Monetary Policy, Foreign Shocks and Macroeconomic Responses in Egypt During Reform Program: A SVAR Study

Mohamed Aseel
School of Economics
Faculty of Economics and Management
University Kebangsaan, Malaysia

ABSTRACT

This paper aims to investigate the effectiveness of monetary policy variables namely money supply and interest rates upon macroeconomics variables in Egypt using quarterly data spanning from 1990.Q1 until 2011.Q4. In addition, this study also examines the effect of external shocks on domestic macroeconomics variables, and the respond of monetary policy to these shocks. This study uses a non recursive SVAR modeling framework in investigating the propagation of monetary policy variables and external shocks upon macroeconomics variables. This paper finds that the monetary policy has a significant effect on inflation, through money supply, and exchange rate through interest rate but money supply and interest rate have a small effect on output. In addition, the foreign shocks have an important effect on output, inflation and exchange rate in Egypt but the responses of monetary policy in Egypt mitigate the importance of these shocks.

Keywords: Monetary policy; foreign shocks; SVAR; economic activity

INTRODUCTION

In the latter half of 1980s, Egyptian economy faced a lot of problems; decreasing in real gross domestic production growth (GDP) (2.5%) in (1989/90), increasing in inflation rate, (25%) in 1986/87), increasing in overall fiscal deficit, (24.5%) of GDP in (1987/88), and increasing in unemployment, (10-15%) of labor force. This internal imbalance was complicated by external imbalance, the current account deficit was (8%) of GDP in (1988/89), which led to inability to pay external debt obligations. Therefore, the Egyptian government has made agreement with International Monetary Fund (IMF) and World Bank in 1991 which is known as the Economic Reform and Structural Adjustment Program (ERSAP) (Abdel khalek 2001) and (Subramanian 1997). The main objective of ERSAP program is to achieve economic growth and improve the standard of living through reforming public enterprises and liberalizing domestic prices and foreign trade. In addition to that, the imports and exports were liberated from any restrictions and the discrimination between the private sector and public sector, in obtaining licenses, input prices, energy prices and credit, was eliminated.

During the (ERSAP) program in Egypt, there are many changes in monetary policy and there are a set of processes that were taken. Firstly, Interest rate liberalization: the Central bank board have decided to liberalize interest rate in 1991. So the banks have the freedom in determining interest rate on deposits and loans (CBE 1990/91). In addition, the reform program has eliminated interest rate ceiling, credit ceiling and developed market for treasury bills. In 1996, the privatization also extended to banking sector and the government have decided to privatize (14) banks¹ to increase competition and efficiency in banking sector (Omran 2007). Secondly, the opening market operations: besides liberalize interest rate, the government have made market for treasury bills and the first treasury bills auction was in 1991 (Abdel khalek 2001). Thirdly, Changing reserve requirement ratio: the reserve requirement ratio has become (15% from gross deposits) in 1990. Fourthly, Changing liquidity ratio: the liquidity ratio that banks keep has become (20%) for domestic currency and (25%) for foreign currency (CBE 90/91). Finally: Exchange rate liberalization: As far as the interest rate, the free exchange rate has been liberalized in 1991 (Abdel khalek 2001).

There are many changes in instruments, operational targets and intermediate targets of monetary policy. The main objectives of monetary policy during the ERSAP program are to decrease inflation, increase output and achieve exchange rate stability (CBE 92/93). The Central Bank of Egypt (CBE) selected money supply (M2) as intermediate target of monetary policy and selected banks

excess reserves to be the operational target of monetary policy until 2005. But after that, in June 2005, the interest rate has been used as intermediate target of monetary policy and the overnight interbank rate has been selected as an operational target of the monetary policy (CBE 05/06). In addition to that, the (CBE) has used a new instrument (i.e opening market operations) in 1991 beside other instruments like reserve requirement ratio and discount rate, in conducting monetary policy in Egypt. The first treasury bills auction was made in 1991. Also, the interest rate and the exchange rate were liberalized in 1991 (CBE 92/93).

After these changes in monetary policy and in Egyptian economy, the monetary policy should be more effective. But the empirical studies found that the effect of monetary policy on output is weak. For example, Moursi et al used VAR model, treated Egyptian economy as closed economy. They found that the impact of monetary policy on real output is ambiguous but it affects on inflation only (Moursi et al. 2006). Rageh also used VAR model, treated Egyptian economy as closed economy and found that the monetary policy shocks have an effect on inflation rate only (Rageh 2010). Therefore, the current study re-examines the effect of monetary policy on output, inflation and exchange rate in Egypt using SVAR model. In addition, it treats Egyptian economy as small open economy and adds new variables (i.e. the United States output). Besides, this paper also studies the relation between money supply and interest rate to know if there is a liquidity puzzle or not. Also, the relation between interest rate and exchange rate is examined to know if there is exchange rate puzzle or not. In addition, it examines the impact of external shocks, namely oil price the United States output and interest rate, on output, inflation and exchange rate in Egypt.

This research aims to study the effect of monetary policy and foreign shocks on macroeconomic variables in Egypt. it shows the relation between interest rate and money supply as monetary policy variables, and output in Egypt to know whether changes in interest rate and money supply result in variation in output or not. Furthermore, this research tends to know if interest rate is a good informative about monetary policy in Egypt. Moreover, the current study aims mainly to identify the relation between money supply and interest rate to monitor whether there is a liquidity puzzle in the Egyptian economy or not. Also, the current study aims mainly to identify the relation between interest rate and exchange rate to know if there is an exchange rate puzzle in the Egyptian economy. Eventually, the study aims to know the effect of the United States output, and interest rate, and oil price (the foreign shocks) on output, inflation and exchange rate in Egypt and the response of monetary policy to these shocks.

This study has lots of merits. Firstly, most researches are related to advancing countries but fewer studies are dealing with the developing countries. So, the current study will fill this gap by studying the effect of monetary policy on output in Egypt. Also, it treats Egyptian economy as a small open economy and substitutes VAR model with non recursive SVAR model because the VAR model has a lot of demerits. For instance, the monetary policy cannot contemporaneously respond to other shocks. Finally, this study is concerned with the effect of foreign shocks, namely oil price, US output and interest rate, on Egyptian economy and the response of monetary policy to these shocks.

LITERATURE REVIEW

In the United States, Friedman and Schwartz studied the relation between money and output in the United States during (1867-1960) and they found that movements in money precede movements in income and there is a causality relation between money and income. They thought that the quantity of money should grow in constant rate that is associated with productivity growth (Friedman&Schwartz 1963). Sims also studied the relation between money and income in the United States and found that the relation between GNP and M1 is significant (Sims 1972). In addition to that, Christiano and Ljungqvist reexamined the U.S postwar period and supported this opinion (Christiano&Ljungqvist 1988).

However, some studies argued that only unanticipated money supply affects output but anticipated money supply could not do that. For example, Barro studied the relation between money, output and price level in the United States after the Second World War (1946-1976) and found that there is a strong relation between unanticipated money and output but the anticipated money does not influence it. Therefore, unanticipated money only influences the output (Barro 1978). But, Mishkin used a rational expectation model to assess the usefulness of the anticipated monetary policy and found

2 The percentage of export to GDP was 26% in 2003 then increased to 38% in 2008 after that decreased to 27% in 2012 (CBE 2012).
that both anticipated and unanticipated money have a significant effect on output and unemployment (Mishkin 1982).

In United States, Sims studied interwar and postwar period using monthly data about money, interest rate and industrial production and vector auto regression (VAR) model. He found that the money stocks emerge as causally prior in both periods. But when a short interest rate is added, the central role of the money evaporates for the postwar period (Sims 1980). In addition to that, Litterman and Weiss found that money does not affect output when interest rate is added to the VAR model and changes in interest rate lead to changes in money and output. Therefore, changes in interest rate dominate changes in money and output (Litterman & Weiss 1983).

In the United States also, Bernanke and Blinder used Granger test and VAR mode and found that the federal funds rate is the best indicator for monetary policy actions in predicting with movements in real macroeconomic variables and there is a significant causality relation between interest rate and income (Bernanke 1992). Bernanke and Gertler also found that the increase in federal funds rate leads to decrease final demand and GDP. Besides, residential investment, the consumption are dropped following a monetary tightening (Bernanke & Gertler 1995).

Other studies have used SVAR model to investigate the effect of monetary policy. For instance, Kim and Roubini studied the effect of monetary policy on exchange rate, prices and output in the United States, German, Japan, France, the United Kingdom, Italy and Canada using non recursive SVAR model. The variables are world oil price, federal funds rate, exchange rate, interest rate, money supply, industrial production and inflation. They found that the effect of monetary policy on the output, prices and exchange rate is significant and is associated with the economic theory and there are not exchange rate puzzle nor price puzzle (Kim & Roubini 2000). Besides, Brischetto and Voss applied Kim and Roubini model in Australia and found that the monetary policy affects price and output (Brischetto & Voss 1999). In Malaysia, Zaidi and Fisher used SVAR model and interest rate shocks as monetary policy variable to determine the relation between monetary policy and output. They found that interest rate shocks explain a small percentage from variations in output (Zaidi & Fisher 2010).

In Egypt, Moursi et al used VAR model and followed Bernanke and Mihov 1995 and Strongin 1995 model. The variables are total reserves, non borrowed reserves, interest rate, inflation and real gross domestic product (GDP). They used non borrowed reserves over total reserves and interest rate as monetary policy variables. They found that the impact of monetary policy shocks on real output and prices are negligible and ambiguous and the monetary policy shocks have an effective impact only on inflation (Moursi et al. 2006). Al-Mashat and Billmierier also used VAR model. The variables are inflation, exchange rate, interest rate, non borrowed reserves, total borrowed reserves, the gross domestic product (GDP), world oil price and federal fund interest rate. They found that the exchange rate channel plays a strong role in propagating monetary shocks to output and prices but other channels (i.e. bank lending, asset price) are weak (Al-Mashat & Billmierier 2008). In addition to that, Rageh examined the validity of using Taylor rule as a robust rule for conducting monetary policy in an Egyptian case using the vector auto regression (VAR) model. The variables are the industrial production (Used as a proxy for GDP), nominal interest rate, Consumer Price Index (CPI) and exchange rate. The study results revealed that the impact of monetary policy shocks on real output is negligible (Rageh 2010).

**THE SVAR MODEL**

Most of the recent studies of monetary policy have selected vector auto regression (VAR) model to study the effect of monetary policy on real economic activity. The use of VARs model was introduced by Sims in (1972) and (1980). Sims developed the VAR model from bivariate to trivariate between (1972) and (1980) (Walsh 2003). But all variables are treated symmetrically and the model did not depend on econometric restrictions in Sims (1980) model. So structural VAR will solve this problem because the SVAR introduces enough restriction to interpret the shocks of the system (Cooley & Dwyer 1998). In addition, the unrestricted VAR also have a lot of limitations; the monetary policy cannot respond contemporaneously to other shocks. For example, if there are increase in inflation rate because of depreciation in a currency in a small open economy. In the VAR, the monetary policy cannot respond to exchange rate shocks. In addition, the unrestricted VAR solves the problem of the price puzzle partially. So SVAR model solves these problems (Kim & Roubini 2000).

**THE Data**

The research uses the quarterly data from (1990) to (2011) and the data is collected from the Central Bank of Egypt (CBE), World Bank (WB) and the International Financial Statistics (IFS). The gross
domestic product (GDP) of Egypt is not available quarterly from (1990) to (2002) but available yearly. Therefore, the GDP yearly data from Central Bank of Egypt (CBE) is converted to quarterly using RATE program. All variables are used in real form except Egyptian interest rate (R) and inflation (π) and the US Federal Funds Rate of (R*).

THE VARIABLES

This model contains eight variables (O*, Y*, R*, Y, π, M, R and E). The variables are separated into two blocks; the foreign block and the domestic block. The foreign block contains three variables (O*, Y*, R*); average world oil price (O*), gross domestic product of the US (Y*) and Federal Funds Rate of the US (R*). The domestic block includes five variables; (Y, π, M, R and E) real gross domestic product (Y), inflation rate (π), real money supply (M), interest rate (R) and real exchange rate (E).

As to foreign variables, the world oil price (O*) is included as a proxy for world commodity prices which reflect the inflationary supply shocks (Kim&Roubini 2000). Besides, the commodity prices give monetary authority expectation of the future inflation that helps to solve price puzzle (Sims 1992). The real foreign output (Y*) is the gross domestic product of the US. The US output is selected because it is the biggest trading partner with Egypt and the world’s leading economic power. The United States was the second country in trading with Egypt (after European countries) before 2011. But in 2011, the trade volume between Egypt and United States increased and became 44,275 million (EG) and the United States has become the first country in trade with Egypt. So changes in the United States output will affect Egyptian economy (Ministry of industry and foreign trade 2011). Also, the gross domestic product of the US is selected in some studies to represent the world economic activity (Berkelmans 2005). The third foreign variable is the Federal Funds Rate (R*). The US Federal Funds Rate is added as a proxy for foreign monetary policy shocks (Kim&Roubini 2000). In addition to that, the US Federal Funds Rate affects Egyptian interest rate through capital markets (Brischetto&Voss 1999).

The internal variables, the real gross domestic product of Egypt (Y) represents the internal activity in Egypt and the research examines the effect of monetary policy and foreign shocks on output, inflation and exchange rate in Egypt. Besides, the real gross domestic product (Y), inflation (π) and exchange rate were selected because they represent the targets of monetary policy in Egypt. The second variable is inflation (π); the percentage change in consumer price index (CPI) was selected to represent inflation in Egypt. The third variable is money supply (M). Money supply has been used because money supply was using as intermediate target for monetary policy in Egypt until 2005. The Central Bank of Egypt (CBE) selected liquidity growth rate (M2) as intermediate target of monetary policy in Egypt (CBE 2002/03). Also, in Sims and Zha (2005) and in Kim and Roubini (2000) the using of money supply (M2) does not affect the results. The fourth variable is interest rate (R) and the interest rate has been selected because the CBE has used interest rate as intermediate target of the monetary policy since 2005 (CBE 2005/06). Money supply and interest rate are used as monetary policy variables because they have been used as intermediate targets of monetary policy during (1990-2011). Tang used both of money supply and interest rate as monetary policy variables in his study about Malaysia (Tang 2006). Finally, the last variable is the real exchange rate (E). The nominal exchange rate reflects the Egyptian pounds per one US dollar (EP/USD) will be transferred to real. An increase in the exchange rate means depreciation in Egyptian pound (EP) relative to the US dollar. The real exchange rate is introduced to capture the effect of monetary policy shocks on real exchange rate and to examine exchange rate puzzle (Kim&Roubini 2000).

THE MODEL

The research follows Kim and Roubini (2000) and Zaidi & Karim (2012) model. They used non recursive identification scheme to determine the contemporaneous relation between the variables. In SVAR model the dynamic relationship between the selected variables is given by this equation:

\[ BY_t = \{L_1 + T_2 L^2 + \cdots + T_k L^k \} Y_t + \varepsilon_t \]

(1)

Where: B is a square matrix (n x n) that summarizes the contemporaneous relationships between the selected variables, \( Y_t \) is a vector (n x 1) of the selected variables (O*, Y*, R*, Y, π, M, R, E) and T (L) is the R^th order matrix polynomial in the lag operator (L). \( \varepsilon_t \) is a vector (n x 1) of structural
innovations which its mean equals zero \( (E(\varepsilon_t) = 0) \) and \( (E(\varepsilon_t \varepsilon'_t) = \Sigma_\varepsilon) \) when \((t=s)\) and \(E(\varepsilon_t \varepsilon'_s) = 0\) otherwise. \( \Sigma_\varepsilon \) is the variance-covariance matrix \((n \times n)\), of the structural innovations. By multiplying equation (1) with \((B^{-1})\) the reduced form of the VAR representation:

\[
Y_t = B^{-1}(T_1L + T_2L^2 + \cdots + T_kL^k)Y_t + B^{-1}\varepsilon_t
\]

(2)

Let \((B^{-1}\varepsilon_t = \varepsilon_t)\), the reduced form of residual in VAR satisfies the conditions \((E(\varepsilon_t) = 0)\) and \(E(\varepsilon_t \varepsilon'_t) = \Sigma_\varepsilon\). In addition, monetary policy structure shocks also are derived from residual structure \((B^{-1}\varepsilon_t = MP_t)\). Where: \(\Sigma_\varepsilon\) is the variance-covariance matrix \((n \times n)\) of the estimated residual that can be accounted from the data. The relation between \(\Sigma_\varepsilon\) the variance-covariance matrix of the estimated residual and \(\Sigma_d\) the variance-covariance matrix of the structural innovations is explained as follow:

\[\Sigma_\varepsilon = B \Sigma_d B^T\]

The contemporaneous structural parameters \((B)\) of the SVAR model in and the equation as follow:

\[
BY_t = \begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O^* \\
B_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & Y^* \\
B_{31} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & R^* \\
B_{41} & B_{42} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & Y \\
B_{51} & B_{52} & B_{53} & 0 & 1 & B_{54} & 0 & B_{55} & 0 & \pi \\
B_{61} & 0 & B_{62} & B_{63} & 0 & B_{64} & 0 & B_{65} & 1 & 0 & \lambda \\
B_{71} & B_{72} & B_{73} & B_{74} & B_{75} & B_{76} & 1 & B_{77} & 0 & \Gamma \\
B_{81} & B_{82} & B_{83} & B_{84} & B_{85} & B_{86} & B_{87} & 1 & 0 & \varepsilon \\
\end{bmatrix}
\]

(3)

Where:

- \((B_{ij})\) is the effect of the variable \((j)\) on the variable \((i)\). For example, \(B_{76}\) is the effect of money supply on interest rate.

According to Cushman and Zha, the identification of monetary policy in a small open economy, the small open economy model should include foreign variables and these variables are treated as exogenous variables. Therefore, the foreign variables affect domestic variables but domestic variables do not affect them.

The World Oil price \((O^*)\) impacts all variables because it reflects expected inflation and inputs’ prices. The US output \((Y^*)\) affects all domestic variables contemporaneously except the domestic interest rate and money supply (monetary policy variables). The US output \((Y^*)\) does not affect the federal funds rate contemporaneously but affects in lagged. The US output does not affect the domestic interest rate and money supply because the research assumes the domestic interest rate and money supply (monetary authorities) do not respond contemporaneously to foreign output shocks (Both of money supply and interest rate were used as intermediate target of monetary policy in Egypt during the period of study). Besides, the research assumes that the monetary authorities in Egypt do not observe the contemporaneous values of US output (Zaidi&Karim 2011). The federal Fund Rate affects contemporaneously on all domestic variables because it is assumed that the monetary authorities in Egypt observe contemporaneously the values of the federal Fund Rate that reflects the foreign monetary policy shocks. This pattern of identifying assumption is used by( Cushman & Zha 1997) and (Zaidi & Karim 2012).

The Egyptian output \((Y)\) affects exchange rate. The output does not affect the prices of goods and services because the current paper assumes the sticky price. Besides, the output does not affect the monetary policy variables (money supply and interest rate) contemporaneously but it influences in lagged because the assumption of information delays about output that prevents monetary policy to react contemporaneously (Kim&Roubini 2000) and (Brischetto & Voss 1999). Inflation \((\pi)\) affects money supply, interest rate and exchange rate because it is assumed that the financial variables (money supply, interest rate and exchange rate) respond contemporaneously to inflation shocks and monetary authorities in Egypt respond contemporaneously to inflation shocks because the price stability is one of the most important targets of monetary policy (Zaidi & Karim 2012). Money supply \((M)\) responds contemporaneously to changes in oil price, US interest rate, inflation and interest rate. On the other
side, money supply affects inflation, interest rate and exchange rate contemporaneously but it affects output in lagged. Interest rate (R) impacts on exchange rate and money supply contemporaneously. The exchange rate responds to all variables and influences on interest rate and inflation because the exchange rate is a financial variable that responds quickly to all information. The interact between interest rate and exchange rate is assumed by (Cushman & Zha 1997) and (Kim & Roubini 2000).

The RESULTS

This paper is interested in examining the effect of monetary policy (money supply) and foreign shocks (oil price, US output and interest rate) on output, inflation and exchange rate in Egypt. Firstly, this paper uses combines between money supply and interest in one model (part A) but there are some puzzles. Therefore, I make a model for interest rate (part B) and a model for money supply (part C). The results will be divided into two branches; the effect of monetary policy and the effect of foreign shocks.

The Effect of Monetary Policy:

The impact of monetary policy on macro economic variables can be captured from the impulse responses of output, inflation and exchange rate to money supply and interest rate shocks. A contraction monetary policy shocks (decreasing money supply or increasing interest rate) should lead to decline output, increase prices and decrease in exchange rate EP/USD (appreciation of Egyptian pond).

Firstly: the relation between money supply and interest rate, the impact of money supply on interest rate should be negative and the effect of interest rate on money supply should be positive. From part A, the response of interest rate to money supply shock is negative; increase in money supply leads to decline in interest rate (fig.1). Therefore, there is not liquidity puzzle. From fig. 1 also, the increasing in interest rate leads to rise in money supply. Secondly, the effect of money supply and interest rate on output: From part A, the increase in money supply leads to increase output while the rise in interest rate decreases output (fig.1). But the effect of money supply and interest rate on inflation and exchange rate do not agree with economic theory and literature review: the increase in money supply leads to decrease inflation (puzzle) and the rise interest rate increases inflation (puzzle). Besides, the increase in money supply decreases exchange rate EP/USD (puzzle) while increase in interest rate raises exchange rate. That means depreciation in Egyptian pound (puzzle). Therefore, these puzzles are treated in part B and C.

In interest rate model part B (fig.2), the increase in interest rate (contraction monetary policy) leads to decrease inflation and exchange rate that means appreciation in Egyptian Pound compared to the US dollar. Therefore, there is no puzzle in the relation between interest rate and inflation and exchange rate. In money supply model part C: (fig.5), the increase in money supply leads to big increase in inflation rate and increase exchange rate that means depreciation in Egyptian pound compared to the US dollar (no puzzles).

The Effect of Foreign Shocks

The responses of output, inflation and exchange rate to oil price, US output and interest rate shocks can be captured from (fig. 3, 4, 6 and 7). Firstly, the world price shock; the rise in world price leads to increase output in general but it decreases inflation. The oil price shock has a significant effect on inflation in Egypt but has a small effect on output. Oil price shock also increases exchange rate and monetary authorities in Egypt respond by increasing interest rate (fig.4) or decreasing money supply (fig.7). Secondly, the US output; the increase in US output leads to raise inflation and exchange rate (depreciation in Egyptian pound) but the effect of the US output on Egyptian output is weak; the Egyptian output increases then decreases after that it increases. Finally, the increase in the US interest rate leads to increase output (fig.6), but the effect of the US interest rate on inflation in Egypt is ambiguous. The increase in the US interest rate leads to decrease exchange rate (appreciation in Egyptian pound) because the monetary authorities in Egypt respond by increasing interest rate (fig.4).

CONCLUSION
This paper studies the effect of monetary policy and foreign shocks on output, inflation and exchange rate using SVAR model (using Rates software) and quarterly data from (1990.q1) to (2011.q4). This paper finds that; firstly, the relation between money supply and interest rate is associated with economic theory and literature review; the increase in money supply declines interest rate (no liquidity puzzle). In addition, the relation between interest rate and exchange rate also is associated with economic theory and literature review (no exchange rate puzzle). Secondly, the monetary policy has a significant effect on inflation (through money supply) and exchange (through interest rate) but it has a small effect on output in Egypt (through money supply and interest rate). Thirdly, the interest rate is better than money supply as intermediate target of monetary policy in Egypt according to the relation between interest rate and other variables. Finally, the foreign shocks (oil price, the US output and interest rate) have a significant effect on output, inflation and exchange rate in Egypt but the responses of monetary authorities in Egypt to these shocks mitigate their significance.

REFERENCES


**Part A: Money and Interest Rate Model**

![Graph of responses of variables to shocks](image)

**FIGURE 1:** The responses of all variables to all variable shocks.

**Part B: Interest Rate Model**
FIGURE 2: The responses of internal variables.

FIGURE 3: The responses of output and inflation to foreign shocks.
FIGURE 4: The responses for of internal variables to all variable shocks.

Part C: Money Supply Model

FIGURE 5: The responses of internal variables.

FIGURE 6: The responses of output and inflation to foreign shocks.
FIGURE 7: The responses of internal variables to all variable shocks.