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MONEY SUPPLY BEHAVIOR IN EGYPT (2004-2019)

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ABSTRACT: *This study aims to investigate whether money supply behaviour in Egypt is exogenously or endogenously determined using data from 2004 to 2019. It aims to identify the determinants of money supply in Egypt and the most important tools used by the central bank to manage it. The study employs the Johansen-Juselius test (1990) to examine the long-run determinants of money supply in Egypt and the error correction model to examine the short-run determinants. We conclude that real GDP, discount rate, budget deficit, and net foreign assets have significant long-term effects on money supply, whereas exchange rate and net domestic assets have no effects. We recommend higher degrees of cooperation between the Central Bank of Egypt and the institutions responsible for the formulation of financial and commercial policies. we also recommend that the central bank continue monitoring foreign assets and strengthen its supervisory activities on banking institutions.*

KEYWORDS: Money Supply, Vector Auto Regression, Error Correction Model.

JEL Classification: C32, E51, G21

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INTRODUCTION

Money has always been a controversial topic in the field of economics. Policymakers designed their tools to manage money supply and control its effects on other economic variables. Besides being a very powerful tool used by monetary policymakers, the expansion or contraction of money affects interest rates, exchange rates, inflation rates, and the production of goods and services. While money demand in Egypt has been intensively studied (see Traih (2015), Mohamed (2005), Teleb (1985;), and Al-Beblawy (1971), money supply has gained less importance in theoretical and applied studies. This study answers the following questions: First, is money supply in Egypt exogenously or endogenously determined? Second, what are the main determinants of the money supply in Egypt? Third, what are the main tools used to control the money supply?

This paper is organized into six sections. Section 1 briefly describes the banking and financial system in Egypt and sheds light on the development of money supply in Egypt. Section 2 discusses the tools that Egypt's central bank uses to manage money supply. Section 3 discusses the theoretical framework of this study, which is divided into two parts. Part A discusses the debate on whether money supply is determined exogenously or endogenously. Part B presents a literature review of empirical studies of money supply behaviour in different countries. Section 4 shows the methodology and sources of data used in this study, and Section 5 shows the empirical results. Finally, Section 6 concludes the paper.

The Banking and Financial System in Egypt

The financial sector in Egypt is divided into the banking sector, which is controlled by the Central Bank of Egypt (CBE), and the non-banking sector, which includes the capital market, insurance companies, financial leasing, factoring, and mortgage firms, which are under the control of the Egyptian Financial Supervisory Authority (EFSA) (Ynceler, 1994). According to the Central Bank of Egypt (2019), there are 38 banks with a total number of 4177 branches in addition to 1017 village banks. The banking density in Egypt is 23.4, which means that, on average, every 23.4 thousand people have one serving branch. The Financial Supervisory Regulatory Authority, established in 2009 by Law No. 10, supervises non-banking financial activities, including capital markets, futures exchanges, insurance, and mortgages; however, banks in Egypt are considered the main financial institutions.

Currency in circulation, demand deposits, and quasi-money (time and saving deposits), which are all components of money supply M2, for the period from 2004 to 2019 are listed in Table 1. To assess the development of these monetary aggregates, data were converted in table 2 into annual growth rates and percentages of the respective 2004 values. From Table 2, 1% is the annual rate of growth in percentage terms and 2% is the percentage of the value of each item to its value in 2004. The tables show that money supply is expanding rapidly, as M2 has increased over time by 730%. The tables show that all components of money supply have spectacularly increased, with the highest increase being for demand deposits, which increased by 1710%, followed by currency in circulation, which increased by 725%, and quasi-money, which increased by 669%. In addition, the proportion of currency outside the banking system to the total money supply seems to decrease over time; the currency in circulation percentage of M1 decreased from 71% in 2004 to 53%, which may reflect improvements in the Egyptian banking system. Furthermore, the main source of the expansion in money supply since 2004 appears to be government credit from banks.

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Table 1. Monetary statistics (2004-2019) (in millions of Egyptian pound)

Year	Domestic Liquidity (1+2) M2	M1	Currency in Circulation Outside The Banking System	Demand Deposits	Quasi-Money (2)
2004	468261	83450	59426	24024	384811
2005	522296	100712	68960	31752	421584
2006	601309	121342	83054	38288	479967
2007	716275	151800	96676	55124	564475
2008	791378	174460	114036	60424	616918
2009	866354	196973	126666	70307	669381
2010	973962	223456	143633	79823	750506
2011	1038871	255581	176578	79003	783290
2012	1167160	288138	205020	83119	879021
2013	1387688	373624	251050	122574	1014064
2014	1606505	445733	277159	168574	1160772
2015	1905464	520592	305061	215531	1384872
2016	2648595	625670	381444	244226	2022925
2017	3202657	737469	407802	329667	2465188
2018	3628681	836045	441935	394110	2792636
2019	3884907	925185	490233	434952	2959722

Source: Central Bank of Egypt database 2019.

Table 2. Monetary Statistics (2004-2019), Annual Rate of Growth and Percentage of 2004 Values

Year	Currency in Circulation		Demand Deposits		Quasi-Money		M2	
	A	B	A	B	A	B	A	B
2004		100.0		100.0		100.0		100
2005	16.0	116.0	32.2	132.2	9.6	109.6	11.5	111.5
2006	20.4	139.8	20.6	159.4	13.8	124.7	15.1	128.4
2007	16.4	162.7	44.0	229.5	17.6	146.7	19.1	153.0
2008	18.0	191.9	9.6	251.5	9.3	160.3	10.5	169.0
2009	11.1	213.1	16.4	292.7	8.5	174.0	9.5	185.0
2010	13.4	241.7	13.5	332.3	12.1	195.0	12.4	208.0
2011	22.9	297.1	-1.0	328.8	4.4	203.6	6.7	221.9
2012	16.1	345.0	5.2	346.0	12.2	228.4	12.3	249.3
2013	22.5	422.5	47.5	510.2	15.4	263.5	18.9	296.3
2014	10.4	466.4	37.5	701.7	14.5	301.6	15.8	343.1
2015	10.1	513.3	27.9	897.1	19.3	359.9	18.6	406.9
2016	25.0	641.9	13.3	1016.6	46.1	525.7	39.0	565.6
2017	6.9	686.2	35.0	1372.2	21.9	640.6	20.9	683.9
2018	8.4	743.7	19.5	1640.5	13.3	725.7	13.3	774.9
2019	10.9	824.9	10.4	1810.5	6.0	769.1	7.1	829.6
	15.2		22.1		14.9		15.4	

A: Annual rate of growth *B: Cumulative index (2004=100)*

Source: Central Bank of Egypt database 2019.

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Money Supply Management

By law, the Central Bank of Egypt controls its money supply. The bank determines the reserve ratio, liquidity ratio, and discount ratio, and makes decisions related to engaging in open market operations and setting credit ceilings, which is perhaps the most direct and effective method of controlling bank credit and money supply. According to the Central Bank of Egypt, the required reserve ratio in Egypt was 20% in the 1980s and had increased to 25% by the beginning of the 1990s. In December 1990, this ratio reduced to 15%. This ratio decreased to 14% from 2001 to 2011. Subsequently, it was gradually reduced to 10% in 2012 to provide banks with more cash. By the end of 2017, the required reserve ratio had increased again to 14% owing to improvements in major economic indicators. The required ratio was approximately 22% in 2001, increased to 33% until 2010, and then increased again to 40% in 2018. However, in general, the central bank does not frequently use this tool to control money supply. In addition to the reserve ratio, the central bank has changed its discount rate over the years. The discount rate was 9% between 2003 and 2017, increased to 11.5% from 2008 to 2009, and then decreased to 9.5% until 2016. In June 2016, it rose again to 12.25% and increased further to 15.25% in May 2017. From July 2017 to June 2018, the rate reached its highest value of 19.25%. The rate then decreased to 17.25% in April 2018 and to 14.75% in 2019. According to the Central Bank of Egypt, banks have been actively engaging in open market operations. The number of open market operations increased by 150% from 2013 to 2016 and by 44% from 2018 to 2019.

In addition, the choice of exchange rate regime, which directly impacts money supply, has long been debated among monetary policymakers in Egypt. In theory, a small open economy that adopts a fixed exchange rate and is highly integrated with the world economy cannot control its money supply because of its impact on its balance of payments. In contrast, a flexible exchange rate completely neutralizes the effect of the balance of payments on the domestic money supply in the long run.

In Egypt, from the sixties to the eighties, the central bank adopted a fixed exchange rate regime. In the nineties, a stabilization process started, and the central bank set the exchange rate as a nominal anchor. In October 1991, the exchange rate was unified and non-bank institutions were allowed to work in the exchange rate market. Since then, the central bank has followed a managed floating policy that stabilized the exchange rate; on average, one USD was equal to 3.39 pounds during the time period between 1994 and 1997. Despite successive devaluations of the local currency, a gap remained between the demand and supply of foreign currency. The Egyptian government, hence, decided to float the Egyptian pound in 2003, which has led to an increase in the exchange rate reaching 5.50 pounds then 6.19 pounds in 2004. However, there are two exchange rate markets and two exchange rates: the rates of the official and black markets. However, the implementation of the interbank system "between banks," which dealt with the market as one unit, led to a decrease in the exchange rate to 5.72. This decline continued reaching 5.52 pounds in 2010. One year later, due to the political disruptions that occurred during the Egyptian revolution in 2011, the exchange rate increased to 5.97 pounds (Hassan, 2013). After several years of political and economic instability, the exchange rate increased, reaching 8.83. With the high pressure placed on the economy, in November 2016, the government decided to float its exchange rate, which led the exchange rate to reach its highest level at 18.5% by the end of November 2016. The rate declined afterwards and continued to be relatively stable at nearly 16 pounds, with a tendency to decline.

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Theoretical Framework

This section is divided into two sections. The first part discusses the debate on whether money supply is determined exogenously or endogenously. Part B presents a literature review of empirical studies on money-supply behaviour in different countries.

Money supply exogenous or endogenous variable

There is debate among researchers about endogeneity and the exogeneity of money supply. This section presents two theories of the money supply.

The Exogenous Theory

The quantity theory of money views the money supply as an exogenous variable. The theory assumes that the central bank controls money supply and determines the amount of money according to its monetary policy targets. The central bank can manage the monetary base using its tools, including open market operations and the required reserve ratio (Kalaji, 2007). According to this theory, which is also called "the money multiplier model," the money supply is determined by changes in broader money aggregates to reserve ratio as M = m x MB. where M is money supply, m is the money multiplier, and MB is the monetary base. Under this assumption, the monetary authorities create money. The money multiplier is determined by the central bank by determining the required reserve ratio and excess reserve ratio, the money multiplier here is stable over time. This stability enables the central bank to effectively control the money supply by controlling the monetary base. According to this theory, monetary policy transmission mechanisms depend mainly on the money supply channel (Sieroń, 2019).

The Endogenous Theory

New Keynesians view money supply as a dependent variable that depends on economic activity. From this perspective, money supply is determined by the real economy, and the supply is endogenously determined by the joint actions of the monetary authority, the asset and liability management decisions of commercial banks, the portfolio decisions of the non-banked public, and the demand for loans (Moore, 1988). The theory of endogenous money supply has the following propositions (Özgür, 2007; Thwaini & Hamdan, 2017; Nayan et al., 2013):

The relationship between money and income in the quantity theory of money is reversed, as money supply is a function of profit expectations; thus, the demand for credit leads to money creation, and this demand for credit is derived from the expectations of profits.

The casual relationship between reserves, deposits, and loans is also reversed, as bank reserves have no influence on loans; thus, the money multiplier model is rejected.

The causal relationship between savings and investment is reversed. In this sense, savings cannot cause investment, as investments cannot be financed by savings because of the creation of income resulting from an increase in investment. Thus, this increase in income causes an increase in savings.

The interest rate is exogenously determined, as the interest rate is not determined by the mechanisms of markets - supply and demand of savings and money; however, the interest rate is determined exogenously by the central bank, according to other economic objectives (Özgür, 2007; Thwaini & Hamdan, 2017; Nayan et al., 2013).

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LITERATURE REVIEW

The behaviour and determinants of money supply have long been studied by researchers worldwide, and the findings vary. Maan (2015) tested the relationship between money supply and real GDP in the Egyptian economy using co-integration and the Granger causality test for the period 1989-2014. The study concluded that there is a strong causal relationship; changes in real GDP explain changes in the money supply. The study also concludes that there is a long-run relationship between M2 and real GDP. El-Soud and Said (2011) tested the relationship between money supply and real GDP in Egypt using a co-integration model and a Granger causality test on data from 1991 to 2011. The author concluded that there is a long-run relationship between real GDP and money supply and a unidirectional causal relationship from real GDP to money supply in the short and long run. Another study by Nayan et al. (2013) used data from 177 countries over 42 years and real gross domestic product per capita, bank lending, and inflation as determinants of money supply. Using the Gaussian mixture model (GMM), the study concluded that real GDP per capita and bank lending are significant determinants of money supply, hence supporting the argument of money supply proposed by post-Keynesian economists. However, inflation was not found to be significant, which is uncommon. Tiwari (2016) analyzed the major money supply determinants in Nepal for the period 2005-2015 using data of reserve money, narrow money M1, and broad money M2. This study tested the money multiplier theory; money is a function of the reserve money and money multiplier. The study considered all factors that affect reserve money and money multipliers as determinants of money supply. These factors include net foreign assets, net domestic assets, reserve ratio, currency ratio, and time-deposit ratio. The author finds evidence that net domestic assets and net foreign assets are the major factors affecting money supply. Using data from another African country, Nigeria and Bakare (2011) examine the determinants of money supply growth from 1981 to 2006. Applying the economic model developed by Fry (1985) suggests that money supply is determined by domestic credit expansion to the private sector, domestic credit to the public sector, net foreign assets, and other net items, Bakare (2011) found that domestic credit expansion to the private sector, domestic credit expansion to the government, and net foreign assets were all statistically significant. Credit expansion to the private sector was shown to have the highest impact, followed by other net items and net foreign assets. Abakpa and Asaph (2018) also explored the determinants of money supply in Nigeria for the period 1981-2015 using data (CPI), real GDP, interest rate, exchange rate, and foreign direct investment. Using the Granger causality test, the authors concluded that there is no causal relationship between CPI, exchange rate, FDI, and money supply and that the only variable that had a causal effect on money supply was real GDP. The author finds a bidirectional relationship between interest rates and money supply. In the long run, the study concludes that money supply is determined by all these variables. Another study conducted by Thwaini and Hamdan (2017) tested whether money supply in Iraq is dependent or independent, covering the period from 1993 to 2015, and investigated the relationship between money supply and fiscal policy. The authors (2017) used the inductive method, which focuses on the pattern of data to reach a general conclusion about the phenomenon or problem under consideration. The study concludes that monetary aggregates, especially M1, are endogenously dependent on fiscal factors related to the public budget. The author concludes that money supply depends on net domestic assets and net foreign assets. Using data from Qatar, Abdulrazag et al. (2003) studied the determinants of money supply, using M2, international reserves, price level, real GDP, and government spending as variables. The author concluded that there is a long-run relationship among all variables; thus, money supply is a function of all included variables. Moreover, the

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author concludes that in the short run, government spending plays an important role in money supply fluctuations. Ahmad and Yadav (2016) used the money multiplier approach to explain money supply determinants in India for 1991–2015. The study concludes that credit to the government is the main source of money stock changes. The author found that net foreign assets and bank credit to the private sector have significant effects on money supply in India. On the other hand, AsriAnanda (2015) used many variables to test their impact on money supply in Indonesia, including the stock market index, CPI, real exchange rate, and real GDP. However, the study concluded that none of these variables had significant effects on M2.

METHODOLOGY AND DATA

Methodology

This study uses the Johansen-Juselius JJ co-integration test to examine money supply behaviour in Egypt. The study begins with the standard augmented Dickey-Fuller (ADF) test as a unit root test to check for stationarity and order of integration before using a VAR model. The JJ co-integration test is then applied, which is an improvement over the Engle-Granger test (1987), as it detects multiple cointegrating vectors and treats all variables as endogenous. The test is used to assess the number of and the validity of co-integration relationship types of JJ tests: trace and eigenvalue. To examine the short-run determinants, this study uses the error correction model ECM. The model is used to examine short-run relationships and long-run adjustments toward equilibrium. The ECM assumes that all variables are stationary at the first difference, or I(1). To apply the ECM, which is part of Engle and Granger's (1987) two-step procedure, we perform the following:

Step 1.

The regression model was run as follows: $Yt=\alpha+\beta Xt + \varepsilon t$, and the residual or error correction term ECT was estimated.

Apply the unit root test for residual or error. If all variables are I(1) (stationary at first difference) and the error is I(0) (stationary at level), cointegration or a long-run relationship exists.

Step 2.

Run the short run regression model as follows: $\Delta Yt=\alpha+\beta\Delta Xt + \gamma ECTt\text{-}1 + \varepsilon t$

where $\hat{I}^2$ is the short-run coefficient. If γ is negative and significant, then the model will adjust toward the long-run equilibrium. If γ is between 0 and 1 (negative and significant), then a monotone adjustment toward equilibrium will occur; if γ is between 1 and 2 (negative and significant), then the equilibrium will be dampened.

The study uses forecast error variance decomposition to explain the fitted VAR by indicating the amount of forecast error variance of each of our variables that can be interpreted by exogenous shocks to other variables in our model. To determine the relative importance of each innovation in the variables, forecast error variance decomposition is used to observe the relative importance of each variable in the VAR model based on its shocks. The variance

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decomposition results can be used to predict the percentage contribution of each variable owing to a change in certain variables in the VAR model (Enders, 2004)

Data

To investigate the behaviour of money supply in Egypt based on theories and empirical studies, we apply the following equation:

$$M2 = a_0 + a_1 RGDP + a_2 BDEF + a_3\ EXCH + a_4 DR + a_5 NDA + a_6 NFA$$

where M2 is the broad money supply, RGDP is the real gross domestic product, BDEF is the budget deficit in Egypt, EXCH is the exchange rate of the US dollar, DR is the discount rate, NDA is the net domestic assets, and NFA is net foreign assets.

All data are quarterly, from 2004 to 2019. All time-series data for M2, DR, NDA, NFA, and BDEF were obtained from the central bank of Egypt. Exchange rate data were obtained from the International Financial Statistics IFS. Nominal GDP data were obtained from the CBE and then treated by the GDP deflator obtained from the IFS to obtain real GDP data.

EMPIRICAL RESULTS

Unit Root Test

The unit root test aims to determine the stationarity of each time series. This study applied the augmented Dickey-Fuller (ADF) test. Table 3 shows the test results for the data at the level and for its first difference.

Table 3. Unit Root Test Results

Variable	Level (p-value)	First-Difference (p-value)
M2	1	0.000
RGDP	0.93	0.0084
DR	0.83	0.000
NFA	0.24	0.005
NDA	1	0.000
BDEF	0.37	0.0038
EXCH	0.91	0.0009

As Table 3 shows, the variables are not stationary at their level, but they are all stationary in their first difference. From these results, we can conclude that all the variables are integrated from order I(1). Integrated from the same order supports using the vector autoregressive model

Lag Length Selection

The optimum lag length was determined using VAR model results. Table 4 lists the lag-length criteria derived from the VAR model.

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Table 4. Optimum Lag Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	114.2311	NA	5.12e-11	-3.829681	-3.576512	-3.731527
1	**582.2835**	**802.3756**	**1.64e-17**	**-18.79584**	**-16.77049***	**-18.01061**
2	648.6805	97.22424	9.56e-18	-19.41716	-15.61963	-17.94487
3	716.4308	82.26818	6.09e-18	-20.08681	-14.51710	-17.92745
4	806.6242	86.97227	2.23e-18	-21.55801	-14.21611	-18.71157
5	912.4657	75.60101*	7.23e-19*	-23.58806*	-14.47398	-20.05455*

* indicates lag order selected by the criterion

Using the Schwarz information criteria (SC), the optimum lag length is one period. This study used the SC criteria because the number of observations was relatively low.

Model Stability

The VAR model should be stable to trust the results. VAR model stability can be checked by the inverse root circle; if there are no roots lying outside the unit circle in the model, the model is stable (Mirdala, 2009). Figure 1 shows the inverse root circle of the VAR model. As shown in the figure, all roots are inside the circle; thus, the model is stable.

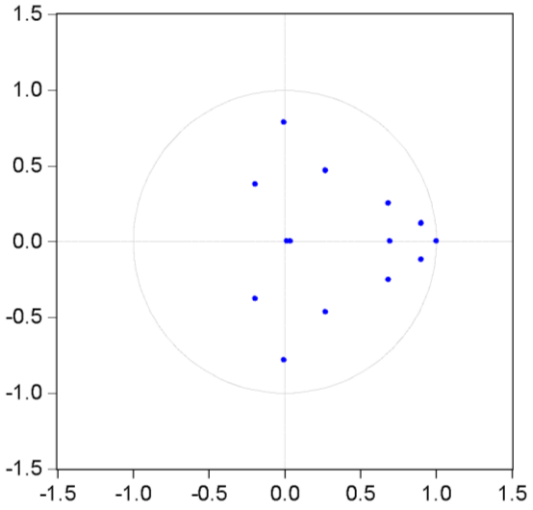

Figure 1. Inverse Roots of AR Characteristic Polynomial

Results of the Johansen-Juselius Co-integration Test

The final step of the Johansen-Juselius co-integration test is to determine the number of co-integration vectors. Table 5 presents the Johansen-Juselius co-integration test results.

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Table 5. Co-integration Test Results

Unrestricted Co-integration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.701177	187.2235	125.6154	0.0000
At most 1 *	0.508268	117.1651	95.75366	0.0008
At most 2 *	0.432592	75.99547	69.81889	0.0148
At most 3	0.303637	43.12826	47.85613	0.1295
At most 4	0.208855	22.13894	29.79707	0.2909
At most 5	0.136169	8.551055	15.49471	0.4085
At most 6	0.001053	0.061135	3.841466	0.8047

Trace test indicates 3 co-integrating equations at the 0.05 level

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.701177	70.05846	46.23142	0.0000
At most 1 *	0.508268	41.16962	40.07757	0.0375
At most 2	0.432592	32.86721	33.87687	0.0656
At most 3	0.303637	20.98932	27.58434	0.2769
At most 4	0.208855	13.58788	21.13162	0.3997
At most 5	0.136169	8.489920	14.26460	0.3311
At most 6	0.001053	0.061135	3.841466	0.8047

Max-eigenvalue test indicates 2 co-integrating equations at the 0.05 level

As shown in Table 5, the trace test indicates that there are three co-integration vectors, while the max-eigenvalue indicates that there are two co-integration vectors at the level of 0.05. The results indicate a long-run relationship between M2 and the variables included in the model. Given that there is at least one cointegration vector among the variables, the analysis normalizes the cointegration vector on M2. The following equation represents the model's findings.

$$M2 = 4.8\,LRGDP - 0.95\,LBDEF + 1.69 LEXCH - 1.4 LDR - 1.1 LNDA - 2.1 LNFA$$

(2.9) (5.16) (1.78) (2.1) (1.21) (4.46)

From the equation derived from the results of Johansson's test, real GDP, discount rate, budget deficit, and net foreign assets have a significant effect on money supply, whereas exchange rate and net domestic assets have no significant effect on money supply in Egypt. The equation reveals that real GDP and money supply have a positive long-run connection, suggesting that changes in real GDP influence long-term changes in money supply, which is consistent with the findings of several theoretical and empirical studies. In the long term, the equation also demonstrates that the discount rate and money supply have an inverse relationship. The greater the discount rate, the higher the cost of borrowing from the central bank. As a result, the quantity of loanable money with commercial banks decreases, reducing the monetary base and money supply. The equation also shows that changes in net foreign assets have a long-term

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inverse relationship with money supply, and the same is true for changes in the budget deficit, which have a long-term inverse relationship with money supply. The negative effect of the budget deficit is not consistent with the theoretical expectation, as it is expected that the budget deficit will be financed by borrowing, whether from the central bank or from abroad and in both cases, this leads to an increase in money supply. This unexpected effect may be due to transfers that were made to some of the data, as some of them were available on a monthly basis and some others were available annually and were converted to quarterly data.

The Error Correction Model

Following our examination of the long-term determinants, ECM was applied to examine the short-term determinants. Table 6 shows the results of the ECM, and Table 7 shows the following step, which estimates the unit root test of the ECT.

Table 6. Results of The Error Correction Regression Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEXCH	-0.030354	0.084206	-0.360474	0.7199
LNDA	0.707192	0.065703	10.76343	0.0000
LNFA	0.202657	0.031926	6.347790	0.0000
LRGDP	0.436693	0.132108	3.305572	0.0017
LBDEF	0.011544	0.015388	0.750177	0.4564
LDR	0.137123	0.095976	1.428728	0.1588
C	-4.246415	0.893140	-4.754477	0.0000
R-squared	0.990876	Mean dependent variable		13.93932
Adjusted R-squared	0.989862	S.D. dependent variable		0.629569
S.E. of regression	0.063389	Akaike info criterion		-2.571446
Sum squared residual	0.216978	Schwarz criterion		-2.329214
Log likelihood	85.42909	Hannan-Quinn criterion		-2.476513
F-statistic	977.4252	Durbin-Watson stat		0.492102
Prob(F-statistic)	0.000000			

Table 7. Augmented Dickey-Fuller Test Results of ECT

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-7.791997 (0.0000)	
1% level	-3.544063	
5% level	-2.910860	
10% level	-2.593090	

*MacKinnon (1996) one-sided p-values.

The results in Table 7 show that the ECT is stationary at this level. Given that all the variables are stationary at the first difference, we run the short-run regression model as follows:

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$$\Delta LnM2 = \alpha + \beta_0 \Delta LEXCH_t + \beta_1 \Delta LNDA_t + \beta_2 \Delta LNFA_t + \beta_3 \Delta LDR_t + \beta_4 \Delta LBDEF_t + \beta_5 \Delta LRGDP_t + \gamma ECT_{t-1} + \varepsilon_t$$

The final steps are listed in Table 8. This table displays the results of the short-run regression model using lagged ECT.

Table 8. Results of The Short Run Regression Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005662	0.050000	0.113231	0.9103
D(DR)	0.025212	0.047691	0.528647	0.5993
D(BDEF)	-0.015581	0.011807	-1.319566	0.1928
D(RGDP)	1.56E-06	1.69E-06	0.920787	0.3614
D(NFA)	0.999999	1.11E-06	899599.6	0.0000
D(NDA)	1.000000	7.87E-07	1271310.	0.0000
D(EXCH)	0.038358	0.064391	0.595711	0.5540
ECT(-1)	-1.051508	0.142377	-7.385366	0.0000

R-squared	1.000000	Mean dependent variable	55076.63
Adjusted R-squared	1.000000	S.D. dependent variable	67148.95
S.E. of regression	0.268870	Akaike info criterion	0.334385
Sum squared residual	3.759125	Schwarz criterion	0.613631
Log likelihood	-2.031563	Hannan-Quinn criterion	0.443614
F-statistic	5.26E+11	Durbin-Watson stat	1.929236
Prob(F-statistic)	0.000000		

As shown in Table 8, the ECT is negative and significant, indicating that a long-run adjustment exists. In the short-run model, the error correction component has a coefficient of -1.051, indicating that instead of monotonically converging to the equilibrium route, the error correction process fluctuates around the long-run value in a damped manner. However, once this process is complete, convergence to the equilibrium route occurs rapidly (Narayan & Smyth, 2006). The short-run regression results show that only net foreign and domestic assets have a significant effect (positive).

Causality Test

Given that M2, DR, RGDP, BDEF, and NFA are co-integrated in the long run, the short-run analysis for these variables is performed using the vector error correction model, while the Granger causality test (1969) is used to examine the short-run dynamic relationship between

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M2 and both net domestic assets and the exchange rate because they are not integrated into the long run. Table 9 presents the causality effects of integrated variables and M2.

Table 9. VEC Granger Causality/Block Exogeneity Wald Tests

Dependent variable: D(LM2)			
Excluded	Chi-sq	df	Prob.
D(LNFA)	2.845688	2	0.2410
D(LRGDP)	0.973409	2	0.6146
D(LBDEF)	7.569588	2	0.0227
D(LDR)	10.59346	2	0.0050
All	21.85581	8	0.0052
Dependent variable: D(LNFA)			
Excluded	Chi-sq	df	Prob.
D(DLM2)	39.80151	2	0.0000
D(DLRGDP)	9.954656	2	0.0069
D(DLBDEF)	11.97521	2	0.0025
D(DLDR)	12.93559	2	0.0016
All	107.6734	8	0.0000
Dependent variable: D(LRGDP)			
Excluded	Chi-sq	df	Prob.
D(LM2)	13.83297	2	0.0010
D(LNFA)	6.907795	2	0.0316
D(LBDEF)	32.02280	2	0.0000
D(LDR)	0.565482	2	0.7537
All	57.38713	8	0.0000
Dependent variable: D(LBDEF)			
Excluded	Chi-sq	df	Prob.
D(LM2)	29.56226	2	0.0000
D(LNFA)	3.599859	2	0.1653
D(LRGDP)	103.6428	2	0.0000
D(LDR)	1.869243	2	0.3927
All	141.4851	8	0.0000
Dependent variable: D(LDR)			
Excluded	Chi-sq	df	Prob.
D(LM2)	4.731931	2	0.0939
D(LNFA)	0.292102	2	0.8641
D(LRGDP)	0.195707	2	0.9068
D(LBDEF)	0.413027	2	0.8134
All	6.592442	8	0.5812

According to the results, there is a causal effect of the budget deficit and discount rate on M2 in the short run, whereas there is no causal effect of both real GDP and net foreign assets on M2 in the short run. The results also show that there are causal relationships that go from M2 to NFA, RGDP, and BDEF.

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Table 10 shows the results of the Granger causality effect on the causal effect of exchange rate and net domestic assets. The results suggest that there is no causal effect of exchange rate and net domestic assets on M2.

Table 10: Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
DLEXCH does not Granger Cause DLM2	58	1.57640	0.2163
DLM2 does not Granger Cause DLEXCH		0.99840	0.3753
DLNDA does not Granger Cause DLM2	58	0.13579	0.8733
DLM2 does not Granger Cause DLNDA		2.66456	0.0789

CONCLUSION

The Central Bank of Egypt utilizes a variety of tools to manage money supply, the most significant of which are open market operations, discount rate, legal reserve rate, and liquidity ratio. This study aimed to determine money supply behaviour in Egypt from 2004 to 2019. Using the VAR model on quarterly data for the broad money supply M2, budget deficit, real GDP, exchange rate, net domestic assets, discount rate, and net foreign assets, this study reached several conclusions. The empirical results show that real GDP has a positive, significant, and long-term effect on money supply in Egypt, whereas discount rate has a significant and long-term negative effect. This is in accordance with several empirical studies.

The causal effect of M2 on the real GDP means that the central bank must target an appropriate level of M2, this is due to the fact that an increase in real GDP growth requires an appropriate increase in the M2 level. The central bank of Egypt should consider the targeted growth rate of real GDP when determining the targeted money supply. These conclusions are supported by the causal effect of M2 on the real GDP in the short run. In addition, the long-term relationship between money supply and the budget deficit, as well as the short-term causal relationship between money supply and the budget deficit, necessitate cooperation between the Central Bank of Egypt and the institutions responsible for forming financial and trade policies in Egypt. Since money supply in Egypt is endogenously determined and given the increasing autonomy of private financial institutions, the central bank of Egypt needs to enhance its banking supervision activities in all aspects; with an appropriate legal and technical framework, the central bank of Egypt can improve its control of financial institutions. In fact, dealing with money supply as an endogenous variable might lead monetary authorities to regard the interest rate as an external variable, making it suitable to use the interest rate as an intermediate monetary policy goal. Finally, the significant long-run effect of net foreign assets on money supply in Egypt means that it is essential for the central bank of Egypt to continue monitoring the determinants of net foreign assets to insulate the economy from possible internal and external shocks that spill over the balance of payments.

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