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Ibrahim L. Awad[1]

THE IMPACT OF RECENT INNOVATIONS IN MONETARY POLICY ON THE MONETARY TRANSMISSION MECHANISM IN EGYPT

The study set out to answer the following two questions: (i) How far can foreign economic shocks explain the behavior of domestic real GDP and domestic price level compared with domestic economic shocks? (ii) Has the reaction function of the central bank of Egypt (CBE) differed in the last few years? Using monthly data on the periods 1998-2002 and 2004-2009, the study estimated a structural VAR model in which the Egyptian economy is treated as a small open economy. The results of the study are as follows: (i) The state of foreign economy has significantly affected domestic inflation and real GDP gap in the last few years. (ii) A sudden depreciation of domestic currency no longer supports domestic economic growth and its impact on domestic price level has relaxed. (iii) The impact of monetary policy actions on domestic price has switched to be swift and significant in the last few years. (iv) The CBE does not regularly intervene in the FX market and no longer confines itself with a target for M2. (v) The CBE has been caring about price stability and real GDP growth, respectively. In addition, the CBE has managed monetary policy more independently in the last few years.
JEL: E40; E50; E52

1. Introduction

Monetary transmission mechanisms (MTMs) are the channels through which monetary policy actions are transmitted to changes in real output and the price level. The process of MTMs begins with an action taken by the central bank (CB), mostly through open market operations (OMO), which transmits to the market interest rate either through the reserves market or through the broad money market (Kuttner & Mosser, 2002).

Although the vast majority of economists agree with Friedman's view about the role of monetary policy, economists are divided regarding the question; how will

[1] *Ibrahim L. Awad is teacher of Economics in the Department of Economics - Faculty of Commerce – Zagazig University – Egypt, e-mail: ibrahimphd@yahoo.com Tel: 0020113111219.*

monetary policy actions affect the real economy in the short run?[2] Taylor (1995) explains MTMs by focusing on the impact of monetary policy actions on both real interest rate and FX rate. But Bernanke and Gertler (1995) give more attention to the complementary effects of monetary policy actions that can be larger than that implied by conventional interest rate channel. Generally speaking, four MTM channels have been highlighted in the literature[3]; the interest rate channel, the exchange rate channel, the assets price channel, and the credit channel (Taylor, 1995; Mishkin, 1995, 2004; Bernanke and Gertler, 1995; Mohanty and Turner, 2008)[4].

Quantifying MTMs is indispensable task for CB regardless the applied monetary policy regime. Firstly, because monetary policy, first of all, is committed to realize and maintain price stability, CB should have accurate estimates about timing and effect of monetary policy actions. Secondly, because the economy's overall response to monetary policy actions incorporates the impact of variety channels, it becomes necessary for CB to distinguish the significant impact of each individual channel. Thirdly, MTMs might be incorporated a change because of financial innovations, liberalizing capital flaws, and structural change. Thus, CB has to have updated estimates for MTMs.

A review of previous studies about MTMs in Egypt indicates that most of these studies do not give much attention to the impact of foreign economic shocks on domestic macroeconomic variables (Hassan, 2003, Noureldin, 2005, Moursi et al. 2007, and Al-Mashat and Billmeier, 2007). Some recent studies about MTMs in Egypt underscored the profound impact of foreign economic shocks on domestic variables (Awad, 2010 and Moursi & El Mossallamy, 2010). Nevertheless, these studies incorporated some limitations.

The study by Awad (2010) quantifies MTMs on the period 1995Q1-2007Q4 using a structural VAR model. The limitations to this study are: (i) The study treats the period of 1995-2007 as a homogenous one. As we will see later, both monetary policy regime and monetary policy objectives underwent considerable change during this period. Specifically, in January 2003 the FX rate was floated, and later the CBE was granted a legal instrument independent upon the new law of the CBE, the

[2] Friedman (1968) avers that monetary policy cannot peg either interest rates or the unemployment rate at their equilibrium rates, through cheap money policy, for more than very limited periods. Unemployment cannot be maintained away from its natural rate without accepting a positive and finite rate of inflation. Thus, monetary policy can affect the real economy only in the short run. In the long run, inflation is a monetary phenomenon, and real output is driven by real factors.

[3] There is also an expectation channel, which has considerable influence on the effectiveness of the other channels mentioned in the text (Mohanty and Turner, 2008). In addition, there is what might be described as a monetarist channel which, focuses on the effect of changes in the relative quantities of assets, rather than interest rates. Because assets are imperfect substitutes in investor's portfolios, a monetary policy that lead to a change in the structure of assets in the investor's portfolios will lead to a relative price changes which in turn can affect real economy (Kuttner and Mosser, 2002).

[4] For details about a description analysis of MTMs, see Awad (2010).

banking sector, and the money. Such financial innovations can affect the MTMs in Egypt, either by changing the overall impact of policy or by altering the channel through which it operates. (ii) The study measures the monetary policy stance using the three-month deposit rate. As indicated by Mohanty, M.S. & Tuner, Philip (2008), the pass-through of policy rate to the bank deposit and lending rates can be precluded in the cases of; a lack of well-developed money and bond markets, and frequent shifts in the risk premium emanating from economic instability.

The study by Moursi & El Mossallamy (2010) examines the design and conduct of monetary policy in Egypt using a dynamic stochastic general equilibrium (DSGE) model. The study employs monthly data on the period January 2002-July 2008. The limitations to this study are: (i) The presumptions of the DSGE model do not fit the current state of monetary policy in Egypt. Where, the CBE does not directly target the rate of inflation through targeting the inflation expectations. In addition, it is widely believed that the CBE maintains an implicit target for the FX rate and applies a sterilized intervention policy (Awad, 2010). (ii) Conducting the analysis upon an implied presupposition that the time series 2002-2008 is homogeneous can lead to misleading results. As mentioned, the CBE (formally) floated the FX rate in January 2003, and during 2003 the CBE practiced large intervention to stabilize the FX market. Such a policy change causes structural change because of breaks in the time series. (iii) As for the monetary policy instrument, the authors employed what they called ' the annualized monthly overnight interest rate on interbank transactions' which, is not published and consequently not available elsewhere except for the CBE. Indeed, the use of unpublished data manipulated by the CBE (maybe it was developed for the purpose of internal use by the CBE staff) casts large doubt on the results of this study.

The current study treats the aforementioned criticisms in Awad (2010) as follows: (i) The study covers the period 1998-2009 rather than the period 1995-2007 as in Awad (2010)[5]. The entire period is divided to two sub-periods; 1998-2002, and 2004-2009[6]. As the time series for each sub-period is very short, the study uses monthly data. Thus, the analysis is conducted for the periods 1998:M8-2002:M12 and 2004:M1-2009M12. (ii) Because of lack of data pertains the overnight interest rates, the study uses the discount rate (DSR) as a measurement for monetary policy stance.

The purpose of the study is to answer the following two questions: (i) How far can foreign economic shocks explain the behavior of domestic real GDP and domestic price level compared with domestic economic shocks? (ii) Has the reaction function of the CBE differed in the last few years?

[5] Starting the analysis from the year 1998 is because of unavailability of data on some variables for the periods before 1998. Specifically, monthly data on the broad money supply, M2, is unavailable in the IFS, CD-R 2010 (the source of the data used in the analysis) for the periods before August 1998.

[6] As the year 2003 incorporated (formal) considerable changes either in the monetary policy regime or in the monetary policy objectives, the MTMs might be changed since then. Thus, the study will exclude the year 2003 from the analysis and compare MTMs during the periods before and after.

The rest of this paper is organized as follows. Section 2 briefly outlines developments of monetary policy objectives and tools since the early nineties decade. Section 3 specifies a structural VAR model in a small open economy. Section 4 treats data and variables used in the analysis. Section 5 discusses the estimated results of a structural VAR model. Section 6 concludes.

2. Developments of monetary policy objectives and tools

In the early nineties decade the Egyptian government endorsed an agreement with the IMF and the WB, known as the economic reform and structural adjustment program (ERSAP). The application of the ERSAP represents the most radical changes in macroeconomic policy in Egypt since the fifties last century[7]. The ERSAP included two broad objectives, namely, (i) switching the economy into a market-based economy via the liberalization of prices, FX rate, interest rate and trade; and (ii) stabilizing the economy and rectifying macroeconomic policies. For the purpose of this study, we will focus on developments of monetary policy objectives and tools during the periods followed the introduction of the ERSAP.

2.1 Developments of monetary policy objectives

One of the most difficult challenges for a researcher is to determine exactly the objectives of monetary policy that the CBE was actually intending to achieve, especially during the period following the introduction of the ERSAP, 1990, until the decision of floating the FX rate, January 2003. One reason for this is that the CBE adopted inconsistent objectives for monetary policy during this period (Moursi, et al., 2007, Kamar and Bakardzhieva, 2003, and Panizza, 2001)[8]. Well after the introduction of the ERSAP, the ultimate objective of monetary policy was determined to be achieving both internal and external stability of domestic currency in line with the national objectives of spurring economic growth and creating more job opportunities. The intermediate target of monetary policy was determined to be the net of domestic credit and later the rate of growth of money supply (M2). The daily operational target of monetary policy was determined to be banks' excess reserves (Abu-Elayoun, 2003)[9].

[7] Before the ERSAP, Egypt signed three stand-by agreements with the IMF, i.e. in 1976, 1978 and 1987. These agreements were very similar to the ERSAP. For social, political and economic reasons these agreements were interrupted.

[8] One example for such inconsistent objectives as Moursi, et al. (2007, P 4) mentioned is that the CBE adopted conflicting objectives especially during the period 1992/1993-1996/1997. In 1992/1993 while the CBE aimed at controlling the monetary expansion, it is also called for a reduction of the interest rate on the Egyptian pound to encourage investment and promote economic activity. During the period 1993/1994-1995/1996, monetary policy objectives were swayed between the two objectives of both economic growth and price stability. In 1996/1997, the CBE reverted to the objective of economic growth via monetary stabilization.

[9] During the fiscal year 2002-2003, monetary policy targeted the rate of growth of domestic liquidity at a rate of 10%, irrespective of the changes in the exchange rate. The actual rate of liquidity growth reached 9.4% (CBE, 2002-2003, 30).

During the aforementioned period, from 1990 until the start of 2003, and for long periods the CBE was targeting the FX rate[10]. Taking into account that the CBE liberalized domestic interest rates on loans and deposits in 1991[11], one may ask; how can the CBE maintain a target of the FX rate and, at the same time, achieve the goal of price stability through maintaining an implicit target of M2? The sterilized intervention policy may give answer to this question. Nevertheless, sterilized intervention policy itself is fragile and can lead to dramatic consequences (Goodfriend, 2008).

In the second half of nineties decade the Egyptian economy incurred external and domestic shocks, i.e. the East Asian crisis in June 1997, Luxor's terrorist attack in November 1997, and the fall of oil prices in 1998. Because of policy inconsistency the CBE was unable to use efficiently either short-term nominal interest rate or banks' excess reserves to manage monetary policy. Indeed, the CBE insisted to defend domestic currency. As a result, the problems of Dollar shortages exacerbated, the CBE lost an influential part of its international reserves (during 1998-2000, international reserves decreased from 18 to 14 billion dollars), and the black market of FX revived in the economy. To stop losses in foreign reserves the CBE conducted successive devaluations on domestic currency as of 2001 and floated domestic currency in the start of 2003.

Clearly, the floatation of the FX rate was an attempt to resolve policy inconsistency originating from the combination of the FX rate rigidity, the reluctance to use international reserves to support the peg to the Dollar and the attempt to reduce the interest rate to activate the economy (Galal, 2003) [12].

Besides liberalizing the FX rate, a new legislation was issued. The Law No. 88 of 2003, as amended by Law No. 162 of 2004 and Law No. 93 of 2005, is a comprehensive law governing the CBE, the banking sector, and money[13]. Under the

[10] During the periods of 1960-2003, different varieties of exchange rate regimes had been experimented in the Egyptian economy, i.e. conventional peg in the sixties, crawling peg in the seventies and eighties, crawling bands in the nineties and managed floating as of 2003. Beside the official price, FX market witnessed multiple prices including prices of both parallel market and black market. In 2004, Egypt successfully unified FX markets (Kamar and Bakardzhieva, 2003).

[11] By January 1991, the CBE had liberalized interest rate on loans and deposits. Accordingly, banks were given the freedom to set their loans and deposit interest rates subject to the restriction that the 3-month deposits rate should not fall below 12 percent per annum. This restriction was cancelled in 1993/1994 (Moursi, et al., 2007, PP 6-7).

[12] Despite formal liberalization of FX rate in January 2003, the CBE has continued to maintain exchange rate stability as one of its key objectives during the following years 2004 and 2005. That makes many commentators suspect that the CBE still have implicit target for the FX rate and do intervene regularly to maintain it (Moursi, et al., 2007, PP. 8). Al-Mashat and Billmeier (2007) examined the MTMs in Egypt. One result of this study is that the exchange rate channel still playing strong role in propagating monetary shocks to output and prices despite the CBE is, formally, no longer use nominal exchange rate as a nominal anchor for monetary policy. In addition, Awad (2010) concluded that the CBE maintains an implicit target for the FX rate and that it applies the sterilized intervention policy.

[13] Available at: www.cbe.org.eg/.

current new legislation, the main function of the CBE is to achieve price stability and banking system soundness within the context of the general economic policy of the state. The CBE was granted legal instrument independence, where the CBE is responsible for implementing monetary policy using the appropriate means that insure the realization of its objectives[14].

2.2 Monetary policy tools

Under the assumption that the influential part of inflation in the Egyptian economy refers to the demand side, the ERSAP was designed to fight the accelerating inflation which occurred in the late eighties decade via controlling aggregate demand. That is why the CBE applied a contractionary monetary policy especially during the first stages of the ERSAP. By liberalizing the interest rate in 1991, the direct means to conduct monetary policy that were used in the previous periods became abolished. Since then, the CBE no longer determines interest rate administratively but rather it affects market conditions using monetary policy tools to conduct nominal rates towards the desired path.

Liberalizing the interest rate coexisted with developing new tools to finance budget deficit using real resources especially, in the first half of the nineties. Treasury bills (TBs) mechanism in the primary market were used intensively to play a central role and interest rates on TBs served as an indicator to the directions of the short-term interest rate within the market. By activating the TBs mechanism, the nominal interest rate began to rise. As a result, real interest rate recorded positive values, especially when the rate of inflation began to recede during the first half of the nineties.

During the second half of the nineties, the CBE aimed at maintaining price stability via stabilizing banks' reserves and hence stabilizing domestic credit and domestic liquidity. To achieve this objective the CBE focused on the secondary market of TBs thus, *repos* and, later, *reverse repos* were used extensively. In 2001, the CBE permitted *repos* for one night at the prevailing discount rate. In September 2002, the CBE shifted from accepting deposits in local currency, in virtue of mutual agreements between the CBE and some other banks, to a new market-based system. According to the new system, the CBE specifies the quantity of deposits required to be deposited and the date and maturity of the transaction. On their part, banks are to

[14] Following Fry's methodology, which assumes that the level of independence of the central bank is determined by fiscal attributes, Awad (2010, 28-52) assesses whether the legal independence granted to the CBE under the latest legislation is factual. The author uses a simple criterion to assess the central bank independence, namely, that the central bank is factually independent if it can fulfill its target without squeezing private sector. Applying this criterion to the case of the CBE, the legal independence granted to the CBE under the latest legislation is not factual.

submit their bids specifying the required quantity and interest rate (CBE, 2002-2003)[15].

As of June, 2005, the CBE developed a new framework for monetary policy implementation. This framework relies on the use of the overnight interest rate on the inter-bank transactions as an operational target for monetary policy, instead of banks' excess reserves. The new framework represented the central bank's main policy instrument, providing the outer bounds of a corridor within which the ceiling is the overnight interest rate on lending from the CBE, and the floor is the overnight deposit interest rate at the CBE (CBE, 2005-2006, 1).

As of August 2005, a new instrument dubbed "the central bank notes" was developed. These notes are issued with a maturity spanning up to two years and are used to absorb banks' excess liquidity, instead of the reverse *repos* of the TBs (CBE, 2005-2006, 6).

3. VAR Model Specifications in a Small Open Economy[16]

3.1 VAR model specifications

Because the error terms in an unrestricted VAR model contains nonzero covariance, an unrestricted VAR model is not attractive tool for policy analysis. The nonzero covariance of the error terms makes the analyst unable to discern the true impact of a shock in the error term. To make the interpretation of policy analysis in a VAR model a straightforward, it becomes necessary to transform the model into one having orthogonal (structural) innovations, i.e. to transform the model so that the error terms are no longer contemporaneously correlated. Thus, the main purpose of structural VAR estimation is to obtain the orthogonal error terms for impulse response analysis (Charemza & Deadman, 1997).

Following Zellner and Palm (1974), Cushman and Zha (1995), and Zha (1998), a structural linear, stochastic dynamic VAR model can take the following representation:

$$A(L)\, Z(t) = \varepsilon(t) \qquad (1)$$

Where $Z(t)$ is an (m x 1) vector of variables, $A(L)$ is an (m x m) matrix polynomial in the lag operator (L) with non-negative power, and $\varepsilon(t)$ is an (m x 1) vector of structural disturbances.

[15] After the CPI-based inflation rate reached to 12.4 percent annually in December 2006 against 7.2 percent in June, 2006 the CBE continued its OMO to contain the inflationary pressures, via absorbing excess liquidity in the banking system, resulting mainly from larger foreign currency inflows (CBE, 2006-2007).

[16] Literally, a small open economy is the case in which the economy's share in international trade is small enough compared with its trading partners that its polices do not alter world prices, interest rate, and income.

A reduced form of (1), which expresses the current endogenous variables ($Z(t)$) as a function of lagged endogenous and current and lagged exogenous variables can be expressed as follow[17];

$$Z(t) = -B(L)\,Z(t) + V(t) \qquad (2)$$

Where, $B = A_0^{-1} A^0$ and $V(t) = A_0^{-1}\varepsilon(t)$.

Clearly, we cannot discern structural shocks $\varepsilon(t)$ from reduced form residuals $V(t)$, because the system expressed by (2) is not identifiable[18]. To identify structural shocks from reduced form residuals, A_0 is imposed as a lower triangular matrix.

3.2 Benchmark identification scheme

Under the assumption of a small open economy, the main focus falls on the effect of a change in foreign economy's variables on domestic economy's variables where it is assumed that foreign variables affect domestic variables without a feedback.

As for Egypt, The USA and the EU represent the main trader[19]. In this study, the Egyptian economy will be treated as a small open economy relative to the USA economy, i.e. the USA economy is a proxy for the world economy. The EU case will be left to another separate study.

The vector of the USA economy's variables ($Z_t^{USA'}$) consists of real GDP (y^{USA}), consumer price index (CPI^{USA}) and the federal funds rate (FFR^{USA}).

$$Z_t^{USA'} = [y^{USA} \quad CPI^{USA} \quad FFR^{USA}] \qquad (3)$$

The vector of the Egyptian economy's variables (Z_t^{EG}) consists of real GDP gap (y^{*EG}), wholesale price index (WPI^{EG}), nominal exchange rate (FX^{EG}), discount rate (DSR^{EG}), and nominal money supply, M2.

$$Z_t^{EG'} = [y^{*EG} \quad WPI^{EG} \quad FX^{EG} \quad DSR^{EG} \quad M2^{EG}] \qquad (4)$$

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[17] For details about the derivation of the reduced form (2), see; Awad, 2010.

[18] Given that the diagonal elements of A_0 are all unity, A_0 contains $n^2 - n$ unknowns. In addition, there are n unknown values var. (ε_t), thus the total unknown values equal n^2. To identify n^2 unknowns from the estimated variance/covariance matrix with $(n^2 + n)/2$ known independent elements, it is necessary to impose an additional $n^2 - [(n^2 + n)/2] = (n^2 - n)/2$ restrictions on the system (Enders and Walter, 2004, pp. 291–293).

[19] The Egyptian economy is quite open regarding the ratios of both exports and imports to GDP. The ratios of exports and imports to GDP (on average for the period 1997–2008) are about 24% and 28 %, respectively, and the degree of openness (trade, % of GDP) is about 52% during the same period (WDI, CD-R 2009). The USA and the EU are the main traders with Egypt. During the period 1990/91–2006/07, 66.5% of Egyptian exports went to the USA and the EU (32.5% and 34%, respectively) and 60% of Egyptian imports came from the USA and the EU (22.4% and 37.5%, respectively) (calculated from data available on the CBE website: http://www.cbe.org.eg/).

Following Christiano et al. (1999), Peersman and Smets (2001), and Mojon and Peersman (2001), the variables of the model take the following order;

$$Z_t' = [y^{USA}\ CPI^{USA}\ FFR^{USA}\ y^{*EG}\ WPI^{EG}\ FX^{EG}\ DSR^{EG}\ M2^{EG}] \quad (5)$$

Thus, structural shocks in the benchmark identification scheme are determined as follow:

$$\begin{bmatrix} \varepsilon_t^{y_t^{USA}} \\ \varepsilon_t^{CPI_t^{USA}} \\ \varepsilon_t^{FFR_t^{USA}} \\ \varepsilon_t^{y_t^{*EG}} \\ \varepsilon_t^{WPI_t^{EG}} \\ \varepsilon_t^{FX_t^{EG}} \\ \varepsilon_t^{DSR_t^{EG}} \\ \varepsilon_t^{M2_t^{EG}} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & 0 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} & 0 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & a_{77} & 0 \\ a_{81} & a_{82} & a_{83} & a_{84} & a_{85} & a_{86} & a_{87} & a_{88} \end{bmatrix} \begin{bmatrix} V_t^{y_t^{USA}} \\ V_t^{CPI_t^{USA}} \\ V_t^{FFR_t^{USA}} \\ V_t^{y_t^{*EG}} \\ V_t^{WPI_t^{EG}} \\ V_t^{FX_t^{EG}} \\ V_t^{DSR_t^{EG}} \\ V_t^{M2_t^{EG}} \end{bmatrix} \quad (6)$$

In the light of this, the benchmark identification scheme summarizes the assumptions of the study about the variables incorporated in the model (Z_t), the monetary policy instrument (DSR), the variables that the CBE looks at when setting its instrument and the interaction of a monetary policy shock with the variables in the feedback rule. A monetary policy shock is identified through a structural decomposition with the variables ordered as in (6). The zero block(s) corresponding to a monetary policy shock (ε_t^{DSR}) indicates that the CBE does not see the subsequent variable (s), $M2_t^{EG}$, when setting its monetary policy instrument. That is, the CBE responds contemporaneously to changes in the foreign and domestic variables preceding the monetary policy instrument. A shock in the monetary policy instrument does have a contemporaneous impact on the following variables, but affects the preceding variables after one lag (one month). Since the above identification scheme will be tested during the periods before and after the floatation of the FX rate, thus we assume that the CBE implicitly maintains a target for the FX rate even after formal floatation of the FX rate in January 2003.

4. Data

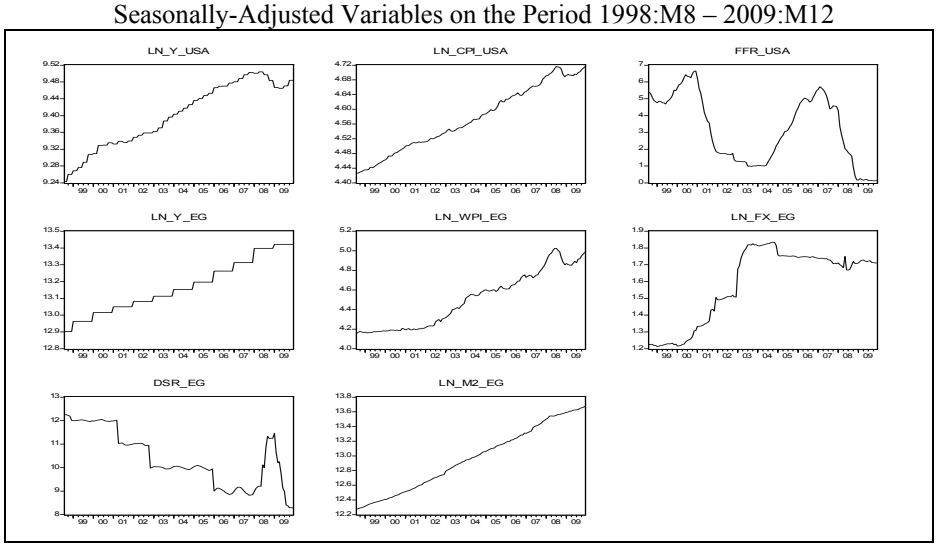
As the year 2003 incorporates profound changes in monetary policy regime, the above benchmark identification scheme is estimated on the periods before and after 2003, i.e. 1998:M8-2002:M12, and 2004M1-2009M12. The source of the data is the IFS, CD-R 2010. Using statistical methods included in E-views 5, monthly data on real GDP is extrapolated from annual data on nominal GDP after deflating it by GDP deflator. Because monthly time series often exhibits cyclical movements that

recur every month, the data are seasonally adjusted using seasonal filter Census-X12 included in the E-views 5. All variables are expressed in logs, except for nominal interest rates, i.e., FFR_t^{USA}, and DSR_t^{EG}.

Figure 1 depicts the behavior of seasonally-adjusted variables on the period 1998:M8- 2009:M12. Clearly, many of these variables incorporate a trend and so express non-stationary behavior. Using the unit root tests (the Augmented Dickey-Fuller unit root test, ADF, and the Phillips-Perron unit root test, PP), all variables are found to be non-stationary, I ~ (1), except for FFR_t^{USA}, and DSR_t^{EG}. According to ADF unit root test, FFR_t^{USA} and DSR_t^{EG} are stationary at 5 % level.

Figure 1

Seasonally-Adjusted Variables on the Period 1998:M8 – 2009:M12



Real GDP gap (y^{*EG}) is calculated using the following formula;

$$y^{*EG} = \frac{\text{Actual Real GDp} - \text{Potential Real GDP}}{\text{Potential Real GDP}} \qquad (7)$$

Where, Actual real GDP is the logarithm of seasonally adjusted real GDP, and Potential real GDP is the trend of actual real GDP estimated by Hodrick-Prescott filter with smoothing parameter, ʎ, Equals to 14400. According to ADF test, real GDP gap is stationary at 5% level. The first differences (after taking logs) are sufficient to achieve stationarity for the rest of variables, as shown in Figure 2.

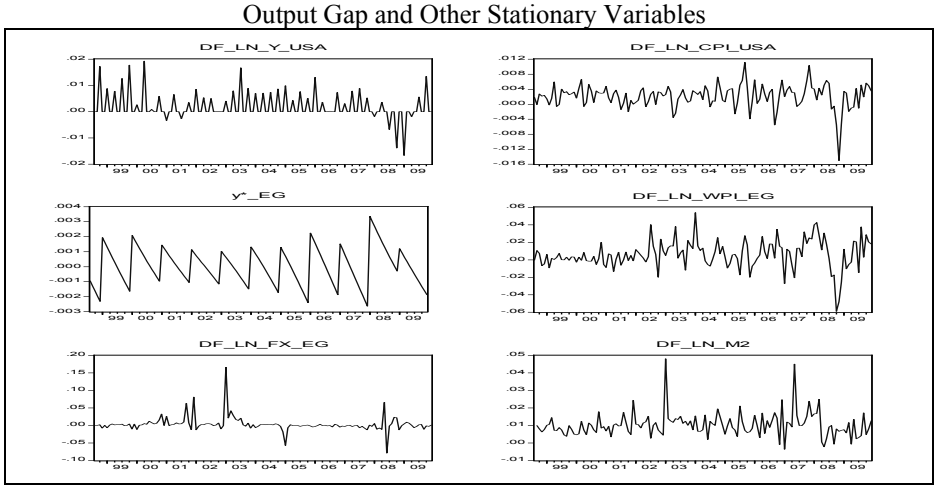
By estimating the model with (or without) stationary variables, all roots are found to be inside the unit root circle, thus the model is stationary[20]. The Schwarz

[20] The Johansen cointegration test indicates 5 cointegrating equations according to the trace test, and 4 cointegrating equations according to the maximum eigenvalue test.

information criterion (SIC) and the Hannan-Quinn information criterion (HQIC) are used to determine the appropriate lag length, which turns out to be one lag.

Figure 2

Output Gap and Other Stationary Variables



5. Results

Responses to structural innovations ordered as in 6 were estimated for each period according to scheme 8 where, *Ln*; stands for the logarithmic value and *D*; stands for the first difference[21].

$$Z_t' = [D\_Ln\_y^{USA}\ D\_Ln\_CPI^{USA}\ FFR^{USA}\ y^{*EG}\ D\_Ln\_WPI^{EG}\ D\_Ln\_FX^{EG}\ DSR^{EG}\ D\_Ln\_M2^{EG}] \quad (8)$$

5.1 The impact of foreign economic shocks on domestic real GDP gap and domestic price [22]

Figure 3 highlights the impulse responses of real GDP gap and domestic inflation to foreign economic shocks during the periods 1998:M08-2002:M12 and 2004:M01-2009:M12[23]. By comparing panel 3 to panel 1, the following differences can be

[21] Responses to structural innovations ordered as in 6 were estimated for each period by introducing the logarithmic value of seasonally adjusted variables either as it is or with the first difference. Because impulse responses in the first case exhibited anomalous behavior it was excluded from the analysis.

[22] Because of limited space, Figures 3 and 4 highlight the direct impact of foreign and domestic economic shocks on both real GDP and domestic inflation. Figures 1- 4 in the Appendix, however, show the full image of responses.

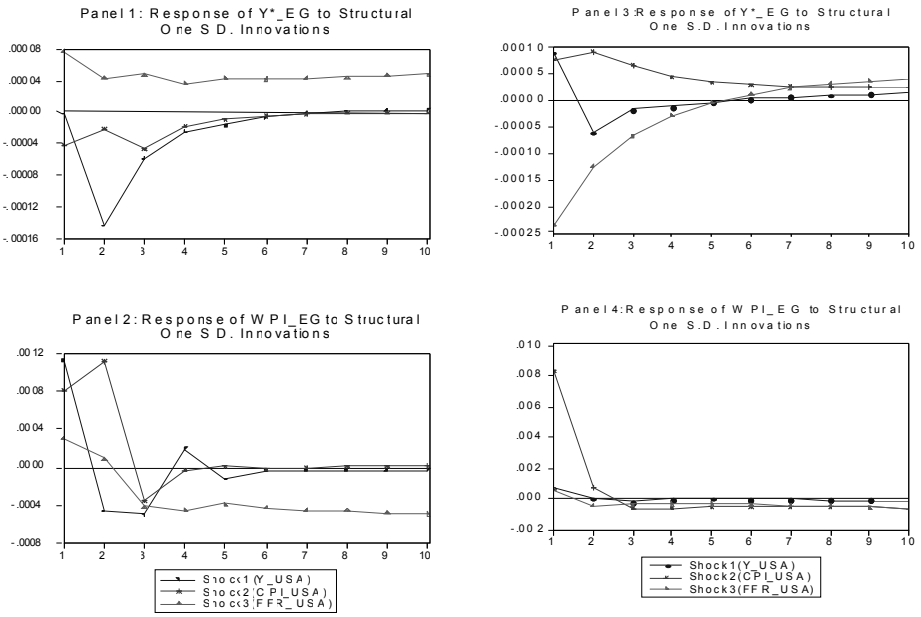
[23] The impulse response function traces out the effect of a one-time shock to one of the innovations on current and future values of other endogenous variables through the dynamic lag structure of the VAR model.

discerned: (i) Response of real GDP gap to a positive shock in real GDP^{USA} has reversed to be positive during the period 2004-2009. That is, in contrast to the period 1998-2002, a positive shock in real GDP^{USA} during the period 2004-2009 causes an expansion in real GDP^{EG}. By considering the response of the CBE to a positive shock in real GDP^{USA}, the CBE is easing monetary policy via cutting DSR^{EG} during the period 2004-2009 whereas, during the period 1998-2002 the CBE did not respond (Appendix, Figures 1 and 2).

Figure 3

Impulse Responses of Real GDP Gap and Domestic Inflation to Foreign Economic Shocks

1998:M08 – 2002:M12 2004:M01- 2009:M12



(ii) Response of real GDP gap to a positive shock in the FFR^{USA} has reversed to be negative and significant (at 10 % level) during the period 2004-2009 comparing to the period 1998-2002. Considering the corresponding response of $M2^{EG}$ to a positive shock in the FFR^{USA} it varies too during the two periods. A positive shock in the FFR^{USA} that was inducing an increase in $M2^{EG}$ during the period 1989-2002 is reversed so that it causes a decrease in $M2^{EG}$ during the period 2004-2009 (Appendix, Figures 1 and 2). Thus, a negative response of real GDP gap during the period 2004-2009 can be referred to domestic monetary tightening in response to a monetary tightening in the foreign economy, i.e. USA economy.

(iii) Response of real GDP gap to a positive shock in CPI^{USA}, although being non-significant, has reversed to be positive in the last period, i.e. a positive shock in CPI^{USA} causes an increase in real GDP^{EG} during the period 2004-2009. Such a varying response of real GDP gap to a positive shock in CPI^{USA} can be explained by

a differing response of the FX rate (EG pounds per USD) to a positive shock in CPI^{USA} during the two periods. A positive shock in CPI^{USA} that was causing an appreciation of domestic currency during the period 1998-2002 no longer influences domestic currency during the period 2004-2009 (Appendix, Figures 1 and 2). This may indicates that the CBE is intervening in the FX market to accommodate the impact of foreign price shocks on domestic currency and hence domestic real GDP growth.

Panels 2 and 4 denote that the magnitude of response of domestic price to a positive shock in foreign prices has increased in the last years. A positive shock in CPI^{USA} has a positive and significant impact (at 5 % level) on domestic price during the period 2004-2009 comparing to the period 1998-2002. Under the possibility that the CBE is intervening in the FX market to accommodate the negative impact of foreign price shocks on real GDP growth, the CBE gives higher weight to either real GDP growth or the FX rate stabilization than domestic price stability, provided that such an intervention in the FX market is not a sterilized one.

5.2 The impact of domestic economic shocks on real GDP gap and domestic inflation

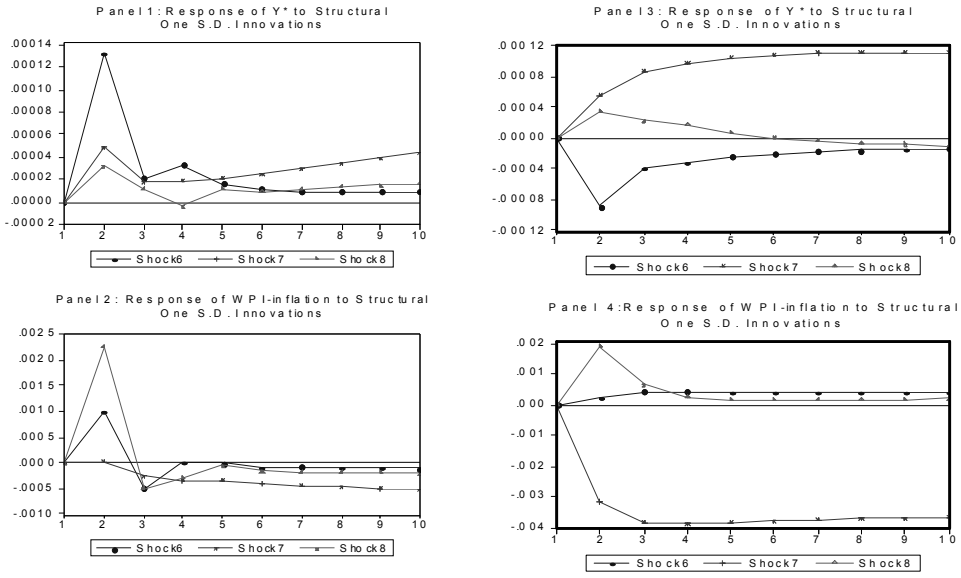
Figure 4 depicts the impulse responses of real GDP gap and domestic inflation to domestic economic shocks. The main differences in responses of both real GDP gap and domestic inflation to domestic economic shocks during the two periods are as follow: (i) During the period 1998-2002, a positive shock in the FX rate (depreciation of domestic currency) positively affects both real GDP gap and domestic price, despite such an effect is not significant. An increase in $M2^{EG}$ depreciates domestic currency thereby real GDP gap (or real GDP growth) and domestic price rise. In addition, the rate of growth of $M2^{EG}$ significantly surges up (at 5 % level) in reacting to a sudden depreciation of domestic currency. During the period 2004-2009, however, the impact of FX rate on real GDP has reversed and its impact on domestic price has relaxed. A positive shock in $M2^{EG}$ no longer depreciates domestic currency. In addition, the rate of growth of $M2^{EG}$ recedes in reacting to a sudden depreciation of domestic currency (Appendix, Figures 3 and 4).

(ii) The impact of monetary expansion on both real GDP gap and domestic price did not incorporate substantial change during the two periods where, a monetary expansion raises price level and has expansionary effect on real GDP.

(iii) The impact of monetary policy actions on domestic price became faster and higher. A positive shock in DSR^{EG} significantly decreases domestic price after one lag during the period 2004-2009 (at 5% level) whereas, during the period 1998-2002 a monetary contraction did not have significant impact on domestic price.

Figure 4
Impulse Responses of Real GDP Gap and Domestic Inflation to Domestic Economic Shocks

1998:M08 – 2002:M12 2004:M01- 2009:M12



5.3 The reaction of monetary policy to both domestic and foreign economic shocks

Figure 5 highlights the main differences in response of domestic monetary policy to domestic and foreign economic shocks during the aforementioned two periods:

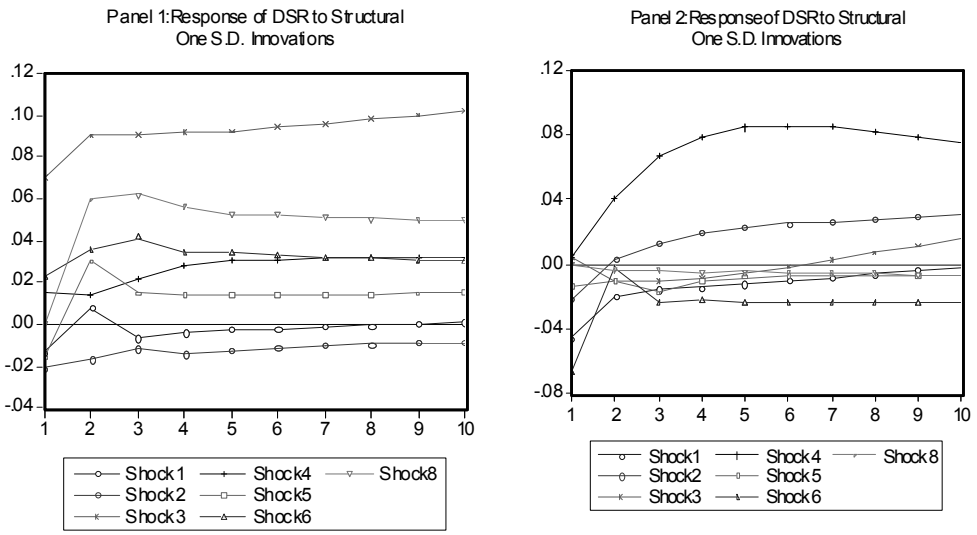
(i) Because the CBE was targeting the FX rate during the period 1998-2002, the FFR^{USA} represented the most important variable that practiced increscent influence on the behavior of DSR^{EG} during that time where, DSR^{EG} movements were significantly responding (at 5 % level) to FFR^{USA} shocks. During the period 2004-2009, however, DSR^{EG} no longer respond to FFR^{USA} shocks.

(ii) Besides targeting the FX rate, the CBE was maintaining an unannounced target for $M2^{EG}$ during the period 1998-2002. The response of DSR^{EG} to a structural innovation in $M2^{EG}$ reflected this fact through a significant response of DSR^{EG} to a positive shock in $M2^{EG}$ (at 5 % level) during the period 1998-2002. On the contrary, during the period 2004-2009 DSR^{EG} does not respond to $M2^{EG}$ shocks. Thus, maintaining an implicit target for M2 by the CBE no longer exist in recent years.

Figure 5

Response of Discount Rate to Domestic and Foreign Economic Shocks

1998:M08 – 2002:M12 2004:M01- 2009:M12



(iii) As the CBE formally was targeting the FX rate during the period 1998-2002, the CBE was responding to a depreciation of domestic currency by raising DSR^{EG}. Nevertheless, the response of $M2^{EG}$ to a depreciation of domestic currency exhibited anomalous behavior during this period. Where, $M2^{EG}$ significantly expands (at 5 % level) in response to a depreciation of domestic currency. One explanation for that is the inconsistency among monetary policy objectives during that time. During the period 2004-2009, however, the response of $M2^{EG}$ to a depreciation of domestic currency, although being non-significant, comes in accordance with our expectations where, $M2^{EG}$ falls in response to a depreciation of domestic currency. The non-significant response of $M2^{EG}$ to a depreciation of domestic currency may denotes an irregular intervention by the CBE in the FX market (see Appendix, Figures 5 and 6).

5.4 Variance decomposition of domestic variables[24]

The analysis of variance decomposition of domestic variables during the aforementioned periods may sheds light on the relative importance of different innovation in explaining the variations of each variable. The variance decomposition of domestic variables, as depicted by Tables 1 and 2, denotes the following differences:

[24] Variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus it provides information about the relative importance of each random innovation in affecting the endogenous variables.

(i) The relative importance of foreign variables in explaining the variations of real GDP gap has increased during the period 2004-2009. Nevertheless, the impact of both foreign and domestic variables as a whole on real GDP gap variations is limited during the two periods. The most influence on real GDP gap variations is because of lagged values of real GDP gap. The impact of lagged values of real GDP gap on the variations of current real GDP gap has relatively decreased during the period 2004-2009. One explanation is that the CBE gives more attention to real GDP growth during the last periods.

(ii) The impact of foreign and domestic variables on the variations of domestic inflation has considerably increased during the period 2004-2009. The impact of foreign variables is mainly resulting from foreign prices, CPI^{USA}, whereas the impact of domestic variables is mainly caused by DSR^{EG}.

Table 1

Variance Decomposition of Domestic Variables (%) during the Period 1998-2002

External Shocks					**Domestic shocks**					
period	$RGDP^{USA}$	CPI^{USA}	FFR^{USA}	**Sum.**	RGD Gap	WPI	FX rate	DSR	M2	**Sum.**
Variance decomposition of real GDP gap										
1 month	0.00	0.21	0.740	0.95	**99.00**	0.00	0.00	0.000	0.00	0.00
3 months	2.01	0.36	0.822	3.20	**93.37**	1.65	1.46	0.210	0.09	3.40
6 months	2.00	0.38	1.160	3.52	**92.80**	1.67	1.50	0.310	0.10	3.60
1 year	1.95	0.37	2.170	4.50	**90.10**	1.67	1.51	1.080	0.22	4.50
Variance decomposition of the rate of inflation (WPI)										
1 month	1.52	0.81	0.110	2.44	0.33	**97.21**	0.00	0.000	0.00	0.32
3 months	1.87	2.22	0.300	4.40	0.40	**87.98**	1.34	0.070	5.70	7.50
6 months	1.91	2.19	0.900	5.00	0.40	**86.89**	1.33	0.490	5.84	8.00
1 year	1.85	2.11	2.360	6.30	0.46	**83.82**	1.36	2.130	5.87	9.80
Variance decomposition of the rate of change in the FX rate										
1 month	0.57	0.42	2.730	3.70	2.60	0.76	**92.90**	0.000	0.00	3.36
3 months	1.35	0.75	3.260	5.36	2.26	0.86	**79.82**	4.790	6.88	14.80
6 months	1.34	0.82	3.220	5.38	2.31	0.87	**77.15**	7.380	6.88	17.44
1 year	1.33	0.85	3.280	5.46	2.36	0.85	**75.68**	8.670	6.93	18.80
Variance decomposition of the discount rate (DSR)										
1 month	0.47	1.17	13.410	15.05	0.68	0.68	1.46	**82.100**	0.00	2.82
3 months	0.23	0.72	18.300	19.25	0.81	1.18	3.09	**69.300**	6.37	11.45
6 months	0.13	0.59	21.530	22.24	1.67	0.90	3.20	**64.600**	7.34	13.11
1 year	0.07	0.42	26.160	26.65	2.34	0.80	3.08	**59.540**	7.55	13.77
Variance decomposition of the rate of growth of M2										
1 month	0.09	1.78	1.060	2.93	0.27	6.90	31.65	0.003	**58.22**	38.80
3 months	2.91	2.46	1.240	6.60	1.31	7.55	29.37	1.070	**54.05**	39.30
6 months	2.89	2.44	1.480	6.80	1.30	7.45	28.96	2.120	**53.32**	39.80
1 year	2.82	2.39	2.040	7.25	1.33	7.29	28.36	3.470	**52.26**	40.45

Table 2

Variance Decomposition of Domestic Variables (%) during 2004-2009

External Shocks					**Domestic shocks**					
period	$RGDP^{USA}$	CPI^{USA}	FFR^{USA}	**Sum.**	RGDP gap	WPI	FX rate	DSR	M2	**Sum.**
Variance decomposition of real GDP gap										
1 month	0.710	0.510	4.71	5.93	**94.000**	0.00	0.00	0.00	0.00	0.00
3 months	0.655	1.022	4.03	5.70	**92.200**	0.86	0.49	0.58	0.09	2.02
6 months	0.610	1.150	3.76	5.52	**90.660**	1.00	0.55	2.13	0.10	3.78
1 year	0.630	1.290	4.02	5.94	**86.820**	0.96	0.59	5.54	0.20	7.29
Variance decomposition of the rate of inflation (WPI)										
1 month	0.190	24.770	0.11	25.07	0.900	**74.00**	0.00	0.00	0.00	0.90
3 months	0.170	21.000	0.20	21.37	0.870	**68.90**	0.07	7.43	1.20	9.60
6 months	0.150	18.630	0.26	19.04	1.430	**60.15**	0.19	18.06	1.10	20.68
1 year	0.140	15.420	0.68	16.24	2.150	**48.50**	0.35	31.8	0.93	35.25
Variance decomposition of the rate of change in the FX rate										
1 month	2.350	0.010	1.64	4.00	1.310	0.42	**94.23**	0.00	0.00	1.76
3 months	2.950	0.170	1.45	4.57	1.960	4.82	**88.34**	0.20	0.07	7.05
6 months	2.940	0.190	1.44	4.57	2.080	4.79	**87.77**	0.69	0.07	7.63
1 year	2.900	0.210	1.44	4.55	2.140	4.74	**86.88**	1.57	0.07	8.52
Variance decomposition of the discount rate (DSR)										
1 month	3.255	0.710	0.02	3.98	0.024	0.27	6.90	**88.74**	0.00	7.20
3 months	1.500	0.350	0.12	1.97	3.370	0.33	2.76	**91.50**	0.01	6.47
6 months	0.870	0.600	0.08	1.55	7.320	0.22	1.80	**89.00**	0.02	9.36
1 year	0.460	1.000	0.26	1.72	8.600	0.16	1.42	**88.00**	0.06	10.24
Variance decomposition of the rate of growth of M2										
1 month	0.003	1.240	3.71	4.95	1.340	0.41	1.02	0.90	**91.34**	2.86
3 months	0.300	1.390	4.30	6.00	2.220	0.74	1.16	0.90	**88.95**	5.02
6 months	0.390	1.380	4.61	6.38	3.000	0.74	1.15	1.08	**87.59**	5.89
1 year	0.500	1.350	4.98	6.83	3.900	0.73	1.10	1.56	**85.80**	7.29

In addition, the influence of lagged values of domestic inflation on the variations of current inflation has considerably declined during the period 2004-2009. This indicates that the CBE is more caring about reducing domestic inflation during the period 2004-2009 comparing to the period 1998-2002.

(iii) Variance decomposition of the FX rate reveals that domestic variables influence the FX rate variations more than foreign variables. Nevertheless, the impact of both foreign and domestic variables get lower during the period 2004-2009 comparing to the period 1998-2002. Moreover, the lagged values of the FX rate incorporate high impact on the FX rate variations during the last period which, indicates that the CBE relaxed regular interventions in the FX market.

(iv) Variance decomposition of monetary policy tool, DSR^{EG}, denotes that the FFR^{USA} was the main source of variation during the period 1998-2002. On the contrary, during the period 2004-2009 the role of foreign variables as a source

of variations has significantly declined. Domestic variables, particularly real GDP gap and FX rate represent the main source of variations of DSR^{EG} during the last periods. While the FX rate plays a pivotal role during a very short run (one month to three months) the real GDP gap plays the most important role during the short run (six months to one year). The greater impact of domestic variables on the monetary policy tool variations during the last years indicates that the CBE uses monetary policy more independently.

(v) Variance decomposition of $M2^{EG}$ comes in consistent with the above conclusions. The FX rate was the main source of variations of $M2^{EG}$ during the period 1998-2002 but its impact has significantly decreased during the period 2004-2009. In addition, because the CBE was formally maintaining an implicit target for $M2^{EG}$ during the period 1998-2002 the impact of lagged values of $M2^{EG}$ on the variations of current values of $M2^{EG}$ was not so high comparing to its counterpart during the period 2004-2009.

6. Conclusions

MTMs are the channels through which monetary policy actions are transmitted to changes in real output and the price level. Four MTM channels are emphasized by most economists in the literature; the interest rate channel, the exchange rate channel, the assets price channel, and the credit channel. As the main job of CB is to achieve price stability, quantifying the MTMs is a necessary step to take the right action. Under financial innovations and liberalizing capital flaws the MTMs might be incorporated a substantial change. Thus, CB has to have updated estimates about both timing and effect of monetary policy actions and the MTM channels that play a dominant role.

Empirical studies about the MTMs in Egypt did not take into account the potential impact of recent developments in both monetary policy regime and monetary policy objectives and tools on the MTMs. Using monthly data on the periods 1998-2002 and 2004-2009, the study estimated a structural VAR model in which the Egyptian economy is treated as a small open economy. The study set out to answer the following two questions: (i) How far can foreign economic shocks explain the behavior of domestic real GDP and domestic price level compared with domestic economic shocks? (ii) Has the reaction function of the CBE differed in the last few years?

The results of the study are as follows: (i) The state of foreign economy has significantly affected domestic inflation and real GDP gap in the last few years, i.e. an expansion or contraction in foreign economy affects domestic economy in the same direction. That might be referred to a change in response of the CBE to foreign economic shocks in recent years comparing to the previous periods in which the FX rate was targeted. (ii) The FX rate shock (a sudden depreciation of domestic currency) no longer supports domestic economic growth and its impact on domestic price have relaxed. That happens because a sudden depreciation of domestic currency has been reacted by the CBE through a decrease in the rate of growth of

M2. (iii) The impact of monetary policy actions on domestic price has switched to be swift and significant. This may indicates that both money and financial markets became more liberalized and more developed. (iv) The CBE has managed monetary policy more independently in the last few years, i.e. the CBE does not link monetary policy tool to movements in the FFR. In addition, the CBE does not regularly intervene in the FX market and no longer confines itself with a target for M2. (v) The CBE has been caring about price stability and real GDP growth, respectively.

In the light of this, we think that the CBE approaches the inflation targeting regime more than any time before. As prerequisites for adopting inflation targeting, however, there are many issues have not accomplished yet. Specifically, the relationship between monetary and fiscal policy should be established on the bases of cooperation not dictation and the obligation for the CBE to finance budget deficit should be abolished.

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Appendix

Figure 1

Responses of Domestic Variables to Foreign Economic Shocks
(1998:M08 – 2002:M12)

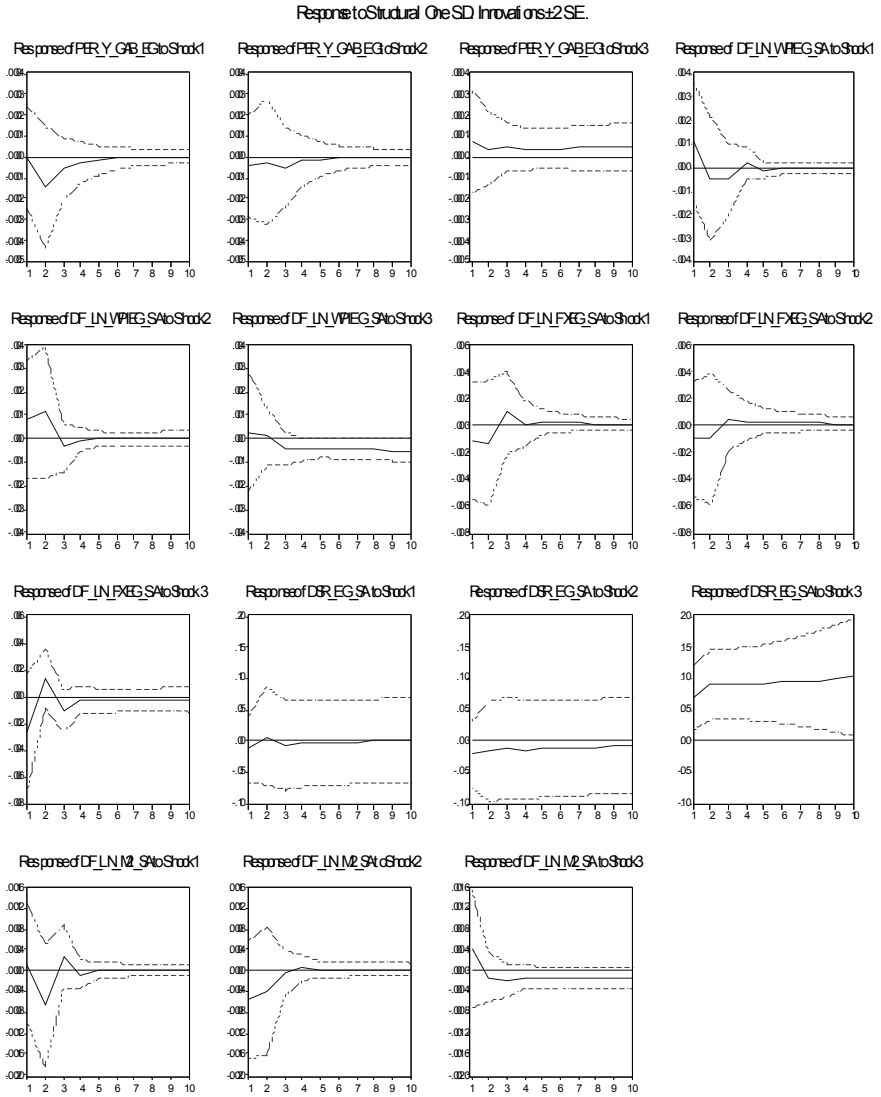

Figure 2

Responses of Domestic Variables to Foreign Economic Shocks
(2004:01 – 2009:M12)

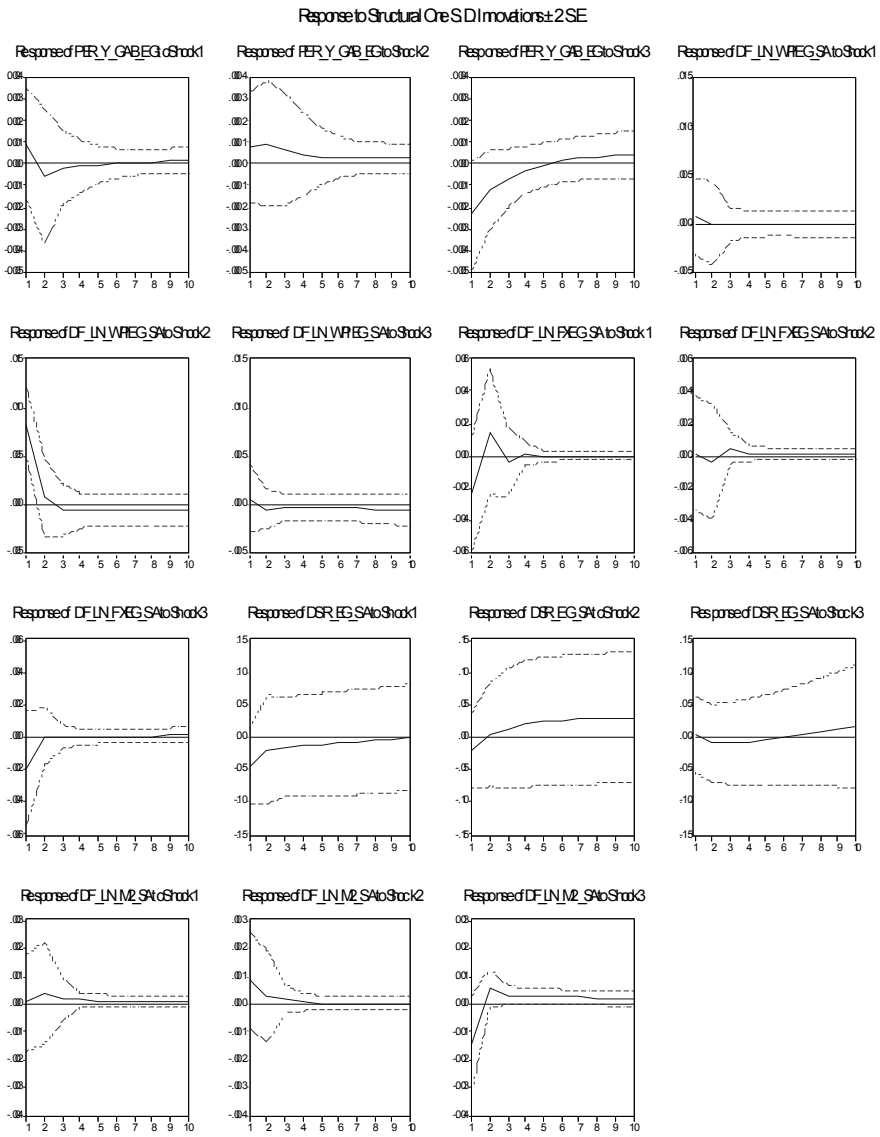

Figure 3

Responses of Domestic Variables to Domestic Economic Shocks
(1998:M08 – 2002:M12)

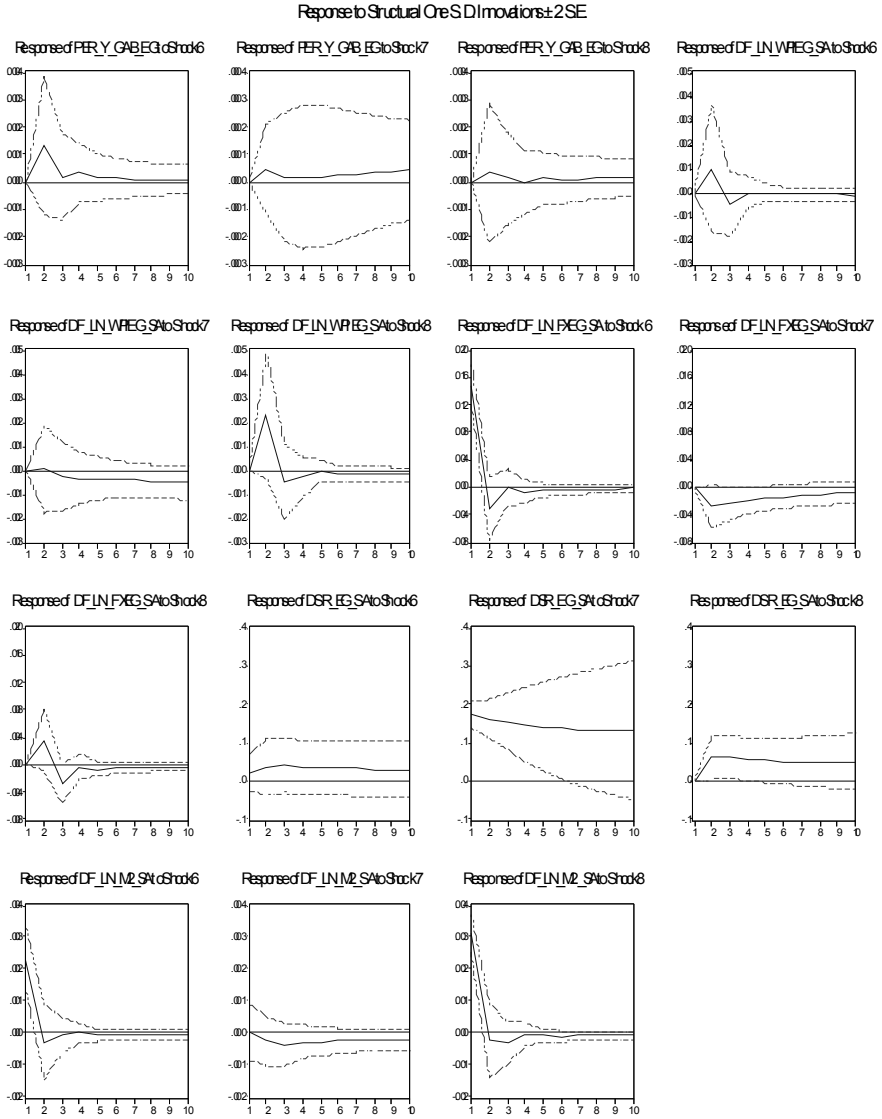

Figure 4

Responses of Domestic Variables to Domestic Economic Shocks
(2004:01 – 2009:M12)