):



Data source: output from variable study data EViews 9.

In the chart above, related to the variables of the study, we find the deviations of the index (ge, ir) in Nigeria, so we chose the long run in the data from 1982 to 2020, and we choose a data plate and cross sectional data from three countries to reach a good result for this study, in Egypt And South Africa did not find a problem in most of the indicators, all the indicators do not contain large deviations in the long-term graph, and this was confirmed by the following statistical tests in this study for the safety of the time series of the study variables.

Unit root test:

Table (2): Unit root test

Variable	level		$Level_1$		$Level_2$	
	statistics	prob	statistics	Prob	statistics	prob
INF	-2.82	0.002				
BM2	-4.3	0.000				
ER	2.9	0.998	-5.7	0.000		
GDP	-1.69	0.049				
GE	-3.23	0.000				
IR	-2.54	0.005				

Data source: From Table No. 1 to 7 Table No. 10 (appendix).

The static condition is considered a prerequisite for studying time series analysis to reach sound and logical results, and the time series is considered static, if the following conditions are met: the stability of the arithmetic mean of the values over time, the stability of the variance over time, and we will test the stativity of the time series through the Extended Ducky Fuller test using Eviews9 it is evident from Table 2 that all the time series for the study variables were static at the level except for the time series for the variable ER. They were static at this level. Therefore, first-order differences were required on ER time series. The results indicated the stability and staginess of the ER variable. After making the first-degree differences, all-time series, so the results indicated the stability and statics of the rest of the variables, and this means that all-time series is stable, which gives a good indication of the progress in the model estimation procedure.

Granger Causality Tests:

Table (3): Granger Causality Tests

Null Hypothesis	F-Statistic	Prob
GE does not Granger Cause INF	0.54348	0.5823
INF does not Granger Cause GE	0.00081	0.9992
IR does not Granger Cause INF	0.64636	0.5260
INF does not Granger Cause IR	4.40878	0.0145
ER does not Granger Cause INF	0.05551	0.9460
INF does not Granger Cause ER	0.66691	0.5154
GDP does not Granger Cause INF	0.00024	0.9998
INF does not Granger Cause GDP	0.01633	0.9838
BM2 does not Granger Cause INF	12.8217	1.E-05
INF does not Granger Cause BM2	1.34556	0.2648

Data source: Table No. 8 (appendix).

By looking at the previous table, we find that all the independent study variables between them and the dependent variable inflation have a long-term, two-way causal relationship, where we find that the probability of the absence of a causal relationship between the dependent variables and the independent variable is not equal to zero, and therefore there is a possibility of a causal relationship between the variables The dependency and the

independent variable, and this indicates the correctness of the extent to which this study was conducted, the estimation of the model and the prediction of the values of the various variables of the study.

Descriptive tests:

Table (4): descriptive tests

	mean	median
INF	12.9	10.1
GDP	1.1	1.8
IR	3.4	3.9
ER	38.4	6.8
Bm2	17.6	14.9
GE	8.9	2.9

Data source: Table No. 9 (appendix).

We find mean[2] inflation in Egypt, Nigeria, south Africa 12.9% (1982-2020), this is ahigh rate, effect in all economic activity, so government in this country, should be work to reduce inflation rate. although three countries have a big economic in Africa in a period of study but citizen in this countries very poor because inflation high rate, so we study here the reasons which cause a high rate inflation in this countries to slave this problem , median[3] indicate also a high rate in inflation 10%, it a main reason to study this case, General government final consumption expenditure (annual % growth) median 2.8% in this countries 1982-2020 it seem not high but look at a long term 1982-2020 seem good, but most citizen in this countries not feel this growth because high inflation, GDP per capita growth (annual %) median 1.79% in this countries 1982-2020 it seem not high but look at a long term 1982-2020 seem good, also most citizen in this countries not feel this growth because high inflation, Official FX rate (LCU per US$, period average) median 6.7% very high in this countries which indicate a big problem in local currency front at others international currency, Real interest rate (%) seem very high, because this rate after discount inflation, so interest rate in banks in this country median 13.4% 1982-2020 very high this effect in investment and total production, and indicate a big problem in volume of money supply, Broad money growth (annual %) median 14.8% it seem high rate in this period 1982-2012 it effect in demand, increase demand which effect in increase in prices of goods and services.

[2] Mean is the ratio of the sum of all observations in the data to the total number of observations. This is also known as average. Thus, mean is a number around which the entire data set is spread.

[3] Median is the point which divides the entire data into two equal halves. One half of the data is less than the median and the other half is greater than the median. Median is calculated by first arranging the data in either ascending or descending order

Estimating model parameters and results of checking its quality

Table (5): Panel Least Squares

R-squared	o.52	Durbin-Watson stat	1.19
Adjusted R-squared	0.50		
F-statistic	24.6		
Prob(F-statistic)	0.0000		

Data source: Table No. 10 (appendix).

Using the method of least squares (OLS) to estimate the parameters of the standard model used, through Eviews9, the results were as follows:

$$INF = 13.30 - 0.12XGDP - 1.18XIR + 0.02XER - 0.02XGE + 0.19XBM_2$$

Covariance test:

Table (6): Covariance test

	GDP	IR	ER	GE	BM_2
INF	-22.6	-114.2	789.6	-130.11	102.5

Data source: Table No. 11 (appendix).

The results of estimating the multiple regression model and covariance test for the time series variables being studied indicate that the coefficient of determination has a value of 0.50, which means that the independent variables explain 50% of the variance in the dependent variable.

The results show that there is a negative relationship between GDP per capita growth and inflation, as the increase in GDP per capita growth leads to a decrease in the inflation. This is compatible with economic theory, as it states that increasing production increases the supply of goods and services, and affects lower prices, thus reducing inflation.

There is also a negative relationship between Real interest rate and inflation, as the increase in Real interest rate leads to a decrease in the inflation, this is compatible with economic theory, as it states that an increase in the real interest rate increases savings and limits spending, thus reducing the demand for goods and services, which limits the increase in inflation.

There is a negative relationship between General government final consumption expenditure and inflation, An increase in the General government final consumption expenditure leads to a decrease in inflation, This is compatible with economic theory, as it states that increasing government spending increases the demand for local goods and services, and thus production will increase to meet this demand, and thus supply will increase and prices will decrease, which reduces inflation rates in the long run.

There is a positive relationship between Official FX rate and inflation, as the increase in Official FX rate leads to an increase in the inflation, this is compatible with economic theory, This is compatible with economic theory, as it states that an increase in the FX rate will increase the demand for foreign currencies, and thus the value of the local currency will decrease against foreign currencies, and therefore the prices of goods and services will increase due to the high cost of importing these goods or production components in these countries.

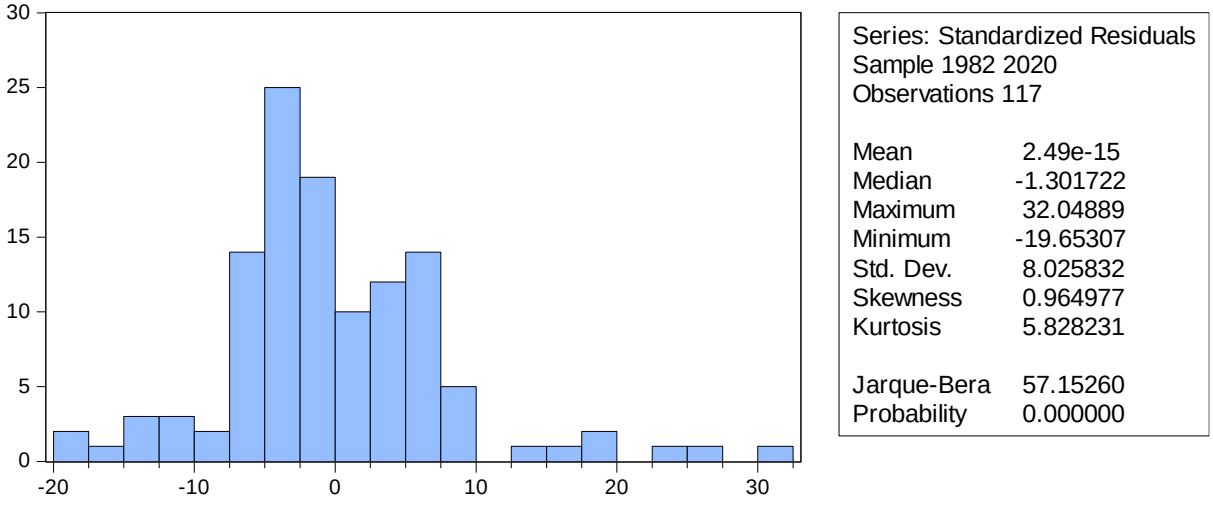
There is also a positive relationship between Broad money growth and inflation, as the increase in Broad money growth leads to increase in the inflation, this is compatible with economic theory, this is compatible with the economic theory, as it states that an increase in the money supply will increase the demand for goods and services, and thus the rise in goods and services will increase, and this will lead, accordingly, to a rise in inflation rates.

4- Results of assessed model quality checks:

In light of the adoption of the estimation of the standard model for the study on the regular least squares method, there are some necessary tests to ensure the validity and quality of the estimated model, to rely on the evaluation results, namely:

Test of the normal distribution condition for the residuals of the estimated model.

figure No. (2): Normal distribution condition for the residuals of the estimated model.



Using the Jarque-Bera test, the test value was (J = 57.15) with a probability of reaching and (p-value =0.000), this result indicates acceptance of the null hypothesis that assumes that random errors (residuals of the estimated model) follow the normal distribution because the test value is less than the tabular value of 5.99 (kurtosis[4] = 5.82) at a degree of freedom of 5%.

[4] the sharpness of the peak of a frequency-distribution curve.

No self-association: Previously, the estimated DW value of the model was 1.19 which means the absence of the mode of the problem of self-association

The previous results of the statistical tests on the study model confirm the quality of the estimated model and its safety from any standard defect, and thus its results can be relied upon in proportion to the economic reality.

Relationships between broad money, FX rate, interest rate and inflation					
#	**Study**	**(positive)**	**(negative)**	**(Long term)**	**(two-way)**
1	**Mishkin (1992)**	A positive relationship between Real interest rate and inflation.			
2	**McCandless & Weber (1995)**				The study shows that there is a high (almost unity) correlation between the rate of growth of the money supply and the rate of inflation in long term.
3	**Ghazali (2003)**	A positive relationship between Real interest rate and inflation.			
4	**Lardic and Mignon (2003)**			The result showed that there is a long-term co-integration relationship between interest rate and inflation.	
5	**Nassar (2005)**	the money supply has a significant **positive** impact on inflation.			

6	**Pelipas (2006)**	the money supply has a **positive** relationship with inflation.			
7	**Anjum (2013)**	increase in money supply leads to increase in inflation rate			

Relationships between broad money, FX rate, interest rate and inflation					
#	**Study**	**(positive)**	**(negative)**	**(Long term)**	**(two-way)**
8	**Kirimi (2014)**	money supply (M2) and FX rate had a **positive** relationship with inflation.			
9	**Alavinasab (2014)**	positive relationship between money supply and inflation		The result showed that there is a **long-term** co-integration relationship between money supply and inflation.	
10	**Nguyen (2015),**	the wide supply of money M2 has a significant **positive** effect on inflation only			
11	**Lowe (2019)**		A negative relationship between Real interest rate and inflation.		

12	**Huyen (2020)**		the FX rate has a **negative** impact on the inflation		

Relationships between broad money, FX rate, interest rate and inflation					
#		**(positive)**	**(negative)**	**(Long term)**	**(two-way)**
13	**Mohamed, R. S. A. (2023)**	The FX rate affects the inflation rate **positively**		the FX rate, had an effect on the inflation rate in the long run. and the result showed that there is a long-term co-integration relationship between interest rate and inflation.	
14	**Shelley & Wallace, (2005)**		A strong negative association was found between filtered money growth and CPI inflation rate at all frequencies examined		
15	**Ofori-Frimpon et al. (2017)**			a long-run positive link between money supply and inflation rate	
16	**Zhang (2017**			a long-run positive link between money supply and inflation rate	
17	**In the study Chaudhary (2018**			money supply and Indian prices cause inflation in the long run.	
18	**Dekkiche (2022)**	The FX rate and broad money affects the inflation rate positively		The result shows that long-run cointegration between variables reveals a long-run relationship	

5- Conclusions:

Egypt, Nigeria and South Africa experienced a high rate of average inflation recording 10% for the period 1982-2020 which had detrimental impacts on all economic activities and thus urging for corrective actions to be conducted by policy makers. Despite having the largest economies in Africa, citizens of these countries suffer from high poverty levels attributed to the prevailing high rates of inflations in them. Consequently, this study aimed at investigating the reasons behind such high levels of inflation.

The final consumption expenditure of the general government in these countries (annual growth rate) showed a median average of 1.79% for the period 1982-2020. Some may state that such rate doesn't seem to be a high one in abstract; however, on a long-term basis it is considered a good one. Citizens in these countries do not feel this growth due to high inflation and FX rates per US dollar which showed an average of 6.7% indicating a serious problem in the local currency against other international currencies.

Our results showed a negative relationship between real interest rate and inflation in conformance with the previous research of Lardic and Mignon, 2003; Lowe, 2019; Mohamed, 2023 and in opposition to Mishken (1992) and Ghazali, 2003.The real interest rate appeared to be very high, because this rate is after discount inflation, so the interest rate in the average banks in these countries was 13.4% 1982-2020 which is considered very high. These factors had substantial impacts on investments and total production indicating a significant problem in the size of the money supply. Broad money annual growth rate recorded a high average rate of 14.8% for the period 1982 to 2012 increasing demand and increasing the prices of goods and services.

Confirming the findings of Anjum, 2013; Alavinasab, 2014; Kirimi, 2014; Lowe, 2019 and contrary to Dekkiche (2022), our study concluded a negative relationship between the growth of per capita GDP and inflation, and this is consistent with economic theory, so these countries must expand the production of goods and services in direct and indirect ways in light of the available financing sources and capabilities, and there is also a negative relationship between the real interest rate and inflation, so there must be a balance between investment and saving, so specialists with a high level of competence and education must be chosen to occupy senior positions to implement monetary policy, to always balance between saving and investment, and there is also a negative relationship between consumer spending The final outcome of the general government and inflation, so government spending must be directed to spending related to production and support for local industries and away from spending on imported goods and services.

In line with Okhiria and Saliu 2008; Kirimi 2014; Lowe, 2019; Dekkiche, 2022; Mohamed, 2023 and opposing to Huyen (2018), we found a positive relationship

between FX rate and inflation, so it is necessary to control the FX rate and hedge by keeping a mixture of foreign currencies to reduce the demand for foreign currencies by increasing exports and decreasing imports.

In addition, we found a positive relationship between broad money growth and inflation which is consistent with the workings of McCandless and Weber, 1995; Nassar, 2005; Pelipas, 2006, Hossain, 2010; Alavinasab, 2014; Kirimi, 2014; Nguyen, 2015; Ofori-Frimpon et al., 2017; Zhang, 2017; Chaudhary, 2018; Joshi, 2021; Dekkiche, 2022. Thus, a balance must strike between the money supply and inflation rates, and always monitor the money supply so that it does not reach the level with which the aggregate demand increases, which affects inflation rates.

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Appendix:

Table (1): unit root test inflation

Panel unit root test: Summary
Series: INF
Date: 01/07/23 Time: 20:17
Sample: 1982 2020
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-section...	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.82136	0.0024	3	111
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat...	-1.80271	0.0357	3	111
ADF - Fisher Chi-square	13.3835	0.0373	3	111
PP - Fisher Chi-square	12.2667	0.0563	3	114

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Eviwes9

Table (2): unit root test GDP per capita growth

Panel unit root test: Summary
Series: GDP
Date: 01/07/23 Time: 20:19
Sample: 1982 2020
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-section...	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.69624	0.0449	3	111
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat...	-2.69643	0.0035	3	111
ADF - Fisher Chi-square	18.5088	0.0051	3	111
PP - Fisher Chi-square	29.9915	0.0000	3	114

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Eviwes9

Table (3): unit root test Broad money growth

Panel unit root test: Summary
Series: BM2
Date: 01/07/23 Time: 20:20
Sample: 1982 2020
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-section...	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.33559	0.0000	3	111
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat...	-3.57135	0.0002	3	111
ADF - Fisher Chi-square	24.0199	0.0005	3	111
PP - Fisher Chi-square	26.9507	0.0001	3	114

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table (4): unit root test General government final consumption expenditure.

Panel unit root test: Summary
Series: GE
Date: 01/07/23 Time: 21:03
Sample: 1982 2020
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-section...	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.23533	0.0006	3	111
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat...	-4.36638	0.0000	3	111
ADF - Fisher Chi-square	30.3166	0.0000	3	111
PP - Fisher Chi-square	60.7650	0.0000	3	114

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table (5): unit root test Real interest rate.

Panel unit root test: Summary
Series: IR
Date: 01/07/23 Time: 21:04
Sample: 1982 2020
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-section...	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.54238	0.0055	3	111
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat...	-2.80473	0.0025	3	111
ADF - Fisher Chi-square	18.5276	0.0050	3	111
PP - Fisher Chi-square	29.7332	0.0000	3	114

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table (6): unit root test Real Official FX rate.

Panel unit root test: Summary
Series: ER
Date: 01/07/23 Time: 21:05
Sample: 1982 2020
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-section...	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	2.91212	0.9982	3	111
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat...	3.67818	0.9999	3	111
ADF - Fisher Chi-square	0.31165	0.9994	3	111
PP - Fisher Chi-square	0.03996	1.0000	3	114

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Eviwes9

Table (7): unit root test Real Official FX rate.

Panel unit root test: Summary
Series: D(ER)
Date: 01/07/23 Time: 21:06
Sample: 1982 2020
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-section...	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.79385	0.0000	3	108
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat...	-5.05198	0.0000	3	108
ADF - Fisher Chi-square	36.0396	0.0000	3	108
PP - Fisher Chi-square	35.7956	0.0000	3	111

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

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Table (8): Granger Causality test:

Pairwise Granger Causality Tests
Date: 01/13/23 Time: 11:24
Sample: 1982 2020
Lags: 2

Null Hypothesis:	Obs	F-Statisti...	Prob.
GE does not Granger Cause INF	111	0.54348	0.5823
INF does not Granger Cause GE		0.00081	0.9992
IR does not Granger Cause INF	111	0.64636	0.5260
INF does not Granger Cause IR		4.40878	0.0145
ER does not Granger Cause INF	111	0.05551	0.9460
INF does not Granger Cause ER		0.66691	0.5154
GDP does not Granger Cause INF	111	0.00024	0.9998
INF does not Granger Cause GDP		0.01633	0.9838
BM2 does not Granger Cause INF	111	12.8217	1.E-05
INF does not Granger Cause BM2		1.34556	0.2648
IR does not Granger Cause GE	111	0.44246	0.6436
GE does not Granger Cause IR		0.42315	0.6561
ER does not Granger Cause GE	111	2.10872	0.1265
GE does not Granger Cause ER		1.63675	0.1995
GDP does not Granger Cause GE	111	6.37209	0.0024
GE does not Granger Cause GDP		0.01919	0.9810
BM2 does not Granger Cause GE	111	0.08535	0.9183
GE does not Granger Cause BM2		1.03114	0.3602
ER does not Granger Cause IR	111	2.10843	0.1265
IR does not Granger Cause ER		2.80686	0.0649
GDP does not Granger Cause IR	111	2.17484	0.1187
IR does not Granger Cause GDP		0.36701	0.6937
BM2 does not Granger Cause IR	111	1.52189	0.2230
IR does not Granger Cause BM2		2.19387	0.1165
GDP does not Granger Cause ER	111	0.61836	0.5408
ER does not Granger Cause GDP		0.09998	0.9049
BM2 does not Granger Cause ER	111	0.15662	0.8552
ER does not Granger Cause BM2		0.24904	0.7800
BM2 does not Granger Cause GDP	111	3.07069	0.0505
GDP does not Granger Cause BM2		2.92474	0.0580

Eviwes9

Table (9): descriptive stat Tests.

	INF	GE	GDP	ER	IR	BM2
Mean	12.96889	8.856828	1.110471	38.42992	3.351553	17.58416
Median	10.07458	2.876441	1.790138	6.771549	3.882873	14.86435
Maximum	72.83550	565.5388	12.27614	358.8108	18.18000	87.76135
Minimum	-0.692030	-23.92624	-13.12823	0.673461	-31.45257	-0.794167
Std. Dev.	11.65350	53.20838	3.426106	73.88970	6.515724	12.37993
Skewness	2.910829	9.950107	-0.725245	2.487446	-1.565971	2.416665
Kurtosis	12.62783	104.2394	5.839149	8.857277	9.527492	12.25408
Jarque-Bera	617.1111	51896.51	49.55286	287.9041	255.5340	531.3702
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	1517.361	1036.249	129.9251	4496.301	392.1317	2057.347
Sum Sq. Dev.	15753.28	328411.2	1361.632	633323.7	4924.741	17778.46
Observations	117	117	117	117	117	117

Eviwes9

Table (10): Panel Least Squares

Dependent Variable: INF
Method: Panel Least Squares
Date: 01/13/23 Time: 14:28
Sample: 1982 2020
Periods included: 39
Cross-sections included: 3
Total panel (balanced) observations: 117

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.30168	1.482906	8.970009	0.0000
GDP	-0.116025	0.240006	-0.483428	0.6297
IR	-1.185045	0.129497	-9.151106	0.0000
ER	0.017354	0.010726	1.617935	0.1085
GE	-0.020639	0.014899	-1.385292	0.1687
BM2	0.186740	0.064863	2.878996	0.0048

R-squared	0.525685	Mean dependent var	12.96889
Adjusted R-squared	0.504319	S.D. dependent var	11.65350
S.E. of regression	8.204603	Akaike info criterion	7.097188
Sum squared resid	7472.021	Schwarz criterion	7.238838
Log likelihood	-409.1855	Hannan-Quinn criter.	7.154696
F-statistic	24.60432	Durbin-Watson stat	1.196596
Prob(F-statistic)	0.000000		

Eviwes9

Table (11): Covariance analysis test.

	INF	GE	GDP	ER	IR	BM2
INF	134.6434441...	0.988599396...	-7.63921048...	-3.16720347...	-51.6379212...	46.99482902...
GE	0.988599396...	2806.933699...	25.92702784...	658.9119844...	-31.5216950...	70.36025824...
GDP	-7.63921048...	25.92702784...	11.63787682...	4.822389795...	5.893770680...	6.141581668...
ER	-3.16720347...	658.9119844...	4.822389795...	5413.023066...	79.68813806...	61.50403518...
IR	-51.6379212...	-31.5216950...	5.893770680...	79.68813806...	42.09179936...	-16.6378658...
BM2	46.99482902...	70.36025824...	6.141581668...	61.50403518...	-16.6378658...	151.9526853...

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