What can SVAR models tell us about the impact of Monetary Policy shocks on Aggregate Demand components and Inflation in Egypt?

Abstract

The purpose of this paper is to investigates monetary policy shocks and their effects on aggregate demand components and inflation within the Egyptian context. In the empirical analysis of the SVAR models applied to quarterly data covering the period 1991–2022, we found the following: First, a higher interest rate policy by the CBE, which aims to contain inflation, produces a large negative shock to private investment and consumption but only a small inflation response, which does not suffice to reverse the worsening trend of inflation. Second, it suffices that the exchange rate deterioration does not counteract the so-called "pass-through" effect. Third, it is the exchange rate, not the inflation rate, that is Granger-causal for monetary policy. Fourth, relying solely on the exchange rate to correct the structural trade deficit has no sufficient impact on removing it. Based on these conclusions, we recommend the following: first, a change in monetary policy toward an inflation-targeting, rule-based set of policies, with a clear and transparent role assigned to the exchange rate, may raise the credibility of the CBE and the effectiveness of monetary policy; and second, Egyptian policymakers should also consider intertemporal alignment of monetary policy with supply-side measures aimed at sustainable growth and unsustainable fiscal and external imbalances—to achieve price stability.

Keywords: Monetary policy shocks; aggregate demand components; exchange rate; inflation; SVAR ; Egypt

ملخص:

تستهدف هذه الورقة دراسة أثر صدمات السياسة النقدية على مكونات الطلب الكلي والتضخم في السياق المصري. ومن خلال التحليل التجريبي لنماذج SVAR المطبقة على بيانات ربع سنوية تغطي الفترة من ١٩٩١ إلى ٢٠٢٢، توصلت الدراسة إلى ما يلي: أولاً، تؤدي سياسة رفع أسعار الفائدة من قبل البنك المركزي المصري، والتي تهدف إلى احتواء التضخم، إلى صدمة سلبية كبيرة لكل من للاستثمارات الخاصة والإنفاق الاستهلاكي. ثانياً، غالباً ما تتعرض جهود البنك المركزي إلى عدم تحقيق أهدافها المنشودة في احتواء التضخم بسبب ما يعرف بتأثير "العبور" والمرتبط باستمرار انخفاض سعر الصرف. ثالثا، إن سعر الصرف، وليس معدل التضخم، هو الذي يشكل السبب وراء قرارات السياسة النقدية للبنك المركزي. رابعاً، إن الاعتماد على سعر الصرف فقط لتصحيح العجز التجاري ليس له تأثير كاف على إزالته. وبناء على هذه النتائج، نوصي بما يلي: أولاً، إن تغيير السياسة النقدية نحو مجموعة من السياسات القائمة على استهداف التضخم، مع إعطاء دور واضح وشفاف لسعر الصرف، قد يزيد من مصداقية البنك المركزي المصري ومن فعالية السياسة النقدية. ثانياً، ينبغي لواضعي السياسات أيضا النظر في مواءمة السياسة النقدية مع تدابير جانب العرض التي تهدف إلى تحقيق مستهدفات النمو المستدام وعلاج الاختلالات المالية والخارجية غير المستدامة لتحقيق استقرار الأسعار.

1. Introduction

Currently, there are almost unanimous views among economic elites that monetary policy is critical in determining economic activity levels and maintaining price stability. In spite of this agreement being there, there is still an issue of efficacy of monetary policies and the transmission mechanism that such studies cover in the research arena. Extensive researches going on in both developed as well as emerging economies, have shown that there is no agreeable measure about the nature and magnitude of the responses to monetary policy interventions and their transmission mechanism which are the key issues to be taken care of by the central bank policymakers. Bernanke and Gertler (1995) had been criticizing the empirical analysis of the impact of monetary policy on the economy because it is done in silence on its transmission mechanisms like it is viewed as a "black box". More recently, for the last two years since the outbreak of pandemic, many central banks across the globe shifted toward an increasingly restrictive monetary policy regime, a rate hike cycle in which they, over and over again, increased the interest rates as a response to the substantial escalation of inflation. It is the extent to which such a policy stance should be introduced; that's to say it depends on discovering how the economy responds to such policies, that's an empirical matter. Incorporating these factors into economic models, either as an exogenous component or endogenously, helps policymakers understand how the economy reacts to policy tightening, especially through its various transmission mechanisms. Monetary policy transmission to the real economy happens through a number of different channels, all of which eventually affect aggregate spending, output, and inflation. In this study, we investigate the responses of aggregate demand components and inflation to monetary policy shocks, focusing specifically on three significant monetary policy transmission channels: the market interest rate channel, a credit supply channel, and the exchange rate channel.

The concept of the market interest rate channel aligns with the Keynesian theory on the cost-of-capital mechanism. According to this theory , base rates are set in such a manner as by them to affect the cost of

capital and, respectively the cost of goods produced with a long-term investment such as housing, fixed investment, inventories, and consumer durables. Consequently, changes in aggregate demand are subsequently reflected in adjustments to production levels and price levels Taylor (1995). On the other hand, the bank-lending channel describes how a tightening of monetary policy can decrease the supply of bank credit in the economy. This tightening affects banks' willingness to lend due to several factors: i) banks' resultant costs of acquiring funds from monetary policy tightening Bernanke & Blinder (1992), ii) agency costs brought between borrowers and lenders that further deteriorates the banking system willingness to lend during periods of tight monetary policy rate or economic recourse; Holmstrom & Tirole (1997); Jiménez et al. (2012), and iii) balance sheet constraints that exacerbate the contraction in credit availability caused by monetary policy tightening Peek & Rosengren (1995); Stein (1998); Van den Heuvel (2002). Furthermore, exchange rate constitutes a vital factor in the conduction mechanism of monetary policy. Alongside the exchange rate channel, policy interest rate fluctuations impact the exchange rate causing movements in the price of goods and services and the level of activities. This mechanism is associated with Mundell's interest rate parity theory, which suggests that when there are movements in capital, the condition holds among countries that an increase in domestic interest rate should be accompanied by an exchange rate hike to equate expected returns both locally and internationally.

Our research differs from the vast majority of prior studies, since it analyzes how the economy reacts through this channel, rather than gauging reactions to changes in the policy interest rate. Central bank policymakers and macroeconomists both stand to benefit from our research, given that it focuses on Egypt, a relatively new economy where existing research on this issue is scarce.

The choice of Egypt is justified by several reasons. First, as an open economy, Egypt is a prototypical case for institutional transition within the MENA region. There have been significant developments in the exchange rate system and more flexibility in monetary policy stance over the last few years, which may increase the effectiveness of monetary policy Taylor

(1995). There is also emerging evidence of a significant degree of autonomy of the Central Bank of Egypt (CBE), which enhances its financial independence and enhances its responsibilities through improving its communication about policies and goals Rodolfo et al. (2020). Second, the CBE has consistently raised interest rates to reduce recent inflationary pressures, which is the general trend practiced around the globe. However, whether such a policy is effective remains a matter for consideration, especially because the inflationary pressures have not been falling despite rising interest rates. Besides, the devaluation of the exchange rate had not shown a solid downward trend despite the interest rate hikes. Moreover, the persistence in the devaluation of the exchange rate has widened the trade deficit. The effectiveness of monetary policy based on interest rates is doubtful in the context of Egypt since the measures are being implemented with discretion, which has not yet evolved toward explicit targeting. Third, very few studies have addressed the extent to which monetary policy shocks affect aggregate demand and inflation in the context of Egypt, and the findings of the previous studies have not been consistent with each other regarding the nature and extent of the effects. Most of the existing research has focused on aggregate GDP and has not tackled the effects on the components of aggregate demand. Moreover, most of the previous studies have viewed monetary policy as a mysterious variable, which has not been deconstructed into its transmission mechanisms.

We used SVAR model based on time-series data up to the year 2022 to perform our empirical analysis in respect to the responsiveness of aggregate demand components and inflation to monetary policy shocks. The result of our analysis throws up interesting areas for discussion. For example, our analysis suggests that restrictive monetary policy has adverse effects on private investment and consumption through the market interest rates in a stronger manner than other channels considered for analysis. Our estimates of inflation responsiveness suggest that about 42% of its error variance is explained by the fluctuations of the exchange rate, whereas about 7% is due to the fluctuations in market interest rates. These results prove to be the first evidence of the dominant role of the exchange rate "pass-through" effect in driving the inflation upward. Furthermore, they demonstrate that

depreciation of the exchange rate does not alone help in correcting the structural trade deficit. These insights suggest that a number of actions must be put in place by the CBE and the government that will help improve the credibility of the central bank, thereby making monetary policy more effective in achieving price stability objectives.

The structure of this paper unfolds as follows: Section 2 delves into the existing literature. Section 3 outlines the empirical framework, details the applicable econometric methodology, and provides an overview of the data along with their historical evolution. Section 4 interprets the empirical results. Finally, Section 5 wraps up the paper, offering conclusions and suggesting potential policy measures.

2. Literature review

This literature review seeks to succinctly summarize significant recent research on the relationship between monetary policy shocks and key macroeconomic indicators, particularly focusing on inflation and aggregate demand components. We initially presented studies conducted on an international scale before transitioning to those conducted within the Egyptian context.

International-scale literature investigates the dynamics of varied countries. For example, Romer and Romer (2004) used the vector autoregressive (VAR) model to document the striking impact of monetary policy on output as well as inflation of the US economy. Results indicate that some new signals of monetary policy shocks yield significantly stronger effects than what is shown by the conventional measures of the federal funds rate. For example, a rise in the new funds rate measure equal to 1% led to a 4.3% contraction in industrial production for the four months that followed. And a restrictive monetary policy produced a 6% fall in the price level after 48 months. In contrast, Uhlig (2005) found that the negative effect of contractionary monetary policy shocks on US real GDP was indeterminate, and this thus implies the neutrality of monetary policy is consistent with US data. Similarly, recent work by Bachmann et al. (2022) showed a weak impact on output and prices caused by the 25-basis point rise in the US policy rate. Finally, Sona et al. (2020) examined the consequences of

eurozone monetary policy shocks for Central, Eastern, and Southeastern Europe (CESEE) and showed differential magnitudes of contraction in both prices and output in response to monetary policy tightening. As per Ella et al. (2022) a new gauge of the Bank of England's monetary policy stance was put forward, it makes it easier to comprehend the effect of monetary policy on the dynamic inflation and the economic growth in the UK. Jakab et al. (2006) performed this in Hungary and found out that investment may go down following monetary policy contraction due higher real interest rates and vaguer on the effects of consumption as compared to the net exports that remained constant during the first two years after the shock. As per Mbarek and colleagues (2019), it has been found that monetary policy changes such as lowering of rates had no significant influence on Tunisian Treasury bond yields. Their findings attribute uncertainty as a main determinant of the efficiency of monetary policy, especially in times of economic shocks when the potential for macroeconomic problem increases, e.g. the stage after the revolution. This manifests the necessity of a keener policy approach that intervenes as early as possible. Khundrakpam and Jain (2012) applied a structural vector autoregression (SVAR) model to assess impacts of the monetary policy on aggregate demand in India, pointing that monetary policy tightening via higher interest rates restrains aggregate demand growth more in private investment and imports. Other studies also have established that tight monetary policy in India restrains economic growth. Similarly, the findings of research on the Vietnamese economy by Sajid and Lan Phi (2018) established that higher interest rates, exchange rates, and foreign shocks affect the output. Khundrakpam (2017) explored the asymmetric effect of monetary policy on diverse dimensions of aggregate demand components in terms of investment, public consumption, and private consumption and also inflation. He differentiated between that of anticipated and unanticipated shock of monetary policy, a methodology that has also been followed in the past research, such as that of Cover (1992), Ravn & Sola (2004), that differentiated a 2-step OLS procedure. They used quarterly data from 1996–97Q1 to 2013–14Q3 in the Indian context. Their result indicates that unanticipated shocks are asymmetric in affecting private consumption, symmetric impact is observed on investment and negligible

impact on public consumption. They found symmetric impact of the unanticipated shocks on inflation. Hürtgen and Cloyne (2014) stressed that a 1-percentage point increase in the policy rate in the UK reduces inflation and output by up to 1% point and 0.6% point, respectively, in the period of 2 to 3 years. Khatat et al. (2020) reviewed Tunisia's monetary policy since 2011. Their study explains long-term money neutrality and indicates that discretionary monetary policy, without a clear nominal anchor, is inconsistent. Moreover, on the basis of the level of economic and financial development achieved and the central bank independence achieved, the adoption of an inflation-targeting framework for monetary policy does not seem to be constrained. Zoaea (2014) described monetary policy shocks and the effects of these shocks on components of aggregate demand in GCC countries. He found that, in Qatar, Oman, and Saudi Arabia, monetary policy shocks hurt investment more strongly, whereas private consumption is significantly affected in Bahrain, Oman, and Saudi Arabia. Kim and Song (2021) reported that workers' consumption reactions to monetary policy shocks were more responsive than retirees in four developed countries, namely, Italy, Japan, Korea, and the US.

As above, several studies have addressed the idea of "pass-through" impact of exchange rates on domestic inflations. For example, Forbes et al (2018) was able to identify that the exchange rate pass-through is very limited in the UK. Anh et al. (2021) examined this phenomenon in five ASEAN countries and had similar results, leading them to conclude that incomplete transmission of exchange rate pass-through was observed in local prices. Shevchuk (2022) replicated these findings in four countries (Czech Republic, Hungary, Poland, and Romania), and was able to support the view that incomplete exchange rate pass-through was the case, as well as the trade-off between output prices and monetary shocks. Ca' Zorzi et al. (2007) emphasized that in such emerging markets, where inflation still holds a figure within the single digits, especially in Asian countries, there is a minimal pass-through effect on import and consumer prices, which is closely similar to the patterns that occur in developed economies. The degree of exchange rate pass-through was also established to be strongly correlated with domestic inflation, which reflected Taylor's hypothesis. Ha et al. (2020) emphasized that the presence of credible inflation targets and

adaptive exchange rate systems results in lower pass-through ratios. Aisen et al. (2021) estimates the exchange rate pass-through in Mozambique. The findings suggested that exchange rate pass-through exhibits asymmetry, substantial magnitude, and rapidity, whereby approximately half of the fluctuations in the exchange rate influence prices within a span of fewer than six months. They revealed a few results**.** Vo,Duc (2019) studied the intensity of exchange rate pass-through affecting import, producer, and consumer price indices in four selected countries of the Asia-Pacific region—namely, Australia, New Zealand, Japan, and Korea. There were several findings of the study. Firstly, results indicated that exchange rate pass-through to domestic prices is passed through the distribution chain; the impact of exchange rate fluctuation was firstly seen at the import prices and then followed by impacts on the producer and consumer prices. Secondly, rising impact of exchange rate pass-through was seen on import prices after the global financial crisis. Thirdly, the changes in the exchange rate pass-through elasticities were mainly influenced by macroeconomic factors, such as inflation volatility, interest rates, and trade openness. Pinshi & Sungani (2018) have studied whether changes in exchange rates have an impact on local prices in DR. Congo, specifically, quantified the level of exchange rate pass-through to inflation within the January 2002 to March 2017 period. The study employed cointegration analysis and applied a vector error correction model. The results indicated that changes in exchange rates have been highly impactful on inflation, and the level of pass-through was recorded to be relatively high. Pham et al. (2022) analyzed the incidence of this phenomenon in Vietnam between 2001 and 2019 using a structural vector autoregressive model. From these results, there was a higher exchange rate pass-through in Vietnam compared to both emerging and advanced economies. The primary factors that contributed to this difference were high and volatile inflation rates, high and volatile trade openness, and the exchange rate regime.

Very little research has been conducted in the Egyptian context regarding how inflation and aggregate demand react to monetary policy shocks. There is undoubtedly a range of views regarding the strength and type of impulses in this reaction. Moreover, most of the existing research

has concentrated on the effects of monetary policy shocks on aggregate economic activity, mainly GDP, and not on the individual components of aggregate demand. For example, Moursi et al. (2007) applied a VAR to investigate the effect of monetary policy shocks on macroeconomic variables. They introduced policy variables (total and non-borrowed reserves and the interest rate) and three variables that were not policy variables: commodity prices, GDP deflator, and real output. They concluded that the long-run neutrality of money is upheld as they found no significant real effects on output. Their results indicated that the CBE had focused on reducing fluctuations in the interest rate rather than using monetary policy to stabilize inflation from 2001 to 2006. Similar to Moursi et al. (2007), Al-Mashat and Billmeier (2008) used the interest rate, that is, the 3-month deposit rate. Their results commented that although the interest rate channel was undeveloped, evidence indicated its development after 2005. Finally, their results revealed the importance of the exchange rate channel in the monetary transmission mechanism. Hachicha and Lee (2009) applied the SVAR model to monetary policy in Egypt, from December 1976 to May 2006. They found that while the interest rate channel in monetary policy was not effective in the short run, the indirect channel was effective in the long run. In their research, they found that commercial bank lending, which is part of the transmission mechanism, was not a strong vehicle for transmitting the monetary policy. Following the same methodology, Abdel-Baki (2010) found how monetary policy affects the real economy after the introduction of banking reforms by looking at the effect of the interest rate and foreign exchange rates channels on output and inflation. Research suggests that the interest rate was significant in driving output but not inflation, while the exchange rate, on the contrary, was significant in determining inflation but did not affect domestic output. They concluded that the two transmission channels were improved after introducing banking reforms. Finally, using the same methodology, they explored more conclusions regarding the fact that the exchange rate was responsible for more impact on inflation than domestic output was reasonable due to the significant volume of imports in the Egyptian economy at that time. Awad (2011) investigates the monetary transmission mechanism in the Egyptian economy in order to answer several questions related to the monetary policy

autonomy, the external shocks' influence on Egypt's real GDP and price levels, and the main transmission channels of the monetary transmission mechanism. The main variables to measure the monetary policy stance include the short-term nominal interest rate, non-borrowed reserves, and non-borrowed reserves to total reserves ratio. The findings indicated that CBE has a non-autonomous monetary policy and was using a sterilized intervention policy. The results showed that the Central Bank's response on the exchange rate changes, and the Federal Funds rate of the United States has highly contributed to explaining domestic short-term nominal interest rate variability. Foreign economic shocks have also played a dominant role in Egypt's real GDP, while domestic economic shocks have had a major role in domestic inflation. Furthermore, the interest rate channel was dominant, with a positive impact on both Egypt's real GDP growth and inflation levels. Shokr et al. (2019) conducts an examination of the impacts of monetary policy on output, inflation, and the exchange rate in Egypt using money supply and the interest rate as two monetary policy instruments. The paper uses the non-recursive SVAR model, and the findings in this study suggest that monetary policy by using either money supply or interest rate has a significant impact on the three macroeconomic variables. Omar and Yousri (2023) used the interest rate as a monetary policy instrument. The result showed a strong long-term impact on output and inflation.

In essence, our review of the existing literature in the area of the effects of monetary policy shocks on inflation and aggregate demand components revealed a major lacuna in the literature with regard to the Egyptian setting. Compared with developed or emerging economies, the subject has not received much attention in Egypt. Furthermore, existing studies have focused almost exclusively on the impact of market interest rates as the main transmission channel on inflation and aggregate demand components and have failed to consider potential impacts on the same through alternative channels. Our work helps to fill this gap and contribute to the empirical literature, primarily in the case of Egypt.

3. Model specification, econometric approach employed, and the dataset utilized.

3.1. Model specification and econometric approach employed.

Evident from the above discussion, VAR models have come to be an effective macro-tool in analyzing the dynamic responses of endogenous variables to external shocks. In this paper, we use this approach to examine how demand components and inflation evolve in response to monetary policy shocks in the context of Egypt. However, conventional reduced-form VAR models do not consider the simultaneous nature of variables, which limits a clear economic interpretation of the effects of various shocks. Structural VAR models (SVAR) address this problem, but, as with conventional reduced-form VARs, they tend to be under-identified and thus do not have unique solutions for shocks. One way of dealing with this problem is to impose restrictions on contemporaneous shocks. For example, consider a SVAR model for a vector y_t of n variables can be expressed as follows:

$$B(L)Y_t = B_0\ (I_n + B_1L + B_2L^2 + ..B_kL^k)\ Y_t = B_0\pi_t = H\epsilon_t \qquad (1)$$

Where $B, B_0, B_1, \ldots B_k$ and H are (n x n) matrices of parameters, Y_t is a vector of the selected variables, π_t is the (n x 1) vector of reduced-form shocks with $\pi_t \sim N\ (0, \sigma)$ and $E\ [\pi_t \pi_v^*\ ] = 0_n$ for all $v \neq t$, and ϵ_t is a (n x 1) vector of structural innovations with $\epsilon_t \sim N\ (0, I_n)$ and $E\ [\epsilon_t \epsilon_v^*\ ] = 0_n$ for all $v \neq t$, and L is the lag operator. The process of determining the structural model involves ensuring that the parameters within B_0 and B matrices can be derived from the reduced form. This methodology aligns with the techniques outlined by Bernanke (1986), and Stock and Watson (2001), which relies on placing short-run restrictions on the parameters of B_0 matrix.

Based on this identification approach, B is characterized as a diagonal matrix, while matrix B_0 must incorporate a minimum number of n (n -1)/2 constraints to achieve precise identification of the system. The LR test is employed to assess the validity of these overidentifying constraints, as well as all other constraints under consideration. Returning to the primary objective of this study, which is to evaluate the reactions of aggregate

demand components and inflation to various monetary policy mechanisms, we construct four models. Each model examines the responses of an aggregate demand component or inflation to monetary policy shocks. These models can formally be depicted by the following vector of variables:

$$Y_t = (AD_t,\ INF_t,\ ER_t,\ CREDIT_t,\ AIR_t) \quad (2)$$

From equation (2), AD_t is the aggregate demand components $(HFCE_t, GFCF_t, CR_t)$, where $HFCE_t$ stands for real consumption expenditure by final households, $GFCF_t$ stands for real gross fixed capital formation in the private sector, CR_t stands for the coverage ratio, which is the ratio of goods and services exports to imports, serving as a substitute for the net exports component, and INF_t refers to inflation rate. The last three variables refer to transmission mechanisms of monetary policy shocks considered in this study which denotes respectively, the exchange rate ER_t, domestic credit to private sector by banks $CREDIT_t$, and average market interest rate AIR_t.

After establishing the equality, $B_0\pi_t = H\epsilon_t$ in Equation (1), we apply the constraints outlined in Equations. (3) and (4) below to delineate the four SVAR models under consideration.

$$\begin{pmatrix} 1 & b_{12} & b_{13} & b_{14} \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & b_{34} \\ 0 & b_{42} & 0 & 1 \end{pmatrix} \begin{pmatrix} \pi_t^{AD} \\ \pi_t^{ER} \\ \pi_t^{CREDIT} \\ \pi_t^{AIR} \end{pmatrix} = \begin{pmatrix} h_{11} & 0 & 0 & 0 \\ 0 & h_{22} & 0 & 0 \\ 0 & 0 & h_{33} & 0 \\ 0 & 0 & 0 & h_{44} \end{pmatrix} \begin{pmatrix} \epsilon_t^{AD} \\ \epsilon_t^{ER} \\ \epsilon_t^{CREDIT} \\ \epsilon_t^{AIR} \end{pmatrix} \quad (3)$$

$$\begin{pmatrix} 1 & b_{12} & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & b_{34} \\ b_{41} & b_{42} & 0 & 1 \end{pmatrix} \begin{pmatrix} \pi_t^{INF} \\ \pi_t^{ER} \\ \pi_t^{CREDIT} \\ \pi_t^{AIR} \end{pmatrix} = \begin{pmatrix} h_{11} & 0 & 0 & 0 \\ 0 & h_{22} & 0 & 0 \\ 0 & 0 & h_{33} & 0 \\ 0 & 0 & 0 & h_{44} \end{pmatrix} \begin{pmatrix} \epsilon_t^{INF} \\ \epsilon_t^{ER} \\ \epsilon_t^{CREDIT} \\ \epsilon_t^{AIR} \end{pmatrix} \quad (4)$$

Where π_t^{AD} and ϵ_t^{AD} are the contemporaneous reduced-form shock associated to one of the three aggregate demand components and structural

shocks, respectively. For all variables π_t^j and ϵ_t^j are reduced form and structural shocks, respectively.

Equation (3) illustrates how restrictions are imposed on the contemporaneous structural shocks. Specifically, we assumed that the aggregate demand components, AD, ($HFCE_t$, $GFCF_t$, CR_t) react contemporaneously to the monetary policy shocks (b_{12}, b_{13}, b_{14}). We also assumed that exchange rate variable, ER, respond with delay to shocks to the aggregate demand components, interest rate, and credit to private sector, where: $b_{21} = b_{23} = b_{24} = 0$. We additionally mandated that $CREDIT$ responds contemporaneously to AIR shocks, (b_{34}). Concerning the AIR, we assume that it reacts contemporaneously to fluctuations in the ER, (b_{42}). Ensuring stability in currency exchange rates stands as a central goal for the Egyptian central bank, a crucial step toward achieving its overarching objective of upholding price stability.

In equation (4), consistent with findings in the "pass-through" literature we assumed that the INF reacts contemporaneously to ER shocks (b_{12}). Concerning the exchange rate ER, it is continued assumed to be feedback variable responding with delay to shocks to AD, $AIR, CREDIT$. We also imposed that $CREDT$ reacts contemporaneously to interest rate AIR shocks (b_{34}). Finally, AIR is assumed, as above, to respond contemporaneously to ER shocks (b_{42}).

Some preliminary checks, which precede estimating our SVAR models, include first examining the stationarity and possible co-integration of the data; second, checking for model stability and selecting the appropriate number of lags for the variables used; and third, verifying the overidentification restrictions. We present estimates in the next section, in Section 4 below. Next, we give a brief overview of the Egyptian data used in this paper, along with their long-term patterns, in the next section.

3.2. Data sources and the selected variables historical evolution

The data used for the analysis are from databases as World Development Indicators (WDI), International Financial Statistics (IFS) and the Central Bank of Egypt (CBE), from 1991 to 2022. All the variables used

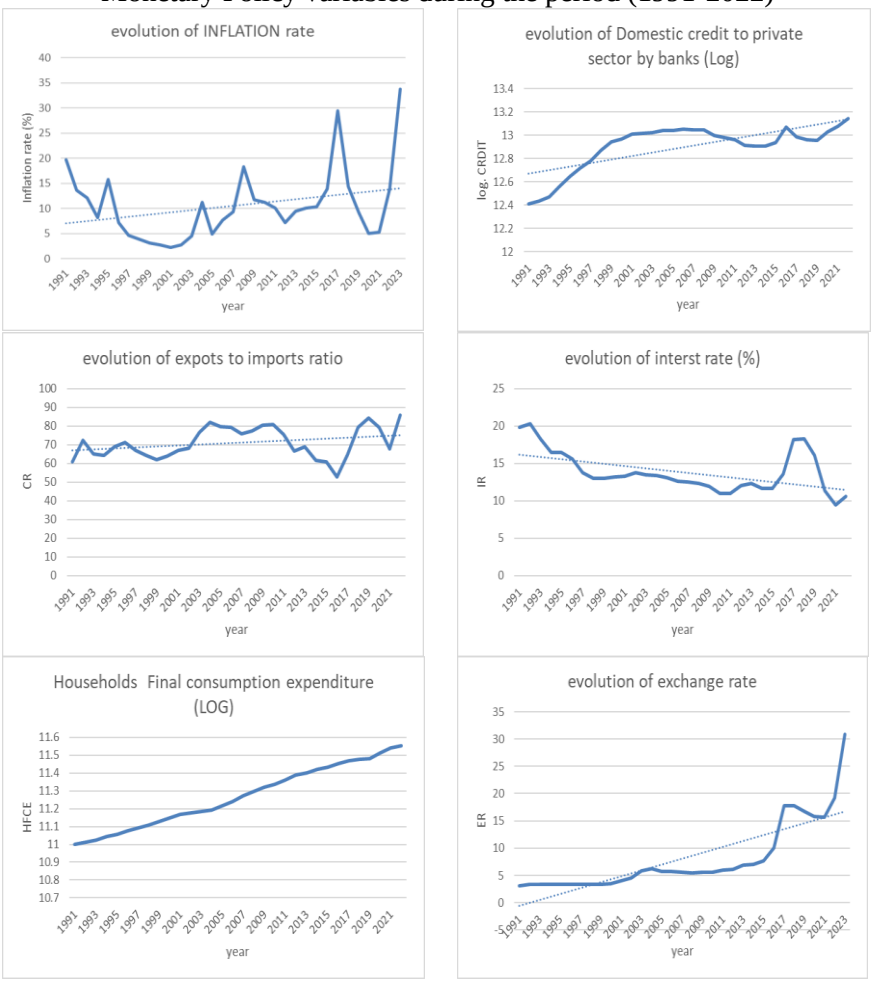
are in constant 2015 US$, except for INF and AIR are expressed as a percentage; CR is a ratio; ER is an index. In the econometric analysis, all the variables are logged except for INF and AIR.

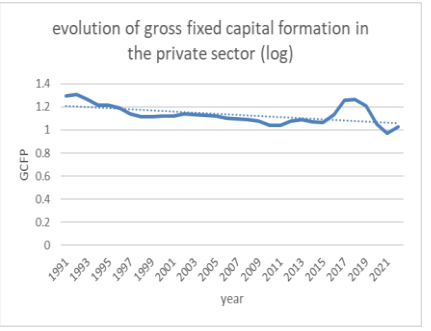
The monetary history and variables under study are of great contribution to the comprehension of the Egyptian context. It is important to note that 2011 marked a watershed moment in Egypt's history-a popular revolution. This revolution realized significant changes in monetary conditions and policies of the Egyptian central bank. Under mounting and structural liquidity pressures and deficits in foreign exchange reserves, it became inevitable that the country adjust to higher exchange rate flexibility. However, even with this new exchange rate regime in place, the Egyptian pound has continued to depreciate against currencies of major trading partners as shown in Figure 1. Simultaneously, the CBE has remained committed to ensuring the liquidity of the banking system; this has allowed growth in credit volume to the economy through the massive refinancing. Figure 1 shows a general upward trend in the volume of private sector credit throughout the study period. Owing to the necessity of ensuring the availability of sufficient liquidity, and the resultant fall in the exchange rate, probably undermined the Central Bank of Egypt's efforts to dampen the resultant inflationary pressures through increases in interest rates. From Figure 1, the inflation rate (INF), has been on an upward trend, surpassing the average of 9% in the studied period. Figure 1 also shows that the inflation rate even peaked at 33% in 2023, given the successive shocks the world economy has had to bear through the impact of supply chains as a result of the COVID-19 pandemic and the Russian-Ukrainian war.

By looking at the trends involved in aggregate demand components, several trends should be noted. As shown in Figure 1, household final consumption expenditure ($HFCE$) is on an upward trend for the past three decades. The trend of ($GFCF$) is downward and tends to be more severe in the past period. Noticeably, though, its decline accelerated in 2020 due to the COVID-19 pandemic outbreak. Another quite interesting aspect is that the analysis of the (CR) shows the continuation of the structural deficit in the

balance of trade as an inbuilt phenomenon in the Egyptian balance of payments.

Figure (1): Trend of the Aggregate demand components, Inflation, and Monetary Policy variables during the period (1991-2022)





4. Estimation and analysis

4.1. Stationarity issue

The data presented in Tables 1a and 1b depict the findings regarding the degree of integration and the potential for cointegration among the variables analyzed in our models. All of the variables demonstrate an order of integration of I(1). Two types of unit root tests were conducted: the augmented Dickey–Fuller (ADF) test and the Philips-Perron (PP) test. Furthermore, after employing the bounds test proposed by Pesaran et al. (2001) in conjunction with critical value computations by Kripfganz and Schneider (2020) and approximate p-values, we ascertain that the null hypothesis of no level relationship cannot be rejected for any of the models at significance levels of 10%, 5%, and 1%. Consequently, our SVAR models are constructed using first-differenced variables, indicating the absence of cointegrating relationships.

Table 1a: Unit root tests results

	ADF		***PP***	
Variable:	**LVL**	**DIF**	**LVL**	**DIF**
Log (HFCE)	-3.664***	-6.637***	-3.680***	-6.349***
Log (GFCF)	-2.582	-6.699**	-2.569	-6.617***
Log (CR)	-2.337	-5.416***	-2.109	-5.822***
INF	-3.116**	-5.647***	-3.171**	-4.235***
AIR	-2.038	-7.679***	-2.224	-7.561***
Log (ER)	-0.208	-3.225**	-0.481	-3.738***
Log (CREDIT)	-4.120***	-6.483***	-3.913***	-6.620***

Notes : *ADF and PP refers to augmented Dickey–Fuller and Phillips–Perron tests respectively. *, **,*** and **** denote significance at 10%, 5%, 1% level.*

Table 1b: ARDL Bounds test for long-run relationships

Sig. level (%)		*Model (1) Log (HFCE)*		*Model (2) Log (GFCF)*		*Model (3) Log (CR)*		*Model (4) Log (INF)*	
		F	**t**	**F**	**t**	**F**	**t**	**F**	**t**
10%	I(0)	3.150	-2.80	3.161	-2.810	3.098	-2.746	3.176	-2.775
	I(1)	4.360	-3.694	4.347	-3.703	4.426	-3.652	4.480	-3.683
5%	I(0)	3.795	-3.152	3.803	-3.160	3.754	-3.115	3.866	-3.148
	I(1)	5.170	-4.095	5.147	-4.099	5.285	-4.072	5.374	-4.110
1%	I(0)	5.333	-3.873	5.330	-3.872	4.894	-3.416	5.566	-3.919
	I(1)	7.082	-4.902	7.028	-4.896	7.355	-4.929	7.558	-4.990
p-value	I(0)	0.417	0.507	0.530	0.922	0.315	0.462	0.300	0.411
	I(1)	0.617	0.802	0.790	0.939	0.398	0.733	0.344	0.656
Test statistic		2.902	-2.332	2.321	0.715	4.288	-2.408	5.176	2.646

Notes : *(a) : Fixed-effects (within) regression. (b) : Random-effects regression. (c): Feasible Generalized Least Squares regression. (d) : Global model significance test. (e) : Modified Wald test for groupwise heteroskedasticity : The null hypothesis H0: sigma(i)^2 = sigma^2 for all i. (f) : Wooldridge test for autocorrelation in panel data : The null hypothesis H0: no first-order autocorrelation. Parameters in brackets are the t-statistics. *, **,*** and **** denote significance of the estimated coefficient at 10%, 5%, 1% and less than 1%, respectively.*

4.2. Optimum lag length

The determination of the lag order is an important aspect of empirical analysis in the specification of the VAR/SVAR model. While there are multiple informational criteria for determining the lag length, such as AIC, SBIC, and HQIC, relying solely on these measures might yield insufficient results if the residuals fail tests for uncorrelation and normal distribution. Hence, akin to Ziaei (2014), our approach entails specifying the lag length in a manner that ensures serial uncorrelation and a normal distribution of VAR residuals. The diagnostic tests for the residuals can be found in Tables 2a and 2b, where a lag length of 4 was chosen. Across all equations within the four SVAR models, the residuals successfully cleared both correlation and normality tests.

Table 2a: Residuals diagnostic tests: Lagrange-Multiplier Autocorrelation test

Model (1) (HFCE)		*Model (2) (GFCF)*		*Model (3) (CR)*		*Model (4) (INF)*	
Lag	**p-value**	**Lag**	**p-value**	**Lag**	**p-value**	**Lag**	**p-value**
1	0.91011	1	0.94225	1	0.32979	1	0.36096
2	0.80097	2	0.18714	2	0.38966	2	0.32437
3	0.47819	3	0.33721	3	0.29269	3	0.23419
4	0.23550	4	0.13659	4	0.75649	4	0..72805

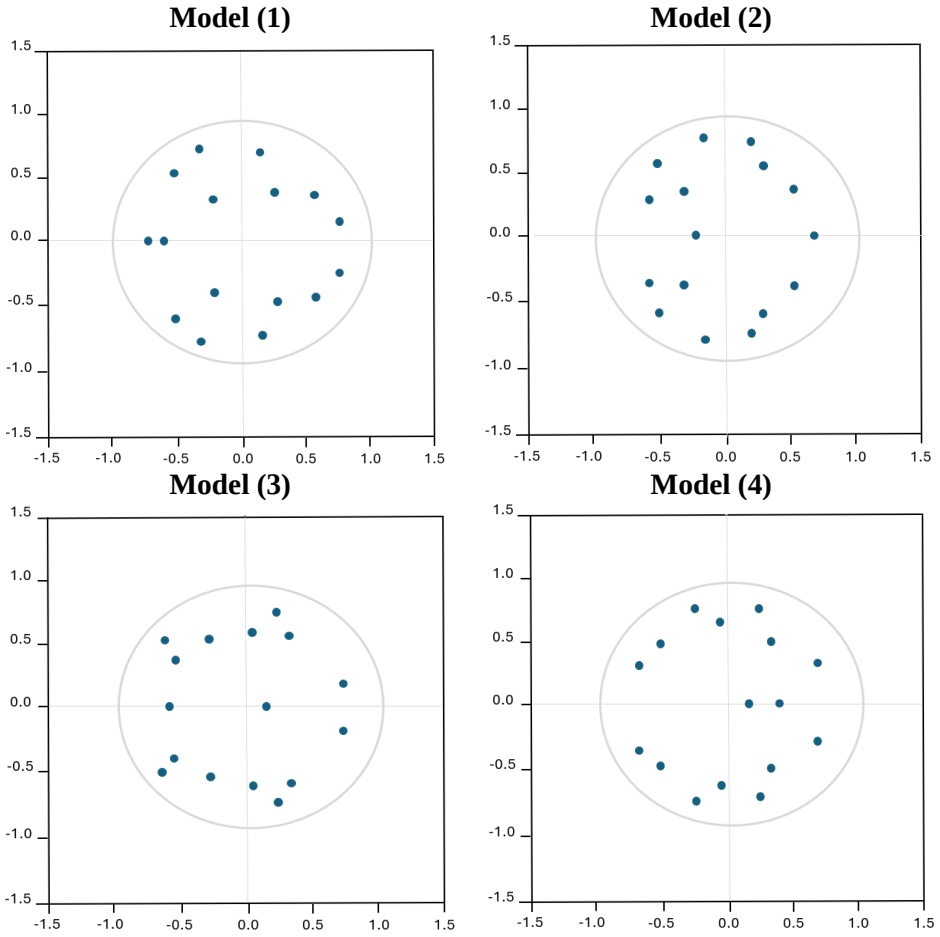
Table 2b: Residuals diagnostic tests: Jarque-Bera Normality test

Model (1) (HFCE)		*Model (2) (GFCF)*		*Model (3) (CR)*		*Model (4) (INF)*	
EQN	**p-value**	**EQN**	**p-value**	**EQN**	**p-value**	**EQN**	**p-value**
HFCE	0..57371	*GFCF*	0.15044	*CR*	0.37598	*INF*	0.25591
ER	0.31953	*ER*	0.91432	*ER*	0.40621	*ER*	0.53213
CREDIT	0.77868	*CREDIT*	0.81490	*CREDIT*	0.14999	*CREDIT*	.092973
AIR	0.15757	*AIR*	0.74426	*AIR*	0.55018	*AIR*	0.51427
ALL	0.38913	*ALL*	0.81044	*ALL*	0.30680	*ALL*	0.73821

4.3. Stability conditions

where the stability condition is contingent upon the optimum lag length selected for the variables in the systems. So, to ensure stability, we opt for a lag length of 4 in all models utilized. The conclusion can be drawn from the data presented in Figure 2. Figure 2 displays the inverse roots of the autoregressive (AR) characteristics polynomial, which depicts the stability of the four estimated SVAR models. Obviously, the graphs confirm the stability of the models as all AR roots lie inside the unit circle, giving credence to generating their respective impulse response functions (IRF).

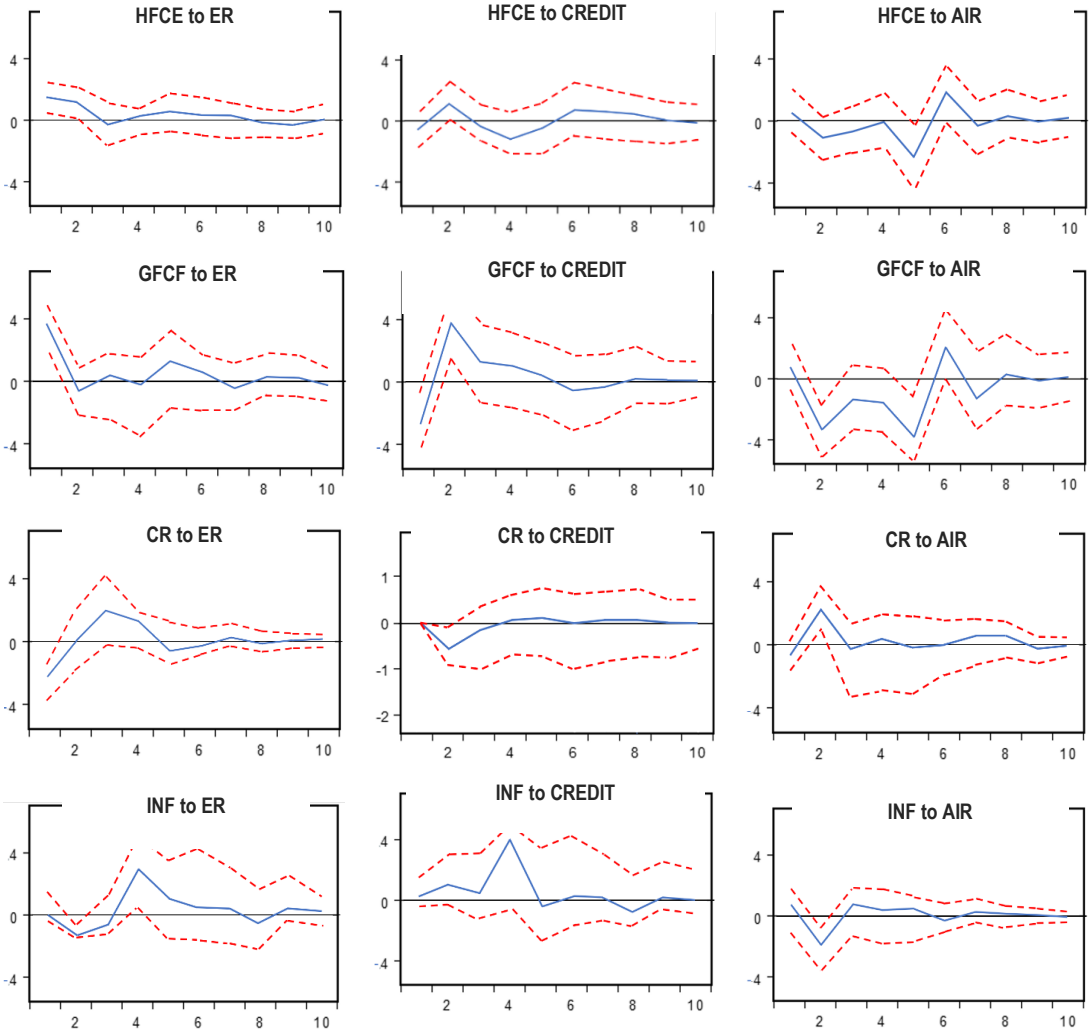
Figure 2: Stability test (inverse roots of AR characteristic polynomial)



4.4. Impulse response functions

Figure 3 illustrates the contemporaneous and lagged impulse response functions derived from four SVAR models. These plots depict the reactions of aggregate demand components to a standard deviation innovation in monetary policy impulses transmitted through ER, $CREDIT$, and AIR. The observed response patterns offer nuanced interpretations. For instance, the impact of a fluctuation in exchange rates ER significantly affects the CR, INF, and $GFCF$.

Figure 3: Aggregate demand components responses to monetary policy shocks



An ER depreciation of one standard deviation induces an increase in the CR by around 1% point in the first two years after the depreciation, which returns to its previous level after the third year. The inflation rate is characterized by a very similar baseline reaction to that of the coverage rate: it increased in the first three years, by an extra 0.3% point, which after the fourth year returns to the previous level. The concurrent reactions of CR and

INF illustrate a "pass-through" effect, whereby import prices translate into local prices. It is likely that the current erosion of the exchange rate has acted as a counterweight to the central bank of Egypt's efforts to counteract the simultaneous inflationary increase via raising interest rates. It finally turns out that the $GFCF$ is characterized by a negative response to the ER depreciation, namely a decrease of around 5%. Since the largest volume of capital goods is imported, the result is quite expected. This also seems to be the case that this effect is fairly transitory since the effects of the shock start to wear off after the fourth year.

The impact of the $CREDIT$ shock seems to be propagated through inflation, though with a weak and statistically insignificant increase of 0.3 points and it remains for about four years and then dissipates. The same shock on $CREDIT$ causes 0.5% points decrease in CR components that dissipates rapidly over time. The increase in $CREDIT$ gives importers the necessary financial support for their operations, which then leads to an increase in imports and a widening of the trade deficit. The increase in $CREDIT$ has, in turn, raised $HFCE$ and $GFCF$ by about 1.5% and 4%, respectively, after one standard deviation increase in the $CREDIT$ growth rate in the first two years following the shock. The effects are temporary and declined over succeeding years.

Similarly, an increase of one standard deviation in interest rate results in roughly a 1% decline of the growth rates of $HFCE$ and about a 4% decline in the growth rate of $GFCF$ annually during the first six years after the shock. These negative consequences are temporary, as both components also return to their initial growth rates by the seventh year. The same AIR shock results in an average increase of 2 percentage points in the CR ratio during the first two years after the shock, although that effect gradually declines thereafter. One possible explanation is that with higher interest rates, imports decline because some importers bear higher costs when borrowing for their import activities. For INF, there is an initial fall of about 2% during the first two years after the shock, followed by a slow restoration to baseline levels. But without a doubt, despite being substantial, this response may not be enough, especially having in mind the very high recent levels of inflation and the

current high level of interest rates, which could make further tightening economically and socially unsustainable in the face of aggregate demand.

4.5. Forecast Error Variance Decomposition (FEVD)

Fractional Error Variance Decomposition (FEVD) quantifies the percentage of variance in forecast errors of a variable which can be explicable by its own shocks or those of another variable at a specified time horizon. As summarized in Table 3 below, the decomposition of this method is done for the four Structural Vector Autoregression SVAR models over a 12-year period. The following discussion of the findings is interesting. At the 3-year horizon, about a quarter of the forecast error of $HFCE$ is explicable through the shocks of the AIR and $CREDIT$ (14.7% for AIR and 9.30 % for $CREDIT$). In increased to 40% by the sixth year (28% for AIR and 11.7% for $CREDIT$). Taken together, the three monetary policy channels explain close to 62% of $GFCF$ error variance by the sixth year. To be noted here is that the AIR shock makes the largest contribution to the variance of the $GFCF$ error at 40% by the sixth year, compared to 14.8% and 7% by $CREDIT$ and ER shocks, respectively. The influence of monetary policy channels to the error variance of CR increases fast from 3.64% in the first year to 44% by the sixth year, with the largest contributions by AIR and ER. The last analysis of variance decomposition by inflation-error gives an indication that nearly 60% of the variance stems from the shock of monetary policy over a period of six years, with exchange rate shock accounting for 35 to 42% of this portion. Meanwhile, interest rates' influence in inflation-error variance remained stable throughout the forecast period, and it remained around 7% throughout.

The outcomes outlined in this section enable us to draw comparisons with prior empirical research on both the global and domestic scales. Initially, our findings of the negative repercussions of monetary policy tightening on aggregate demand components align with the majority of referenced international studies (Bachmann et al. (2022); Bhavesh & Anuradha (2017); Jakab et al. (2006); Khundrakpam & Jain (2012); Ziaei (2014), among others). Nevertheless, unlike those studies, our analysis distinguishes between the impacts resulting from changes in market interest rates and those associated with credit-bank volume and exchange rates, thus enhancing the identification of the monetary policy transmission channels that are more likely to influence

economic activity. Additionally, our finding concerning the significant extent of the pass-through phenomenon within the Egyptian context corresponds with the results reported in international literature on this topic (Anh et al. (2021); Pinshi & Sungani (2018); Forbes et al. (2018); Shevchuk (2022); Pham et al. (2022); among others).

Table 3: Forecast Error Variance Decomposition (Percentage Points)

Model (1)			***VDPP***	
Forecast Horizon	***HFCE***	***ER***	***CREDIT***	***AIR***
1	70.6	3.51	6.54	7.80
3	57.6	*3.64*	9.30	*14.7*
6	38.4	*4.2*	11.7	*28.0*
9	37.3	*5.08*	10.8	*29.2*
12	36.7	*4.95*	10.6	*30.1*
Model (2)			***VDPP***	
Forecast Horizon	***GFCF***	***ER***	***CREDIT***	***AIR***
1	64.2	11.62	12.82	2.13
3	40.8	*6.37*	18.32	*25.33*
6	26.0	*7.02*	14.82	*39.93*
9	23.6	*8.09*	14.32	*41.9*
12	22.9	*8.54*	14.02	*43.67*
Model (3)			***VDPP***	
Forecast Horizon	***CR***	***ER***	***CREDIT***	***AIR***
1	86.83	0.81	1.01	1.82
3	52.35	*6.99*	6.18	*27.5*
6	48.95	*12.71*	7.06	*24.45*
9	48.65	*12.54*	6.87	*25.15*
12	47.95	*12.41*	7.24	*25.65*
Model (4)			***VDPP***	
Forecast Horizon	***INF***	***ER***	***CREDIT***	***AIR***
1	79.89	15.07	0.25	0.81
3	49.07	*35.1*	4.06	*8.79*
6	42.5	*41.5*	7.74	*10.12*
9	40.7	*41.5*	7.92	*13.08*
12	40.5	*40.8*	9.81	*11.7*

We find that changes in the exchange rate explain between 35% and 42% of the variation in inflation over time in Egypt. There is also very little evidence that the market interest rate plays a significant role in shaping the inflation dynamics compared to the exchange rate. These findings, therefore, underline that the significance of the CBE paying more attention to the ability to transparently communicate its interest rate policy, especially regarding how it is consistent with the management of the exchange rate. Our results show that changes in the exchange rate occur before changes in

the interest rate, indicating that the actual outcomes of the Central Bank of Egypt's monetary tightening strategy in the past decade are not consistent with the announced objectives. Such a difference between the actual and announced objectives of the CBE undermines the transparency and credibility of its policies and distains the effectiveness of its monetary interventions. Transitioning from discretionary to rule-based monetary policies with evidently defined objectives and transmission mechanisms would create transparency and credibility, allowing economic agents to better predict the actions of the central bank and to better stabilize the economy. This means that the creation of transparency and credibility of the central bank and its policies is basic for achieving these goals.

5. Conclusion and suggestions for policy

The aim of this paper is to test the effect of monetary policy shocks on the responsiveness of aggregate demand components and inflation in Egypt. By using quarterly data for the period 1991 to 2022, we demonstrate that the interest rate tightening that the Egyptian central bank has pursued over the past decade has largely dampened aggregate spending, particularly private investment, and consumption. Still, this effectiveness is constrained due to the insignificant effect on inflation, compounded by the unfavorable "pass-through" effect of further depreciation of the local currency. In this regard, questions have been raised regarding the efficiency and effectiveness of the central bank in price stabilization and credibility. The central bank needs to enhance its credibility and efficiency by easily communicating to the public the framework of monetary policy and reducing the use of discretion. It needs to consider alternatives to measures that will further legitimize monetary policy towards achieving price stability. Such will include policies that will enhance competitiveness by increasing the productivity of the labor force and moving forward with advancement in technology. It will not only improve economic growth but also restore fiscal and external sustainability, increase the exchange rate, and reduce the existing inflationary pressures.

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