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Boosting Economic Growth through Monetary Policy: An Empirical Study in Egypt (1991–2022)[1]

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Abstract:

For Egypt to meet the 17 Sustainable Development Goals (SDGs) by 2030, economic growth is an essential prerequisite. The Central Bank of Egypt can use monetary policy as a practical tool to achieve this goal. However, economists have differing opinions regarding the impact of monetary policy on economic growth. The present study assesses the association between monetary policy and economic growth in Egypt from 1991 to 2022, using the Vector Autoregression (VAR) and the Vector Error Correction (VECM) models, to investigate both the short-run dynamics and the long-run relationships. Our findings indicate that the money supply and domestic credit provided by banks in Egypt have a significant positive effect on economic growth, while the real interest rate has a significant negative impact in both the short run and the long run. Accordingly, Egypt should adopt a proactive and transformative monetary policy to achieve economic growth and sustainable development.

Keywords: Monetary policy, Economic growth, Money supply, Real interest rate, Domestic credit provided by banks to the private sector, VAR model, VECM, Egypt.

تعزيز النمو الاقتصادي من خلال السياسة النقدية: دراسة تجريبية في مصر (1991-2022)

الملخص:

لكي تتمكن مصر من تحقيق أهداف التنمية المستدامة السبعة عشر بحلول عام 2030، يعد النمو الاقتصادي شرطًا أساسيًا. فإنه يمكن للبنك المركزي المصري استخدام السياسة النقدية كأداة عملية لتحقيق هذا الهدف. ومع ذلك، تختلف آراء الاقتصاديين فيما يتعلق بتأثير السياسة النقدية على النمو الاقتصادي. تقوم الدراسة الحالية بتقييم العلاقة بين السياسة النقدية والنمو الاقتصادي في مصر في الفترة من 1991 إلى 2022، باستخدام نموذجي الانحدار الذاتي (VAR) ونموذج تصحيح الخطأ (VECM)، لدراسة كل من الديناميكيات قصيرة المدى والعلاقات طويلة المدي. وتشير النتائج إلى أن عرض النقود والائتمان المحلي المقدم من البنوك في مصر لهما تأثير إيجابي على النمو الاقتصادي، في حين أن سعر الفائدة الحقيقي له تأثير سلبي على المدى القصير والطويل. وبناء على ذلك، يتعين على مصر أن تتبنى سياسة نقدية استباقية وتحويلية لتحقيق النمو الاقتصادي والتنمية المستدامة.

الكلمات المفتاحية: السياسة النقدية، النمو الاقتصادي، المعروض النقدي، سعر الفائدة الحقيقي، الائتمان المحلي الخاص، نموذج (VAR)، نموذج (VECM).

Jel classifications: E52, O11, F63, CO1

1. Introduction

Monetary policy is an important tool that helps central banks attain their main macroeconomic objectives: a desired balance of payments, and a certain level of stability in terms of inflation, exchange rate and others. High employment, economic growth as well as the stability of prices, interest rates, and financial and exchange markets are the primary goals of monetary policy (Mishkin, 2004). Economic growth is necessary for achieving the Sustainable Development Goals (SDGs)[2] by 2030 because it is expected to reduce poverty and inequality and create employment. Analyzing monetary policy impacts on economic growth is necessary for policymaking reforms. Hence, the main objective of this paper is to assess the impact of monetary policy on economic growth in Egypt from 1991-2022. This paper will determine whether monetary policy can be employed to achieve sustainable economic growth in Egypt by 2030. Monetary policy is important for developing countries as it helps the central bank and the financial institutions to manage interest rates, investment, saving and their balance of trade (Ghandour, 2017). Therefore, many studies have focused on analyzing the impact of monetary policy on economic growth.

There was a debate in the literature on assessing the impact of such a policy on economic growth. Theoretically, the classical theory argues that monetary policy doesn't affect economic growth in the long run, while the Keynesians think that monetary policy has an impact on economic growth in the short run but in case of the absence of a liquidity trap. Based on the monetarist's view, monetary policy only impacts economic growth in the short run. Empirically, Moursi and El Mossallamy (2010) found that monetary policy promotes economic growth in Egypt, while Moursi et al. (2006) and Awad (2011) found that monetary policy has an insignificant effect on economic growth in Egypt.

(2) After failing to achieve the Millennium Development Goals by 2015, the United Nations formulated the 17 Sustainable Development Goals in 2015 to be achieved by 2030. The SDGs contain three aspects: environmental, social, and economic.

The present study will contribute to the literature by estimating the impact of money supply, domestic credit provided by banks and real interest rate simultaneously on economic growth in Egypt over the period (1991-2022) using a time series analysis. This time frame is chosen for the fact that Egypt has had an economic reform and structural adjustment program (ERSAP) in place since 1991 and the data is available up to 2022. The vector auto-regressive (VAR) model and the vector error correction model (VECM) techniques are used to examine the impact of monetary policy on economic growth in Egypt in the short run and the long run respectively from (1991-2022). The research hypothesis is as follows:

H0: Monetary policy does not have a significant impact on economic growth.

H1: Monetary policy has a significant impact on economic growth.

The paper is structured as follows. Section 2 provides a review of the theoretical and empirical literature on the connection between monetary policy and economic growth. Section 3 presents the estimation methodology, the model specification and the trend of the variables by displaying the stylized facts, using data from the World Bank. Section 4 gives an empirical analysis and displays the results. Finally, section 5 presents the conclusion and policy recommendations based on the findings of the empirical analysis.

2. Literature review:

The central bank possesses a diverse range of tools to implement monetary policy, which includes discount lending, open market operations, and required reserve ratios. The utilization of these techniques influences interest rates, investment, and real GDP via various transmission channels (Miller and Van Hoose, 2006). Some countries provide full independence of policy and autonomy to their central bank, while others do not. In recession periods, monetary policy is employed to increase money supply to regulate aggregate demand through open market operations. An expansionary monetary policy decreases the interest rate; thus, public spending increases to reach an equilibrium of a potential output level and full employment. As a result, monetary policy is undoubtedly one of the most significant drivers of economic growth and development because it influences various economic variables.

The association between monetary policy and economic growth has been extensively studied in the literature, with abundant research available. However, the relationship between the two is still not entirely clear. This

section will begin by examining theories that demonstrate the relationship between monetary policy and economic growth, followed by citations of empirical studies.

2.1 Theoretical literature review

According to Jhingan's theoretical framework (2003), the overall demand is impacted by the quantity of money, the cost of money (interest rate), and the accessibility of credit. An increase in the money supply results in a decrease in the interest rate. This decrease in interest rates leads to an increase in investment due to the marginal efficiency of the capital. Through the multiplier effect, the additional investment increases effective demand, which ultimately boosts income, output, and employment. To prevent a decreasing trend in pricing, the central bank lowers the bank rate when prices are low. Commercial banks can borrow money from the central bank at a low cost, reducing then their lending rates. This might improve the borrowing environment among businesspeople and encourage investments, leading to an increase in production, employment, income, and demand. The central bank also employs selective credit restrictions to influence specified credit types for particular objectives. Typically, these restrictions take the form of shifting margin requirements to engage in economic speculative activity. In the event of a recession in a specific industry, the central bank lowers the margin requirements to encourage borrowing.

The origins of monetary theory and economic growth theories can be traced back to the classical quantity theory of money (QTM) (Gali, 2008). After the Keynesian Liquidity Preference Theory's development in the 1930s, monetarism emerged, which was a manifestation of the QTM. In the past three decades, several other theories, including the New Classical Real Business Cycles, the New Keynesian Model, and the New Consensus Model (NCM), have been at the forefront of monetary policy analysis (Goodfriend and King, 1997; Arestis and Sawyer, 2008; Chari *et al.*, 2008). Despite the passage of time, the focus of previous studies that examine the impact of monetary policy on real variables, particularly on output, has remained ambiguous in the short and long term (Walsh, 2003). Furthermore, most research has primarily concentrated on industrialized countries and long-term monetary policy neutrality (Asongu, 2014).

Per the classical view, money functions as a medium of exchange. Classical monetary theory delves into the correlation between monetary policy and economic variables. The classical quantity theory of money, as proposed by Irving Fisher, elucidates the relationship between money and price through the equation MV= PT [(3)]. In this theory, the velocity of money (V) and output (T) are deemed constant. As such, the classical view holds that money neutrality prevails. Specifically, if the central bank increases the money supply (M2), then only nominal variables will be impacted (prices will increase), but it will not have any effect on real variables (production remains constant) in the long term (Jhingan, 2003). Keynes, however, criticized the assumption that there was no trade-off between inflation and output (Keynes, 1936).

According to the Keynesian theory, an increase in money supply decreases interest rates, increasing investment, production, income, employment, and output (Jhingan, 2003). In the short run, Keynes assumes rigid prices and an endogenous money demand that depends on income and interest rates, according to the "*liquidity preference theory"*. The liquidity preference money supply (LM curve) assumes a positive relationship between interest rates and output. The IS-LM model reflects the relationship between output and interest rates in the short run and is used to analyze output rather than inflation. The liquidity preference theory combines the money supply by the central bank with money demand to reach the money equilibrium level. The money supply is exogenous, and its increase leads to the shrinking of interest rates until the money demand equals the money supply. The lower the interest rate, the higher the marginal efficiency [(4)] of investment and capital, which increases output. However, Keynes doubted the effectiveness of monetary policy when the economy is in a liquidity trap. When an economy suffers from a liquidity trap, the uncertainty of the financial market increases and people prefer having cash rather than debt. In this case, an expansionary monetary policy does not increase income and does not stimulate economic growth. Therefore, fiscal policy is more effective in this situation. Modern

[(3)] Where M is the money supply, V is the velocity of money, P is the price and T is the number of transactions and for simplification, it's considered the real total output. MV (the total money supply) and PT (the total value of output) are equal.

[(4)] Expected rates of return on investment as further investment units are made during a particular time period and under specific circumstances. The profitability of an investment can be determined by comparing these rates with the market rate of interest.

theories, such as Romer (2006), violate the assumption of exogenous money supply in the classical and Keynesian views.

Monetarists posited in 1950 that an increase in the money supply would cause short-term growth of real output but have a neutral effect on output in the long run (Amacher and Ulbrich, 1986). They based this on the quantity theory of money, which assumes that velocity is stable and that nominal income is mainly a function of the money supply (Friedman and Schwartz, 1963, 1970; Friedman 1968). Monetarists utilized real wages instead of nominal wages to re-engineer the Phillips curve (Gottschalk, 2005) and assume long-run money neutrality, which aligns with the classical perspective. This theory is supported in the literature by Bernanke and Mihov, (1998); Bullard, (1999); and Nogueira, (2009).

After monetarism, real business cycle models appeared, including the New Classical Model, the New Keynesian Model, and the New Consensus Model. The main distinction between these theories lies in their treatment of nominal rigidities in wages and prices as well as how demand is handled (Good-friend and King, 1997; Palley, 2007). The New Classical Monetary Model operates on the assumption of perfect competition, flexible prices, and money neutrality regarding real variables. Additionally, this model presupposes imperfect information among agents, agent rationality, and continuous market clearing (where supply equals demand). In this model, the equilibrium of employment, real interest rate, and output are not determined by monetary policy; rather, technological variations are the primary driving force. These assumptions served as the basis for the two ideas that make up the New Classical Real Business Cycle (RBC) theory: Business cycles are produced by rational agents acting in an environment characterized by perfect competition and frictionless markets to adapt optimum to real shocks, most notably the technology, which has no impact on money. The continuous market clearing assumption and the rational expectations hypothesis predict that monetary policy will not affect real GDP, with only unexpected changes in monetary policy having a temporary impact on real variables (Mankiw, 2006). These assumptions are subject to both theoretical and empirical critiques, however. These assumptions are criticized theoretically by the New Keynesian theorists (Mankiw, 2006), while empirical studies have also raised questions about their validity (Gottschalk, 2005). The primary characteristic that distinguished New Keynesian Economics was the incorporation of

monopolistic competition and sticky prices within RBC frameworks (Goodfriend and King, 1997).

According to the New Keynesian models, with an exogenous shock and a change in monetary or fiscal policy, quantities are adjusted, but prices and wages remain rigid in the short term. Firms engaged in monopolistic competition set prices for goods, and households choose wages for labor. The term "New Keynesian Economics" describes the rethinking of conventional Keynesian models to make them consistent with the principles of microeconomics. This theory affirms long-run neutrality and argues that monetary policy can only have a short-term impact on output. There is still limited empirical support for the usage of the New Keynesian models, and the theory's applicability is questioned in part due to the absence of the role of money (Arestis and Sawyer, 2008).

The rise of the New Classical Model and New Keynesian Model eventually gave rise to the New Consensus Model that combined the rational expectations of the former with the short-run rigidities in wages and prices of the latter. This model became the benchmark for inflation targeting that drew attention to the priority of price stability above any other objectives, including growth, in which interest rates assume the lead instrument of monetary policy. This model stipulates that in monetary policy, long-term price stability is the main objective that is coupled with the support of short-run output stabilization. The model's short-run dynamics assume temporal nominal rigidities, but since the market can clear due to reasonable expectations, there are no implications for long-term economic activity. The New Consensus Model aggregate demand curve demonstrates an inverse relation between output level and real interest rate, indicating output stabilization. This suggests that a short-term rate monetary policy can influence the economy's demand side, which gradually moves toward long-term supply-side equilibrium (Fontana and Palacio-Vera, 2007).

There is considerable resistance to the presumptions and practicality of the NCM. The notion lacks enough factual evidence to justify its validity (Chari et al., 2008; Arestis and Sawyer, 2008). Its practical usefulness, particularly in developing countries and open economies, is limited by the absence of money and exchange rate functions, inadequate treatment of markets (financial, labor, and capital markets), dependence on a single instrument, and autonomous central banks (Arestis, 2009; Arestis and

Sawyer, 2008; Fontana and Palacio-Vera, 2007). Moreover, the NCM and its theoretical presumption of inflation elasticity into other variables may not apply to economies with persistent supply-driven inflation (Arestis and Sawyer, 2008; Fontana and Palacio-Vera, 2007). Woodford (2007) has recently proposed forward-looking targeting for production stabilization. Rejecting the NCM, not only stimulates discussion on past concepts but also raises a general question about the impact of monetary policy on output (Fontana, 2010).

2.2 Empirical literature review

Khabo and Harmse (2005) have conducted an empirical analysis through an OLS model and have found that there is a significant positive relationship between the money supply and economic growth in South Africa. Their analysis used annual data from 1960-1997. In contrast, using the structural VAR technique (SVAR) in Egypt, Moursi *et al.* (2006) found that monetary policy shocks have a significant impact on inflation only. Similarly, Al-Mashat and Billmeier (2008) conducted an investigation using the same model and found that monetary policy has an insignificant effect on real output. They also identified that the interest rate channel is weak in Egypt due to the weakness of the banking system in developing countries. Berument and Dincer (2008) studied the effects of the monetary policy for Turkey for the years 1986-2000 and identified that a contractionary monetary policy temporarily affects the output, leading to a statistically significant decrease in output over three months. Hachicha and Lee (2009) used the SVAR model and found that interest rates have insignificant effects on output and inflation in Egypt.

Amarasekara (2009) evaluated the effects of monetary policy on economic growth and inflation in Sri Lanka, a small open developing economy, utilizing recursive VAR methodology on monthly data spanning the period from 1978 to 2005. Recursive VAR results indicated an adverse and significant impact of interest rates on economic growth. A similar result was found by Abdel-Baki (2010) in Egypt using a non-recursive SVAR model. Ogunmuyiwa and Ekone (2010) found a significant positive relationship between money supply and economic growth in Nigeria, both in the short and long run, from 1980-2006, using OLS. Moursi and El Mossallamy (2010) analyzed Egypt's monetary policy and its effect on

inflation and growth through the estimation of a dynamic stochastic general equilibrium (DSGE) model using the Bayesian approach. They used monthly time series data that covers 2002 to 2008 as the sample years. In the process, what the researchers found is that a negative monetary policy shock affected considerably more output than inflation, implying that monetary policy can be eased to level up growth without causing inflation.

In Awad's (2011) study, a notable effect of monetary policy on inflation in Egypt was found, while output was insignificantly affected. This is consistent with the findings of Moursi et al. (2006), based on the recursive SVAR model. In a study on the effect of money supply on economic growth in Iran from 1974 to 2008, Nouri and Samimi (2011) found that money supply has a positive and significant relationship using the VAR model. Senbet (2011) also applied the VAR approach to show the relative effects of fiscal and monetary policies on output in the USA and has shown a positive and significant effect of money supply on economic growth. Jawaid et al. (2011) applied Co-integration and ECM techniques to show that money supply and economic growth have positive and significant long-run as well as short-run relationships in Pakistan using annual time series data from 1981 to 2009.

Several studies have been undertaken to estimate the monetary transmission mechanisms (MTMs) in various countries. Montiel et al. (2012), for example, used recursive and structural VAR techniques to estimate the MTMs in Tanzania during the period 2002-2010. Their results show that monetary policy has an insignificant effect on output. Munyengwa (2012), however, argues that monetary policy is effective in Botswana, mainly through the interest rate channel followed by credit and exchange rate channels by using a VAR model for the period 1995-2009.

In Nigeria, Onyeiwu (2012) used OLS over the period 1981-2008 and found that money supply has a positive effect on the economy. Vinayagathasan (2013) estimated the impact of monetary policy on the real economy in Sri Lanka by using a seven-variable structural VAR model based on monthly time series data covering the period January 1978-December 2011. The study results suggested that interest rate shocks have a considerable impact on output. Conversely, a positive money shock has an erratic impact on the output, where output falls rather than increases.

In a contrary approach, Fasanya *et al.* (2013) used time-series data from 1975 to 2010 to analyze how Nigeria's monetary policies affected

economic growth. They employed the Error Correction Model (ECM) and found that money supply had an insignificant impact on economic growth. The study of Havi and Enu (2014) examined the relative impact of monetary and fiscal policies on economic growth in Ghana from 1980-2012. The OLS results showed that money supply has a significant positive impact on the Ghanaian economy.

In contrast, by conducting a VAR model, Mutuku and Koech (2014) estimated the impact of monetary and fiscal policy shocks on economic development in Kenya using time series data from 1997 to 2010. They demonstrated that monetary policy (including the money supply and short-term interest rates) had an insignificant impact on real output. They suggested that the weak structural, institutional, and regulatory environment was responsible for the weak nexus. Kamaan (2014) also discovered that monetary policy did not affect economic growth by using the vector auto-regressive (VAR) model to assess the effects of monetary policy on economic growth in Kenya.

Shokr, Abdul Karim and Zaidi (2019) discovered that monetary policy tools had a substantial impact on Egypt's output by conducting a non-recursive SVAR model. Elshafei and Abdallah (2022) found a positive correlation between domestic credit and economic growth in Egypt from 1976-2018, using an OLS model. Chuba and Yusuf (2022), using an OLS model, further studied the Nigerian economy from 1991 to 2020, and found a positive long-run relationship between money supply, domestic credit by banks, and economic growth. Further, the long-run relationship between treasury bill rate and economic growth was significant and negative.

After such a long review of existing theoretical as well as empirical literature, it seems that the nexus between monetary policy and growth is given a wide role to play within the literature. Yet, the findings are mixed and the relationship remains inconclusive. Several studies, including Havi and Enu (2014), Amarasekara (2009), Elshafei and Abdallah (2022), and Vinayagathasan (2013), have shown a significant impact of monetary policy on economic growth. Conversely, some studies, such as Cyrus and Elias (2014), Kamaan (2014), Hachicha and Lee (2009), and others, have shown an insignificant impact.

Therefore, the current study will contribute to the literature by simultaneously estimating the impact of money supply, domestic credit

provided by banks, and real interest rate on economic growth in Egypt, during the period ranging between 1991-2022. Findings will provide important insights into the relationship between monetary policy and economic growth in Egypt, adding to the body of knowledge already existing on this topic.

3. Methodology and Description of Data

This section describes data as well as the empirical model employed to assess the influence of monetary policy on Egypt's economic growth, over the period spanning from 1991 to 2022. This study specifically investigates the impacts of the real interest rate, money supply, and domestic credit provided by banks to the private sector on economic growth, providing insight into their influence on Egyptian economic performance as a whole.

3.1 Data and Variables Description

The present paper aims to investigate the impact of money supply, domestic credit provided by banks to the private sector, and real interest rates on economic growth during the period of 1991-2022. The study utilizes annual time series data comprising 32 observations, obtained from the World Bank for the aforementioned time frame. The selected time span from 1991 to 2022 is of considerable significance when considering the economic environment of Egypt, primarily because it encompasses the period during which the Economic Reform and Structural Adjustment Programme (ERSAP) was initiated in 1991. The implementation of this program was a direct reaction to the nation's economic challenges, which included high inflation, an increasing fiscal deficit, and substantial external debt burdens. In addition, while the data is not available beyond 2022, the information up to this point enables a thorough examination of the enduring patterns and trends in the Egyptian economy subsequent to ERSAP. This capability allows for the monitoring of economic growth trends and the evaluation of the efficacy of policy interventions, specifically monetary policy.

The data on monetary policy was procured from the World Development Indicators Database (WDI). It is crucial to note that each variable in this database has a unique definition, and comprehending the definition is fundamental for accurate analysis. As per the World Bank, broad money (current LCU) is defined as "the total amount of currency outside

banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper."

According to the World Bank, domestic credit extended by banks to the private sector represents the "financial resources provided to private entities by deposit-taking institutions, excluding central banks, through loans, non-equity securities purchases, trade credits, and other accounts receivable". These resources establish a claim for repayment and may include credit extended to public enterprises in some countries. The analysis will also employ the real interest rate (%) as an independent variable. This variable is defined by the World Bank as "the lending interest rate adjusted for inflation as measured by the GDP deflator". It is worth noting that lending rates' terms and conditions vary by country, limiting their comparability.

In addition, the research will utilize Gross Domestic Product per capita (constant 2015 US$) as a measure of economic growth. The World Bank defines GDP per capita as "the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products, divided by midyear population". Depreciation of fabricated assets or depletion and degradation of natural resources are not considered in the calculation. The values are expressed in constant 2015 prices, denominated in U.S. dollars, and converted from domestic currencies using 2015 official exchange rates. However, for a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.

3.2 Stylized Facts and Descriptive Statistics

In this section, the stylized facts and descriptive statistics aim to show the trends of the following four key variables (GDP per capita, money supply, domestic credit provided by banks to the private sector, and real interest rate) on a macroeconomic level. The presentation of these stylized facts will help investigate the relationship between monetary policy and economic growth in Egypt between 1991 and 2022, by using data from the World Development Indicators (WDI).

3.2.1 Economic Growth in Egypt

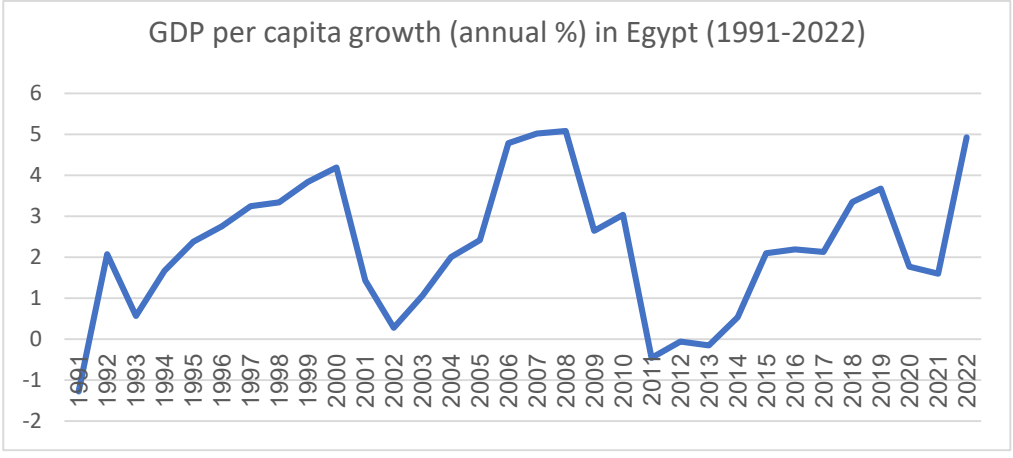
The measure of economic growth in Egypt is based on the Gross Domestic Product (GDP) per capita, which serves as the dependent variable in the present study. Due to the problems that surrounded the Egyptian economy in the mid-1980s, particularly after the collapse of oil prices, the Egyptian government decided to adopt an ambitious economic reform and structural adjustment program (ERSAP) in 1991 in cooperation with the International Monetary Fund and the World Bank. The main objective of this program was to enhance the effectiveness of monetary policy. However, during the implementation of ERSAP, Egypt encountered several challenges for instance, the Luxor terrorist attack and the East Asian financial crisis in 1997 that significantly influenced economic growth, price stability, and the exchange rate in Egypt (Awad, 2011).

Figure 1 shows the annual evolution of the GDP per capita growth rate in Egypt from 1991-2022 using data from the WDI. The trend line reveals that Egypt's economic growth hasn't improved significantly since 1991. Notably, Egypt experienced a significant increase in its economic growth in 1992, when GDP per capita increased from -1.28 % in 1991 to 2.07 % in 1992. This remarkable increase can be attributed to the implementation of the ERSAP in 1991. This program succeeded in reducing inflation, enhancing the current account balance, and permitting a large-scale investment in infrastructure and productive projects. However, Egypt's GDP per capita growth rate dropped in 2001 (1.43 %) after reaching 4.19 % in 2000, following its integration into the World Trade Organization (WTO) in 1995. This decline was due to external factors such as the 11 September terrorist attack, which significantly reduced revenues from tourism, oil, and Suez Canal. Economic growth resumed an upward trend in 2004 and reached 5.08 % in 2008, thanks to a series of structural reforms implemented that year. These reforms included improvements made to the banking and taxation systems, exchange rate controls, acceleration of the privatization program's implementation, and the creation of a more favorable business environment. Additionally, net foreign direct investments from Gulf countries stimulated economic growth.

However, economic growth began to decline again reaching 2.65 % in 2009 due to the global financial crisis. In 2011, Egypt's GDP per capita growth rate collapsed (-0.46 %) from 3.04 % in 2010, owing to the revolution

and political instability that year. Economic growth recovered and reached 3.68 % in 2019. Unfortunately, COVID-19 emerged in 2020, causing global demand to decrease, and Egypt's economic growth to decline reaching 1.59 % in 2021. Subsequently, economic growth accelerated and reached 4.93 % in 2022 (World Development Indicators). Egypt's economic growth was boosted in 2022, due to several elements including global economic factors, some policies implemented by the government, in addition to a sectoral recovery such as the tourism sector.

Fig. 1 GDP per capita growth (annual %) in Egypt (1991-2022)

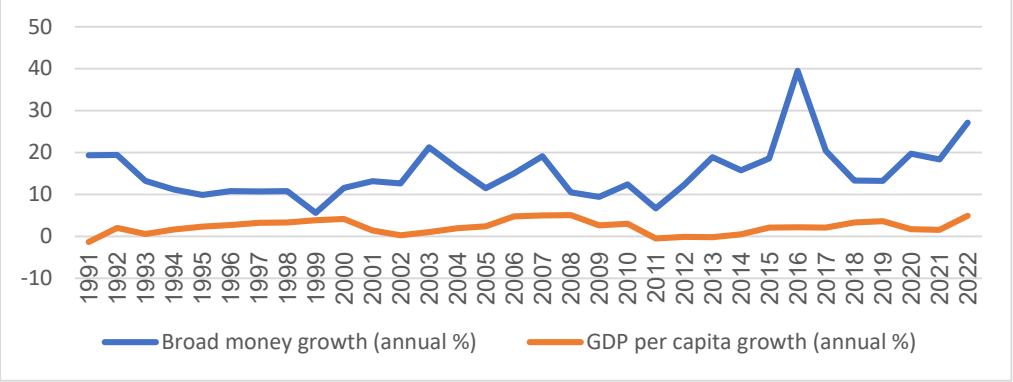


Source: *Constructed by authors using World Development Indicators (WDI) data.*

3.2.2 Money Supply and GDP per capita in Egypt

The main objective of the CBE is to achieve both price and exchange rate stability. To manage the money supply, the CBE employs several tools including open market operations, discount rate, legal reserve rate, and liquidity ratio. Figure 3 demonstrates a positive relationship between money supply and inflation; as the money supply increases, inflation rises. However, the correlation between money supply and GDP per capita growth rate, as shown in Figure 2, is not as clear. For instance, in 1999, when money supply growth decreased to 5.6%, economic growth increased to 3.84 %. In contrast, in 2003, an increase in money supply to 21.2% led to a growth in GDP per capita to 1.06 % compared to 0.27% in 2002 after the floatation of the exchange rate.

Fig. 2 Broad money growth and GDP per capita growth (annual %) in Egypt (1991-2022)

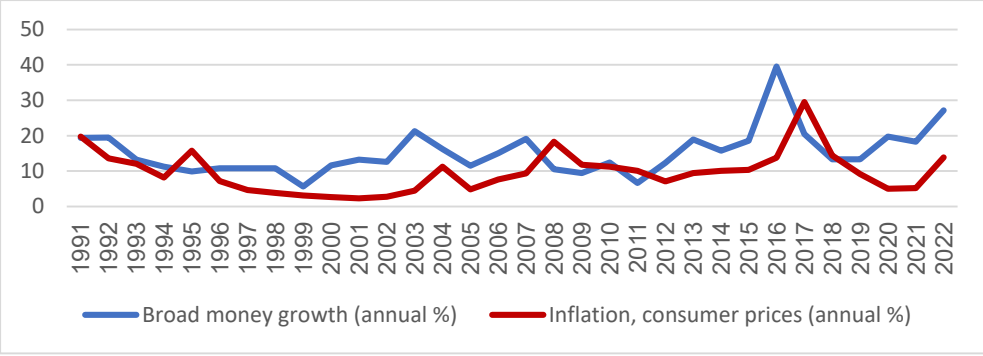


Source: *Constructed by authors using data from World Development Indicators (WDI).*

The pass-through effect [(5)] caused by the devaluation of the Egyptian currency relative to the US dollar after floating the exchange rate in 2003 is the primary driver behind the increase in the inflation rate due to imported inflation. This surge in the inflation rate prompted the CBE to announce its inflation-targeting policy in 2005. From 2007 to 2012, there was a positive relationship between money supply and economic growth. In 2016, the Egyptian government borrowed 12 billion dollars from the IMF, which then imposed restrictions on the monetary and fiscal policy to reduce the budget deficit. These restrictions included the floatation of the Egyptian currency against the US dollar, reduction of subsidies on food, and energy price hikes. After the floatation of the exchange rate in 2016, the money supply increased to 39.5%, while economic growth decreased to 2.19 %. In 2020, during the pandemic, money supply increased to 19.7% and then to 28% in 2022 compared to 13.27% in 2019, while economic growth dropped to 1.77 % from 3.68 % in 2019 due to reduced demand (WDI). Additionally, the substantial surge in Broad Money Growth that has occurred recently could be attributed to monetary policy measures such as quantitative easing, which had been implemented in response to economic downturns. Money growth fluctuations may serve as an indicator of monetary policy adjustments, changes in banking liquidity, or inflationary tendencies.

[(5)] Exchange rate fluctuations impact on domestic inflation for traded and non-traded goods.

Fig. 3 Broad money growth % and inflation in Egypt (1991-2022)

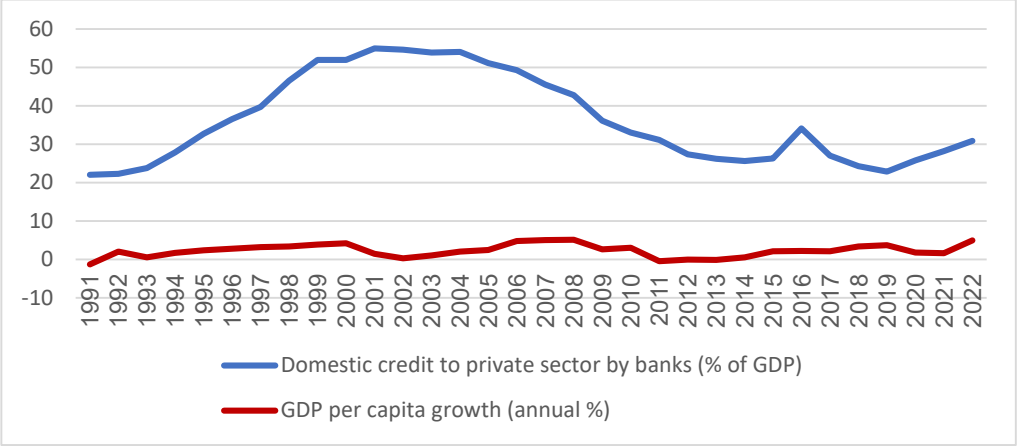


Source: *Constructed by authors using data from World Development Indicators (WDI).*

3.2.3 Domestic credit provided by banks to the private sector (% of GDP) and economic growth in Egypt:

This study employs domestic credit provided by banks to the private sector as a measure of investment. As depicted in Figure 4, the association between domestic credit to the private sector provided by banks and GDP per capita growth is ambiguous. The proportion of bank credit to the private sector relative to GDP even declined during high economic growth periods. Domestic credit provided by banks to the private sector demonstrated an upsurge from 1991 (22.5% of GDP) to peak at 54.04% of GDP in 2004. Although domestic credit peaked, there were no corresponding peaks in GDP growth; rather, it followed a range of moderate stability. However, from 2005, domestic credit to the private sector began to decline reaching 25.6% of GDP in 2014. This trend was primarily due to a significant capital outflow during the global financial crisis, which resulted in a drop in bank deposit growth and, consequently, a reduction in lending rates to the private sector. In the meantime, the government received increased financing from the banking sector, further decreasing credit availability in the private sector (Herrera, Hurlin, and Zaki, 2013). Bank credit to the private sector witnessed a resurgence in 2015 and 2016 (34.13% of GDP), then decreased to 28.52% of GDP in 2017, and ultimately reached 24.02% of GDP in 2019. The Post - 2010 credit contraction occurred due to significant political and economic uncertainty in Egypt, however, it was not accompanied by a corresponding decline in GDP per capita growth. In 2020, domestic credit provided by banks to the private sector increased again to 27.10% of GDP reaching 31% of GDP in 2022 (WDI).

Fig. 4 Relationship between domestic credit provided by banks to the private sector (% of GDP) and GDP per capita growth (annual%) in Egypt (1991-2022)



Source: *Constructed by authors using data from World Development Indicators.*

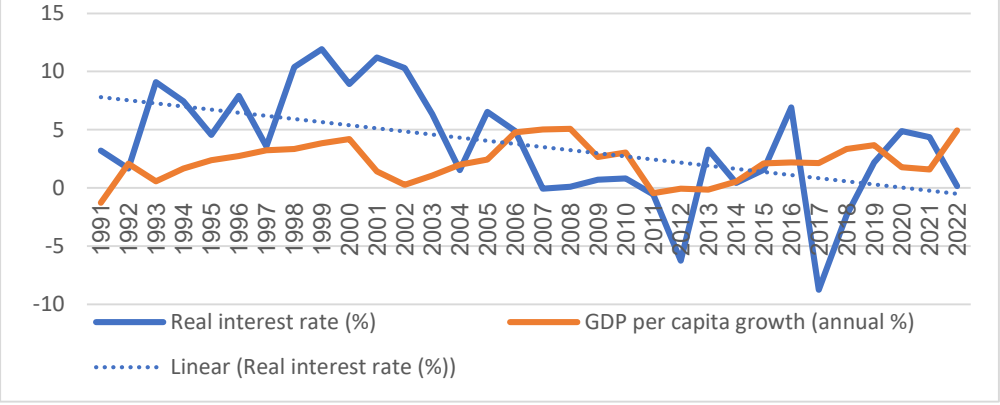
3.2.4 Real interest rate and GDP per capita growth in Egypt

The real interest rate is an essential economic indicator that is obtained by deducting inflation [(6)] from the nominal interest rate. According to Fisher Equation, a direct correlation exists between inflation and nominal interest rates, whereas an inverse correlation exists between inflation and real interest rates. Figure 5 illustrates the relationship between GDP per capita growth rate and the real interest rate in Egypt from 1991 to 2022. Over time, the real interest rate exhibited a consistent downward trend. In general, there exists a negative correlation between the real interest rate and GDP per capita growth. In 1993, for example, a rise in the real interest rate to 9.1% resulted in a decline in GDP per capita growth relative to the previous year. In contrast, GDP per capita growth increased from 1994 to 1997 as the real interest rate declined. Despite a substantial surge in the real interest rate to 11.936% in 1999, there was a concurrent rise in GDP per capita growth. In 2001, however, the rise in the real interest rate was accompanied by a decrease in GDP per capita growth. Subsequent years exhibited comparable trends, wherein variations in the real interest rate exerted an influence on the growth of the GDP per capita. The aforementioned observations underscore the complex correlation that exists between the real interest rate and GDP per capita

[(6)] The Central Bank of Egypt strives to maintain price stability by managing inflation.

growth in Egypt which was possibly affected by economic, political, and global factors.

Fig. 5 Relationship between real interest rate and GDP per capita growth in Egypt (1991-2022)



Source: *Constructed by authors using data from World Development Indicators.*

3.2.5 Correlation coefficients:

The correlation statistical analysis indicates that each explanatory variable was significantly related to the explained variable, as shown in Table 1 presenting the Pearson correlation coefficients between the study variables. Additionally, the maximum correlation coefficient between each variable is less than 0.50. Therefore, there is no serious multicollinearity problem[7].

Table 1 Correlation coefficients:

	(1)	(2)	(3)	(4)
(1) Log_gdp	1			
(2) Log_bms	0.877***	1		
(3) Rir	-0.385**	-0.416**	1	
(4) Dcb	0.197*	-0.339	0.499**	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In sum, since the descriptive statistics do not provide conclusive evidence regarding the relationship between the aforementioned independent variables and economic growth, the subsequent section aims to conduct a

([7]) Based on the rule of thumb, if the correlation coefficients between each explanatory variable, excluding the variable itself, are all below 0.5, it indicates the absence of multicollinearity.

more formal empirical analysis to investigate the role of monetary policy in influencing economic growth in Egypt from 1991 to 2022.

3.3 Estimation Methodology and Model Specification

The selection of fundamental variables and the formulation of research hypotheses are predominantly based on the theoretical evidence presented by Jhingan (2003) and the empirical study by Chuba and Yusuf (2022), as outlined in the literature review. Consequently, the model incorporates GDP per capita, money supply (M2), real interest rate, and domestic credit provided by banks. The GDP per capita is evaluated at 2015 constant US dollars, while the money supply is evaluated at the current LCU. The domestic credit provided by banks to the private sector and the real interest rate are expressed as percentages of GDP.

The econometric model of the OLS regression is specified as follows:

$$Log\_gdp = \alpha_0 + \alpha_1 log\_bms + \alpha_2\ dcb + \alpha_3 rir + Ut. \quad \textbf{(1)}$$

Where gdp is an indicator of economic growth, bms is an indicator of broad money supply, dcb is an indicator of domestic credit provided by banks, and rir is an indicator of the real interest rate. The natural logarithm is applied to both gdp and bms to adjust for their large values and to smooth the data. Ut represents the error term, and α0, α1, α2, and α3 are the coefficients of the independent variables. We anticipate a positive correlation between money supply and economic growth, a positive association between domestic credit provided by banks to the private sector and economic growth, and a negative association between real interest rates and economic growth (Jhingan, 2003, Chuba and Yusuf, 2022).

Given the research objectives, the research hypothesis is the following:

H0: Monetary policy has no significant impact on economic growth.

H1: Monetary policy has a significant impact on economic growth.

The first step in analyzing the impact of economic variables on growth is often an application of ordinary least square (OLS) regression on equation (1). However, such a technique becomes problematic when dealing with time-series data, as these series may be non-stationary series leading to spurious regression results. This is because the mean and variance of non-stationary series are not constant, which can cause an overestimation of the impact of

independent variables on growth, leading to false positive or negative relationships. Therefore, it is essential to first test the stationarity of the data to ensure the accuracy and reliability of time series analysis and to select the reliable time series method.

Stationarity in time series data is characterized by a flat, trendless series without seasonality, a constant autocorrelation structure and constant variance over time. The Augmented Dickey-Fuller (ADF) unit root test [8] developed by Dickey and Fuller (1979) is a reliable method to test the stationarity of variables and the order of integration. The results of the ADF unit root test are presented in Table 2. The test shows that all variables are non-stationary at levels since the ADF test statistic is lower than the 5% critical value. However, all variables are stationary at the first difference, as indicated by their ADF test statistics greater than the 5% critical value. The ADF test further indicates that all variables have the same order of integration at a 5% significance level.

Table 2 Augmented Dickey-Fuller Unit Root Test

Variables	Levels		First difference		Order of integration
	ADF Test Statistic	5% Critical value	ADF Test Statistic	5% Critical value	
Log_gdp	-0.944	-3.600	-3.937	-3.600	I (1)
Log_bms	-1.261	-3.588	-3.772	-3.592	I (1)
Dcb	-2.864	-3.596	-2.061	-1.950	I (1)
Rir	-2.049	-2.992	-3.517	-2.997	I (1)

Source: Authors computations using Word Development Indicators (1991-2022).

The selection of an appropriate lag length is also a crucial step to ensure accurate and reliable results (Rehal, 2023). Incorrect lag length specifications can lead to inaccurate findings and autocorrelation problems. To determine the optimal lag length, Akaike's Information Criteria (AIC),

[8] The null hypothesis of this test is that there is a unit root, which means that the variables are non-stationary, and taking the first difference is required. We reject the null hypothesis if the ADF test statistic is greater than the critical values and the variables become stationary. A series is referred to be I (0), or integrated of order 0, if it is stationary without making any difference. Conversely, a series is referred to as I (1) or integrated of order one (1) if it is stationary after taking the first differences.

Schwarz or Bayesian Information Criteria (SIC or BIC), and Hannan-Quinn Information Criteria (HQIC) are commonly employed. Each of these criteria specifies a minimum lag order of 1. Table 3 provides the results of the lag length test based on the aforementioned criteria. The FPE, SBIC, and HQIC propose one lag, whereas the AIC recommends four lags. Based on the Akaike information criterion, a lag length of four is preferred to avoid an autocorrelation issue.

Table 3 Lag length selection-order test:

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-155.273				2.46065	12.2518	12.3075	12.4453
1	5.67046	321.89	16	0.000	.000036*	1.10227	1.38095*	2.07004*
2	21.3988	31.457	16	0.012	.000041	1.12317	1.6248	2.86515
3	35.0767	27.356	16	0.038	.000064	1.30179	2.02636	3.81798
4	61.6164	53.079*	16	0.000	.000054	.491047*	1.43856	3.78145

Endogenous: log_gdp log_bms dcb rir
Exogenous: _cons

Source: *Authors computations using Word Development Indicators (1991 – 2022).*

After determining a suitable lag length and provided that the variables have the same order of integration, the Johansen (1988) cointegration test [(9)] can be utilized to test the number of cointegrating variables or the long-run relationships among variables. In the Johansen test, the null hypothesis of a maximum rank of zero implies that there is no cointegration, whereas the null hypothesis of a maximum rank of one or two implies that there are one or two cointegrating equations, respectively. The null hypothesis is rejected if the trace statistic or max statistic exceeds the 5% critical value.

Notably, in the short run, variables may be out of equilibrium and may diverge from their equilibrium state, but if they are cointegrated, they tend to converge toward their long-run equilibrium. If the variables are cointegrated, it is said that their linear combination is stationary. Thus, this test can be used to uncover several cointegrating relationships between variables.

Upon establishing a cointegration among the variables and confirming that all the variables are integrated of order one, the Vector Autoregressive

[(9)] In this test, there are two statistics (trace statistic[9] and max statistic[9]) that are compared to the 5% critical value. Sometimes, the trace and max statistics may yield different results, in this case, the trace statistics is preferred.

(VAR) model and the Vector Error Correction Model (VECM) can be utilized to investigate the short-term and the long-run relationships. In time series research, VAR models are frequently employed to analyze the dynamic interactions between variables. These models are widely regarded as critical forecasting tools in macroeconomic or policy-making institutions. In the VAR model, all the variables are endogenous, as the dependent variable is a function of its lagged values and the lagged values of other variables within the model (Rehal, 2023). The VECM is a special case of the VAR model with error-correcting terms. The VECM enables us to calculate both short-run and long-run coefficients. By employing VECM estimation, long-run equilibrium relationships between variables and short-run departures from that equilibrium can be observed. The adjustment coefficients also demonstrate how short-run deviations or disequilibrium are fixed (Rehal, 2023). The VECM reduces the lag length by one because, in theory, the variables in the VAR model are at level, whereas the variables in the VECM are in their first difference form.

The Johansen cointegration test results, presented in Table 4, indicated that the null hypothesis of no cointegration was rejected as both the trace and max statistics were greater than the 5% critical value [(10)]. However, at a maximum rank of two and three, the null hypothesis of 2 cointegrating equations and 3 cointegrating equations, respectively, was accepted, as both the trace and max statistics were lower than the 5% critical value. Based on the Johansen cointegration test results, it can be inferred that there exists a long-run equilibrium relationship between all variables. As all the variables are integrated of order one, we can proceed with a VAR to examine the short-run relationship. Additionally, since the variables are cointegrated, a VECM can be applied to examine the long-run relationship.

[(10)] At a maximum rank of one, the null hypothesis of one cointegrating equation was also rejected as both the trace and max statistics were higher than the 5% critical value.

Table 4 Johansen cointegration test with a constant trend and four lags

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	52	19.198718	.	84.8354	47.21
1	59	41.450703	0.81944	40.3314	29.68
2	64	54.85564	0.64340	13.5215*	15.41
3	67	61.414052	0.39619	0.4047	3.76
4	68	61.616395	0.01544		

maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	52	19.198718	.	44.5040	27.07
1	59	41.450703	0.81944	26.8099	20.97
2	64	54.85564	0.64340	13.1168	14.07
3	67	61.414052	0.39619	0.4047	3.76
4	68	61.616395	0.01544		

Source: *Authors computations using Word Development Indicators (1991-2022).*

The econometric model of the VAR for the short run with 4 variables and 4 lags is specified as follows:

$$1.\ log\_gdp_t = \alpha + \sum_{\boldsymbol{m=1}}^{\boldsymbol{m=4}} \boldsymbol{\beta_m\, log\_gdp_{t-m}} + \sum_{p=1}^{p=4} \gamma_p \log\_bms_{t-p} + \sum_{j=1}^{j=4} \delta_j \,\mathrm{dcb}_{t-j} + \sum_{i=1}^{i=4} \varphi_i \,\mathrm{rir}_{t-i} + u_{1t}$$

$$2.\ log\_bms_t = d + \sum_{m=1}^{m=4} \beta_m \log\_gdp_{t-m} + \sum_{\boldsymbol{p=1}}^{\boldsymbol{p=4}} \boldsymbol{\gamma_p\, log\_bms_{t-p}} + \sum_{j=1}^{j=4} \delta_j \,\mathrm{dcb}_{t-j} + \sum_{i=1}^{i=4} \varphi_i \,\mathrm{rir}_{t-i} + u_{2t}$$

$$3.\ dcb_t = b + \sum_{m=1}^{m=4} \beta_m \log\_gdp_{t-m} + \sum_{p=1}^{p=4} \gamma_p \log\_bms_{t-p} + \sum_{\boldsymbol{j=1}}^{\boldsymbol{j=4}} \boldsymbol{\delta_j\, dcb_{t-j}} + \sum_{i=1}^{i=4} \varphi_i \,\mathrm{rir}_{t-i} + u_{3t}$$

$$4.\ rir_t = v + \sum_{m=1}^{m=4} \beta_m \log\_gdp_{t-m} + \sum_{p=1}^{p=4} \gamma_p \log\_bms_{t-p} + \sum_{j=1}^{j=4} \delta_j \,\mathrm{dcb}_{t-j} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{i=4}} \boldsymbol{\varphi_i\, rir_{t-i}} + u_{4t}$$

All the variables are in levels and have equal lags of four and u_{xt} is the error term.

The VECM will be utilized to analyze the long-run relationship between variables that are cointegrated. The VECM can be specified as follows:

$$1.\ \Delta log\_gdp_t = \alpha + \sum_{\boldsymbol{m=1}}^{\boldsymbol{m=4-1}} \boldsymbol{\beta_m \Delta \log\_gdp_{t-m}} + \sum_{p=1}^{p=4-1} \gamma_p \Delta \log\_bms_{t-p} + \sum_{j=1}^{j=4-1} \delta_j \Delta \,\mathrm{dcb}_{t-j} + \sum_{i=1}^{i=4-1} \varphi_i \Delta \,\mathrm{rir}_{t-i} + \lambda_1 ECT_{t-1} + u_{1t}$$

$$2.\ \Delta log\_bms_t = b + \sum_{m=1}^{m=4-1} \beta_m \Delta \log\_gdp_{t-m} + \sum_{\boldsymbol{p=1}}^{\boldsymbol{p=4-1}} \boldsymbol{\gamma_p \Delta \log\_bms_{t-p}} + \sum_{j=1}^{j=4-1} \delta_j \,\Delta \mathrm{dcb}_{t-j} + \sum_{i=1}^{i=4-1} \varphi_i \Delta \,\mathrm{rir}_{t-i} + \lambda_2 ECT_{t-1} + u_{2t}$$

$$3.\ \Delta dcb_t = \sigma + \sum_{m=1}^{m=4-1} \beta_m \Delta \log\_gdp_{t-m} + \sum_{p=1}^{p=4-1} \gamma_p \Delta \log\_bms_{t-p} + \sum_{\boldsymbol{j=1}}^{\boldsymbol{j=4-1}} \boldsymbol{\delta_j \Delta \,\mathrm{dcb}_{t-j}} + \sum_{i=1}^{i=4-1} \varphi_i \,\Delta \mathrm{rir}_{t-i} + \lambda_3 ECT_{t-1} + u_{3t}$$

$$4.\ \Delta rir_t = \theta + \sum_{m=1}^{m=4-1} \beta_m \Delta \log\_gdp_{t-m} + \sum_{p=1}^{p=4-1} \gamma_p \Delta \log\_bms_{t-p} + \sum_{j=1}^{j=4-1} \delta_j \Delta \,\mathrm{dcb}_{t-j} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{i=4-1}} \boldsymbol{\varphi_i \,\Delta \mathrm{rir}_{t-i}} + \lambda_4 ECT_{t-1} + u_{4t}$$

$\beta_m, \gamma_p, \delta_j \ and\ \varphi_i$ are short-run dynamic coefficients. λ_i is the parameter of speed of adjustment to the long-run equilibrium. It is always necessary to have a negative sign for this parameter to reach the long-run equilibrium. Error correction term (ECT_{t-1}) is the lagged value of the residuals found by cointegrating the dependent variable on the regressors. u_{it} are the residuals (Virenrehal, 2023).

The Engle-Granger causality Wald test [(11)] is a widely used statistical technique to establish the unidirectional and multidirectional relationships between variables in the short run. The test determines if a variable granger causes another variable, which in turn implies that the former can be used to forecast the latter. A variable is considered to be a good predictor if it lowers the forecasting error when added to the forecast model. Conversely, a variable fails to Granger-cause another variable if, for the other variable in the equation, lags are not statistically significant. Additionally, it is not

[(11)] The null hypothesis of this test is that there is no causality. The null hypothesis is rejected if the p-value is lower than or equal the critical value 0.05.

worthwhile to anticipate future values of one variable based on past values that do not hold statistical significance (Eric, 2021).

As a final step, diagnostic tests are applied to evaluate how well the models fit and to make sure that the model is stable, there is no autocorrelation, and the variables are distributed normally. Lagrange multiplier (LM) test is used to examine the autocorrelation in the VAR and VECM models. In the presence of autocorrelation, the results of the models cannot be regarded as reliable. To eliminate autocorrelation, additional lags must be included. Moreover, VECM and VAR models are tested for stability using Eigenvalue stability conditions. The VAR stability criteria state that the modulus of each eigenvalue must be less than 1. As per the VECM stability criteria, the model will exhibit "K-r" unit moduli. In this context, "r" represents the number of cointegrating vectors, whereas "K" refers to the number of endogenous variables in the model. The error terms of the VAR and VECM models must adhere to a normal distribution. The Jarque-Bera test, kurtosis, and skewness [(12)] can be employed to assess normality (Rehal, 2023).

4. Empirical Results

The OLS outcomes are displayed in Table 5. At a 95% confidence interval, the p-value of the F-statistic indicates that the entire model is significant. The R-squared value is substantial at 0.9847, indicating that the independent variables—money supply, real interest rate, and domestic credit provided by banks—account for 98.47% of the variation in economic growth. Money supply and domestic credit provided by banks to the private sector coefficients are positive and statistically significant, implying their substantial influence on economic growth. A 1% increase in money supply and domestic credit extended by banks to the private sector will result in a 33% and 0.32% increase in economic growth, respectively. In contrast, the real interest rate exhibits a statistically significant and negative impact, indicating its substantial adverse influence on economic growth, all else being equal. An increase of 1% in the real interest rate is associated with a 0.56% decrease in economic growth. These OLS outcomes align with the empirical

[(12)] The null hypothesis posits that the error terms have a normal distribution.

findings of Chuba and Yusuf (2022) and the theoretical framework proposed by Jhingan (2003).

Table 5 OLS regression results

Source	SS	df	MS	Number of obs	=	30
				F(3, 26)	=	557.38
Model	4.33929504	3	1.44643168	Prob > F	=	0.0000
Residual	.067471169	26	.002595045	R-squared	=	0.9847
				Adj R-squared	=	0.9829
Total	4.40676621	29	.151957456	Root MSE	=	.05094

log_gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
log_bms	.3306349	.009699	34.09	0.000	.3106983	.3505715
dcb	.0032656	.0009457	3.45	0.002	.0013217	.0052096
rir	-.0056251	.002712	-2.07	0.048	-.0111997	-.0000504
_cons	17.06403	.2705729	63.07	0.000	16.50786	17.6202

Source: *Authors computations using Word Development Indicators (1991-2022).*

The Engle-Granger causality Wald test, which determines the direction of causality between money supply, real interest rate, and domestic credit extended by banks and economic growth in the short run, is presented in Table 6. With a p-value of zero, the table demonstrates that these three independent variables granger cause economic growth in the short run. While the real interest rate can be used to forecast domestic credit, this does not hold for domestic credit provided by banks to the private sector. Except for the real interest rate and domestic credit provided by banks, all other variables exhibit a bidirectional relationship.

Table 6 Engle-Granger causality test

Equation	Excluded	chi2	df	Prob > chi2
fdiff_log_gdp	fdiff_log_bms	12.785	4	0.012
fdiff_log_gdp	fdiff_dcb	13.676	4	0.008
fdiff_log_gdp	fdiff_rir	16.419	4	0.003
fdiff_log_gdp	ALL	45.664	12	0.000
fdiff_log_bms	fdiff_log_gdp	19.789	4	0.001
fdiff_log_bms	fdiff_dcb	14.238	4	0.007
fdiff_log_bms	fdiff_rir	14.828	4	0.005
fdiff_log_bms	ALL	40.437	12	0.000
fdiff_dcb	fdiff_log_gdp	17.849	4	0.001
fdiff_dcb	fdiff_log_bms	17.527	4	0.002
fdiff_dcb	fdiff_rir	21.587	4	0.000
fdiff_dcb	ALL	51.556	12	0.000
fdiff_rir	fdiff_log_gdp	11.285	4	0.024
fdiff_rir	fdiff_log_bms	10.528	4	0.032
fdiff_rir	fdiff_dcb	2.1573	4	0.707
fdiff_rir	ALL	19.843	12	0.070

Source: *Authors computations using Word Development Indicators (1991-2022).*

The results of the VAR model in Table 7 (and Appendix A) show that money supply initially promotes growth by having a significant positive impact during the third lag, but this turns into a significant negative effect during the fourth lag. The real interest rate has a statistically significant negative impact on economic growth during the second, third, and fourth lags, indicating that higher borrowing costs may hinder investment and economic activity. On the other hand, domestic credit extended by banks significantly boosts economic growth within the second lag, emphasizing the important role accessible credit plays in immediate economic expansion.

Table 7 VAR model results:

Equation	Parms	RMSE	R-sq	chi2	P>chi2
fdiff_log_gdp	17	.010126	0.8470	138.383	0.0000
fdiff_log_bms	17	.05117	0.7097	61.1145	0.0000
fdiff_dcb	17	3.17198	0.7563	77.59744	0.0000
fdiff_rir	17	4.88445	0.6167	40.22008	0.0007

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fdiff_log_gdp						
fdiff_log_gdp						
L1.	.4851104	.2055993	2.36	0.018	.0821432	.8880776
L2.	.4712373	.1933286	2.44	0.015	.0923202	.8501545
L3.	-.5453078	.1734474	-3.14	0.002	-.8852585	-.2053572
L4.	-.0047389	.1765579	-0.03	0.979	-.3507861	.3413084
fdiff_log_bms						
L1.	.0105663	.0303968	0.35	0.728	-.0490103	.0701429
L2.	-.0085568	.0348813	-0.25	0.806	-.0769228	.0598092
L3.	.115501	.0357819	3.23	0.001	.0453698	.1856322
L4.	-.0989072	.0382698	-2.58	0.010	-.1739145	-.0238998
fdiff_dcb						
L1.	.0011264	.0007275	1.55	0.122	-.0002995	.0025523
L2.	.00142	.0005478	2.59	0.010	.0003464	.0024937
L3.	-.0000497	.0006254	-0.08	0.937	-.0012754	.001176
L4.	-.000493	.0005622	-0.88	0.381	-.001595	.0006089
fdiff_rir						
L1.	-.0007688	.0004778	-1.61	0.108	-.0017053	.0001677
L2.	-.0014056	.0005825	-2.41	0.016	-.0025472	-.0002639
L3.	-.0023704	.0006031	-3.93	0.000	-.0035525	-.0011883
L4.	-.0017678	.0006023	-2.93	0.003	-.0029483	-.0005873
_cons	.0223171	.011129	2.01	0.045	.0005047	.0441295

Source: *Authors computations using Word Development Indicators (1991-2022).*

After performing the first difference, the VAR model is deemed stable according to the diagnostic tests presented in Appendix C, as the modulus of each eigenvalue is less than one. At a lag order of 2, no autocorrelation is observed, and the error terms follow a normal distribution ($p = 0.26$, supporting the acceptance of the null hypothesis).

The results of the long-run equation, with log_gdp serving as the dependent variable, are presented in Table 8. The signs of the coefficients are reversed in the long run. The economic growth would increase in the long run by 28,42%, all else being equal, if the money supply were to increase by 1%. Ceteris paribus, a 1% increase in domestic credit extended by banks will

result in a 0.68% increase in long-term economic growth. Nevertheless, a 1% long-term increase in real interest rates will result in a 2.7% contraction in economic growth, all else being equal. Hence, it can be deduced that domestic credit extended by banks to the private sector (dcb) and money supply (log_bms) exert a substantial positive influence on long-term economic growth (log_gdp). The real interest rate (rir), on the other hand, exerts a substantial adverse effect on economic growth. At the 1% significance level, each coefficient exhibits statistical significance.

Table 8 Long-run relationships

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
log_gdp	1	.	.	.	.	.
log_bms	-.2841776	.0082341	-34.51	0.000	-.3003161	-.2680391
dcb	-.0068531	.0008	-8.57	0.000	-.0084211	-.0052851
rir	.0270235	.0033109	8.16	0.000	.0205343	.0335127
_cons	-18.06257	.	.	.	.	.

Source: *Authors computations using Word Development Indicators (1991-2022).*

Calculation of the error correction term:

$ECT_{t-1} = 1.000\log\_gdp_{t-1} - 0.284\log\_bms_{t-1} - 0.007\mathrm{dcb}_{t-1} + 0.027\mathrm{rir}_{t-1} - 18.062$

The statistical analysis reveals that the adjustment term (-0.268) in Table 9 (and Appendix B) is significant at the 1% level. This suggests that any deviations from the long-run equilibrium that occurred in the previous year are rectified in the current year with a convergence speed of 26.8%. Consequently, this correction process establishes a stable long-term relationship among the variables. The rate at which economic growth (log_gdp) returns to equilibrium following alterations in money supply, domestic credit extended by banks, and real interest rates is denoted as 26.8% in this particular model.

Table 9 VECM regression results

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_log_gdp	14	.008333	0.9852	801.2584	0.0000
D_log_bms	14	.044639	0.9562	261.9492	0.0000
D_dcb	14	3.47555	0.5916	17.38293	0.2363
D_rir	14	4.61914	0.4942	11.72655	0.6283

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_log_gdp						
_ce1						
L1.	-.2682577	.0764583	-3.51	0.000	-.4181133	-.1184022
log_gdp						
LD.	.08294	.2364451	0.35	0.726	-.3804839	.546364
L2D.	.3436953	.2374292	1.45	0.148	-.1216574	.8090481
L3D.	-.1969526	.2098245	-0.94	0.348	-.608201	.2142958
log_bms						
LD.	.0032533	.0414915	0.08	0.938	-.0780685	.0845751
L2D.	-.0173553	.048257	-0.36	0.719	-.1119373	.0772267
L3D.	.0449521	.0424748	1.06	0.290	-.038297	.1282012
dcb						
LD.	-.0015268	.0008118	-1.88	0.060	-.0031178	.0000642
L2D.	.0007981	.0007693	1.04	0.300	-.0007098	.002306
L3D.	.0006701	.0007386	0.91	0.364	-.0007775	.0021177
rir						
LD.	.0063735	.0019554	3.26	0.001	.0025411	.010206
L2D.	.0044108	.0014446	3.05	0.002	.0015795	.0072421
L3D.	.0018122	.000859	2.11	0.035	.0001285	.0034959
_cons	.0891479	.0206055	4.33	0.000	.0487618	.1295339

Source: *Authors computations using Word Development Indicators (1991-2022).*

Based on the diagnostics tests presented in Appendix D, the VEC Model is stable at 3-unit moduli. No autocorrelation is found at a lag order of four and the error terms are normally distributed based on the Jarque-Bera test.

To summarise, it can be inferred that the money supply, domestic credit provided by banks to the private sector, and real interest rates have notably influenced Egypt's economic growth between 1991 and 2022. More specifically, the domestic credit provided by banks to the private sector and the money supply have a significant positive impact on economic growth, while the real interest rate has a significant negative impact, in both the short-run and the long-run. The results are consistent with the theoretical framework proposed by Jhingan (2003) and supported by the empirical study conducted by Chuba and Yusuf (2022). Their findings indicate a significant positive impact of money supply and domestic credit provided by banks on economic growth and a significant negative impact of the treasury bill rate on economic growth in Nigeria. Moreover, the results of the present study align with the earlier research conducted by Abdel-Baki (2010), who found that interest rates substantially adversely affect economic growth in Egypt, by using a non-recursive SVAR model. However, our study findings are

inconsistent with the research conducted by Hachicha and Lee (2009), who, using the SVAR model, found out that interest rates had a negligible impact on both output and inflation in Egypt. Furthermore, Moursi et al. (2006), Al-Mashat and Billmeier (2008), and Awad (2011) demonstrated that monetary policy had a negligible impact on real output, and the influence of the interest rate channel was feeble in Egypt.

5. Conclusion, Recommendations, and Future Research

5.1 Conclusion

Although there is an increasing body of knowledge, there is no consensus among economists regarding the influence of monetary policy on economic growth.

This study analyzed the impact of monetary policy on economic growth in Egypt from 1991 to 2022 using a time series analysis. Monetary policy's short- and long-term effects on economic growth are examined using the VAR model and the VECM. The results show a significant positive impact of the money supply and domestic credit provided by banks to the private sector on economic growth and a significant negative impact of the real interest rate on economic growth in Egypt, both in the short and long term. Thus, we can refute the null hypothesis that monetary policy has no meaningful effect on economic growth. Therefore, monetary policy can serve as a means to attain economic expansion and the Sustainable Development Goals (SDGs) (United Nations) in Egypt.

Factually, there are some potential limitations to this study. Initially, it failed to examine the impact of fluctuations in exchange rates on economic growth. The exchange rate is a vital factor that significantly affects several economic aspects, including the value of domestic currency, domestic inflation (the pass-through effect), international trade, capital flows, and financial stability. Thus, it serves as a conduit via which monetary policy affects the entire economy, by influencing firms, consumer behavior, and investment decisions, affecting the aggregate demand, which is the key factor in in determining economic expansion, price stability levels, and employment rates. The present study employed annual data from 1991 to 2022. However, to account for the fluctuating exchange rates, it would be imperative to have quarterly data. Furthermore, it is crucial to have quarterly data on real interest

rates. Yet regrettably, before 2004, such data was unavailable. Therefore, including exchange rates using quarterly data can be adopted in future research.

5.2 Policy Recommendations:

Drawing upon its findings, the study proposes the subsequent courses of action to assist Egypt in attaining the Sustainable Development Goals by 2030 while also meeting its inclusive economic growth target.

Since the study indicates a significant negative impact of real interest rates on economic growth, the CBE should undertake a more accommodative interest rate policy, particularly in periods of economic downturns. This may involve cutting interest rates to facilitate commercial banks' access to the Central Bank's capital at diminished expenses, thereby stimulating borrowing and investment for businesses and reducing capital outlays for the entire economy. Additionally, given the significant positive effect that money supply and domestic credit have on economic growth, policymakers should support policies that improve the private sector's access to credit. This might involve reducing the reserve requirements for banks or targeting lending programs designed to stimulate new investment in strategic sectors. Sustaining appropriate interest rates and extending domestic credit lines are two ways in which the Central Bank of Egypt must direct its monetary policy to foster an environment that will entice both domestic and foreign investment.

The government should also support sectors that are most sensitive to changes in monetary policy, such as manufacturing and services. This could be achieved by providing incentives for investment in these sectors, through either tax exemptions or subsidies, in order to maximize the positive effects of the monetary policy.

Moreover, to strengthen the impact of monetary policy on economic growth, it is recommended that the CBE endeavors to promote financial inclusion as a means of increasing domestic credit. To accomplish this, the CBE should expand the network of branches of financial service providers to allocate funds to initiatives and small-scale projects that specifically target women and low-earnings individuals. These initiatives generate employment opportunities and sustainable income sources for lower-income individuals,

thereby contributing to the eradication of poverty and the promotion of economic growth.

Additionally, the establishment of green banks by the CBE, which provide sustainable finance, is essential for the successful attainment of the SDGs. These banks will provide funding for initiatives that benefit the environment and society as a whole, including labor-intensive projects that create jobs, small, medium, and micro enterprises, and initiatives involving renewable energy and energy efficiency.

The CBE should also improve its transparency and credibility by releasing comprehensive reports that evaluate previous and forthcoming economic events, thereby fostering investor confidence. Finally, as long as the CBE controls the money supply, it might be feasible to meet the goal of economic expansion by offering cash balances without resulting in inflation. To achieve this, the Central Bank's autonomy to decide without intervention from the government must be firmly upheld.

5.3 Future Research:

The present study suggests that future research should delve into sector-specific studies to understand how monetary policy affects various sectors of the economy differently. By assessing which sectors respond most to changes in interest rates or credit availability, monetary interventions could be more effectively tailored. Additionally, future research should focus on how monetary policy affects economic growth in different regions of Egypt, this may help policymakers understand regional disparities in access to credit, investment, and growth, and thus they will be turned to design more focused regional development strategies. Furthermore, it is worth noting that analyzing how far global economic conditions, such as international interest rates and foreign direct investment trends, interact with domestic monetary policy to affect economic growth would be useful to give insights into the effect of external shocks on the Egyptian economy.

6. List of references:

1. Abdel-Baki, M. (2010). “The effects of bank reforms on the monetary transmission mechanism in emerging market economies: evidence from Egypt”. African Development Review, Vol. 22 No. 4, pp. 526-539.
2. Abdullah, Y. (2020). “The impact of monetary policy on economic growth in Turkey”. East University.
3. Alavinasab, S. M. (2016).” Monetary policy and economic growth a case study of Iran”. International Journal of Economics.
4. Al-Mashat, R. and Billmeier, A. (2008), “The monetary transmission mechanism in Egypt”, Review of Middle East Economics and Finance, Vol. 4 No. 3, p. 2
5. Amacher, R. C., and Ulbrich, H. H. (1986). Principles of macroeconomics. Cincinnati, Ohio, South-Western Publishing Co.
6. Amarasekara, C. (2009). “The impact of monetary policy on economic growth and inflation in Sri Lanka”. Central Bank of Sri Lanka Staff Studies, 38, pp. 1-44.
7. Arestis P. and Sawyer, M.C. (2008). “A Critical Reconsideration of the Foundations of Monetary Policy in the New Consensus Macroeconomic Framework”. Cambridge Journal of Economics, Vol. 32, No. 5, pp. 761-79.
8. Arestis, P. (2009). “New Consensus in Macroeconomics: A critical appraisal”. University of Cambridge.
9. Asongu, S. A. (2014). “A note on the long-run neutrality of monetary policy: new empirics”. European Economics Letters, Vol.3, No.1, 1-6.
10. Awad, I.L. (2011). “The impact of recent innovations in monetary policy on the monetary transmission mechanism in Egypt”. Economic Studies, Vol. 4, pp. 186-212.
11. Bernanke, B.S and Mihov, I. (1998). “Measuring monetary policy”. The quarterly journal of economics, Vol. 113, No.3.
12. Berument, H. and Dincer, N. (2008), “Measuring the effects of monetary policy for Turkey”. Journal of Economics Cooperation 29 (1), 83-110.
13. Bullard, J. (1999). “Testing long-run neutrality propositions: Lessons from the recent research”. Federal Reserve Bank of St. Louis Review, Vol. 81, No.6, pp. 57-78.
14. Central Bank of Egypt (CBE), Annual Report, various issues
15. Central Bank of Egypt. (2023). Sustainable Finance.
16. Chari, V.V., Kehoe, P.J. and McGrattan, E.R. (2008). “New Keynesian Models: Not yet useful for policy analysis”. NBER working paper series, Vol.14313. Cambridge, M.A.
17. Chuba, M. A., and Yusuf, L. D. (2022). "Monetary Policy and Sustainable Development Goals in Nigeria". International Journal of Advanced Economics, Vol. 4, No. 6, pp. 107-115.

18. Cyrus, M. and Elias, K. (2014). "Monetary and Fiscal Policy Shocks and Economic Growth in Kenya: VAR Econometric Approach". Journal of World Economic Research. Volume 3, Issue 6, pp. 95-108.
19. Dickey, D. A., and Fuller, W. A. (1979). "Distribution of the estimators for autoregressive time series with a unit root". Journal of American Statistical Association, Vol. 74, No. 366, 427- 431.
20. Elshafei, A. and Abdallah, R. (2022), "The Impact of Real Interest Rate, Net Domestic Credit, Government Expenditure on Economic Growth in Egypt from 1976 to 2018". Scientific journal for economics and commerce.
21. Eric, E. (2021). *Introduction to Granger causality*. Aptech.
22. Fasanya, I.O., Onakoya, A.B.O., and Agboluaje, M.A. (2013). "Does monetary policy influence economic growth in Nigeria?" Asian Economic and Financial Review, Vol, 3, No.5.
23. Fontana G. (2010). "The Return of Keynesian Economics: A Contribution in the Spirit of John Cornwall's Work". Review of Political Economy, Vol. 22, No.4, pp. 517-33.
24. Fontana G. and A. Palacio-Vera (2007). "Are long-run price stability and short-run output stabilization all that monetary policy can aim for?". Metroeconomica, Vol. 58, No.2,pp. 269-298.
25. Friedman, M and Schwartz, A. (1963). "Money and business cycles". Review of Economics and Statistics, pp.32-64.
26. Friedman, M and Schwartz, A. (1970). "Monetary Statistics of the United States: Estimates, Sources,Methods". Columbia University Press for the NBER, New York.
27. Friedman, M. (1968). "The role of monetary policy". American Economic Review, Vol. 58, No.1, pp. 1-17.
28. Gali, J. (2008). "Monetary policy, inflation and business cycle: An introduction to the New Keynesian Framework". Oxfordshire: Princeton University Press.
29. Ghandour, D. G. (2017). "The Role of the Monetary Policy in Achieving EconomicGrowth in Syria". Journal of Economics and Finance, Vol. 8, No. 2, 74-48.
30. Goodfriend, M. and King, R.G. (1997). "The new neoclassical synthesis and the role of monetary policy". NBER Macroeconomics Annual, Vol.12, pp. 231- 283.
31. Gottschalk, J. (2005). "Monetary Policy and German Unemployment Problem in Macroeconomic Models: Theory and Evidence". Berlin German, Springer-Verlag Berlin Heidelberg.
32. Hachicha, A. and Lee, C.F. (2009), "Are structural vars with Long-Run restrictions useful for developing monetary policy strategy in Egypt?", Review of Pacific Basin Financial Markets and Policies, Vol. 12 No. 3, pp. 509-527.
33. Havi, E. D.K. and Enu, P. (2014). "The effect of fiscal policy and monetary policy on Ghana's economic growth: which policy is more potent?". International Journal of Empirical Finance, Vol 3, No.2, pp. 61-75.

34. Herrera, S., Hurlin, C., and Zaki, C. (2013). "Why don't banks lend to Egypt's private sector?". *Economic Modelling*, *33*, 347-356.
35. Hicks, J.R. (1937). "Mr Keynes and the classics: a suggested interpretation". Econometrica, Vol 5, pp.147-159.
36. Jawaid, S.T., Quadri, F.S., and Ali, N. (2011). "Monetary-fiscal-trade policy and economic growth in Pakistan: Time Series Empirical Investigation". International Journal of Economics and Financial Issues, Vol.1, No. 3, pp.133- 138.
37. Jhingan, M. L. (2003). "Macro-economic theory". 11th revised and enlarged ed. Delhi, Vrinda Publications (P) Ltd.
38. Johansen, S. (1988). "Statistical analysis of cointegrating vectors". Journal of Economic Dynamics and Control, 12, 231-254.
39. Kamaan, C, K. (2014). "The effect of monetary policy on economic growth in Kenya". International Journal of Business and Commerce, Vol 3, No.8.
40. Keynes, J.M. (1936). "The General Theory of Employment, Interest and Money". Macmillan, London.
41. Khabo, V. and Harmse, C. (2005). "The impact of monetary policy on economic growth of a small open economy: the case of South Africa". South African Journal of Economic and Management Sciences, Vol. 8, No.3.
42. Mankiw, G. (2006). "The macroeconomist as scientist and engineer". Journal of Economic Perspectives, Vol. 20, No. 4, pp. 29-46.
43. Miller, R.L. and Van Hoose, D.D. (2006). "Money, Banking, and Financial Markets". 3rd Edition, Thomson Advantage Books, Thomson South-Western West, pp.379-385.
44. Mishkin, F.S. (2004). "The Economics of Money, Banking, and Financial Markets". 6thEdition, Addison Wesley Longman, New York, USA.
45. Monamodi, N. (2019). "The impact of fiscal and monetary policy on economic growth in Southern African Custom Union (SACU) member economies between 1980 and 2017: a panel ARDL approach". Available at SSRN 3480082.
46. Monteil, P., Adam, C., and O'Conell, S. (2012). "Financial architecture and the monetary transmission mechanism in Tanzania". CSAE Working Paper, WPS, 03.
47. Moursi, T.A., El Mossallamy, M. and Zakareya, E. (2006), "A review of contemporary monetary policy in Egypt" The Cabint Infornation and Decision Support Center, No. v1.
48. Moursi, T, A. and El Mossallamy, M. (2010). "Monetary policy analysis with New Keynesian Models for Egypt". Information and Decision Support Center (IDSC) of the Egyptian Cabinet Working paper.
49. Munyengwa, T. (2012). "Monetary policy transmission mechanism in Botswana: How does the central bank policy rate affect the economy?". University of the Western Cape, South Africa.

50. Nogueira, R. P. (2009). “Is monetary policy really neutral in the long run? Evidence for some emerging and developed economies”. Economics Bulletin, Vol 29, No. 3, pp. 2432- 2437.
51. Nouri, M. and Samimi, A.J. (2011), “The impact of monetary policy on economic growth in Iran”. Middle East Journal of Scientific Research, Vol. 9 No. 6, pp. 740-743.
52. Ogunmuyiwa, M.S. and Ekone, A.F. (2010), “Money supply-economic growth nexus in Nigeria”. Journal of Social Sciences, Vol. 22 No. 3, pp. 199-204.
53. Onyeiwu, C. (2012). “Monetary policy and economic growth of Nigeria”. Journal of Economics and Sustainable Development, Vol.3, pp. 7.
54. Palley T.I. (2007). “Macroeconomics and monetary policy: Competing theoretical frameworks”. Journal of Post Keynesian Economics, Vol. 30, No.1, pp. 61-78
55. Romer, D. (2006). “Advanced Macroeconomics”. 3rd Ed. ed. New York: McGraw-Hill/Irwin.
56. Senbet, D. (2011). “The relative impact of fiscal versus monetary actions on output: VAR approach”. Business and Economics Journal, pp. 1-11.
57. Shokr, A.K.Z. and Zaidi, M.A.S. (2019). "Monetary policy and macroeconomic responses: non-recursive SVAR study of Egypt". Journal of Financial Economic Policy, Vol. 11 No. 3, pp. 319-337.
58. Twinoburyo, E.N., and Odhiambo, N.M. (2018). “Monetary Policy and Economic Growth: A Review of International Literature”. Journal of Central Banking Theory and Practice, Vol. 7, Iss. 2, pp. 123-137.
59. United Nations. (n.d.). “The 17 goals | sustainable development”. United Nations.
60. Vinayagathasan, T. (2013). “Monetary policy and the real economy: A Structural VAR Approach for Sri Lanka”. National Graduate Institute for Policy Studies, Vol.13, No.13.
61. Virenrehal. (2023). “VECM estimation and interpretation - spur economics”. SPUR ECONOMICS.
62. Walsh, C. E. (2003). “Monetary Theory and Policy”. The MIT Press, Second Edition.
63. Woodford, M. (2007). “The case of forecast targeting as monetary policy strategy”. Journal of economic perspectives, Vol.21, No.4, pp. 3-24.
64. World Bank. (2022). Financial Inclusion.

Appendix A

VAR model results

Equation	Parms	RMSE	R-sq	chi2	P>chi2
fdiff_log_gdp	17	.010126	0.8470	138.383	0.0000
fdiff_log_bms	17	.05117	0.7097	61.1145	0.0000
fdiff_dcb	17	3.17198	0.7563	77.59744	0.0000
fdiff_rir	17	4.88445	0.6167	40.22008	0.0007

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fdiff_log_gdp						
fdiff_log_gdp						
L1.	.4851104	.2055993	2.36	0.018	.0821432	.8880776
L2.	.4712373	.1933286	2.44	0.015	.0923202	.8501545
L3.	-.5453078	.1734474	-3.14	0.002	-.8852585	-.2053572
L4.	-.0047389	.1765579	-0.03	0.979	-.3507861	.3413084
fdiff_log_bms						
L1.	.0105663	.0303968	0.35	0.728	-.0490103	.0701429
L2.	-.0085568	.0348813	-0.25	0.806	-.0769228	.0598092
L3.	.115501	.0357819	3.23	0.001	.0453698	.1856322
L4.	-.0989072	.0382698	-2.58	0.010	-.1739145	-.0238998
fdiff_dcb						
L1.	.0011264	.0007275	1.55	0.122	-.0002995	.0025523
L2.	.00142	.0005478	2.59	0.010	.0003464	.0024937
L3.	-.0000497	.0006254	-0.08	0.937	-.0012754	.001176
L4.	-.000493	.0005622	-0.88	0.381	-.001595	.0006089
fdiff_rir						
L1.	-.0007688	.0004778	-1.61	0.108	-.0017053	.0001677
L2.	-.0014056	.0005825	-2.41	0.016	-.0025472	-.0002639
L3.	-.0023704	.0006031	-3.93	0.000	-.0035525	-.0011883
L4.	-.0017678	.0006023	-2.93	0.003	-.0029483	-.0005873
_cons	.0223171	.011129	2.01	0.045	.0005047	.0441295
fdiff_log_bms						
fdiff_log_gdp						
L1.	.1148073	1.038987	0.11	0.912	-1.921571	2.151185
L2.	-1.934752	.9769782	-1.98	0.048	-3.849594	-.0199103
L3.	.2933228	.8765094	0.33	0.738	-1.424604	2.01125
L4.	-1.470625	.8922283	-1.65	0.099	-3.219361	.2781101
fdiff_log_bms						
L1.	.2936041	.1536089	1.91	0.056	-.0074638	.5946721
L2.	-.4799769	.176271	-2.72	0.006	-.8254616	-.1344921
L3.	.4682749	.1808222	2.59	0.010	.1138699	.82268
L4.	-.2248908	.1933947	-1.16	0.245	-.6039374	.1541558
fdiff_dcb						
L1.	-.0091457	.0036764	-2.49	0.013	-.0163513	-.0019402
L2.	.0003713	.0027683	0.13	0.893	-.0050544	.005797
L3.	-.0078537	.0031603	-2.49	0.013	-.0140477	-.0016597
L4.	.0077248	.0028412	2.72	0.007	.0021562	.0132933
fdiff_rir						
L1.	.0056866	.0024146	2.36	0.019	.0009541	.0104191
L2.	.0090622	.0029436	3.08	0.002	.0032929	.0148315
L3.	.0111362	.0030478	3.65	0.000	.0051625	.0171098
L4.	.0057363	.0030438	1.88	0.059	-.0002294	.0117021
_cons	.2635369	.0562399	4.69	0.000	.1533087	.3737652

Source: *Authors computations using STATA.*

VAR model results *(continued)*:

fdiff_dcb						
fdiff_log_gdp						
L1.	-100.3285	64.40592	-1.56	0.119	-226.5618	25.90475
L2.	-38.0381	60.56202	-0.63	0.530	-156.7375	80.66129
L3.	51.26941	54.33405	0.94	0.345	-55.22336	157.7622
L4.	-145.1832	55.30845	-2.62	0.009	-253.5858	-36.78062
fdiff_log_bms						
L1.	-20.46135	9.522081	-2.15	0.032	-39.12429	-1.798415
L2.	-22.43862	10.92688	-2.05	0.040	-43.85492	-1.022322
L3.	-2.828018	11.20901	-0.25	0.801	-24.79728	19.14124
L4.	24.00825	11.98837	2.00	0.045	.5114857	47.50502
fdiff_dcb						
L1.	.2036891	.2278948	0.89	0.371	-.2429764	.6503547
L2.	.1588579	.1716026	0.93	0.355	-.177477	.4951927
L3.	.0420787	.1959021	0.21	0.830	-.3418824	.4260398
L4.	.3755434	.1761211	2.13	0.033	.0303523	.7207346
fdiff_rir						
L1.	.1228257	.1496783	0.82	0.412	-.1705383	.4161897
L2.	-.0089554	.1824707	-0.05	0.961	-.3665914	.3486807
L3.	.2398342	.1889323	1.27	0.204	-.1304664	.6101348
L4.	-.4377708	.1886828	-2.32	0.020	-.8075823	-.0679592
_cons	12.87157	3.486264	3.69	0.000	6.038618	19.70452
fdiff_rir						
fdiff_log_gdp						
L1.	-61.05503	99.17695	-0.62	0.538	-255.4383	133.3282
L2.	-86.71536	93.25784	-0.93	0.352	-269.4974	96.06664
L3.	135.2721	83.66754	1.62	0.106	-28.71326	299.2575
L4.	-225.259	85.168	-2.64	0.008	-392.1852	-58.33281
fdiff_log_bms						
L1.	-36.6046	14.6628	-2.50	0.013	-65.34315	-7.866044
L2.	-13.29582	16.82601	-0.79	0.429	-46.27421	19.68256
L3.	-4.194914	17.26046	-0.24	0.808	-38.02479	29.63496
L4.	21.43683	18.46057	1.16	0.246	-14.74521	57.61888
fdiff_dcb						
L1.	.0821355	.350929	0.23	0.815	-.6056728	.7699438
L2.	-.1419216	.2642462	-0.54	0.591	-.6598346	.3759914
L3.	-.0907021	.3016644	-0.30	0.764	-.6819535	.5005493
L4.	.3272882	.2712042	1.21	0.228	-.2042623	.8588387
fdiff_rir						
L1.	-.5388702	.2304855	-2.34	0.019	-.9906136	-.0871269
L2.	-.5154159	.2809818	-1.83	0.067	-1.06613	.0352982
L3.	.1014419	.2909318	0.35	0.727	-.4687741	.6716578
L4.	-.306631	.2905476	-1.06	0.291	-.8760939	.2628319
_cons	14.42993	5.368405	2.69	0.007	3.908052	24.95181

Source: *Authors computations using STATA.*

Appendix B

VECM results

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_log_gdp	14	.008333	0.9852	801.2584	0.0000
D_log_bms	14	.044639	0.9562	261.9492	0.0000
D_dcb	14	3.47555	0.5916	17.38293	0.2363
D_rir	14	4.61914	0.4942	11.72655	0.6283

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_log_gdp						
_cel						
L1.	-.2682577	.0764583	-3.51	0.000	-.4181133	-.1184022
log_gdp						
LD.	.08294	.2364451	0.35	0.726	-.3804839	.546364
L2D.	.3436953	.2374292	1.45	0.148	-.1216574	.8090481
L3D.	-.1969526	.2098245	-0.94	0.348	-.608201	.2142958
log_bms						
LD.	.0032533	.0414915	0.08	0.938	-.0780685	.0845751
L2D.	-.0173553	.048257	-0.36	0.719	-.1119373	.0772267
L3D.	.0449521	.0424748	1.06	0.290	-.038297	.1282012
dcb						
LD.	-.0015268	.0008118	-1.88	0.060	-.0031178	.0000642
L2D.	.0007981	.0007693	1.04	0.300	-.0007098	.002306
L3D.	.0006701	.0007386	0.91	0.364	-.0007775	.0021177
rir						
LD.	.0063735	.0019554	3.26	0.001	.0025411	.010206
L2D.	.0044108	.0014446	3.05	0.002	.0015795	.0072421
L3D.	.0018122	.000859	2.11	0.035	.0001285	.0034959
_cons	.0891479	.0206055	4.33	0.000	.0487618	.1295339
D_log_bms						
_cel						
L1.	1.124125	.4095825	2.74	0.006	.3213582	1.926892
log_gdp						
LD.	1.743441	1.266622	1.38	0.169	-.7390928	4.225974
L2D.	-1.481027	1.271894	-1.16	0.244	-3.973893	1.011839
L3D.	-1.91143	1.124017	-1.70	0.089	-4.114462	.2916026
log_bms						
LD.	.2200298	.2222673	0.99	0.322	-.2156061	.6556658
L2D.	-.2288738	.2585099	-0.89	0.376	-.7355438	.2777962
L3D.	.4173874	.227535	1.83	0.067	-.0285729	.8633477
dcb						
LD.	-.000106	.0043485	-0.02	0.981	-.008629	.0084169
L2D.	.0060693	.0041213	1.47	0.141	-.0020084	.0141469
L3D.	-.0058263	.0039567	-1.47	0.141	-.0135813	.0019286
rir						
LD.	-.0235693	.0104749	-2.25	0.024	-.0440997	-.0030388
L2D.	-.015805	.0077385	-2.04	0.041	-.0309721	-.0006379
L3D.	-.0067594	.0046018	-1.47	0.142	-.0157788	.00226
_cons	-.0971119	.1103824	-0.88	0.379	-.3134574	.1192336

Source: *Authors computations using STATA.*

VECM results *(continued)*:

D_dcb						
_ce1						
L1.	4.022375	31.89005	0.13	0.900	-58.48097	66.52572
log_gdp						
LD.	34.54879	98.61904	0.35	0.726	-158.741	227.8386
L2D.	-61.58052	99.02951	-0.62	0.534	-255.6748	132.5137
L3D.	-69.19828	87.51583	-0.79	0.429	-240.7261	102.3296
log_bms						
LD.	-23.98719	17.30571	-1.39	0.166	-57.90576	9.931375
L2D.	-19.94927	20.12755	-0.99	0.322	-59.39854	19.5
L3D.	11.49846	17.71585	0.65	0.516	-23.22396	46.22088
dcb						
LD.	.1228975	.3385739	0.36	0.717	-.5406951	.7864901
L2D.	.2727614	.3208854	0.85	0.395	-.3561625	.9016853
L3D.	.0265261	.3080663	0.09	0.931	-.5772727	.6303248
rir						
LD.	.089006	.8155745	0.11	0.913	-1.509491	1.687503
L2D.	.1595496	.602516	0.26	0.791	-1.02136	1.340459
L3D.	.2528257	.3582961	0.71	0.480	-.4494217	.9550732
_cons	7.585596	8.594359	0.88	0.377	-9.259039	24.43023
D_rir						
_ce1						
L1.	29.00728	42.38308	0.68	0.494	-54.06202	112.0766
log_gdp						
LD.	148.5469	131.0684	1.13	0.257	-108.3425	405.4363
L2D.	-127.9929	131.6139	-0.97	0.331	-385.9514	129.9657
L3D.	-56.60041	116.3118	-0.49	0.627	-284.5674	171.3666
log_bms						
LD.	-36.15443	22.99994	-1.57	0.116	-81.23348	8.924625
L2D.	-3.602445	26.75027	-0.13	0.893	-56.03201	48.82712
L3D.	7.226133	23.54503	0.31	0.759	-38.92127	53.37354
dcb						
LD.	.0999137	.4499774	0.22	0.824	-.7820259	.9818532
L2D.	.1524247	.4264688	0.36	0.721	-.6834388	.9882882
L3D.	-.1760479	.4094316	-0.43	0.667	-.9785191	.6264234
rir						
LD.	-1.20924	1.083929	-1.12	0.265	-3.333702	.9152218
L2D.	-.9550012	.8007664	-1.19	0.233	-2.524474	.6144721
L3D.	-.2631347	.476189	-0.55	0.581	-1.196448	.6701785
_cons	-1.04729	11.42223	-0.09	0.927	-23.43444	21.33986

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	3	2715.604	0.0000

Source: *Authors computations using STATA.*

Appendix C
Diagnostics tests for the VAR model

1. Stability condition test:

Eigenvalue stability condition

Eigenvalue	Modulus
-.3880711 + .8659912*i*	.948968
-.3880711 - .8659912*i*	.948968
-.6953587 + .6408877*i*	.945654
-.6953587 - .6408877*i*	.945654
.7570624 + .5643782*i*	.944281
.7570624 - .5643782*i*	.944281
-.8928649 + .1185341*i*	.900699
-.8928649 - .1185341*i*	.900699
.8408468 + .1079848*i*	.847752
.8408468 - .1079848*i*	.847752
-.1194608 + .8365042*i*	.844991
-.1194608 - .8365042*i*	.844991
.2510277 + .7839953*i*	.823203
.2510277 - .7839953*i*	.823203
.4685854 + .5508578*i*	.723199
.4685854 - .5508578*i*	.723199

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

Source: Authors computations using STATA..

2. Autocorrelation test (Lagrange-multiplier test)

lag	chi2	df	Prob > chi2
1	40.7720	16	0.00060
2	12.0064	16	0.74354

H0: no autocorrelation at lag order

Source: Authors computations using STATA.

3. Normality test (Jarque-Bera test)

Jarque-Bera test

Equation	chi2	df	Prob > chi2
fdiff_log_gdp	0.646	2	0.72395
fdiff_log_bms	2.530	2	0.28222
fdiff_dcb	0.934	2	0.62697
fdiff_rir	1.056	2	0.58980
ALL	5.166	8	0.73971

Source: Authors computations using STATA.

Appendix D
Diagnostics tests for the VECM

1. Stability condition test:

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
1	1
.7553576 + .5110247*i*	.911982
.7553576 - .5110247*i*	.911982
-.3384484 + .8458306*i*	.911031
-.3384484 - .8458306*i*	.911031
-.8523775	.852378
.8071344	.807134
.1670245 + .5847582*i*	.608144
.1670245 - .5847582*i*	.608144
-.4461011 + .3790968*i*	.585423
-.4461011 - .3790968*i*	.585423
.3510665	.351067
-.09812849 + .1812331*i*	.206094
-.09812849 - .1812331*i*	.206094

The VECM specification imposes 3 unit moduli.

Source: Authors computations using STATA.

2. Autocorrelation test (Lagrange-multiplier test)

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	13.5763	16	0.63024
2	15.7490	16	0.47061
3	23.5865	16	0.09893
4	14.0864	16	0.59227

H0: no autocorrelation at lag order

Source: Authors computations using STATA.

3. Normality test (Jarque-Bera test)

Jarque-Bera test

Equation	chi2	df	Prob > chi2
D_log_gdp	0.609	2	0.73746
D_log_bms	5.073	2	0.07916
D_dcb	0.703	2	0.70359
D_rir	0.203	2	0.90343
ALL	6.588	8	0.58167

Source: Authors computations using STATA.