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Impact of Exchange Rate Fluctuations on Money Velocity in the Egyptian Economy

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Abstract:

This study aims to demonstrate the impact of exchange rate changes on the velocity of money in the Egyptian economy, especially after the exchange rate underwent several changes that led to a significant depreciation of the Egyptian pound. The velocity of money has been influenced by various economic variables, including the interest rate, gross domestic product (GDP), per capita income, foreign reserves, exports and imports, the degree of financial development, and the broad money supply.

Among these, the exchange rate is considered one of the most significant influencing variables, as it serves as a dual economic adjustment tool to achieve both internal and external balance.

To achieve this goal, the study utilized annual time series data spanning from 2000 to 2024. It employed two approaches: the analytical approach, which encompasses economic theories that identify the key determinants of exchange rate fluctuations and the velocity of money, aiming to uncover the pathways through which the exchange rate influences the velocity of money. Additionally, the econometric approach was applied, using time series data for both independent variables and the dependent variable through the ARIMA model.

The results of the study indicated a significant positive correlation between the exchange rate, per capita income, and the velocity of money. Conversely, the study found a significant negative correlation between foreign currency reserves, the broad money supply, and the velocity of money.

Key words: Money Velocity, foreign reserves, M_2 (the broad money supply), GDP per capita, Exchange Rate

Introduction:

In recent macroeconomic research, monetary models have evolved to incorporate imperfect competition and nominal rigidities within the dynamic stochastic general equilibrium (DSGE) framework. These models, often called New Keynesian, demonstrate that changes in monetary policy settings can significantly impact real variables. Monetary policy now serves as a stabilization tool and an independent driver of economic fluctuations. Researchers have actively explored alternative monetary policy rules, adapting them to changing macroeconomic conditions using the new generation of models. Galí, J., & Monacelli, T. (2002)

The exchange rate plays a pivotal role in macroeconomics, as fluctuations in the exchange rate affect the velocity of money through several channels, including inflation, international trade, foreign investment, capital flows, and interest rates. Krugman, P. R., & Obstfeld, M. (2003)

The exchange rate is of great importance in determining commodity prices by influencing the relative prices between local and foreign goods. Any changes in the exchange rate reflect on inflation, production, and overall economic activity, thereby affecting foreign trade. All of this in turn impacts the velocity of money.

The velocity of money refers to the number of times a unit of currency is used in transactions over a specific period. Changes in the velocity of money are significant due to their impact on the monetary stability of a country. Similar to changes in the amount of money issued by the central bank, increases or decreases in the velocity of money have the same effect on economic activity as changes in the money supply.

The velocity of money reflects the dynamism of economic activity and its level of development. This is important for monetary policymakers in controlling liquidity and avoiding inflationary pressures. If they can accurately predict the velocity of money and the factors affecting it, they can achieve a certain level of money supply that aligns with the desired levels of real GDP growth and inflation rate.

Undoubtedly, the velocity of money is influenced by various factors such as income levels, per capita income, interest rates, foreign reserves, liquidity, and the volumes of exports and imports. Among these, the exchange rate stands out as a crucial economic indicator, reflecting the relationship between domestic and foreign prices and thereby impacting inflation.

Exchange rate fluctuations influence the velocity of money through various channels, particularly by affecting income. When the local currency appreciates, residents' purchasing power for imported goods and services increases, boosting consumption and, consequently, the velocity of money.

Conversely, a depreciation of the local currency makes local investments more appealing, attracting more funds into the economy. This influx of capital stimulates economic activity, thereby increasing the velocity of money.

Additionally, successive declines in the local currency's exchange rate against foreign currencies can lead to higher inflation rates. This prompts individuals to spend more quickly to avoid future price hikes, further accelerating the velocity of money

As for foreign trade, when the exchange rate of the local currency decreases, it means that exported products become cheaper for foreign buyers, which increases their demand and consequently increases the volume of foreign trade, leading to an increase in the velocity of money.

Changes in exchange rates impact foreign investments, influencing foreign investors' decisions to invest in a country. This, in turn, affects cash flow volumes and the velocity of money, Okoth (2013). When the central bank intervenes to adjust the exchange rate as part of its monetary policy, it also affects interest rates, leading to various impacts on the velocity of money. For instance, if the local currency's exchange rate decreases, the central bank may raise interest rates to attract more foreign capital and increase the currency's value (Okoth, 2013; Latief & Lefen, 2018). Therefore, these and other factors should be considered when examining the impact of exchange rates on the velocity of money in the Egyptian economy.

The exchange rate is one of the most important economic indicators that reflect the state of the economy in facing various economic shocks and the strength of the local currency against foreign currencies. The Egyptian economy has undergone numerous changes in the exchange rate of the pound relative to other currencies, which have affected many economic variables, Indeed, the impact of exchange rate changes on the velocity of money can be complex and multifaceted, influenced by numerous factors. Therefore, a comprehensive understanding of the country's economic situation is essential to accurately analyze the effect of exchange rate fluctuations on the velocity of money.

So the study attempts to answer the following questions: -

- **To what extent do exchange rate changes reflect on the velocity of money in the Egyptian economy from 2000 to 2021?**
- **"What is the impact of other variables such as interest rates, per capita income, foreign exchange reserves, local liquidity, and the volume of exports and imports on the velocity of money?**
- **Has the monetary authority been able to regulate local liquidity in line with economic growth through exchange rate policies?"**

Therefore, the aim of this study was to determine the direction of the relationship between the exchange rate and other variables affecting the velocity of money.

Theoretical Framework of Economic Theories:

Economists have developed various theories to explain the determinants of exchange rates, which in turn influence the velocity of money. The diversity in economic and financial indicators affecting currency value has resulted in multiple theories. These theories can be categorized into those based on economic variables and those based on financial variables.

First: Theories Based on Economic Variables

1- Purchasing Power Parity (PPP):

This theory was originally developed by the Swedish economist Gustav Cassel in 1922. It explores the relationship between purchasing power and exchange rates. The fundamental concept is that the exchange rate

of a currency is determined by its purchasing power both domestically and internationally. In other words, the value of a currency is based on what it can buy within the country compared to what it can buy abroad. Therefore, the exchange rate between two currencies is influenced by the relative price levels in the respective countries.

This theory relies on the following formulations:

- ***Absolute Formulation:***

The absolute purchasing power parity theory suggests that the exchange rate between the currencies of two countries should be equal to the ratio of their respective price levels. In other words, the purchasing power of a currency in one country should match its purchasing power in another Officer, L. H. (2022). The formula is expressed as:

$$S = P/P^*$$

Where:
S: Nominal exchange rate between the domestic currency and the foreign currency
P: Domestic price level
P*: Foreign price level

The reasoning behind this theory is that the domestic price level should be equal to the exchange rate multiplied by the foreign price level. However, the absolute purchasing power parity theory is built on a simplified model that overlooks several key factors, such as transportation costs, differences in consumption patterns across countries, and the presence of non-tradable goods and services. Moreover, the theory assumes efficient markets, whereas, in reality, we operate in imperfect economic markets where flexible prices allow for more effective market functioning Voinea, (2012).

There are also statistical difficulties, such as the construction of a price index, given that goods across different countries are not homogeneous. The price index includes both tradable and non-tradable goods, further complicating the practical application of this theory.

- *Relative Formulation:*

In contrast to the absolute formulation, the relative formulation is based on assumptions such as transportation costs, the free flow of information, and the elimination of trade barriers that prevent price

parity. This formulation emphasizes determining the equilibrium exchange rate by factoring in the inflation index. The nominal exchange rate adjusts to offset inflation differences between the two countries, meaning exchange rate equilibrium is reached when the rate of change in the exchange rate matches the rate of change in the price ratio Officer, L. H. (2022).

The relative version of the Purchasing Power Parity (PPP) theory asserts that the relationship between exchange rates and prices is determined not by a fixed level but by changes over time:

$$\Delta S = \Delta P^* - \Delta P$$

This equation shows that the rate of change in the nominal exchange rate equals the difference between the inflation rates in the domestic and foreign countries, Voinea (2013). This formulation suggests that countries with higher inflation rates will experience a decline in their currency value, impacting their trade balances.

- *Monetary Formulation:* **Rogoff, K. (1996)**

Within monetarist theory, the concept of Purchasing Power Parity (PPP) appears in a slightly different form, though it retains the core principle of the law of one price. Monetarists distinguish between two categories of goods: internationally tradable goods and non-tradable goods. According to their view, the law of one price applies strictly to internationally tradable goods, and the exchange rate is determined by the following mathematical formula:

$$e = PT / PT^* \longrightarrow 1$$

- **e represents the exchange rate.**
- **PT represents the prices of domestically traded goods.**
- **PT* represents the prices of internationally traded foreign goods.**

To express domestic prices, we use the following mathematical equations:

The following equations describe the relationship between domestic and foreign prices, considering the share of internationally traded goods:

- ***Domestic Prices*:**

$$P = \alpha PT + (1- \alpha) PN \longrightarrow 2$$

Where:

α: The share of internationally traded goods in the total domestically produced goods

PN: Prices of domestically non-tradable goods

- ***Foreign prices*:**

$$P^* = \alpha^* P^*T + (1- \alpha) PN^* \longrightarrow 3$$

α^*: The share of internationally traded goods in the total goods produced in the foreign country

Let's assume:

- **β is the equilibrium relative price between non-traded and traded domestic goods:**

$$\beta = P N / PT \longrightarrow 4$$

- **β^* is the equilibrium relative price between non-traded and traded foreign goods:**

$$\beta^* = P^* N / P^*T \longrightarrow 5$$

The domestic price level can be defined using only the prices of internationally traded goods as follows:

$$P = \alpha PT + (1 - \alpha) \beta PT \longrightarrow 6$$

The foreign price level can also be defined using only the prices of internationally traded goods as follows:

$$P^* = \alpha^*. P^*.T + (1 – \alpha^*) \beta^*.P^*.T$$

- **By substituting, we obtain:**

$$\gamma : [\alpha + (1 – \alpha)\beta]$$

$$\gamma *: [\alpha * + (1 - \alpha *)\beta *]$$

- **The domestic price level is:**

$$P = \gamma.P.T \longrightarrow 7$$

- **The foreign price level is:**

$$P^* = \gamma^*.P^*.T \longrightarrow 8$$

By substituting equations 7 and 8 into equation 1, we obtain the exchange rate as follows:

$$e = \frac{p}{P*} \cdot \frac{\gamma*}{\gamma} \longrightarrow 9$$

The foreign exchange rate is determined by the ratio of domestic to foreign price levels, as detailed in equation 9, and the relative importance of non-tradable goods, represented by α*, α, β*, and β.

While the monetary formulation offers a convincing explanation for equilibrium exchange rates based on price levels, its practical application reveals limitations. The theoretical assumptions are not fully supported by empirical evidence, as the law of one price has only been observed for certain globally traded commodities, such as gold, oil, minerals, and some agricultural products, MacDonald R. (2007).

The Balassa-Samuelson effect suggests that the simple Purchasing Power Parity (PPP) theory might not accurately reflect price differences between countries. This is because countries with higher productivity often have stronger currencies and higher price levels than PPP theory would predict, leading to discrepancies in price levels across nations, Krugman, Obstfeld et al. (2003).

One limitation of this theory is that it does not consider other factors influencing exchange rates, such as income levels, interest rates, and speculative activities. For instance, higher income levels can increase imports and thereby impact demand for foreign currency. Furthermore, the PPP theory is focused solely on the current account balance and does not encompass the entire balance of payments.

2- Balance of Payments Theory:

This theory, formulated by economist John Maynard Keynes, posits that the exchange rate of a currency is determined at the point where the demand for foreign currencies equals the supply of foreign currencies. The balance of payments deficit or surplus serves as the main criterion for evaluating currencies, Krugman, Obstfeld et al. (2003).

When a deficit occurs in the balance of payments, it indicates a higher demand for foreign currency and an increased supply of the domestic currency, leading to a depreciation of the domestic currency's value. Conversely, a surplus in the balance of payments results in higher demand for the domestic currency, which causes its value to appreciate.

Some economists argue that World War I supported this theory, as the German mark's value remained stable despite an increase in the money supply, a higher velocity of money, and rising general price levels. This stability was attributed to the equilibrium in the balance of payments, which allowed Germany to avoid relying on imports.

However, the theory has limitations. It primarily examines how the balance of payments affects the exchange rate but does not consider how fluctuations in the exchange rate impact the balance of payments. Changes in a currency's external value—whether an appreciation or depreciation—can significantly influence exports and imports. Furthermore, the balance of payments affects the exchange rate through economic transactions, which complicates the exclusion of short-term capital flows. These flows are adjustments made by the state to correct imbalances in the balance of payments, but excluding them is impractical, as capital account transactions are an essential part of the balance of payment.

3- Productivity Theory:

This theory focuses on the link between relative productivity levels in two countries and their impact on exchange rates. For economic balance and monetary stability, the exchange rate should reflect productivity trends. A country with higher productivity in a specific sector can produce goods at a lower cost, leading to lower export prices. This

creates greater demand for its currency, thereby increasing its value relative to other currencies, Feenstra, R. C., & Taylor, A. M. (2014).

The local currency should be valued according to the productivity levels of various sectors within the national economy. If productivity is low and the currency is set above its true value, it will result in higher domestic prices (due to reduced production) and decreased exports (due to the stronger currency). Furthermore, higher demand for foreign goods will contribute to a larger trade deficit and, ultimately, a bigger balance of payments deficit.

The Productivity Theory's explanation of exchange rates is based on several economic concepts, including those discussed by Rogoff (1996).

1. **Balassa-Samuelson Model: This model suggests that countries with higher productivity in tradable goods will experience an increase in their real exchange rate.**

2. **Relative Purchasing Power Parity Equation: This equation emphasizes that differences in productivity lead to changes in the prices of tradable goods, which in turn affect the exchange rate.**

<u>Second: Theories Based on Monetary and Financial Variables:</u>

1- Quantity Theory of Money:

This theory examines how changes in the money supply and its velocity impact the general price level and the depreciation of the domestic currency. It emphasizes the reciprocal relationship between the exchange rate and the velocity of money, Blanchette, Jude (2005).

When prices rise, demand for domestic goods decreases, leading to a reduction in exports and an increase in imports. This situation boosts the demand for foreign currency to pay for imports while decreasing the demand for domestic currency, which results in a lower exchange rate. On the other hand, if the money supply decreases and its velocity slows down, the overall price level of goods and services falls. This decrease in prices increases demand for exports, thereby raising the demand for the domestic currency and increasing its exchange rate.

A key criticism of this theory, according to Keynesian economics, is that price changes are not solely influenced by changes in the money supply. Thus, fluctuations in exchange rates cannot be explained by changes in the money supply alone.

2- Interest Rate Parity Theory:

Economic theories have long indicated that exchange rates are significantly influenced by financial variables, including domestic and foreign interest rates, as well as the demand and supply for monetary and financial assets. The Interest Rate Parity Theory, developed by the English economist John Maynard Keynes, explains the relationship between the money market and the foreign exchange market.

It shed light on the difference between domestic and foreign interest rates and the changes in both the spot and forward exchange rates. According to the theory, investors cannot achieve higher returns abroad than those available in the domestic market when investing in assets with higher interest rates than those prevailing locally. This is because the interest rate differential is offset by the difference in the spot and forward exchange rates, Krugman (2003). The process is outlined as follows:

Option 1:

Investors can invest an amount M in their local market for one year, earning an interest rate of i_d. At the end of the period, they receive an amount of $(1 + id)$

where:

- **id is the domestic interest rate.**

Option 2:

Alternatively, investors can place their funds in foreign markets and hedge against risks. This involves converting the invested amount into foreign currency at the current exchange rate, investing it abroad at the prevailing foreign interest rate, and then converting it back to the domestic currency at the forward exchange rate to recover the invested

amount. The final amount the investor receives can be calculated using the following relationship:

$$\frac{M}{Cc}(1 + ie)Ct$$

Where:

- **Cc represents the current spot exchange rate, which is the rate for immediate delivery of foreign currency in exchange for the domestic currency.**
- **Ct represents the forward exchange rate, which is the agreed rate for buying or selling a specific amount of foreign currency at a future date.**
- **ie is the foreign interest rate.**
- **M/Cc represents the conversion of the amount M from foreign currency into the domestic currency at the current spot exchange rate.**

The spot exchange rate (Cc) refers to transactions involving the immediate exchange of currencies and is influenced by factors such as inflation rates, interest rates, and the balance of payments. In contrast, the forward exchange rate (Ct) is the agreed rate for a future transaction and is affected by the supply and demand for foreign currencies and speculation.

An investor who hedges against currency risk is willing to invest in either domestic or foreign financial instruments based on the premise that expected returns are equal. This can be expressed by the following equation:

$$(1 + id) = \frac{M}{Cc}(1 + ie)Ct$$

This theory demonstrates that exchange rate fluctuations are influenced by interest rates in the short term, in contrast to the Purchasing Power Parity theory, which explains exchange rate changes over the long term.

Despite the validity of this theory, there are some factors that can undermine its effectiveness:

- **When central banks implement exchange rate controls, this can create barriers that hinder the movement of capital.**
- **Speculative activities in foreign currencies can lead to volatility in exchange rates.**

3- Portfolio Balance Theory:

The Portfolio Balance Theory explains how exchange rates are determined by the balance of supply and demand for various financial assets, such as bonds and stocks, and by international investors' investment decisions. This theory complements others like Purchasing Power Parity and Interest Rate Parity, but it focuses specifically on how investors allocate their portfolios across different currencies.

Key contributions to this theory come from economists such as Branson (1972, 1976), McKinnon (1969), and Dornbusch (1975), with further developments by Branson and others (1977, 1979), Gertler and Henderson (1977), and Branson and Henderson (1985), Wang (2020).

According to this theory, investors aim to achieve an optimal balance in their portfolios by diversifying their investments among various currencies and assets. This balance is based on the expected returns and risks associated with each currency or asset. Investors make decisions to buy or sell foreign currencies to attain the best possible balance between returns and risks. Wang (2020)

The total demand for each asset class can be represented by the following equations:

$$W = M + B + F \longrightarrow 1$$

These equations align with the total demand for assets (WWW), where:

- **M represents the total money supply,**
- **B represents domestic bonds,**
- **F represents foreign bonds.**

This equation reflects the components of total wealth (WWW) and demonstrates how they sum up to the overall demand for assets in the economy.

The following equations reflect the equilibrium conditions in the asset markets for the simple Portfolio Balance Model, where the supply of money, domestic bonds, and foreign bonds equals the desired holdings:

In this model, equilibrium is achieved when the actual supply of money, domestic bonds, and foreign bonds matches the amount that investors want to hold.

$$M = m (r, r^* + \Delta e , W) \longrightarrow 2$$

Equation 2 demonstrates the demand for money in the portfolio, which is inversely related to the domestic interest rate. Additionally, it is inversely related to the foreign interest rate, adjusted for the expected change in the exchange rate, known as the return on foreign bonds ($r^*+\Delta e$). Conversely, the demand for money is positively related to total wealth (W).

$$B = b (r , r^* +\Delta e , W) \longrightarrow 3$$

Equation 3 shows that the demand for domestic bonds is positively related to the domestic interest rate, inversely related to the return on foreign bonds, and positively related to total wealth.

$$F = f (r , r^* +\Delta e , W) \longrightarrow 4$$

In Equation 4, the demand for foreign bonds is positively related to the expected return on foreign bonds, inversely related to the interest rate on domestic bonds, and positively related to total wealth.

In a balanced portfolio, the exchange rate plays a crucial role in maintaining equilibrium between asset demand and supply. When the local currency depreciates, it increases the value of foreign assets, thereby boosting overall wealth. This increase in wealth expands the demand for all types of assets, including money. The resulting wealth effect from the local currency's depreciation will drive up domestic interest rates to restore balance in the money market, as the demand for money rises.

A depreciation of the local currency necessitates an increase in domestic interest rates to achieve equilibrium in the money market. In the domestic securities market, this depreciation and the subsequent rise in domestic interest rates will lead to higher demand for local bonds, which in turn increases bond prices and lowers bond yields to rebalance the market.

In the foreign securities market, higher domestic interest rates reduce demand for foreign bonds, leading to their sale. This results in an excess

supply of foreign currency in the exchange markets and a rise in the exchange rate of the local currency.

In summary, the exchange rate ensures balance across both domestic and foreign markets within the framework of the portfolio balance theory. Kallianiotis (2021).

Literature Review:

Examining the quantitative economic determinants of money velocity provides an opportunity to understand the relationship between money and various economic variables. The exchange rate stands out as a key factor influencing money velocity, given its effect on the trade flows of exports and imports, as well as capital movements. Additionally, the exchange rate serves as a crucial tool in monetary policy to achieve both internal and external economic balance.

This analysis can offer valuable insights into economic dynamics and help guide monetary policy decisions. Money velocity is a crucial element in monetary policy, and accurate data on it is essential for crafting effective policies. Understanding its relationship with economic cycles is vital for sustaining a stable and strong economy. Moreover, money velocity significantly influences the transmission of policy measures and can impact key economic indicators like inflation and economic growth.

Consequently, studies are often classified according to their relationship with economic growth and other economic variables. The research on money velocity in Iraq from 1980 to 2013 offers valuable insights, particularly in identifying the factors that influence money velocity and their implications for the country's monetary policy. Wesam Al Aneiz (2015) discovered a long-term relationship between these factors and money velocity, suggesting that they have a lasting impact on money velocity in Iraq. Furthermore, the study revealed that money velocity is unstable, underscoring the importance of careful consideration when formulating monetary policy in Iraq.

Additionally, Castañeda and Cendejas (2023) examine the relationship between changes in money velocity and monetary growth. Through an analysis of data spanning a century, they find that fluctuations in money velocity are typically short-lived and tend to revert to the mean. They

also identify periods of monetary equilibrium when money velocity stays close to its average.

Similarly, Sameer Neema and Ghnin Salih (2021) emphasize the importance of understanding the relationship between cash balances and income flow over time, noting that changes in spending can occur independently of the money supply. Their study aims to predict the path of money velocity in the Iraqi economy up to 2030 using the ARIMA method. They conclude that fluctuations in government spending, driven by changes in oil revenues, have rendered the money supply an endogenous variable, thereby limiting the monetary authorities' capacity to control the trajectory of money velocity changes.

Köse Y and Alı, S. (2021) studied the effects of monetary and fiscal policies on economic growth in Iraq. Analyzing factors such as the exchange rate, inflation, cash as a monetary tool, public debt, government spending, and state revenues using data from the Central Bank of Iraq (2005-2019), they employed the ARDL Bound Test and OLS. The study found that the exchange rate negatively impacts economic growth, while inflation and money supply have positive effects. In contrast, government debt and expenditures negatively affect growth, whereas state revenues have a positive impact.

To investigate the complex interplay between monetary growth, economic growth, and inflation in Egypt, Ahmed EL Talbany (2022) examined the relationship between economic growth and inflation rates from 1990 to 2020. The study revealed a significant correlation among GDP, inflation rates, and money velocity. By employing a standard model, the study estimated these relationships and conducted static tests, unit root tests, and co-integration analyses. The findings demonstrated stability in both inflation rates and money velocity after accounting for first differences, while economic growth remained steady. Furthermore, the study explored factors influencing money velocity in Egypt and its reaction to changes in economic growth and inflation, identifying a long-term integrative relationship that indicates fluctuations in economic growth and inflation directly affect money velocity.

In summary, these studies highlight that expansionary monetary policies aimed at increasing national output can potentially result in higher inflation rates. They underscore the complex interplay between economic growth, inflation, and money circulation, emphasizing the

importance of carefully managing monetary policies to achieve sustainable economic growth and maintain stable inflation levels.

The global economic downturn has reduced credit activity, domestic production, and foreign direct investment, challenging economic growth. Bojan Dimitrijević and Ivan Lovre (2012) investigate how monetary policy can stimulate economic growth without causing inflation. Their study analyzes money demand and supply, the quantity theory of money, and monetary policy tools. They recommend a new approach to money creation and monetary instruments, emphasizing the need for a strong link between money supply and real GDP growth, effective control of the money supply, and maintaining stable long-term interest rates to ensure stable money velocity. This approach could significantly enhance economic growth over the long term.

Nyumuah Felix S. (2018) explored how fluctuations in interest rates and exchange rates impact money demand in emerging economies, specifically Equatorial Guinea, Gambia, Nigeria, and Uganda. Using time series data and a standard log-linear money demand function, the study analyzed variables such as income, interest rates, inflation rates, exchange rates, and their volatilities. The findings reveal that, generally, fluctuations in interest and exchange rates do not significantly affect money demand in these countries. However, the money demand functions in these economies exhibit signs of instability. The study recommends that monetary authorities should focus on inflation-targeting policies and use interest rates as a primary tool for policy implementation.

Previous research relying on linear models assumed that exchange rate fluctuations had symmetrical effects on money demand in developing countries but did not find a significant relationship. However, Oskooee et al. (2019) used a nonlinear model and discovered that exchange rate fluctuations have a significant impact on money demand in most emerging economies, with these effects being asymmetric.

To identify the key factors affecting the velocity of money, Alvin Prasetyo (2018) examines the determinants of money demand and velocity in Indonesia. Utilizing data from the International Financial Statistics and employing the ARDL method, his study covers the period from Q1 2000 to Q4 2017. The analysis finds that all variables are stationary at I(0), and the Bound test indicates cointegration, leading to the use of the ARDL (4, 2, 0, 0, 0) model. The results reveal that both

economic growth and the rupiah/USD growth rate have a significant impact on the long-term and short-term growth of M2, while the velocity of money in Indonesia displays an upward trend.

Yara Sakran (2022) aims to assess the impact of the foreign exchange rate on macroeconomic indicators in Egypt by quantitatively analyzing its relationship with key variables such as inflation rate, budget deficit, balance of payments (BOP), and foreign direct investment (FDI) from 1990 to 2020. Using time series analysis tools and the Autoregressive Distributed Lag Model (ARDL), the study finds a long-term negative effect of the exchange rate on the budget deficit, as well as a short-term negative impact. Additionally, it reveals a short-term positive effect of the exchange rate on inflation and the balance of payments, with no significant impact on foreign direct investment.

Rola Ismail and Hussein Hassan (2018) analyzed macroeconomic factors affecting money velocity (VM) in Syria from 1990 to 2010 using ADF testing and the ARDL method. They found a positive relationship between per capita income growth and VM, supporting the quantity theory of money. In contrast, the real exchange rate, population growth rate, and degree of monetization were negatively associated with VM in both the short and long terms. The development of the banking sector had a positive short-term effect on VM but a negative long-term effect. The inflation rate negatively impacted VM in the short term but was insignificant in the long term. The study concludes that increasing the money supply without causing high inflation is not an effective monetary policy strategy.

Djamal DEKKICHE (2022) used a VECM regression model to examine the relationship between money supply and inflation rate in Egypt from 1990 to 2019. The model included four independent variables: money supply (MS), imports (IMP), Gross Domestic Product (GDP), and exchange rate (EXCH). Using the Johansen-Juselius co-integration test and Vector Error Correction Model, the study identified both long-term and short-term relationships among the variables. It was found that, except for GDP, all other factors had a positive effect on the inflation rate. The study concluded that the money supply is the main long-term predictor of inflation rate in Egypt.

Inflation in Egypt has fluctuated significantly over the years. Before the early 1970s, it was relatively low, averaging under 5 percent. After the 1973 oil shock, inflation rose to about 13 percent annually until the mid-

1980s and then exceeded 20 percent annually from 1986 to 1992. By the early 1990s, a stabilization program reduced inflation to single digits in 1993/1994 and slightly above 6 percent in 1996/1997.

As interest rates vary due to adjustments by the Federal Reserve and the impact of crises and conflicts, Zogb and Elkary (2014) explore the causal relationship between exchange rate fluctuations and changes in the general price level in Algeria from 1980 to 2014. They use the vector autoregression model (VAR) to analyze and describe the nature of this relationship. The study finds a long-term dynamic relationship between the exchange rate and inflation. Additionally, it shows that the real effective exchange rate of the dinar has a minimal impact on inflation.

Additionally, T. Kerrouche and Ayachimed (2022) examine the causal relationship between the exchange rate and money velocity in Algeria from 1990 to 2017. Their study aims to determine the direction of this relationship using the Granger causation test. Unit root tests for stationarity revealed that both the exchange rate and money velocity are stable at their respective levels. The results show a short-term causal relationship primarily flowing from money velocity to the exchange rate.

Magdy Masoud (2023) conducted a study on exchange rate fluctuations and their impact on money velocity, focusing on the Libyan case from 1970 to 2010 using Gregory and Hansen's methodology. The study found a long-term integrative relationship between the variables, as indicated by the cointegration regression methods. However, it also revealed that there was no significant long-term relationship between the exchange rate and money velocity throughout the study period. Additionally, the author showed a one-way causal relationship running from money velocity to the exchange rate, but only in the long term.

Since World War II, fluctuations in U.S. M1 velocity have primarily been driven by sustained disturbances in interest rates, which are closely linked to short-term interest rates and account for most long-term variations in M2-M1 velocity. Persistent shocks specific to M2-M1 have had minimal impact. Hypothetical simulations suggest that, in the absence of these enduring interest rate shocks, M1 velocity would have remained more stable and fluctuations in M2-M1 velocity would have been less pronounced historically.

In contrast, Oyadeyi (2024) investigated the velocity of money and its implications for monetary policy in Nigeria using the quantile ARDL approach. This study highlights the importance of understanding money velocity for shaping demand, managing liquidity, and controlling inflation, with the exchange rate playing a crucial role in influencing money velocity and achieving economic balance.

The dynamics of money velocity have evolved, resulting in a gradual change in how macroeconomic shocks affect it. Omid M. Ardakani (2023) explores how money velocity responds to external shocks within a system of equations that jointly determine money velocity, real output growth, money growth volatility, expected inflation, and risk premium. The research also examines the regime-switching characteristics of money velocity using a Bayesian threshold approach. The main findings of the study reveal a significant decline in money velocity following negative shocks to output and expected inflation, which is then followed by a sharp increase.

Poroshenko et al. (2021) investigated how money supply, money velocity, interest rates, and inflation impact non-cash transactions in Indonesia, using a quantitative research approach with causal analysis. The study analyzed 480 data points from 2012 to 2019, sourced from Bank Indonesia and the Central Statistics Agency. Findings revealed that money supply, money velocity, and inflation significantly influence non-cash transactions. Specifically, changes in non-cash transaction volumes lead to a notable elastic response from the money supply. This study underscores the important implications for government policies, particularly those related to monetary policy and money supply demand in Indonesia.

Our study shares similarities with previous research in that it investigates the determinants of money velocity, including factors like exchange rates, inflation, and per capita income. However, the main difference is in our focus and context. While earlier studies have looked at how variables such as exports, imports, foreign reserves, and interest rates influence exchange rates and, in turn, money velocity, our study specifically examines the direct impact of exchange rates on money velocity. This contrasts with previous work, which often explored the broader causal relationships between these variables.

Methodology:

To achieve the study's objectives and confirm its hypotheses, a descriptive and analytical approach was followed. Theories were presented, and data and numerical indicators were used to illustrate the impact of exchange rate changes on the velocity of money in Egypt. This was done using econometric methods to identify the most important economic variables.

Data Source:

The study examines the impact of exchange rate changes on the velocity of money, addressing several variables as follows:

Variable name	Symbol	Definition	Source
Money Velocity(Y)	M V	Money velocity indicates how often a single unit of currency is spent on goods and services over a specific timeframe. It is determined by dividing the GDP by the total money supply, reflecting the speed at which money moves through the economy. Mv = GDP/ m2	Central Bank of Egypt
Foreign reserves(x1)	Total Res	They are foreign financial assets held by central banks in foreign currencies, including foreign currencies, foreign financial assets, Special Drawing Rights (SDRs), and gold.	World Data Bank
Money Supply(x2)	M2	is a measure of the money supply that includes cash, checking deposits, and easily convertible near-money assets like savings deposits and money market securities. It represents a broader classification of money compared to M1.	Central Bank of Egypt
Real Interest Rate(x3)	Real rate	It is the rate that takes into account the impact of inflation on returns from investments and loans. Real interest rate = Nominal interest rate - Inflation rate	World Data Bank
GDP per Capita(x4)	Per capita income	GDP per capita is the total economic output of a country divided by its population, indicating the average income per person and helping to assess the standard of living and economic prosperity.	World Data Bank
Import(x5)	Im	Bringing goods, services, or information into a country to meet domestic demand.	World Data Bank
Gross Domestic Product(x6)	GDP	It is the total value of goods and services produced during a certain period of time and is an indicator of the size and performance of the economy.	World Data Bank
Export(x7)	Ex	Sending goods, services, or information to other countries to generate income and boost the economy.	World Data Bank
Foreign Exchange Rate(x8)	Ex Rate	It is the price of a particular country's currency relative to the currency of another country	World Data Bank
Financial Development(x9)	M1/M2	The degree of financial development is calculated by dividing M1 by M2	Central Bank of Egypt

The study will analyze the impact of exchange rate fluctuations on the velocity of money and the nature of their relationship within the Egyptian economy. This analysis will be based on annual data from 2000 to 2024 and will be guided by the following hypotheses:

1. **There is a significant inverse relationship between Total foreign reserves and money velocity.**
2. **There is a significant inverse relationship between M2 and money velocity.**
3. **The real interest rate has a positive impact on and money velocity.**
4. **Exchange rate changes have a significant negative impact on money velocity.**
5. **There is a significant relationship between Gross Domestic Product (GDP) and money velocity**
6. **There is a positive relationship between GDP per capita and money velocity.**

This study utilized annual data from the period 2000 to 2024 for the economic variables mentioned below. The authors employed multiple linear regression as the analysis method. The econometric and statistical tests conducted in this study include classical assumption tests, as well as the t-test and F-test.

Table (1): Multiple Linear Regression Model

Dependent Variable: LOG(LM_V)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.618451	1.198843	6.354835	0.0000
LTOTAL_RESERVE (X1)	-0.157229	0.063841	-2.462827	0.0299
LM2 (X2)	-0.372119	0.094429	-3.940734	0.0020
REAL_INTRESET_RATE (x3)	0.001371	0.003283	0.417646	0.6836
LGDP_PERCAPITA (x4)	0.740117	0.143308	5.164536	0.0002
IMPORT (x5)	-0.002670	0.003071	-0.869380	0.4017
GDP (x6)	0.005247	0.010596	0.495231	0.6294
EXPORT (x7)	0.011186	0.005498	2.034458	0.0646
EXCHANGE_RATE (x8)	0.050486	0.013745	3.672974	0.0032
FINANCIAL_DEVELOPMENT (x9)	0.041465	0.577571	0.071793	0.9439

R-squared	0.944291	Mean dependent var	5.099288
Adjusted R-squared	0.902510	S.D. dependent var	0.138448
S.E. of regression	0.043228	Akaike info criterion	-3.141694
Sum squared resid	0.022424	Schwarz criterion	-2.645765
Log likelihood	44.55863	Hannan-Quinn criter.	-3.024868
F-statistic	22.60064	Durbin-Watson stat	1.977719
Prob(F-statistic)	0.000003		

Forecasting Equation:

$$LM\_V = 7.61845125225 - 0.15722899619X_1 - 0.372119178076X_2 + 0.00137114654353X_3 + 0.740117177233X_4 - 0.00267023582323X_5 + 0.00524724767068X_6 + 0.0111860780937X_7 + 0.0504855071186X_8 + 0.0414654237604X_9$$

The test results indicate that several economic variables are statistically significant. Total reserve money is significant with a p-value of 0.0299. The money supply is significant at p-values of 0.0020, while GDP per capita is significant with at 0.0002. The exchange rate is significant at p-value 0.0032. The overall model is highly significant, with a p-value of 0.0000, an R^2 explain 0.94 from model, and a Durbin-Watson statistic of 1.97.

To conduct time series analysis, it is essential that all series involved in the analysis are stationary. This is because R^2 and t-statistics can provide misleading results when stationarity is not achieved, increasing the risk of spurious regression (Newbold and Granger, 1974; Gujarati and Porter, 2009). Unit root tests are the most commonly used method for assessing the stationarity of a series (Gujarati, 1999).

Table (2): Dickey-Fuller test for stationarity

Variable	ADF(calculated)	ADF at 5% critical	Result
Money Velocity	-4.622209	-3.040391	Stable at 2nd difference
LTOTAL_RESERVE	-3.874974	-3.040391	Stable at level
LM2	-4.759690	-1.961409	Stable at 2nd difference
LGDP_PERCAPITA	-5.251298	-3.020686	Stable at 2nd difference
EXCHANGE_RATE	-3.326465	-3.012363	Stable at 1st difference

Source: Done by authors, depending of EViews (12)

According to the augmented Dickey-Fuller test, time series variables may not be stationary at the level, which implies they might contain a unit root. They become stationary after taking either the first or second difference, indicating that they are integrated of order one or twice.

For the LTOTAL_RESERVE variable, the ADF test indicates that it is "stable at level," meaning the series is naturally stationary, with its statistical properties, like the mean and variance, remaining consistent over time. There is no need for differencing since the series does not exhibit any trends, seasonality, or other forms of non-stationary behavior.

For the exchange rate variable, it becomes stationary after taking the first difference. In contrast, the other variables such as broad money supply, money velocity, and per capita income only become stationary after taking the second difference.

Overall, the degree of stationarity varies among the variables, with some requiring a first difference to achieve stationarity, while others need a second difference.

Data forecasting:

The ARIMA model is especially valuable for analyzing time series data that are not initially stationary. By identifying the appropriate values for p, d, and q, the model can effectively capture trends and forecast future values. The optimal model is chosen using statistical tools such as Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots, along with evaluation metrics like the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

Table (3): ARIMA Model

Dependent Variable: LOG(LM_V)
Method: ARMA Maximum Likelihood (BFGS)
Date: 03/05/24 Time: 17:03
Sample: 2000 2024

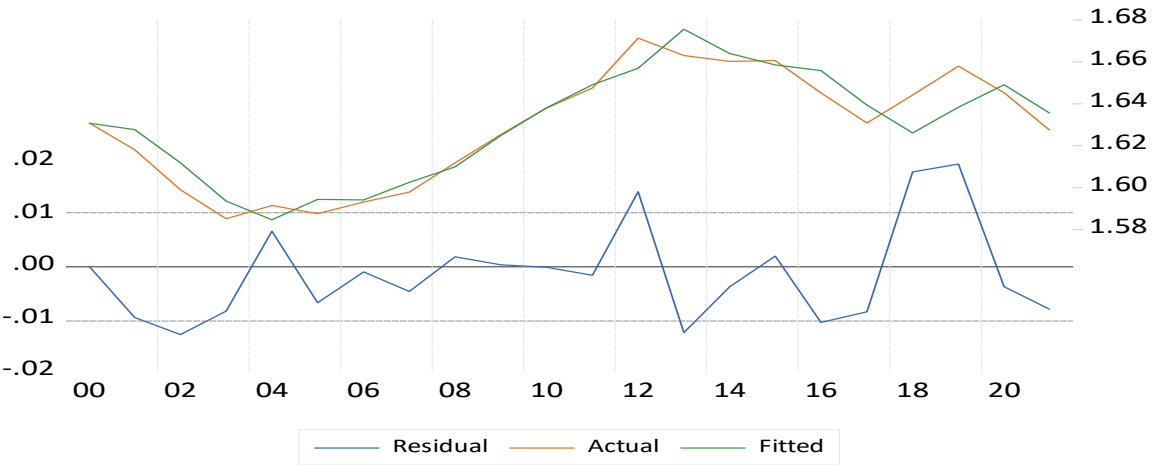
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.630498	0.004003	407.3307	0.0000
AR(1)	1.843267	0.074018	24.90292	0.0000
AR(2)	-0.938225	0.059126	-15.86830	0.0000
MA(1)	-0.999997	9041.812	-0.000111	0.9999
SIGMASQ	8.24E-05	0.025751	0.003198	0.9975

R-squared	0.883598	Mean dependent var	1.628748
Adjusted R-squared	0.856210	S.D. dependent var	0.027226
S.E. of regression	0.010324	Akaike info criterion	-5.885227
Sum squared resid	0.001812	Schwarz criterion	-5.637263
Log likelihood	69.73750	Hannan-Quinn criter.	-5.826814
F-statistic	32.26149	Durbin-Watson stat	1.750396
Prob(F-statistic)	0.000000		

Inverted AR Roots	.92-.30i	.92+.30i
Inverted MA Roots	1.00	

Based on the previous table of ARIMA model results, the autoregression degree is AR= (1) and MA= (1) The t-test value was 24.90292 and the F-test value was 32.26149 both have p- value equal 0.000, indicating that the null hypothesis is rejected in favor of the alternative hypothesis. The R^2 coefficient of determination, representing the strength of the association, reached 88% while the remaining percentage12% reflects other factors not included in the model. The following figure illustrates the model's quality and suitability for prediction.

Figure (1): Fitted Model

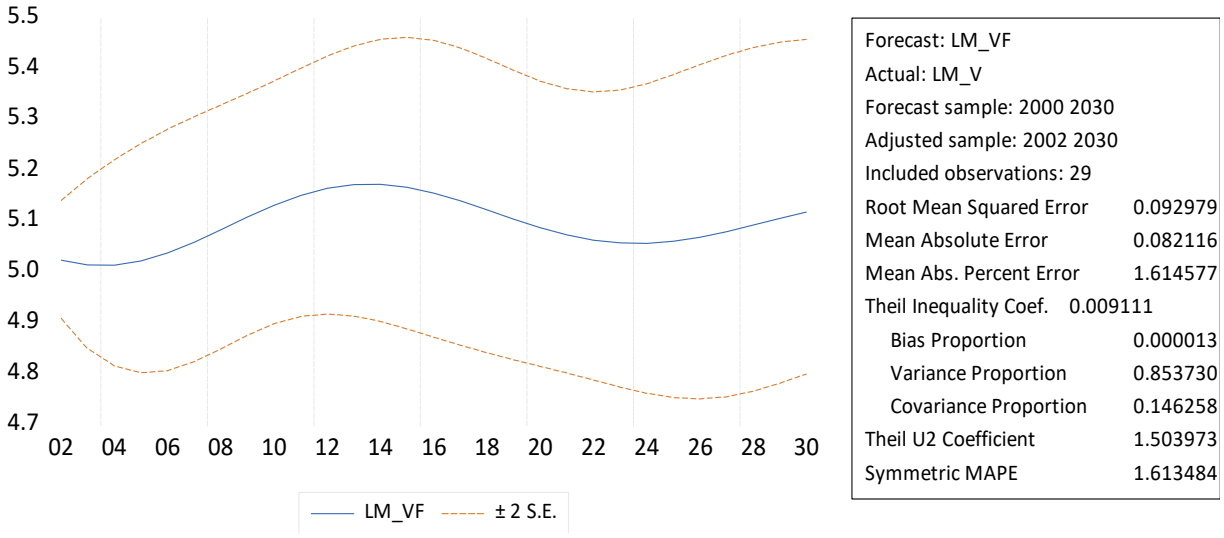


The figure above indicates that the ARIMA model is well-fitted, as evidenced by the minimal difference between the actual and fitted values.

The forecast model (LM_VF) for money velocity shows relatively good accuracy, as evidenced by the low error metrics (RMSE, MAE, MAPE). The low bias proportion suggests that there is minimal systematic bias, while the high covariance proportion indicates that most of the forecast error results from random variations rather than a poor alignment with the underlying trend.

After adjusting the time series to achieve stability, the future values for money velocity up to 2030 were determined. The results show that, after taking the logarithm, money velocity will fluctuate between the values of (5.057901 , 5.119092), indicating its instability .This fluctuation is attributed to the prevailing economic conditions during that period, including the revolutions followed by the devaluation of the pound.

Figure (2) Future trends in money velocity.



To forecast the exchange rate variable, the ARIMA model was applied, revealing the variable's rank with an autoregressive degree (AR) of 1 and a moving average degree (MA) of 1. This indicates that the function is integrated of the first order, meaning it has stabilized at the first difference. The model's significance is confirmed by an R^2 value of 87%, suggesting a strong correlation, while the remaining 13% is explained by another factors not included in the model This is demonstrated in the following table.

Table (4): Forecasting Exchange Rate

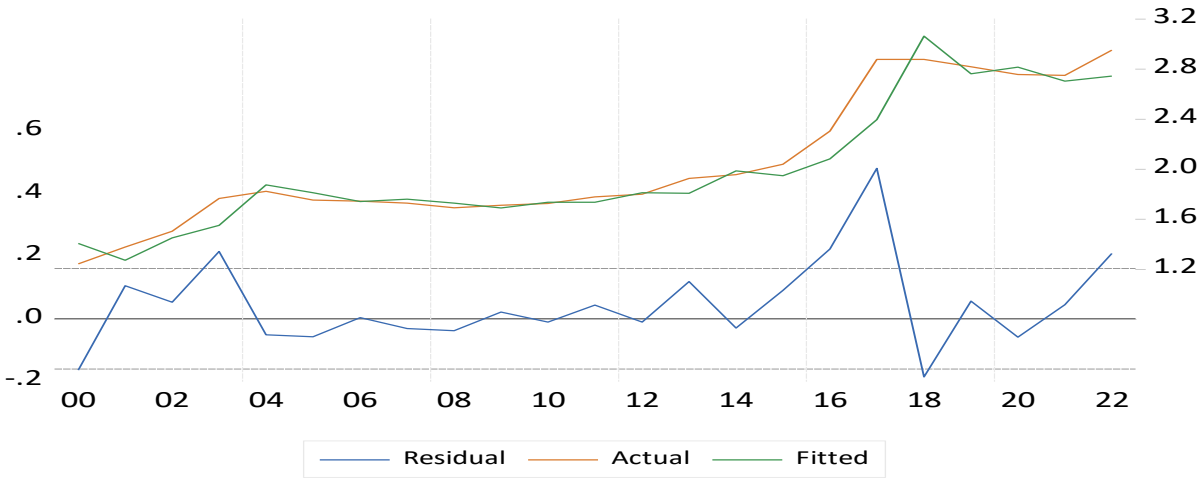
Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 09/11/24 Time: 06:51 , Sample: 2000 2024

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.090206	0.704445	2.967169	0.0079
AR(1)	0.960465	0.152078	6.315622	0.0000
MA(1)	0.449835	0.357696	1.257590	0.2238
SIGMASQ	0.021253	0.005387	3.945447	0.0009

R-squared	0.920496	Mean dependent var	2.040228
Adjusted R-squared	0.907943	S.D. dependent var	0.528654
S.E. of regression	0.160399	Akaike info criterion	-0.513291
Sum squared resid	0.488826	Schwarz criterion	-0.315814
Log likelihood	9.902850	Hannan-Quinn criter.	-0.463626
F-statistic	73.32714	Durbin-Watson stat	1.798497
Prob(F-statistic)	0.000000		

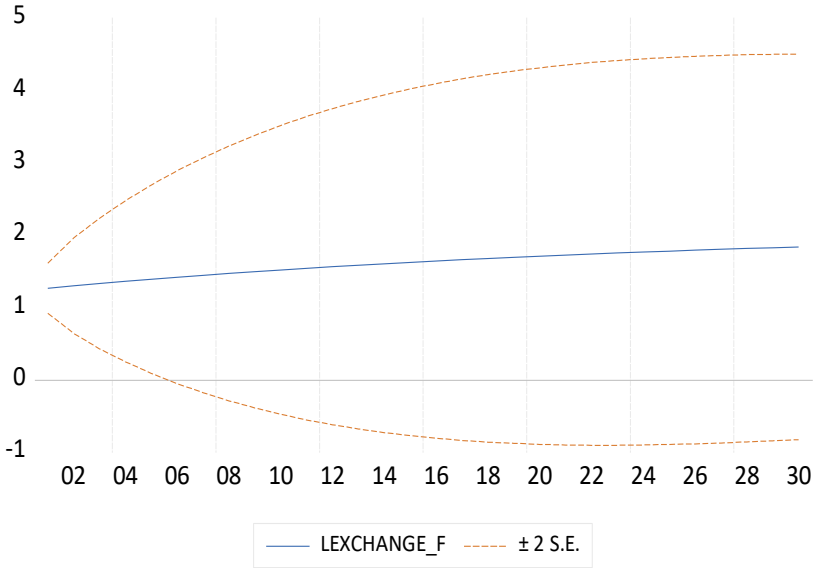
Figure (3): An illustrative chart of future values for exchange rate fluctuations.



The forecast model (EXCHANGE_RF) for the exchange rate demonstrates moderate accuracy. The error metrics (RMSE, MAE, MAPE) indicate that there is potential for improvement, especially considering the relatively high MAPE and Theil U2 coefficients. The low bias proportion suggests minimal systematic bias, while the balance between variance and covariance proportions implies that forecast errors arise from both random fluctuations and differences in variability between the predicted and actual data.

After stabilizing the time series, the future exchange rate values up to 2030 were determined. The results indicate that the exchange rate fluctuates between 1.263328 and 1.833516, highlighting its instability.

Figure (4) Future trends in Exchange Rate



Forecast: LEXCHANGE_F	
Actual: LEXCHANGE_RATE	
Forecast sample: 2000 2030	
Adjusted sample: 2001 2030	
Included observations: 30	
Root Mean Squared Error	0.666995
Mean Absolute Error	0.545485
Mean Abs. Percent Error	23.70769
Theil Inequality Coef.	0.181587
Bias Proportion	0.668837
Variance Proportion	0.286750
Covariance Proportion	0.044413
Theil U2 Coefficient	3.524326
Symmetric MAPE	27.83999

Results:

Our study examines the impact of exchange rate changes on the velocity of money circulation. It incorporates various other variables related to real and monetary factors that influence exchange rates, as outlined by the economic theories discussed. The results of the statistical analysis reveal that the independent variables account for 94% of the variation in the dependent variable, demonstrating a strong explanatory power.

1. ***First Hypothesis:*** **There is a significant inverse relationship between Total foreign reserves and money velocity.**

The results indicate a statistically significant inverse relationship between foreign currency reserves and the velocity of money circulation. This relationship can be explained by the policies governing the use of foreign reserves in economic management.

For instance, using foreign reserves to support the Egyptian pound against other currencies, particularly the US dollar, in order to maintain currency stability may reduce the amount of liquidity available in the local market, leading to a decrease in the velocity of money circulation. Additionally, the government utilizes foreign reserves to cover trade deficits, pay off external debts, and settle interest payments, resulting in the outflow of foreign currency from the country, a reduction in local liquidity, and a slowdown in the velocity of money.

Moreover, employing foreign reserves to maintain monetary stability may come at the expense of local investments, potentially causing economic activity to slow down and further decreasing money velocity.

2. ***Second Hypothesis:*** **There is a significant inverse relationship between M2 and money velocity**

The results indicate a significant inverse relationship between money supply and money velocity. When people increase their savings in the form of time deposits or savings accounts due to expectations of economic instability, a substantial portion of the available money in the economy is not used for consumption or investment. This causes a significant amount of money to be effectively removed from circulation, reducing market activity and slowing down the velocity of money.

Similarly, companies often increase their savings during periods of negative economic expectations as a precaution against potential risks. This further reduces spending, leading to a decline in the velocity of money circulation.

3. ***Third Hypothesis:*** **The real interest rate has a positive impact on money velocity.**

The results indicate no significant relationship between the real interest rate and money velocity. This could be because the interest rate in Egypt does not truly reflect the overall increase in price levels or compensate for the loss of purchasing power, resulting in a negative real interest rate.

Additionally, the lack of a significant relationship could be attributed to a large portion of the Egyptian economy operating within the informal sector, where money circulates outside the formal banking system and is not influenced by the official interest rate.

4. ***Fourth Hypothesis*****: Exchange rate changes have a significant negative impact on money velocity.**

The study findings indicate a significant positive relationship between the exchange rate and the money velocity. This suggests that the economy is heavily impacted by global economic conditions due to Egypt's growing dependence on imports. From 2000 to 2024, the relationship between exchange rate and the velocity of money was positive, aligning with economic theories. An increase in the dollar exchange rate results in a depreciation of the local currency, reducing the purchasing power of the pound. This prompts individuals to invest in other value-preserving assets, such as gold, which in turn boosts the velocity of money circulation.

An increase in the dollar exchange rate leads to higher import prices for essential goods, which drives up inflation and raises local prices. As a result, individuals may increase their spending on goods and services in anticipation of further price hikes, thereby boosting money velocity. Additionally, investors and traders are likely to accelerate the circulation of money to purchase foreign currencies or assets that retain value, further enhancing the velocity of money.

5. ***Fifth Hypothesis:*** **There is a significant relationship between Gross Domestic Product (GDP) and money velocity**

The statistical analysis results show no significant relationship between Gross Domestic Product (GDP) and money velocity. This lack of significance can be attributed to the poor interconnection among economic sectors in Egypt. Thus, an increase in GDP in one sector may not necessarily lead to increased economic activity in other sectors, limiting the impact of GDP on the velocity of money.

Moreover, if the government absorbs a significant portion of GDP for debt repayment or deficit financing, a substantial part of the funds does not reach the private sector to boost investments. This reduces the influence of GDP on money velocity.

6. ***Sixth Hypothesis:*** **There is a positive relationship between GDP per capita and money velocity.**

The results show a significant positive relationship between GDP per capita and money velocity. When individual incomes improve, particularly for lower and middle-income groups who tend to spend a larger proportion of their income, spending levels rise. This increased expenditure among these groups leads to a higher of money velocity.

Reviewing other economic variables such as financial development and the trade balance, it becomes evident that financial development does not significantly impact on money velocity. This limited effect may be due to the inefficient use of bank assets and insufficient investment in activities that could enhance the velocity of money.

As for imports and exports, the study finds no significant relationship between these variables and the velocity of money. This is largely due to the nature of the Egyptian economy, where imports significantly exceed exports. Consequently, a substantial amount of currency is withdrawn from the country, reducing local liquidity. Additionally, since a large portion of foreign trade is conducted through credit, the velocity of money is not notably influenced by import and export activities.

In conclusion; our findings provide insight into the comparison of several studies on the impact of economic factors on the velocity of money circulation. Here's a summary of the key comparisons:

- **Kerrouche, T., & Ayachimed, A. (2022) and Majdi Masoud (2023) identified a unidirectional causal relationship from the velocity of money to the exchange rate and confirmed the significant influence of the exchange rate on money circulation velocity.**
- **Ahmed El-Telbani's (2022) emphasized the importance of the relationship between economic growth rates and money velocity, while our study found no statistical significance for this effect, attributing the difference to the specific characteristics of the Egyptian economy.**
- **Oyadeyi, O. O. (2024) aligns with our findings, also confirming the significant impact of the exchange rate on money velocity.**
- **Nyumuah, F. S. (2018) is consistent with ours in showing no significant effect of interest rates on the velocity of money circulation.**
- **Al Aneiz, W. (2015) concurs with our conclusion that the velocity of money circulation is unstable, underscoring the need for careful consideration when designing monetary policies.**

Overall, our analysis highlights the importance of thoroughly examining various economic factors when studying their effects on money velocity, as outcomes differ across studies and depend heavily on the economic context.

Recommendations:

These suggestions stem from a deep understanding of the Egyptian economy's dynamics and challenges. Their successful implementation hinges on maintaining a flexible exchange rate to ensure stability in the velocity of money.

To stabilize the exchange rate and strengthen the Egyptian economy, the following actions are suggested:

1. **Boost foreign currency reserves by promoting export sectors and offsetting the impact of declining Suez Canal revenues.**

2. **Promote market diversification for Egyptian companies to decrease reliance on specific currencies or markets.**
3. **Enhance the investment climate to attract foreign investments and ensure steady cash flows.**
4. **Focus on productive sector investments to lessen dependence on imports and ease pressure on the local currency.**
5. **Increase financial inclusion by expanding access to financial services and supporting financial technology to accelerate money circulation.**
6. **Regulate informal currency markets and curb illegal trading to stabilize exchange rates and reduce market volatility.**

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