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Fiscal and Monetary Policy Interactions in Egypt During the Period 2003 to 2018

Islam Mohamed Abdelwahhad

Abstract

This research paper teste the interactions between fiscal and monetary policies in the Egyptian Economy using quarterly data through the period Q1 2003 to Q4 2018. The paper tested an econometric model using OLS multiple regression where Real GDP is its dependent variable and Government Debt as a percentage of GDP, Inflation, Budget Deficit as a percentage of GDP, and Interest Rate are four independent variables representing fiscal policy and monetary policy targets. The real GDP reflects the stabilization target which is the main aim for both fiscal and monetary policies. A long-run regression equation is obtained on the form;

$$LOG\ RGDPt = -2.9 + 0.25\ LOG\ GOVDET\ t + 0.002\ LOG\ INFRt - 0.09\ LOG\ BUDDEF\ t - 0.32\ LOG\ INTRt + ut$$

The results indicate that there is a static long-run and short-run relationships between the variables where 1% increase in Inflation causes Real GDP to increase by 0.002%, 1% increase in Government Debt as a percentage of GDP causes Real GDP to increase by 0.25 million dollars, 1% increase in Budget Deficit as a percentage of GDP causes Real GDP to decrease by 0.09 million dollars, 1% increase in Interest Rate causes Real GDP to decrease by 0.32 million dollars.

Finally, the study states that interactions between fiscal and monetary policies in the Egyptian economy exists in both short-run and long-run but it can be considered in a weak shape. There is a need for more coordination between the Central Bank of Egypt (the head of monetary authorities) and the Ministry of Finance (the responsible for fiscal policy) in order to strengthen the impact of interactions between fiscal and monetary policy towards achieving more stabilization in the Egyptian Economy.

Keywords: Fiscal and Monetary Policies Interactions, Egypt, OLS.

Introduction

Achieving the optimal coordination between monetary and fiscal policies is always considered an important point of research for both policy officials and economists. The main target for this coordination is to achieve macroeconomic stabilization. Consequently, the results for coordination can be seen in interest rates, inflation rate, fiscal deficit, and the public debt levels.

In Egypt, the economic situation reflects the lack for this coordination. As a result, the Egyptian economy lost its macroeconomic stability during the last decade and especially during the period 2015/2016 to 2017/2018. Therefore, the Egyptian economy has witnessed huge budget deficit reaching 11% of GDP at June 2017 and two digit annual inflation rate achieving a historic record that reached 35.2% at July 2017. On the same road, monetary authority failed to keep interest rates on one digit level in most cases. Consequently, interest rates on 91-Day treasury bills reached 18.97% in September 2017. Moreover, the Egyptian public debt reached around 131.7% of GDP by December 2016. In USA, the economic situation is totally different. Although the US economy has suffered from a huge budget deficit during the last decade, annual inflation rate reached only 1.7% in July 2017. Moreover, The Federal Reserve left its federal funds rate at 1.25 percent in July 2017. The US economy achieved these wonderful macroeconomic stability after a long period of coordination between monetary and fiscal policies. This remarkable coordination enabled the US economy to get rid of high inflation and interest rates appeared during 1980's decade. In 1980, inflation rate reached 13.58% and interest rate reached 20% which were historical heights for the US economy. This research paper is trying to investigate the reasons behind achieving the US economy this remarkable success to lower both inflation and interest rates. It looks like a trial to get a large and valuable experience from the US fiscal and monetary interactions. Independent

policies and reactions taken by monetary authority may cause conflicting interests with fiscal policies. Consequently, game theory framework can play a crucial rule to resolve this dispute. The goal is to study fiscal and monetary policy interactions using a game theory environment. So, the paper will use three scenarios. The first is the normal form game where policymakers will be allowed to use their instruments without cooperation. The second is the extensive form game where fiscal and monetary authorities move sequentially. The third is the cooperative game where fiscal and monetary authorities use their instruments simultaneously but with cooperation in order to achieve maximum social welfare as a common goal. It is clear that there is a lack of research on fiscal and monetary policy interactions in Egypt. In addition, there is no papers that applied the methodology of game theory on such type of topics. This study is considered the first to investigate this topic using game theory approach. Of course, it is required to add to this field of study in Egypt a research paper on this topic to guide policy makers towards achieving macroeconomic stabilization. This study is aiming to investigate the best scenario for interactions between fiscal and monetary policies in Egypt. Also, the study will apply the game theory approach to perform the analysis. Finally, it will provide policy recommendations to Egyptian policy makers regarding the application of fiscal and monetary policies in Egypt. Finally, this paper will end up with some policy recommendations to the Egyptian policy makers to simulate the US policy makers in achieving this historical success. The remainder of the paper is organized as follows. The next section discusses the macroeconomic model and some aspects of game theory analysis. The third section describes the fiscal and monetary policy games. The fourth section discusses and analyzes the coordination and interactions between fiscal and monetary policy in USA. The Egyptian case and differences between Egypt and USA are presented and analyzed in the fifth section. Finally, the

sixth section is dedicated to the conclusion and policy recommendations to the Egyptian policy makers. The study is intending to ask the following questions; what is the current situation of interactions between fiscal and monetary policies in Egypt? What is the impact of interactions between fiscal and monetary policies on the stabilization of the Egyptian Economy? What are the policy recommendations for the Egyptian policy makers?

Literature Review

Returning back to Backus and Driffill (1985) and Tabellini (1985), the theory of repeated game was used to prove that, under discretionary policymaking, equilibria could appear with low inflation. Engwerda (1998) and Engwerda et al. (1999, 2002) modeled dynamic games among monetary and fiscal authorities. They induced monetary and fiscal authorities to take care of conflicting interests and not to concentrate only on their own goals. Several models of European Central Bank (ECB) and European Monetary Union (EMU) were built in Dixit (2001) to analyze fiscal and monetary policy interactions in some countries. He found that the mechanism of decision making in the ECB achieved moderate stable inflation. Also, he emphasized that unconstrained national fiscal policies play a dangerous role that may undermine the ECB's monetary policy commitment. In addition, a monetary and fiscal policy framework in the EMU area using Engwerda et al. (2002) model was implemented in Van Aarle et al. (2002). He studied various interactions, externalities, and spillovers involving macroeconomic policies under alternative policy regimes. Lambertini and Rovelli (2003) used a game theory approach to study monetary and fiscal policy coordination. In a Stackelberg scenario, they concluded that every policy maker prefers to be the follower. In a strategic game, they claimed that fiscal authorities would behave to take the lead. On the other hand, Favero (2004) showed that the type of shock hitting the economy may determine the degree

of the strategic complementarity or substitutability between monetary and fiscal policy. Moreover, when monetary and fiscal policy rules are inertial and not coordinated, countercyclical fiscal policy may reduce welfare.

Kirsanova et al. (2005) extended the traditional three-equation Taylor-rule New Keynesian model to include fiscal policy and study policy coordination. They used three scenarios to study policy interactions; the first is non-cooperative policies, the second is partially cooperative policies, and the third is benevolent policies. They found the results that under the benevolent scenario, the monetary authority will bear all the burden of the stabilization.

Finally, in Saulo, Rego and Divino (2013) described the optimal monetary and fiscal interactions using three scenarios: normal form game, Stackelberg game, and when authorities behave cooperatively. They found that, in the Brazilian case, Stackelberg solution provided the lowest welfare loss where the monetary policy was the leader and the fiscal policy was the follower. This paper aims to benefit from all of the last described papers to know the optimal coordination between monetary and fiscal policy in Egypt.

Methodology

The study assumes that using game theory approach, fiscal and monetary policies can achieve better interactions in Egypt. This paper will use game theory models to analyze interactions between monetary and fiscal policies in Egypt. There are two individual players. They are the monetary authority which is the Central Bank of Egypt (CBE) and the fiscal authority that is the Ministry of Finance (MOF). Each player has an instrument; interest rate (i) and government spending (g).

The Model

This paper will start with the most recent models that were used in Saulo, Rego and Divino (2013). Therefore, the New Keynesian framework is used to analyze optimal monetary and fiscal policy rules. The paper will use a linear approximation in log form of an Ordinary Least Squares (OLS) model. The OLS model explains fluctuations in economic growth and effects of monetary and fiscal policies. The model consists of the New Keynesian Phillips curve as an aggregate supply equation and the IS curve as an aggregate demand equation. In addition, there is an intertemporal budget constraint.

Following Saulo, Rego and Divino (2013), in this paper, the IS curve proposed by Woodford (2003) is amended to include the effects of public debt on aggregate demand. So, the paper considers the following IS curve in log-linearized form under a closed economy;

$$X_t = E_t X_{t+1} - \sigma (i_t - E_t \pi_{t+1}) + \alpha b_t + r_t^n \qquad (1)$$

Where X_t is the output gap (difference between actual and potential output), i_t is the nominal interest rate, r_t^n is a demand shock, E_t represents the time t expected value of the next period inflation rate π_{t+1} and output gap X_{t+1}.

b_t is the real stock of government debt, $\sigma > 0$ is the intertemporal elasticity of substitution in private spending, and α measures the sensitivity of the output gap with respect to the debt.

This paper follows Kirsanova et al. (2005) in modeling b_t. Therefore, b_t is a function of the stock of debt in the previous period b_{t-1}, flows of interest payments, government spending, and revenues. This function will be as follows:

$$b_t = (1 + i^*)\, b_{t-1} + B\, i_t + G_t - T\, X_t + \eta_t \qquad (2)$$

Where i^* is the equilibrium interest rate, B accounts for the steady state value of the debt, i_t is the interest rate, G_t represents the government spending, T is the tax rate, X_t denotes the output gap, and η_t is the debt shock.

With regard to aggregate supply (Phillips curve), firms has to take a decision to determine a price that maximizes their profit. Following the assumption of price rigidity (Calvo 1983), it implies that a fraction $0 < \vartheta < 1$ of prices remains fixed during each period. Therefore, the derivation of the (log-linearized) aggregate supply will be as follows:

$$\pi_t = K\, X_t + \beta\, E_t\, \pi_{t+1} + V_t \qquad (3)$$

Where the current inflation rate π_t depends on the expected E_t inflation rate at t +1, and the current output gap X_t.

Following Woodford (2003), V_t is a supply shock. There is a trade-off between inflation versus output gap stabilization. The parameter $\kappa > 0$ measures the sensitivity of inflation with respect to the output gap and β, where $0 < \beta < 1$ is the Intertemporal discount factor.

Therefore, government spending and interest rate stands for monetary policy and fiscal policy variables respectively. In equation (1), monetary policy transmission appears when an increase or decrease in the interest rate is greater than the expected increase or decrease in the inflation rate at t + 1. On the other hand, equation (2) states that an increase or decrease in the government spending raises or lowers the level of debt, which in turn increases (or decreases) the level of activity in the economy which driven in equation (1). Changes in the aggregate demand causes changes in inflation which is driven from equation (3).

Consequently, the basic equilibrium conditions of the model is defined using the equations (1), (2) and (3).

The Econometric Model:

Following (Samuel et al., 2018) the study uses an econometric model based on OLS and co-integration models in order to estimate the relationships and the impact of devaluation on economic growth and other macroeconomic variables in Egypt. Variables are log-transformed to ensure linearity.

The study aims to estimate the following linear regression equation in Egypt using quarterly data for these variables through the period Q1 2003 till Q4 2018;

$$LOGRGDPt=\beta0 + \beta1\ LOGGOVDET\ t + \beta2\ LOGBUDDEF\ t + \beta3\ LOGINFRt + \beta4\ LOGINTR\ t + ut$$

Where;

RGDP = Real Gross Domestic Product,

GOVDET = Government debt as a percentage of GDP,

BUDDEF = Budget deficit as a percentage of GDP,

INFR = Inflation rate,

INTR = Foreign exchange rate,

Ut = Error Term

In this model, Real Gross Domestic Product is the dependent variable where Government debt as a percentage of GDP, Budget deficit as a percentage of GDP, Inflation rate, and Interest rate are the independent variables. The paper will use data retrieved from official resources like Ministry of Finance, central bank of Egypt,

reports of the World Bank, and the international monetary fund to observe the impact before and after the devaluation.

Econometric Results and Analysis:

The first step in this econometric analysis is to conduct Dickey Fuller test for the group of variables in this study in order to reach to stability and determine the level of integration among these variables.

Dickey Fuller Test of Unit Root to Test the Stability of Examined Variables:

In Dickey Fuller test, H0 and H1 are formulated as follows:

H0: the variable includes unit root (i.e. it is not stable).

H1: the variable does not include unit root (i.e. it is stable).

Judgment rule is based on level of probability of T-test. If probability is more than 0.05, H0 cannot be rejected (i.e. the variable is stable). If probability is less than or equals 0.05, H0 can be rejected and H1 is accepted (i.e. the variable is not stable). The test can be conducted once again after taking differences of integration degree test of the variable. If the variable becomes stable after taking first differences, the variable is integrated of the first degree. It is represented by the symbol I (1). If the variable becomes stable after taking second difference, the variable is integrated of the second degree. It is represented by the symbol I (2) and so on. Therefore, conducting this test for the study variables, the following results is found;

Table 1
ADF unit root test results for RGDP and
The independent variables

ADF statistics		
Variables	Levels form	First Differenced
RGDP	3.32	-8.959
GOVDET	2.12	-6.559
BUDDEF	0.25	-11.972
INFR	1.02	-5.459
INTR	0.45	-11.369

From the last table 1, it is noted that integration of orders zero is not existed for these variables. Therefore, first differences have been taken in order to reach stationarity for these variables. This means that the alternative hypothesis is rejected which indicates that these variables are integrated of order higher than zero. Consequently, when the first differences were taken for these variables, the null hypothesis that $\alpha 1 = 1$ is rejected for all of them which indicates that these variables are integrated of order one I (1).

Table 2
Co-integration Analysis among Variables

Included observations: 300

Trend assumption: Linear deterministic trend

Series: RGDP GOVDET BUDDEF INFR INTR

Lags interval (in second differences): 1 to 4

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.31	34.07	14.85	0.003
At most 1 *	0.22	22.45	16.7	0.02
At most 2	0.035	2.87	18.4	0.84

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integrating Coefficients (normalized by b'*S11*b=I):

RGDP	GOVDET	BUDDEF	INFR	INTR
-1.36	-0.10	0.89	0.73	0.30
0.24	-0.24	-0.14	-0.31	-0.99
-2.03	0.05	1.41	0.78	0.32
0.44	-0.06	0.82	-0.45	-0.45
-3.03	0.05	1.21	0.68	0.66

Unrestricted Adjustment Coefficients (alpha):

D(RGDP)	0.06	0.008	0.02	0.002
D(GOVDET)	0.04	0.006	0.03	0.001
D(BUDDEF)	0.03	0.006	0.04	0.001
D(INFR)	0.02	0.002	0.01	0.001
D(INTR)	0.05	0.004	0.03	0.002

1 Co-integrating Equation(s): Log likelihood -158.0883

Normalized co-integrating coefficients (standard error in parentheses)

RGDP	GOVDET	BUDDEF	INFR	INTR
1.000000	0.055	-0.43	-0.58	-0.41
(0.03)	(0.04)	(0.11)	(0.05)	(0.12)
RGDP	GOVDET	BUDDEF	INFR	INTR
1.000000	0.000000	-0.65	-0.59	0.076
(0.02)	(0.01)	(0.12)	(0.06)	(0.03)

Adjustment coefficients (standard error in parentheses)

D(RGDP)	-0.05
	(0.01)
D(GOVDET)	-1.42
	(0.62)
D(BUDDEF)	-0.18
	(0.03)
D(INFR)	0.16
	(0.05)
D(INTR)	-0.03
	(0.02)

2 Cointegrating Equation(s): Log likelihood -125.30

Normalized cointegrating coefficients (standard error in parentheses)

RGDP	GOVDET	BUDDEF	INFR	INTR
1.000000	0.000000	-0.45	-0.50	-0.04
		(0.1210)	(0.0682)	(0.0191)
0.000000	1.000000	-0.052	0.61	0.08
		(0.7491)	(0.3938)	(0.0685)

RGDP	GOVDET	BUDDEF	INFR	INTR
-0.71	-0.04	-0.52	-0.59	-0.67
(0.02679)	(0.01297)	(0.17310)	(0.05426)	(0.1210)

Adjustment coefficients (standard error in parentheses)

D(RGDP)	-0.03	-0.002
	(0.01)	(0.003)
D(GOVDET)	-1.4	-0.61
	(0.68)	(0.12)
D(BUDDEF)	-0.13	-0.001
	(0.02)	(0.005)
D(INFR)	0.15	0.006
	(0.04)	(0.01)
D(INTR)	-0.04	-0.002
	(0.01)	(0.003)

3 Cointegrating Equation(s): Log likelihood -135.4

Normalized cointegrating coefficients (standard error in parentheses)

RGDP	GOVDET	BUDDEF	INFR	INTR

1.000000	0.000000	0.000000	0.38	-0.113
			(0.26)	(0.02)
0.000000	1.000000	0.000000	0.81	0.15
			(0.32)	(0.06)
0.000000	0.000000	1.000000	1.42	-0.04
			(0.15)	(0.01)
Adjustment coefficients (standard error in parentheses)				
D(RGDP)	-0.06	-0.002	0.049	
	(0.04)	(0.003)	(0.022)	
D(GOVDET)	-1.00	-0.67	0.80	
	(1.65)	(0.13)	(0.75)	
D(BUDDEF)	-0.10	-0.001	0.07	
	(0.07)	(0.005)	(0.03)	
D(INFR)	0.20	0.006	-0.12	
	(0.16)	(0.013)	(0.07)	
D(INTR)	-0.03	-0.002	0.045	
	(0.04)	(0.003)	(0.021)	

In table 2, results of testing for co-integration relationships between the variables are presented. It is the first stage of (Engle and Granger, 1987) two-stage producer which is the static long-run regressions. The results from the ADF unit root tests on the residuals in every bivariate static long-run equation showed in Table 2 indicate that residuals in all static long-run equations are integrated of order one. This means that the variables in every bivariate equation are co-integrated. Therefore, there is a long-run relationship between these variables. In other words, all of series data have a

long-run relationship. As a consequence, they can be modelled as specified before to find out parameter estimate using empirical data. That is assured by results shown in the following Table 3.

Table 3 clarifies the Ordinary Least Squares (OLS) estimates between variables where RGDP is the dependent variable and the other four variables are the independent variables. The results indicate that there is a static long-run relationship between the variables. Coefficients of the independent variables are as follows;

Interest Rate (-0.32) and Budget Deficit (-0.09) reflecting negative relationships between both Real GDP and these two variables. The other two variables have positive coefficients reflecting a positive relationship between RGDP and these two variables. The coefficients are; Government Debt as a percentage of GDP (0.25), and Inflation (0.002). These coefficients can be verified as follows;

- 1% increase in Inflation causes Real GDP to increase by 0.002%,
- 1% increase in Government Debt as a percentage of GDP causes Real GDP to increase by 0.25 million dollars,
- 1% increase in Budget Deficit as a percentage of GDP causes Real GDP to decrease by 0.09 million dollars,
- 1% increase in Interest Rate causes Real GDP to decrease by 0.32 million dollars,

The last column that represents the probabilities for these coefficients are all less than 0.05 and R-squared and Adjusted R-squared are 0.91 and 0.89 respectively which means that the long-run relationship between these independent variables and Real GDP is highly significant.

Table 3

OLS Estimates between Variables and Static long-run model for the effect of independent Variables on RGDP

Dependent Variable: RGDP

Method: Least Squares

Date: 05/09/19 Time: 20:24

Sample: 1 300

Included observations: 300

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOVDET	**0.25**	1.34	1.7	**0.0483**
BUDDEF	**-0.09**	0.61	0.10	**0.0164**
INFR	**0.002**	0.41	-3.51	**0.0006**
INTR	**-0.32**	0.36	-3.88	**0.0006**
C	**-2.9**	4.16	-0.12	**0.0049**

R-squared	**0.91**	Mean dependent var	0.88
Adjusted R-squared	**0.89**	S.D. dependent var	5.3
S.E. of regression	5.02	Akaike info criterion	4.7
Sum squared resid	256.9	Schwarz criterion	6.85
Log likelihood	-165.04	Hannan-Quinn criter.	4.6
F-statistic	4.15	Durbin-Watson stat	3.4
Prob (F-statistic)	0.003		

Therefore, the regression equation can be written as follows;

$$LOG\ RGDP_t = -2.9 + 0.25\ LOG\ GOVDET_t + 0.002\ LOG\ INFR_t - 0.09\ LOG\ BUDDEF_t - 0.32\ LOG\ INTR_t + u_t$$

Consequently, the analysis must be transferred into the second stage of (Engle and Granger, 1987) to confirm this co-integration relationship through applying the Error Correction (EC) models expressed. Results for this second stage analysis are presented in the coming Table 4.

Table 4
The Error Correction (EC) Model for the Effects of Independent Variables on RGDP

Vector Error Correction Estimates
Date: 05/09/19 Time: 22:28
Sample (adjusted): 4 300
Included observations: 300
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
RGDP (-1)	2.6
	(0.31)
	[4.1]

C	-12.62	

Error Correction:	D(GOVDEB)	D(RGDP)
CointEq1	0.002	-0.31
	(0.001)	(0.04)
	[0.56]	[-6.12]
D(GOVDEB(-1))	**-0.05**	0.57
	(0.03)	(2.08)
	[-0.69]	[0.26]
D(INFR)	**-0.02**	-0.40
	(0.02)	(2.12)
	[-0.25]	[-0.19]
C	**-0.38**	-2.8
	(0.12)	(3.1)
	[-3.02]	[-0.90]
BUDDEF	**-0.03**	1.79
	(0.03)	(0.71)
	[-1.1]	[2.3]

INTR	**-0.059**	-0.6
	(0.01)	(0.38)
	[3.8]	[-2.3]
R-squared	**0.75**	0.46
Adj. R-squared	**0.71**	0.55
Sum sq. resids	9.5	125.6
S.E. equation	0.25	6.3
F-statistic	5.51	17.5
Log likelihood	-4.51	-499.9
Akaike AIC	0.16	6.5
Schwarz SC	0.32	6.7
Mean dependent	0.04	-0.23
S.D. dependent	0.28	8.48
Diagnostic tests for the chosen EC model		
ARCH	**0.628**	
	(0.717)	

As presented in Table 4, the model where Real GDP is its dependent variable and Government Debt as a percentage of GDP, Inflation, Budget Deficit as a percentage of GDP, and Interest Rate contains Error Correction Model (ECM) which is consistent with the previous results obtained for the static long-rum regression and the ADF unit root tests for the residuals. Moreover, it is showed that the assumptions

behind this EC model are supported by the diagnostic test Autoregressive Conditional Heteroscedasticity (ARCH).

Conclusion:

The paper investigated the interactions between fiscal and monetary policies in the Egyptian Economy using quarterly data through the period Q1 2003 to Q4 2018. The paper tested an econometric model using OLS multiple regression where Real GDP is its dependent variable and Government Debt as a percentage of GDP, Inflation, Budget Deficit as a percentage of GDP, and Interest Rate are four independent variables representing fiscal policy and monetary policy targets. The real GDP reflects the stabilization target which is the main aim for both fiscal and monetary policies. The results indicate that there is a static long-run and short-run relationships between the variables where 1% increase in Inflation causes Real GDP to increase by 0.002%, 1% increase in Government Debt as a percentage of GDP causes Real GDP to increase by 0.25 million dollars, 1% increase in Budget Deficit as a percentage of GDP causes Real GDP to decrease by 0.09 million dollars, 1% increase in Interest Rate causes Real GDP to decrease by 0.32 million dollars.

Finally, the study states that interactions between fiscal and monetary policies in the Egyptian economy exists in both short-run and long-run but it can be considered in a weak shape. There is a need for more coordination between the Central Bank of Egypt (the head of monetary authorities) and the Ministry of Finance (the responsible for fiscal policy) in order to strengthen the impact of interactions between fiscal and monetary policy towards achieving more stabilization in the Egyptian Economy.

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Investigating Inflation Dynamics in Egypt: Modelling Using VAR Analysis

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Abstract

The present paper examined factors influencing inflation dynamics in the Egyptian economy. A Vector Auto Regression Model (VAR) was estimated using annual data spanning the years 1991–2023. The empirical model's results verified that the inflation rate reacts favorably in the initial phase aftershocks mostly to itself then to output gap, the exchange rate depreciation, global food prices, and domestic liquidity growth rate. Additionally, expectations appeared to be significant since, in the year immediately after a shock, the inflation rate responds favorably to the shock itself, supporting the hypothesis that inflationary expectations will cause inflation to increase. In the short run, the primary drivers of inflation are the country's internal fluctuations (85.4%), which are followed by the output gap (7.8%), devaluation of the Egyptian pound against the US dollar (3.4%), increases in the price of food globally (3.1%), and the pace of expansion of the broad money supply (0.2%). In the long run, inflation dynamics become its own fluctuations (40%), the production gap (14.2%), the growth rate of internal liquidity (8.5%), the price of food globally (6.8%), and the Egyptian pound's nominal devaluation in relation to the US dollar (30.4%). Therefore, inflation expectations followed by exchange rate devaluations and output gap constitute the main determinants of inflation in the Egyptian economy.

Keywords: Inflation dynamics, VAR model, Inflation expectations, Co-integration, and IRF.

1. Introduction:

Inflation is a significant macroeconomic variable that occurs when the overall level of prices rises fast and consistently over time (Barro, 2008). This is unacceptable to the public and policymakers. Inflation, from the public's perspective, creates uncertainty about future pricing. This influences spending, saving, and investing decisions and leads to resource misallocation. It also allows for significant income and wealth redistributions from savers to debtors. Inflation, according to policymakers, impedes economic growth and development by discouraging savings and investments. These considerations explain why policymakers work so hard to lower inflation and why various scholars pay close attention to the topic.

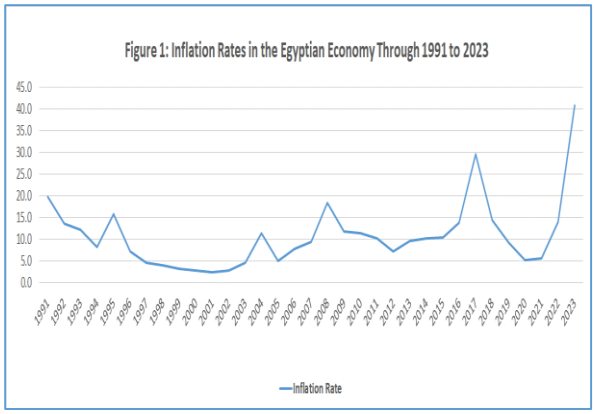
The costs and advantages of inflation on social and economic effects are debatable, however it is commonly acknowledged that excessive rates of inflation are never healthy for any economy. As a result, managing inflation is a fundamental goal of the government in maintaining a healthy economy, and as such, the monetary authority must identify and comprehend the sources and determinants of inflation. When the sources and

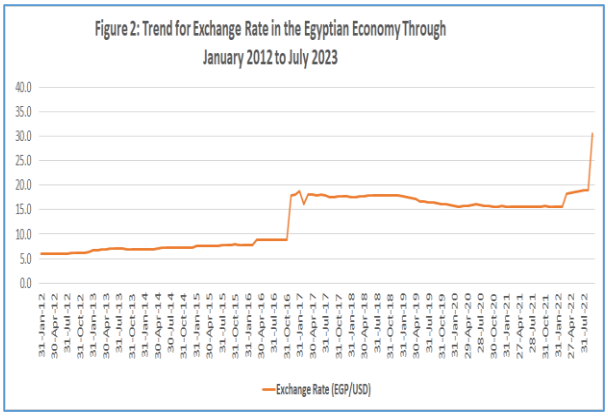
Inflation can be caused by a variety of factors, including expansive monetary or fiscal policy (or both), and this sort of inflation is known as demand-pull in nature. Profit or salary increases can also cause inflation, which can be characterized as aggregate, sectoral, or cost-push inflation. Temporary inflation, such as that caused by war or a natural calamity, is easily detected. Higher pricing for imported products and services, as well as other external factors, can have an impact on the local economy, generating inflation. This is known as import-induced inflation.

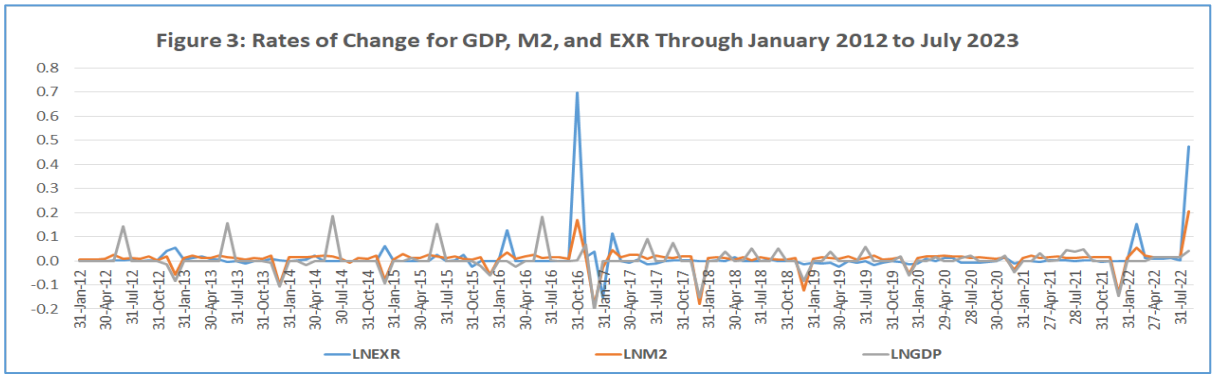
Low inflation rate is considered one of the main foundations that establish macroeconomic stabilization at any economy. On the other hand, high inflation rates cause deterioration in real value of money and negative interest rates which decrease domestic aggregate savings and investments. Therefore, high inflation rates have an assured negative effect on real GDP growth rates. Moreover, high inflation rate has harmful effects on exchange rate casing sever appreciation in national currency against foreign currencies. As a result, the competitiveness of national exports would deteriorate which lead to deficit in the trade balance and balance of payments. Therefore, the media, economists, and the general public have recently focused on the subject of inflation in Egypt, regardless of its consequences for development strategy. Millions of Egyptians in the lower

and middle classes are struggling with rising food costs, which are affecting consumer spending and diminishing buying power, raising the cost of living. Egypt has experienced a gradual rise in inflation rates since 2003.

In Egypt, inflationary pressures were frequently preceded by a devaluation phase. Researchers expected that ERPT would be one of the key sources of inflation in Egypt because of the durability of these shocks (Massoud, 2014; Helmy, 2018). As seen in Figures 1 and 2, once the Egyptian pound was floated in November 2016, inflation progressively soared to 32% in 2017. Then, inflation was controlled to reduce to reach 5 percent and 5.5 percent in 2020 and 2021 respectively. However, it achieved a historical increase to jump to 40.7 percent in July 2023[1]. Several economists attributed price hikes on rising food and energy costs. The increase in gasoline prices, in particular, had a significant influence on total inflation. The following figures 1 and 2 declare important facts about inflation rate fluctuations and exchange rate depreciations. In addition, figure 3 presents the rates of change for GDP, broad money supply (M2), and exchange rate.







[1] Egyptian Ministry of Finance, the Financial Monthly Report, October 2023.

Since June 2014, the Egyptian people elected a new President with hopes to save the Egyptian Economy from the case of stagflation happened in the aftermath of the two revolutions. Consequently, the new government has taken several economic reforms which targeted to boost economic growth rates, liberalize the foreign exchange market through devaluating the Egyptian Pound, abolish subsidies gradually in order to get rid of the Egyptian budget deficit, and decrease unemployment rates.

Therefore, the most recent applied economic reforms in Egypt raised calls about its implications on the inflation rate. Recently, inflation rates in Egypt have recorded historical records that reached 40.7% at July 2023[2], as a result for several economic reforms have been taken by the Egyptian policy makers since 2014. The paper aims to investigate the inflation causes in the Egyptian Economy during the period 2014 to 2018 in order to set advices and recommendations for the Egyptian government officials with regards to persistent inflation rates that has appeared since 2014.

In 2018, government authorities agreed to implement a new pricing method to allow the Egyptian market to move in lockstep with worldwide rates (Baz, 2018). This came after a lengthy period of managed prices, which made the transition much more difficult; also, end customers bore the majority of the burden. The source of inflation, however, is not the only aspect to be considered. Matter of fact, another factor to consider is the long period during which the economy suffered before reaching single digits. The sensitivity of developing countries to trade shocks is a major factor distinguishing them from advanced markets.

Commodities contribute for a major percentage of exports and production in many emerging nations, causing dramatic changes in exchange rate movements. The impact of exchange rate fluctuations on prices explains a significant portion of the increase in pricing power, particularly in emerging nations where import costs account for a big portion of final consumption and intermediate items (Zubaidi, 2017). As a result, we anticipate that an increase in import prices will not have the same impact on inflation as a decrease in import prices. Similarly, a depreciation in the home currency may not have the same effect on inflation as an appreciation. The purpose of this study is as follows.

[2] Egyptian Ministry of Finance, the Financial Monthly Report, October 2023.

The monetary policy aims of keeping low and stable inflation requires a strong knowledge of the mechanisms of inflation in each country (Oloko et al., 2021). Because inflation may be caused by multiple sources at the same time, a single theory may not be adequate, and a combination of theories may be a good solution. Because of the increasing degree of trade and economic integration, the focus of this study is to investigate the impact of foreign price transmission (pass-through) on domestic inflation, which is sometimes referred to as "imported inflation" (McCarthy, 2007; Lagoa, 2014; Salisu et al.,2018).

Therefore, this study is an attempt to analyse the effects of recent economic procedures and reforms on inflation in the Egyptian Economy during the period 1991 to 2023. The paper is targeting to ask important questions related to causes and effects of inflation in the Egyptian Economy during the period 1991 to 2023 such as;

What are the main economic policies affecting inflation in Egypt in the aftermath of two revolutions? What are the main causes and sources for persistent high inflation rates appeared in Egypt recently? To what extent recent economic reforms succeeded in controlling inflation rates in Egypt? What are the economic reforms that the Egyptian Economy needs to combat high inflation rates? What are the main recommendations for the Egyptian policy makers to control inflation?

In this context, the purpose of this paper is to examine Egypt's inflation dynamics from 1991 to 2023 in order to pinpoint the primary drivers of inflation in the Egyptian economy and determine how much Egypt's "inflation dynamics" deviate from or resemble those observed by empirical research on other economies.

The following six sections make up the paper: To begin with: Overview. The second is the theoretical backdrop and literature review. Third: Egypt's recent changes to its monetary policies. Fourth: Expected outcomes and econometric methodology. Fifths: Results interpretation and empirical analysis. Sixths: Policy implications and conclusion.

2. Literature Review:

Many studies have been conducted around the world to investigate the causes of inflation. This section will discuss various theoretical and empirical studies on inflation in developed and developing countries.

2.1 Review of Theoretical Studies:

A large body of economic research is devoted to the factors and causes of inflation, and the impact of inflation in the economy has long been discussed. The definition of inflation varies widely. Inflation is defined by Vane and Thompson (1979) and Bronfenbrenner and Holzman (1965) as an increase in the overall price level, which is equal to a constantly diminishing value of money. The rate of inflation is defined by Flemming (1976) as variations in the rate of the overall level of prices in the economy.

The monetarist model, the Keynesian approach, and the structuralist model are the three basic theories that explain the source of inflation. Furthermore, the paper attempted to explain both demand-pull and cost-push inflation.

Domestic inflation, according to the monetarist, is generated by an excess supply of money inside the economy, as described by (Friedman, 1969). Domestic inflation, according to monetarists, cannot be generated by changes in money demand and the cost of producing goods and services in the country. Rather, the money supply stimulates transaction mechanisms, causing demand to eventually exceed the money supply (Likukela, 2007). Furthermore, monetarists emphasised that the government budget deficit is an important factor that contributes to inflation. This is due to the fact that when there is a budget deficit, the government is forced to borrow or create additional money to cover expenditures. As a result, more money is in circulation, leading in inflation (Ogbokor and Sunde, 2011).

According to Keynesians, a fixed monetary policy that restricts the money supply won't ensure that economic activity is kept under control. Spending is affected by both the amount of money in circulation and the speed at which it is being spent (Ogbokor and Sunde, 2011). Monetarists, on the other hand, believe that changes in interest rates, not the amount of money in the economy, are what cause inflation. Accordingly, there will be a higher demand for money, which will lead to people having more money on hand or more money moving around the economy, which will raise prices.

According to structuralists, cost pressure, demand pressure, and structural factors all contribute to inflation. Real-world monetary prices, like wages, may change as a result. Since wages are typically rigid downward, inflation may result (Ogbokor and Sunde, 2011; Likukela,

2007). Furthermore, the structuralists go on to claim that shifting economic structure results in higher relative prices. As a result, there is a change in the money supply, which has an impact on money prices.

Cost-push inflation happens when the supply curve shifts, requiring higher prices for any level of output than it did before the shift (Hiller, 1997). A push for high paying wages and price mark-up over employers' costs are examples of factors that are thought to contribute to a change in aggregate supply. In general, rising wages and the cost of raw materials are more likely to cause price increases.

Demand-pull inflation is believed to occur when real aggregate demand rises at any price level (Hiller, 1997). Inflation occurs when the economy's aggregate demand exceeds the economy's aggregate supply. According to Hiller (1997), as GDP rises, that is, when the national economy grows, unemployment falls and people are more willing to spend more. The economy will have more money but less products and services, driving prices to rise. Prices, on the other hand, are not likely to rise further since supply will rise in the long term due to demand.

Finally, according to Frisch (1977), the impacts of international inflation on domestic inflation are transferred via several channels, including the liquidity effect, price effect, and demand effect.

2.2 Review of Empirical Studies:

Various econometric techniques have been used to analyse inflation determinants in specific countries or groups of countries. Some evidence in the literature that analyses a group of nations indicates that demand-pull inflation is the main kind of inflation. Jongwanich and Park (2009), for example, used the vector auto regression (VAR) model to analyse different forms of inflation in emerging Asia from 2007 to 2008. Their empirical findings reveal that excess aggregate demand is far more important in defining inflation in emerging Asia than cost-push. Jongwanich and Park (2011) expanded their analysis of inflation in developing Asia by examining the spill over effects of global food and oil price shocks. Their empirical findings indicate that the pass-through of global food and oil price shocks to domestic prices in developing Asia has been quite low.

Deme and Fayissa (1995), Dwyer and Fisher (2009), and Amisano and Fagan (2011) are examples of cross-country or group-country studies that show demand-pull inflation to be consistent with the monetarist theory of inflation, in which money supply plays a significant role in driving inflation (2013). They claim that the money supply, or money growth, is a positive and statistically significant predictor of inflation. In the long term, it is commonly acknowledged that money growth and inflation are one-to-one connected, however there are conflicts between money supply and inflation in the short run. Many studies show that the money supply has an impact on inflation in the long run but not in the short run (Christensen 2001; Deme & Fayissa 1995; Dwyer & Fisher 2009). Dhaka et al. (1994) analysed inflation in the United States from 1947 to 1978 and found that money supply is the major predictor of inflation. Their empirical findings contradict those of Castelnuovo (2010), who found that the global indicator had a statistically significant impact on forecasters' inflation expectations in the United States.

Tiwari et al. (2014) investigated the link between the consumer price index (CPI) and the producer pricing index (PPI) for Mexico in terms of cost-push inflation. Their empirical findings show that there is a bidirectional link between CPI and PPI, with CPI leading PPI in short intervals (1 to 7 months) and PPI leading in longer times (8-32 months). Christensen (2001) shown that in the short run, real supply shocks had a greater impact on inflation than money growth. He discovered that if the economy is subjected to a considerably higher real supply shock, low inflation rates are certainly consistent with a relatively high money growth rate.

Various research projects have sought to clarify international transmission inflation or the impact of international transmission on domestic inflation (Juselius 1992; Kim & Hammoudah 2013; Milani 2010; Yang et al. 2006). In general, their empirical findings suggest that external variables, or foreign output, have a significant impact on domestic inflation. Domestic inflation is heavily influenced by changes in US inflation and worldwide output. Significant empirical research has found that oil price shocks have an impact on output and inflation (Álvarez et al. 2011; Valcarcel & Wohar 2013). Durevall et al. (2013) proposed that the long-run development of domestic pricing was influenced by fluctuations in international food and commodities prices. Agriculture supply shocks impact food inflation in the short term, creating substantial variations from long-run price trends.

Cheng and Tan (2002) examined quarterly data from 1973 to 1997 to assess the elements that drove inflation in Malaysia. To perform regression tests, the study employed the time series technique, which included multivariate co-integration, vector-error correction modelling, impulse response functions, and decompositions. The results indicated that inflation in other Asian nations had a significant influence on Malaysian inflation. Tan and Cheng (1995) investigated the relationship between money, output, and prices in Malaysia. Their empirical findings indicate that the central bank may be able to successfully maintain price stability at the producer level by managing the money supply, but not at the consumer level.

Gaomab II (1998) estimated Namibian inflation from 1973 to 1996. The study tested time series and forecasting using co-integration, an error correction model, and structural stability. The findings found that South African pricing and inflation dominated Namibian prices and inflation. Furthermore, the results revealed that the rest of the world, particularly the United States, had little influence, though the effect was indirect via South Africa.

Corrigan (2005) used quarterly data from 1986 to 2004 to examine the link between import prices and inflation in the United States. The study used a triangular model to investigate the relationship between economic-wide inflation and import prices, a proxy of the economy's demand excesses, and the inertia variable. According to the findings, import prices had an important influence in determining inflation trends.

Likukela (2007) investigated the factors of inflation in Namibia between 1993 and 2003. The co-integration test and the error correction model were used in the study to examine the relationship between inflation and independent variables. The outcomes of the South African and USA pricing indices were all important when assessing Namibian inflation. Similarly, Ogbokor and Sunde (2011) investigated whether Namibia's inflation is caused by imports. The OLS (Ordinary Least Square) approach was used to determine the connection between imports and inflation using data from 1990 to 2007. The findings revealed that imports strongly influence inflation in Namibia.

Tsalinski and Kyle (2000) used monthly data to investigate the drivers of Bulgarian inflation from 1991 to 2000. Over the last decade, Bulgarian inflation has been shown to have

gone through two radically different regimes. The spring of 1997 marked the transition between the two regimes, when the previous period's hyperinflationary tendency was stopped by the establishment of a currency board. They discovered that earlier inflation had been mostly driven by monetary expansion and, to a lesser extent, by past inflation. Following the establishment of the currency board, inflation was no longer determined by monetary growth.

In the OECD, Boschen and Weise (2003) modelled the likelihood of a big increase in inflation during a period of either constant or decreasing inflation, a phenomenon known as an inflation start. The findings suggest that three variables contribute to these long-term inflationary rises. First, rapid real GDP growth increases the likelihood of an inflationary start because it represents policymakers' attempts to exploit the short term Phillips curve, which in most situations leads to greater inflation. Second, because inflation shocks in the world's largest economy tend to be dispersed worldwide, the difference between US inflation and domestic inflation increases the likelihood of an inflation start. Finally, if a general election is held, the likelihood of inflation beginning in that year increases. The rationale for this is that most government programmes aimed at influencing voters are inflationary. In contrast, increases in oil prices, a stable exchange rate, fiscal policy, and government policy initiatives have little influence on the possibility of an inflationary spiral.

Bowdler and Nunziata (2004) expanded on Boschen and Weise's approach in subsequent work. They contend that the openness to international trade index is one indicator of the possibility of an inflationary start that Boschen and Weise (2003) did not investigate. Even after adjusting for the characteristics highlighted by Boschen and Weise (2003), their empirical findings suggest that increased trade openness decreases the possibility of an inflationary start. The comparison of different model parameters suggests that what counts for the probability of an inflationary start are variations in openness over time rather than cross-country variances in openness.

Al-Otaibi (2001) examined the link between oil revenues, money supply, and price level, focusing on the relevance of oil revenues in the money supply process in Saudi Arabia. The findings suggest that non-oil revenue plays an important role in the Saudi money supply mechanism. Furthermore, oil revenue is the system's stimulant and has no direct impact on the price level. Aljebrin (2006) conducted a study to assess the main determinants of inflation in three

oil-based economies (Saudi Arabia, Kuwait, and Bahrain) using time series from 1971 to 2000 and the Johansen co-integration technique, which revealed that the inflation roots in developing oil-based economies are strongly influenced by the oil market and its income, in which oil production growth and oil price growth rate, non-oil GDP growth rate, and liquidity are all important.

Finally, Ghavam Masoodi and Tashkini (2005) employed the ARDL method in another study to investigate the long-term relationship between the inflation rate and its effective factors in Iran. According to the findings of this study, the most major elements contributing to inflation in Iran are GDP, the imported goods price index, liquidity, and the exchange rate.

For Egypt, (Ali, 2011) investigated the determinants of inflation in Egypt during 1980 to 2009. It found that 33% of changes of inflation rate is attributed to inflation inertia, 31% is attributed to demand-pull inflation, 20% is attributed to supply side shocks, 15% is attributed to fiscal deficit, and finally only 1% is attributed to the exchange rate pass through effect.

Important research publications are also available, including those by Fanzza and Soderling (2006), El-Sakka and Ghali (2005), and Helmy. (2008). According to these research, high inflation produced a feedback effect that increased the budget deficit. Persistent budget deficits and the sources of their financing also created inflationary pressures by influencing monetary aggregates and public expectations. One of the main reasons Egypt's currency rate peg failed was unresolved fiscal difficulties. While acknowledging the significance of monetary policy, these empirical studies also made the case for the role of public debt dynamics and fiscal policy in maintaining price stability. (Helmy, 2008) found that reducing the budget deficit, net government debt, and government borrowing are essential factors in raising the effectiveness of the monetary policy to control inflation pressures in the Egyptian Economy. In addition, directing government spending towards boosting economic growth is highly required to keep inflation rate at low level. Also, increasing the flexibility of exchange rate is required to keep the monetary policy effective in managing liquidity.

3. Methodology and Data:

Following the traditional Phillips curve, this study assumes that the current inflation is determined by lagged (previous) inflation and output gap. The following equation can be used to illustrate the

conventional Phillips curve, which links inflation to both the lagged values of inflation and the output gap:

$$\pi_t = \beta\, \pi_{t-1} + \gamma\, Y_t^*$$

Therefore, this study assumes that there is a relationship between inflation as a dependent variable and the independent variables; domestic liquidity growth rate, output gap, exchange rate depreciation, and world food prices.

The study uses an econometric model, Vector Auto-regression (VAR) model, in order to investigate the determinants of inflation in the Egyptian Economy. Inflation is the dependent variable in the model and the independent variables are domestic liquidity growth rate, output gap, exchange rate depreciation, and world food prices. With regard to domestic liquidity, the study uses M2 as a proxy for this variable. For output gap, the study uses the same methodology used in the Hedrick-Prescott filter that was used also in (Elbaz, 2014).

The study uses annual data across the period 1991 to 2023. Data for domestic liquidity growth rate, output gap, exchange rate are obtained from the Financial Monthly published by the Egyptian Ministry of Finance. Data for world food prices is collected from World Bank Global Economic Monitor (GEM) Commodities database.

Therefore, the study examines an econometric model the contains the following variables;

- LNGDPG: it identifies the natural logarithm of growth in the GDP gap, calculated using the Hedrick-Prescott filter.
- LNM2: it identifies the natural logarithm of growth rate of money supply “domestic liquidity”.
- LNEXR: it identifies the natural logarithm of the exchange rate of the Egyptian pound against the US dollar.
- LNGDPD: it identifies the natural logarithm of the GDP deflator, which represents domestic inflation rate.
- LNFFPI: A measure of the monthly variation in international prices of a basket of food commodities is the FAO Food Price Index (FFPI). It is comprised of the average price index of five commodity categories, weighted by the average export proportions of those

groups from 2014 to 2016. It is used to determine how changes in global food prices affect domestic inflation.

3.4 Calculating the Output Gap in Egypt 1991 till 2023:

The Hodrick-Prescott (HP) filter (Cerra, v. and S. Chaman, 2000) is a smoothing technique that has grown in popularity due to its adaptability in tracking the features of the variations in trend output. It may be used to assess the divergence of growth rate from its potential.

Table 1. Summary statistics and correlations

	LNGDPD	LNM2	LNEXR	LNFFPI	LNGDPG
Mean	3.61	27.15	1.856	4.428	5.64E-05
Median	3.39	27.27	1.746	4.518	1.29E-05
Maximum	5.52	27.97	3.418	4.967	0.003
Minimum	2.25	26.45	1.144	3.973	-0.003
Std. Dev	0.918	0.440	0.641	0.303	0.002
Skewness	0.463	-0.029	0.830	0.069	0.155
Kurtosis	2.025	1.960	2.599	1.711	2.123
Jarque - Bera test for normality	2.489	1.493	4.013	2.311	1.189
Probability	0.288	0.474	0.134	0.315	0.552
Obs.	33	33	33	33	33
Sum	119.28	896.07	61.223	146.13	0.0019
Sum Sq. Dev.	26.975	6.198	13.141	2.941	8.43E-05
LNGDPD	1.000				
LNM2	0.9406	1.000			
LNEXR	0.9582	0.9240	1.000		
LNFFPI	0.7880	0.7415	0.6721	1.000	
LNGDPG	0.0133*	-0.0272	-0.0367	0.1344	1.000

- * Denotes significance at a 95% confidence level.
- Source: Authors' calculations using E-views 12.

Following logarithmic modifications, Table 1 displays the correlation matrix and descriptive statistics for the study's data. Results of the Jarque-Bera test for normality, as shown in Table 1, indicate that the five variables do not have a normal distribution. In VAR analyses it is not uncommon that non-normal residuals are found (Lanne and Helmut, 2005). Furthermore, it is easy to see that these variables have a strong positive and statistically significant link when examining the coefficient matrix.

Looking at the correlations' coefficients presented in table 1, one can easily investigate that there exists strong positive correlations between the GDP deflator and M2, EXR, and FFPI while there is a weak positive correlation between GDP deflator and GDP gap.

a. Testing Unit Root Tests for all Variables:

To assess the existence of unit roots, the paper employs the Augmented-Dickey Fuller (ADF) tests (Dickey & Fuller, 1979), (Dickey & Fuller, 1981), (M. Hashem Pesaran & Shin, 1999), and (M. H. Pesaran, Shin, & Smith, 2001). The null hypothesis states that there is a unit root problem in the data set, and the P-value is used to make this determination. Furthermore, this test is conducted since the stationarity of the supplied data must be verified before creating the econometric model.

3.6 Augmented Dickey-Fuller (ADF) Unit Root Test

In the present paper, we apply the Augmented Dickey-Fuller (ADF) test as described in Dickey and Fuller (1979 and 1981) to analyse the order of integration for a non-stationary time series. The ADF test can be carried out as shown in equation (1);

$$\Delta Y_t = \Phi \cdot Y_{t-1} + {}^{k}\Sigma_{i=1}\, \Phi_i \cdot \Delta Y_{t-i} + \varepsilon_t \qquad (1)$$

Where k is the number of lags for Yt-i that need to be present in order to maintain degrees of freedom and allow autocorrelation in ε t.

Conversely, the autoregressive coefficient (α 0) can be expressed as follows;

$$Y_t = \alpha_0 Y_{t-1} + \varepsilon_t$$

Therefore, we can rewrite it to be;

$$\Delta Y_t = (\alpha_0 - 1) Y_{t-1} + \varepsilon_t$$

In the event that α 0 is less than 1, Yt is integrated of order 0. If not, a further test must be conducted;

$$\Delta\Delta Y_t = (\alpha_t - 1) \Delta Y_{t-1} + \varepsilon_t$$

In the event where α 1 is less than 1, Yt is integrated of order one. Thus, until stationarity, this process is performed endlessly.

Using E-views 12, the current investigation shows that there is evidence of a unit root in the two variables. As a result, the ADF test shows that the two variables are non-stationary. The findings of the ADF tests are explained in Table 2, where the natural logarithms of GDP deflator (LNGDPD), (LNM2) the natural logarithms of M2, (LNEXR) the natural logarithms of exchange rate depreciation, (LNFFPI) the natural logarithms of FAO Food Price Index and GDP gap (LNGDPG) are given.

Table 2. Augmented Dickey-Fuller (ADF) unit root tests results.

ADF (With trend)	LNGDPD	LNM2	LNEXR	LNFFPI	LNGDPG
In Levels	0.525	-2.488	-1.663	-2.940	-2.701
In First Differences	-2.857	-4.443**	-3.161	-4.460**	-4.938**
In Second Differences	-5.607**	N/A	-5.426**	N/A	N/A
Critical Values 5% level	-3.587	-3.562	-3.568	-3.562	-3.587
Integration Level	I(2)	I(1)	I(2)	I(1)	I(1)

** Significant at 5% level
Source: Authors' estimations using E-views 12 with the same data.

LNGDPD, LNM2, LNEXR, LNFFPI and LNGDPG, the model variables, are clearly integrated where we find LNGDPD and LNEXR integrated of order one (2) and the other three variables are integrated of order one (1). The study is adequately warranted to investigate the co-integration test to this model in order to ascertain the linkages between the two variables, given that the unit root test has demonstrated that the variables are found to be of the same order of integration. To bolster these conclusions, the study also performs Phillips-Perron (PP) Unit Root Tests.

3.7 Phillips-Perron (PP) Unit Root Tests

Importantly, the main difference between the ADF tests and the Phillips-Perron (PP) unit root tests seems to be how heteroskedasticity and serial correlation in errors are handled. The main advantage of PP tests over ADF tests is their increased ability to withstand typical forms of error term heteroskedasticity. Furthermore, there is no need to specify a lag duration while using the PP test regression. Thus, regression from the PP test may look like this;

$$\Delta Y_t = \beta_0 . D_t + \Phi i . Y_{t-i} + \varepsilon_t \qquad (2)$$

Since ε t is I(0), it might be heteroskedastic in this situation. Under the null hypothesis Φi = 0, the asymptotic distributions of the PP and ADF tests are the same. The asymptotic distributions of the PP and ADF tests are identical. The article found that when PP tests are conducted with E-views 12, the outcomes are identical to those of ADF tests. Table 3 presents model's PP test results.

Table 3. Phillips-Perron (PP) unit root tests.

PP (With trend)	LNGDPD	LNM2	LNEXR	LNFFPI	LNGDPG
In Levels	0.0818	-1.870	-0.505	-2.058	-2.637
In First Differences	-1.736	-4.389**	-2.077	-4.485**	-2.874
In Second Differences	-5.268**	N/A	-7.003**	N/A	-5.503**
Critical Values 5% level	-3.57	-3.562	-3.57	-3.562	-3.57
Integration Level	I(2)	I(1)	I(2)	I(1)	I(2)

** Significant at 5% level
Source: Authors' estimations using E-views 12 with the same data.

It is evident from Table 3 that the results of ADF testing are guaranteed by PP unit root tests. It is established that there are two variables, LNM2 and LNFFPI, integrated of order one I(1). The rest of them are integrated of order one I(2).

These results establish the validity of evaluating co-integration connections for this variable system. There exist integrated static long-run equations of order two, and co-integration relationships among the five variables are expected to be identified. This shows that in every bivariate equation, the variables are co-integrated.

Based on the Akaike information criteria, just one lag was incorporated in the empirical VAR model estimation. To make sure the results were legitimate, diagnostic tests were used. Tests for stability, autocorrelation, heteroscedasticity, and normality were performed. These tests' outcomes verify that there are no issues with autocorrelation, heteroscedasticity, or stability with the model. The following table 4 provides a summary of these tests' results.

Table 4. Testing for the VAR model

Diagnostic Test	VAR Model	
	Test Statistic	P-value
Residual Serial Correlation LM Test	196.38	0.0000
Residual Heteroskedasticity Tests	130.25	0.2891
Stability Test	VAR test satisfies stability conditions	No root lies outside the unit circle
Residual Normality Tests	24.38	0.0066

Source: Authors' estimations using E-views 12 with the same data.

4. Results

The direction and strength of the linear relationship between the dependent and explanatory variables can easily be examined by the correlation matrix illustrated in table 2. Furthermore, the correlation coefficient value establishes the relationship's intensity, which can be either weak, moderate, or strong. Looking at table 2, results show the existence of strong positive nonlinear relationship between inflation and money sully growth rate (M2), depreciation of exchange rate, and FAO Food Price Index. Also, there is a weak positive nonlinear relationship between inflation and GDP gap. Consequently, these outcomes give the present paper strong incentive to test the co-integration association in this system of variables.

Using the KAO test, a co-integration connection between the test variables was discovered in the following table (5). It also suggests that there is a long-term link between the factors. And as table (5) illustrates, the null hypothesis is rejected and the alternative hypothesis is accepted when the p-value is smaller than the 10% significance level. Thus, after discovering that there is a co-integration between the variables and that they are integrated at level. Consequently, the VAR model will be applied.

Table 5. Kao co-integration Test

ADF	t-Statistic	Prob.
	-1.435895	0.0845
Residual variance	0.025630	
HAC variance	0.034004	

The empirical model's findings ought to address the following two key queries:

1. How would inflation react to itself, the production gap, the depreciation of the exchange rate, the growth rate of "domestic liquidity" in the money supply, and the global food price shock?
2. What are the primary causes of the dynamics of inflation in the Egyptian economy?

Two primary analytical tools—variance decompositions (VDs) and impulse response functions (IRFs)—could be used to analyze the VAR model's results. These resources can aid in providing answers to the two previously posed questions.

Table 6. VAR models outputs

	Model 1
VARIABLES	LNGDPD
LNGDPD(-1)	0.8515***
P-value	(0.16)
LNGDPD(-2)	-0.0022***
P-value	(0.16)
C	1.7521***
P-value	(0.25)
LNM2	0.0888**
P-value	(0.05)
LNEXR	0.2570**
P-value	(0.04)
LNFFPI	0.1837**
P-value	(0.04)
LNGDPG	3.0985***
P-value	(0.10)
R-squared	0.9985
Adjusted R-squared	0.9980
Observations	31

*, **, *** denote 1%, 5% and 10% levels of significance respectively.

From table 6, results prove that all variables of the model are significant at least on 10% significance level. Hence, results declare that 1% rise of inflation in the previous year (GDPD (-1)) increases inflation by 85%. In addition, 1% increase in broad money supply (M2) growth rate would lead to an increase of 0.09% increase in inflation rate. Also, 1% increase in exchange rate leads to inflation rise by 0.26%. In addition, a rise of 1% of world food prices should cause inflation rate by 0.18%. Moreover, an increase of 1% in GDP gap would cause inflation rate to boost by 3%.

Table 7. Granger Causality Test

	Chi-squared	P-value
LNM2 does not granger cause GDPD*	21.735	0.0002
LNEXR does not granger cause GDPD*	13.086	0.0109
LNFFPI does not granger cause GDPD*	23.150	0.0001
GDPG does not granger cause GDPD**	3.119	0.5381
GDPD does not granger cause M2*	23.653	0.0001
GDPD does not granger cause EXR***	8.326	0.0804
GDPD does not granger cause FFPI***	9.004	0.0610
GDPD does not granger cause GDPG**	9.112	0.0584

*, **, *** denote 1%, 5% and 10% levels of significance respectively.

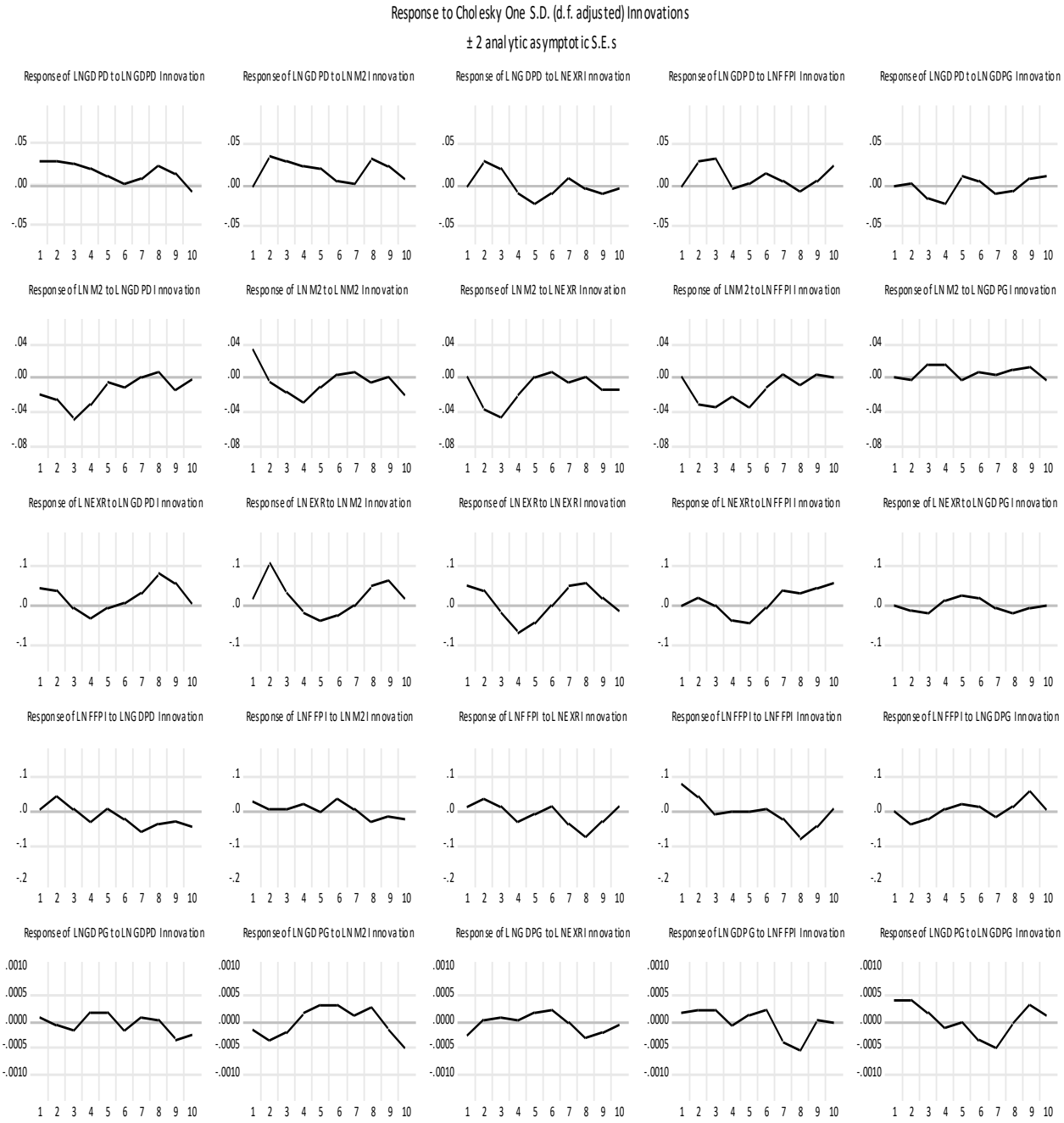
The present paper conducts VAR Granger Causality/Block Exogeneity Wald Tests in order to investigate the causality relationships among variables inside this model where the results are presented in table 7. Table (7) illustrates that broad money supply, exchange rate depreciation, and World food prices granger cause inflation (GDPD) but GDP gap does not. On the other hand, it is showed from table 7 that inflation (GDPD) granger causes all other variables in the model. Additionally, these findings support the view by both El Baz (2014) and Panagiotis, Liargovas, and Argyrios (2023).

Table 8. Impulse Response Functions (IRFs)

Period	D(LNFFPI,2)	D(GDPG,1)	D(EXR,1)	D(M2,1)	D(GDPD,1)
1	0.015937	1.374095	0.545791	0.829395	2.438220
	(0.68129)	(0.64379)	(0.59744)	(0.57532)	(0.39553)
2	0.484312	0.240378	1.728340	-0.577611	-0.61597
	(0.82621)	(0.83542)	(0.79288)	(0.73728)	(0.46831)

Source: Authors' calculations.

Figure 4. Impulse Response Function (IRF)



To elucidate the effects of sudden, unforeseen shocks to the inflation on the pertinent study variables. It makes use of the Impulse Response Function (IRF). Moreover, this test is structured around the VAR test that is shown in both table 8 and Figure (4). As a result, Figure (4) shows the IRF data and illustrates how M2, exchange rate, FAO Food Price Index, and GDP gap reacted to inflation.

Inflation Dynamics and Determinants:

Under VAR framework, it is highly recommended to use the variance decomposition of inflation, which shows the variables that may be accountable for inflation dynamics, to visualize the factors that determine inflation. Therefore, the present paper looks into the dynamics of inflation across one- and five-year time frames. Over the course of a year, the main causes of inflation are its own swings (85.4%), which are followed by the output gap (7.8%), then exchange rate depreciations of the Egyptian pound compared to the US dollar (3.4%), then increases in global food prices (3.1%), and finally the growth rate of broad money supply (0.2%). Over a five-year period, the main causes of inflation are its own swings (40%) and the nominal devaluation of the Egyptian pound relative to the US dollar (30.4%), the output gap (14.2%), the growth rate of domestic liquidity (8.5%), and the price of food globally (6.8%), look at table 9 below.

This indicates that, over a 1-year horizon, factors other than inflation expectations can account for roughly 14.6% of inflation dynamics, and over a 5-year horizon, such factors can account for around 60% of inflation dynamics.

Table 9: Variance Decomposition (VD) for Inflation

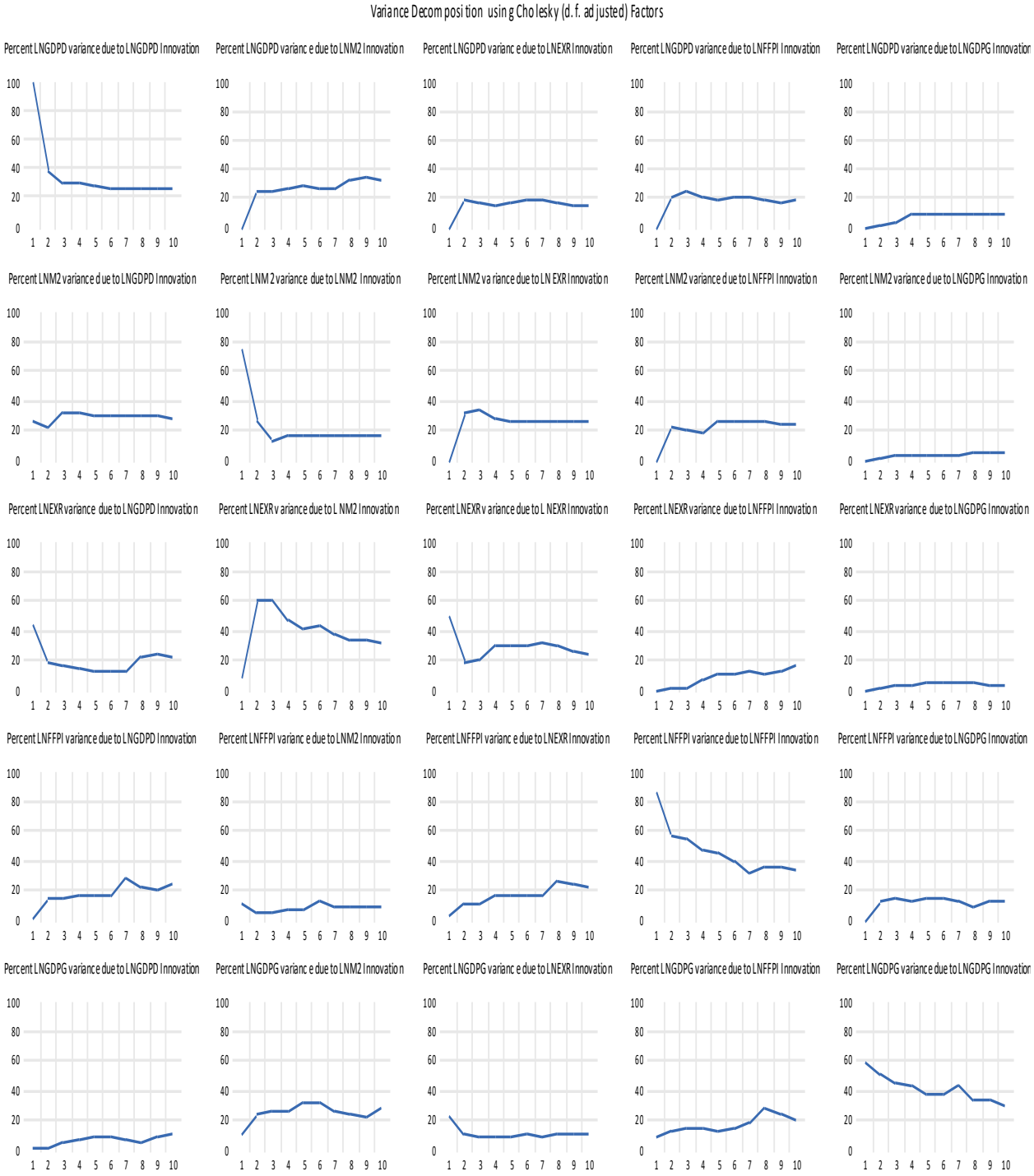
Period	S.E.	D(LNFFPI,2)	D(LNGDPG,1)	D(LNEXR,1)	D(LNM2,1)	D(LNGDPD,1)
1	0.208807	3.10965	7.800087	3.377756	0.2880	85.40963
2	0.278901	1.832804	5.18867	15.64112	7.973465	69.36394
3	0.315994	2.678710	4.59022	30.98323	8.093932	53.65390
4	0.333560	2.660934	14.38003	30.44221	8.482262	44.03456
5	0.340685	6.819361	14.21629	30.40432	8.538147	40.02188

Source: Authors' calculations.

These findings are largely consistent with those of other empirical research. Almonsour (2010) came to the conclusion that the money supply, foreign prices, and the country's own changes account for the majority of the short-term dynamics of Yemeni inflation. Over a one-year period, approximately 67.79% of the dynamics of inflation can be attributed to inflation alone. However, over a five-year period, shocks to the money supply, domestic demand, exchange rate, and foreign prices account for roughly 60% of the dynamics of inflation in Yemen. Moreover, El Baz (2014) founded outcomes that are closed to the present paper findings where he found that, within a one-

year period, around 67% of the dynamics of inflation can be attributed to inflation itself while within the five-year time horizon this percentage becomes only 44%.

Figure 5. Variance Decomposition



The Figure 5 shows that the outcomes, however, were all favorable.

5. Discussion

This paper investigated inflation dynamics and determinants inside the Egyptian economy in order to fill that gap in the literature. Therefore, the paper tests the relationship between GDP deflator as a dependent variable and output gap, broad money supply, depreciations of the Egyptian Pound against the US dollar, and global food prices as independent variables.

However, most of the literature papers did not cover the latest changes in the exchange rate market where it was published before November 2016. Hence, the study covers the period from 1991 to 2023 in the Egyptian economy to include the recent changes in exchange market and the historical rise of inflation rates through the years 2022 and 2023. Based on the authors' best knowledge, it is the first empirical work to adopt the latest developments and data for Egypt to develop inflation dynamics.

In addition, the present paper is considered to be the first trial to employ VAR model that applied the Impulse Response Function (IRF), Granger Causality tests, and Variance Decomposition to investigate inflation dynamics in Egypt. The outcomes declare that inflation in Egypt is highly determined by inflation expectations in both short run and long run. Also, output gap and devaluation of the Egyptian pound against the US dollar play crucial roles in pushing inflation rates in the Egyptian economic scene.

In the short run, 85% of inflation is determined through inflation expectations while four other factors determine only 15%. However, in the long run, inflation expectations role to determine inflation decreases to become only 40% while 60% of inflation can be attributed to the other factors; depreciations of the Egyptian Pound against the US dollar, output gap, broad money supply growth, and global food prices respectively. Consequently, these outcomes is in line with the previous literature discussed earlier. See for example El Baz, (2014), Ali (2011), and Almonsour (2010).

6. Conclusion

Egypt's own dynamics are the main cause of inflation, which is then influenced by the production gap, the rate at which the Egyptian pound depreciates in relation to the US dollar, global food prices, and growth in broad money supply.

Short-term price stabilization is achieved by restricting exchange rate depreciation. Slowing the rate of depreciation will help restrict the extent of imported inflation in the near run. The findings suggest that the authorities should be careful in monitoring the possible impact of foreign prices on the dynamics of inflation. Eventually, though, the depletion of foreign reserves will make it more challenging to keep the exchange rate steady.

To reduce inflationary pressures over the medium run, fiscal and monetary policy must be closely coordinated. Significant effects of shocks to the money supply and domestic demand need policy collaboration between the Ministry of Finance and the Central Bank of Egypt (CBE). Expansionary fiscal and monetary policies in such a tiny open economy can lead to demand-pull inflation, which when coupled with cost-push inflation might jeopardize social and macroeconomic stability. To achieve a suitable balance between price stability and economic growth, close coordination will be required; this should be anticipated to lessen inflationary expectations. It is recommended that the fiscal authorities evaluate the areas where inflation is caused by discretionary spending over a medium period of time. Furthermore, it is imperative to manage the expanding budget deficit in order to guarantee the inappropriateness of the monetary policy necessary for price stabilization.

In order to manage market liquidity and moderate the rate of depreciation in the medium run, the CBE should increase the use of monetary instruments. It should also keep advancing the development of its modelling and forecasting skills in order to be able to implement forward-looking monetary policy. The central bank must implement more counter-cyclical monetary policy in conjunction with fiscal austerity and the establishment of a nominal anchor to stabilize inflation expectations in order to lower the costs of deflation.

Finally, it is highly recommended for the CBE to become more transparent in inflation targeting process. The following conditions must be met for inflation targeting in Egypt to be successful: the targeted inflation rate must be announced; there must also be a transparent monetary framework that allows the central bank to regularly update economic agents on what has been accomplished, what is still lacking, and the reasons behind the central bank's success or failure in targeting inflation. Through conducting transparent monetary policy, the central bank will gain more credibility and be able to lower inflation expectations. Therefore, the CBE will be capable to achieve the desired level of inflation that the paper recommend to become one digit inflation rate.

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