Interest rate rule for the conduct of monetary policy: analysis for Egypt (1997:2007)

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Abstract

The main objective of the paper in hand is to examine the validity of using Taylor rule as a robust rule for conducting monetary policy in case of Egypt. In this context, the paper works through two main pillars. *First*: parts two and three; critically analyze the theoretical grounds for using an interest rate rule in conducting monetary policy. *Second*: part four; emphasize how the Taylor rule can be empirically estimated and evaluated. Consistently; this exercised while estimating and evaluating both simple backward and forward-looking Taylor rule for Egypt, guided by lessons from selected countries` experiences in estimating Taylor rule like U.S.A., U.K and Chile.

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I. Introduction

> "The predominant weight of the existing evidence suggests that the effects of monetary policy on real economic activity are systematic, significant, and sizeable. Yet questions remain, both about individual empirical results and, more broadly, about the different methodological approaches that researchers have used to investigate these effects" Friedman (1995).

The quantity theory of money has overwhelmed the theory and practice of monetary policy for long, implying a long existing perception of monetary policy as a passive instrument in real economic activity, and central banks as merely institutional means of stabilizing monetary targets, denying the potential influence of central banks on real economic growth.

However, the increasing dominance of New Keynesian literature in recent decades subverts the orthodox view of monetary policy by building down the "Fisherian" assumptions on price and wage flexibility. The New Keynesian framework with prices or/ and wages rigidity, known as Dynamic Stochastic General Equilibrium (DSGE) Models, creates a channel for monetary policy to affect real macroeconomic variables through systematic policy actions using a monetary policy rule.

Although the significance of setting transparent policy rules through which central banks can manage market expectations was highlighted by Lucas and Sargent (1981). Nevertheless, the revival of academic and policy interest in "policy rules" was brought about with the introduction of John Taylor's monetary policy reaction function known as "Taylor rule" in his famous "Discretion versus policy rules in practice" (1993), following closely the observed path of the U.S. short-term interest (Fed Fund rate) rate in the late 1980s through early 1990s. Taylor demonstrated that a simple reaction function (Taylor Rule) can respond to movements in fundamental variables (inflation and output gap) using a simple policy instrument (a short-term interest rate). Latterly, numerous modifications have been introduced to "Taylor's Rule" (Clarida, Gali and Gertler, 2000; et al), with specific applications to the US economy and other countries.

Nevertheless, a particular gap in existent economic literature lies in disregarding the importance of studying the scope of applying monetary policy rules to various country groups; whether policy rules are fit for application in all countries or whether they are case-specific to certain economies, and if found adequately general for application in all central banks, what are the specified measures to adapting such rules to specific country cases.

In case of Egypt, economic literature is devoid of any explicit detailed attempt to construct a simple monetary policy rule for the Central Bank of Egypt (CBE). Adopting an interest rate rule was merely addressed in an implicit fashion, without explicit emphasis on both the theoretical rationale for using Taylor rule for monetary policy conduct, and how this rule can be empirically evaluated (Moursi, El Mossallamy and Zakareya, 2007). The thesis at hand is the first attempt to study these issues explicitly, whether theoretically or empirically. Hence, the purpose of this paper is to examine the validity of using an interest rate policy rule, specifically the Taylor rule, as a robust rule for conducting monetary policy in case of Egypt.

The time frame of the study at hand covers the period extending from January 1997 to December 2007 (on a monthly basis). This period experienced two key events for the central bank of Egypt; first*:* floatation of the Egyptian pound at the end of January 2003. The high inflation rates that came about in the aftermath of the floatation of the Egyptian pound seemingly encouraged the CBE to advocate price stability and low inflation rates (along with banking system soundness) as the main monetary objective[1]. *Second*: managing the short-term interest rate as an operational target for conducting the monetary policy in June 2005[2], instead of excess reserves. This action was taken as a prerequisite infrastructure for adapting an inflation-targeting regime, where the new system of policy management is based on conventional macroeconomic theorization, which predicts that it would be possible to stabilize output, prices and control inflationary pressures via monetary tightening. In practice, there are no assurances that the actual results obtained from a monetary contraction would match the theorized facts. In particular instances, an increase in interest rate could, in special circumstances, lead to a rise in the price and/or output levels[3].

Such mysteries are likely to expose the effectiveness of the CBE monetary policy and its capacity to check inflation and achieve the price stabilization objective. Consequently, an analytical need revealed for understanding the dynamic behavior of prices and output in response to different monetary policy shocks. Discerning the structure of those responses should also be useful to investigate the prospects of pursuing a monetary policymaking framework based on a formal inflation-targeting approach as proposed recently by the CBE (CBE 2004/2005).

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[1] The importance of realizing price stability as an intervening principal objective of monetary policy was further emphasized by the recent structural reforms, which encompassed the establishment of the Coordinating Council, under the leadership of the Prime Minister, in January 2005 and the Monetary Policy Committee affiliated to the CBE Board of Directors in mid-2005.

[2] To manage the interest rates (including the overnight interbank rate) and implement its monetary policy, the CBE established a new operational framework early in June 2005, known as the corridor system, with a ceiling and a floor for the overnight interest rates on lending from and deposits at the CBE, respectively.

[3] Only in case of inequality of income distribution, where liquidity is unfairly distributed among different sectors of the economy.

II. Types of Monetary Policy Implementation

Part two through three: the paper critically analyzes the theoretical ground for using and estimating an interest rate rule for conducting monetary policy. So, it begins with exploring the foundation of the interest rate rules and its monetary policy implementation alternatives. This is in addition to reviewing the advantages and disadvantages of each alternative.

The paper, then, highlights the role of the interest rate rules in satisfying the monetary policy goals. Finally, it discusses Taylor (2001) central bank reaction function in case of both closed and open economy, and the significance of the exchange rate in the open economy central bank reaction function.

A- Types of Monetary Policy Implementation: Rules versus Discretion

An extensive literature addresses the question of whether it is preferable to implement monetary policy by a rule or by discretion. This question has traditionally been referred to as **the issue of rules versus discretion** (Federal Reserve Board, 2002).

In a strict interpretation of a rules-based regime; policymakers commit to how they will adjust their policy instrument, in response to incoming data or to changes in the forecast. Once this rule is specified, their judgment no longer is relevant to the policy outcomes. On the other side, in a discretionary regime, policymakers do not commit in advance to a specific course of action, but instead they apply their judgment, deciding on each occasion what policy is appropriate.

A strict rules-based policy establishes an unequivocal commitment by policymakers to achieve their policy objectives, especially meeting their inflation objective. Such a commitment, in turn, increases the transparency and accountability of monetary policy and thereby helps to pin down inflation expectations. In principle, the resulting credibility about policymakers' commitment to price stability could reduce the cost of disinflation, if inflation were to rise above the objective, and could reduce the spillover of supply shocks-that is autonomous shocks to the price level-into broader price movements.

Even if we cannot imagine policymakers turning over the conduct of policy to a rule, research on rules might provide guidance to policymakers that could improve their judgmental adjustments to policy. In turn, good discretionary policy therefore should be, in some meaningful way, rule-like, though it might be impossible to write down in a simple or even complicated equation all the complex considerations that underpin the conduct of such a systematic monetary policy.

In this spirit, in 1993, John Taylor a systematic monetary policy informed by policy rules but flexible enough to adapt to structural changes and other real-world complexities. This was in many economists` view, the best direction for monetary policy. This regime based on complementarity between rules and discretion was encouraged by John Taylor was widely discussed. It provides the advantage of the both the rules based and discretionary monetary policy, where it shows that the usage of the rules should be as a good guidance to policymakers which could improve their judgmental adjustments to policy.

B- The role of monetary policy rules in satisfying the goals of monetary policy

The time inconsistency literature argues[4] that a purely discretionary policy setting leads to higher long-run inflation (Kydland and Prescott 1977, and Barro and Gordon 1983). In such circumstances, a credible commitment by the central bank to maintain price stability can reduce the inflation bias from monetary policy. In the past, such a commitment was often imposed externally by a fixed exchange rate, or internally by a monetary growth target. However, in the meantime, both approaches have lost their importance: the former has proved to be unsustainable in the face of growing capital flows and financial markets' imperfections, and the latter has failed because of large-scale shocks to money demand functions.

Against this backdrop, a recent and growing body of literature has argued that inflation targeting provides a convenient mechanism for central banks to combine rules and discretion in conducting monetary policy. For example, Svensson (1999) describes inflation targeting as "decision making under discretion" where central banks follow what he calls a "targeting rule" by which they set interest rates to reduce the deviation between the conditional inflation forecast (the "intermediate target" of policy) and the inflation target to zero over the target horizon[5]. In this setting, the central bank is not committed to any particular instrument arrangement and therefore gains considerable flexibility in setting its interest rate. The typical process involves the central bank revising its inflation and output forecast in each period (corresponding to the frequency of the monetary policy committee meetings) based on the information available to it at that time. If the conditional inflation forecast is higher than the target, the central bank will increase the interest rate to minimize such deviations by the end of the targeting horizon, and vice versa. The private sector then decides its consumption and investment plans based on the central bank's reaction. Blinder (1998) calls this "enlightened discretion" and argues that it is close to what many policymakers try to do in practice[6].

[4] As discussed in the above section.

[5] Similarly, Bernanke and Mishkin (1997) characterize inflation targeting as a framework under which policymakers exercise "constrained discretion". According to White (2002), an important practical benefit of rules in monetary policy is that they can constrain the behavior of central banks and promote transparency.

[6] This is also clear from Taylor (1993, 2002), who defines rules as the systematic response of the central bank to inflation and output deviations and not a fixed setting for monetary policy.

The need for greater monetary discipline in emerging market economies has been generally stressed against the backdrop of their relatively high inflation and low policy credibility. In a recent paper Calvo and Mishkin (2003) discuss why emerging market economies are vulnerable to “sudden stops” of capital inflows and repeated exchange rate collapses. Attributing financial crises in emerging market economies to their weak institutional credibility, they suggest that central banks in these economies should be subject to “constrained discretion” through inflation targeting, making it harder for them to follow an “overly expansionary monetary policy”. To the extent that this leads to a more transparent and accountable instrument setting behavior by the central bank, it can pin down investors’ confidence and reduce vulnerability to crisis.

Taylor (2002) provides another reason for adopting a rule-based monetary policy in emerging economies. He argues that anticipation effects of monetary policy are higher when the central bank follows a systematic approach in setting interest rates. Given their less developed financial markets, such effects are likely to be lower in emerging economies. Yet monetary policy could still have significant impacts through movements of wages and property prices. More predictable central bank behavior is therefore expected to improve the transmission and effectiveness of monetary policy. Indeed, over the last decade of the 20th. century, the conduct of monetary policy in emerging market economies has increasingly moved in this direction.

C- <u>The central banks` reaction function:</u>

Given the above discussion, there are reasons to believe that central banks’ reaction function-especially in emerging market economies-needs to consider their multiple objective setting.

The equations stated below summarize the standard aggregate model where the central bank sets the interest rate according to both the inflation and the output gap as follows (Taylor 1999):

1- <u>In case of closed economy:</u>

$$y_t = -\beta(i_t - \pi_t - r) + u_t \quad \ldots\ldots\ldots\ldots\ldots (1)$$

$$\pi_t = \pi_{t-1} + \alpha y_{t-1} + e_t \quad \ldots\ldots\ldots\ldots\ldots (2)$$

$$i_t = \delta_{\circ} + \delta_1 \pi_t + \delta_2 y_t \quad \ldots\ldots\ldots\ldots\ldots (3)$$

where: y, i, π and r are the output gap, the central bank policy rate, the inflation rate, and the long-run equilibrium real interest rate respectively. β, α are slope parameters and u & e are stochastic disturbance terms.

Equations (1) and (2) are the closed economy aggregate demand and supply equations (backward-looking Phillips curve).
Equation (3): defines the policy rule, whereby the central bank changes its policy rate according to the current period inflationary and output gap, given the policy parameters δ_0, δ_1, and δ_2.

A crucial condition for the stability of this model is that the reaction coefficient on inflation (δ_1) should be above unity[7]. The aggregate demand function is then negatively sloped with respect to the inflation rate. Faced with a price shock (e) the central bank increases its interest rate by more than the rise in inflation, which raises real interest rates until inflation returns to the target.

Given the underlying Phillips curve relationship in (2), the coefficient on the output gap (δ_2) in the reaction function depends on two factors: the slope of the aggregate supply curve and the weight given to the variability of output in the loss function. For instance, a flat supply curve implies that a policy shock to reduce inflation will significantly increase output variability, suggesting, ceteris paribus, a relatively small coefficient.

Moreover, a standard practice followed by many researchers is to include a lagged interest rate term in the reaction function (3), reflecting the desire of central banks to smooth interest rate changes. The economic rationale behind such smoothing has been well documented in the literature[8]. Moving the policy rate by small steps in the same direction increases its impact on the long-term interest rate because market participants expect the change to continue and hence price their expectations into forward rates. Acting gradually also reduces the risk of policy mistakes, when uncertainty about model parameters is high and policymakers have to act on partial information.

Another reason is that central banks may care about the implications of their actions for the financial system: if markets have limited capacity to hedge interest rate risk, a sudden and large change in the interest rate could expose market participants to capital losses and might raise systemic financial risks.

Other reasons could include avoiding reputation risks to central banks from sudden reversals of interest rate directions.

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[7] Substituting equation (3) into equation (1) gives the slope of the aggregate demand function as $-\beta(\delta_1 - 1)/(1+ \beta\, \delta_2)$. Hence the stability of the policy rule requires that $\delta_1 > 1$.

[8] For recent reviews see Lowe and Ellis (1997), and Sack and Wieland (1999).

2- In case of open economy: The monetary policy reaction to the exchange rate

The exchange rate is the key variable while speaking about the monetary policy reaction function in the context of open economies. Particularly, when the exchange rate pass-through into prices is very high, this key variable is likely to assume a special importance for the monetary policy.

Focusing upon an open economy interest rate reaction function, the central bank reacts to the actual inflation rate, output gap, and the changes in the exchange rate in the following way (Taylor (2001):

$$y_t = -\beta(i_t - \pi_t - r) + u_t \qquad \text{……………} (1)$$
$$\pi_t = \pi_{t-1} + \alpha y_{t-1} + e_t \qquad \text{…………....} (2)$$
$$i_t = \delta_\circ + \delta_1 \pi_t + \delta_2 y_t + \delta_3 \Delta xr_t + \delta_4 \Delta xr_{t-1} + \delta_5 i_{t-1} \qquad \text{……………} (4)$$

where: y, i, π, xr and r are the output gap, the central bank policy rate, the inflation rate, the log level of the real effective exchange rate, and the long-run equilibrium real interest rate respectively. β, α, δ are slope parameters and u & e are stochastic disturbance terms. Δ is the first difference operator.

Reasons behind adding the exchange rate to the interest rate reaction function in case of open economy:

A familiar argument, pioneered by Taylor (2001), is that if the exchange rate depreciates due to a temporary disturbance, the interest rate should remain unchanged (first row of Table A below). This is because such exchange rate movements do not have much effect on expectations of inflation, and a central bank that reacts to inflation will indirectly take into account the consequences of the exchange rate movement for its policy[9]. If the depreciation is due to a decline in the demand for exports, the central bank faces a positive price shock as well as a negative demand shock, making an interest rate increase less necessary.

Attempts to reduce exchange rate volatility might also increase output volatility; Ball (1999) shows that, in such circumstances, targeting a long-run inflation rate that excludes exchange rate effects is more helpful. This may increase the short-run inflation volatility, but will greatly reduce output variability.

[9] Mishkin and Savastano (2001) argue that reacting "too heavily and frequently" to exchange rate movements raises the risk that the exchange rate might become the de facto anchor for monetary policy.

Table 1
A Simple Matrix of Monetary Policy Reaction to the Exchange Rate

	Real Shock	**Financial Shock**
Temporary Shock	No reaction	No reaction
Permanent Shock	Fiscal policy	Monetary policy

Source: derived by the author.

Another case theoretically meriting no monetary response, is a depreciation caused by a permanent real shock; for instance, a secular decline in the terms-of-trade or a negative productivity shock. A first best policy may be to adjust other policies, in particular fiscal policy to align the aggregate absorption level in the economy (second row of Table A, left-hand column).

On the other hand, Ball (2002) points out that if the adverse exchange rate shock is from the financial side (for example, a sudden withdrawal of foreign investors from the country), an increase in the interest rate may be an appropriate response to stabilize both inflation and output (second row of Table A, right-hand column). While currency depreciation will increase external demand and prices, a higher interest rate will reduce domestic demand and stabilize inflation[10].

Nevertheless, in practice, many emerging market economies intervene to stabilize the exchange rate by changing interest rates, and the scale of such intervention also tends to be large. This raises the question of the factors that may account for this behavior. One reason, consistent with theory, is that major currency depreciations in emerging market economies have, in fact, been due to financial shocks, often resulting in high inflation. Second, exchange rate shocks tend to be large and persistent in emerging economies, which can create a dilemma for the central bank. If it chooses to absorb the exchange rate depreciation it might risk overshooting the inflation target and lose credibility. At the same time, defending the currency might require raising the interest rate to a very high level, which can cause large output losses.

[10] Ball (2002) argues that the most appropriate policy instrument in this case is a combination of the exchange rate and the interest rate (a monetary conditions index (MCI)) rather than the interest rate alone. Using the recent experience of Australia and New Zealand, he demonstrates that a response based on the MCI reduces output volatility compared to a response based on the interest rate when the source of the shock is a financial disturbance. Wollmershäuser (2003) reaches a similar conclusion by showing that central banks can reduce uncertainty about output and inflation by reacting to exchange rate shocks stemming from financial disturbances. A problem with this view, however, is that the MCI is not an instrument and that it is difficult to separate financial from real shocks.

In a recent study, Ho and McCauley (2003) show that emerging economies that miss their inflation targets are generally the ones experiencing sharp exchange rate volatility. This suggests that central banks may be ready to raise rates when faced with large currency depreciations. But they may, at the same time, prevent sharp contraction of the economy even at the cost of missing the inflation target.

Central banks in emerging market economies may also assign a relatively higher weight to the exchange rate for reasons other than price stability - most importantly, maintaining financial stability.

Calvo and Reinhart (2002) attribute such "fear of floating" behavior on the part of emerging economies to the high risk premium they have to pay because of their low institutional and policy credibility[11]. Such resistance to floating may be particularly high in countries with thin exchange markets, which are vulnerable to one-way expectations and herd behavior. A disorderly depreciation can encourage speculation through leads and lags in trade transactions and short-term capital flows, giving the exchange rate its own momentum.

Many recent experiences of exchange market intervention go to support this concern. Partly because its exchange market is thin, India has tried to avoid excessive exchange rate volatility through foreign-exchange and interest rate interventions. When the Philippine peso came under strong depreciation pressure in the middle of 2001 and again in early 2003, the central bank raised reserve requirements to limit currency speculation (Mohanty and Klau 2004).

In some cases, financial imperfections such as a large amount of external debt or debt indexed to the exchange rate may have made the case for monetary policy intervention even stronger. Eichengreen (2002) and Goldstein and Turner (2004) have recently highlighted the adverse consequences of exchange rate depreciations in countries with a high degree of dollarization. Sharp currency depreciations in such circumstances, it is argued, can cause widespread bankruptcies and even change the sign of the exchange rate in the aggregate demand function from positive to negative.

This rather unconventional contractionary impact of the exchange rate makes it necessary for the central bank to raise rates defensively against major exchange rate shocks[12].

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[11] In a recent paper, Alesina and Wagner (2003) argue that the "fear of floating" critically depends on the state of political institutions. Countries with poor political institutions end up with more volatile exchange rates than countries with sound political institutions.

[12] See also Kamin and Klau (1997) on the contractionary effects of the exchange rate on output.

III. The Taylor rule: A Literature Survey

After exploring the foundation of the interest rate rules and its monetary policy implementation alternatives in the previous section, the paper focuses on the initial interest rate rule "Taylor (1993)" and its modifications ending with showing the augmented Taylor rule which is tailored for each individual country case. The paper, then, highlights how the interest rate rules can be used or abused while implementing monetary policy, from both descriptive and perspective points of view. In addition; it discusses both foundations of the theoretical and empirical choice of a benchmark rule

Finally, after the previous theoretical base, the paper sheds light on how Taylor rule can be statically estimated and the best way to interpret and implement it.

<u>**A-** Taylor rule and its modifications</u>

Taylor Rule (1993) defined as; a simple rule works through an instrument[13], which responds only to both inflation and output gap.

Taylor (1993) suggested this rule as an explanation of the monetary policy setting for the early years of Alan Greenspan's chairmanship of the Board of Governors of the U.S. Federal Reserve System, thereafter "the Fed" (1987–92). This rule became very popular, since it described a complicated process in very simple terms and fitted the data very well.

Starting by a description for the original Taylor rule (1993) and present the modifications it has since undergone:

- The Taylor rule (1993):

$$i_t = r^* + \pi_t + C_\pi(\pi_t - \pi^*) + C_y y_t = C + (1 + C_\pi)\pi_t + C_y y_t \quad \text{..........} (5)$$

where: i_t is the short-term nominal interest rate in period t; r* is the real interest rate; π_t- π^* is the "inflation gap" which represents the difference between the actual inflation π_t and the inflation target π^*; $y_t = \log Y_t - \log Y^*_t$ is the output gap, where Y_t is the real GDP and Y^*_t is the potential output[14], and the coefficients C_π and C_y are positive.

In the original Taylor (1993) formulation, C_π and C_y were both 0.5, the inflation and real interest rate targets were 2 percent each, and hence the constant C was equal to 1.

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[13] The policy rate (the nominal short-term interest rate).

[14] Taylor (1993) identified potential output empirically with a linear trend, while other papers use quadratic, Hodrick-Prescott trends, or other more sophisticated techniques.

This original Taylor rule has undergone various modifications as researchers have tried to make it either more realistic or appropriate. This part will discuss those modifications suited for rules not based on asset prices[15], since these are the ones most commonly used.

• One modification to the original rule has been to incorporate forward-looking behavior in order to counteract the seeming shortsightedness of policymakers, making the short-term interest rate a function of central bank expectations of output gap and inflation rather than their contemporaneous values[16].

• An alternative modification has been to introduce lags of inflation and output gap. It has been pointed out in the literature that because it is not possible to know the actual output gap and inflation at the time of setting the interest rate, using lags would make the timing more realistic (McCallum, 1999a)[17].

• Interest rate-smoothing behavior (including a lagged short-term interest rate among the fundamentals) is the single most popular modification of the Taylor rule. Clarida, Gali, and Gertler (1999) note that, although the necessity of including an interest rate smoothing term has not yet been proven theoretically, but it seems rather intuitive for several reasons[18].

• As simple as it is, the Taylor rule cannot possibly take into account all the factors affecting the economy. Policymakers are known to react not only to movements in the output gap and inflation, but also to movements in the exchange rate, stock market, and political developments, etc. The way to capture this issue would be to introduce a new variable, a so called policy shock variable, reflecting the judgmental element of the policymaking process.

• Some authors suggest the use of unemployment gap as opposed to output gap, to improve the fit of the data, as suggested by Taylor (1999) and Orphanides and Williams (2003).

• This modification reflects Okun's law (1962), which links the output gap and the unemployment gap. This type of rule tends to perform quite well in terms of stabilizing

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[15] For estimations of monetary policy rules with asset prices and exchange rates in industrial countries, see Chadha, Sarno, and Valente (2004).
[16] The central bank expectations considered are either formed within a model, as in Clarida, Gali, and Gertler (2000), or actual estimates of the central bank in real time, as done by Orphanides (2001). Mehra (1999) has estimated short-term interest rate as a function of inflation expectations contained in bond rates.
[17] Lag-based rules are not necessarily backward-looking, since lags serve as indicators of future values (see Tchaidze, 2004).
[18] Reasons mentioned in the literature include model uncertainty, fear of disrupting capital markets, loss of credibility from a sudden large policy reversal, the need for consensus building for a policy change, and the exploitation by the central bank of the dependency of demand on expected future interest rates, signaling the central bank's intentions toward the general public.

economic fluctuations, at least when natural rates of interest and unemployment are accurately measured[19].

• Finally, it has been suggested to use rates of growth of unemployment, or of the output gap, to account for measurement errors in the real-time estimates of the natural rate of unemployment and/or output (McCallum, 1999a, and Orphanides and Williams, 2003).

So; many modifications have been made to the simple Taylor rule equation(5) (as Orphanides, 2001; etc.), to include more other variables as the exchange rate and the lagged nominal interest rate.

These modifications were made according to each individual country case, using the variables which could affect the country's monetary policy reaction function most as shown in the next equation:

$$i_t = r^* + \pi_t + \gamma_1(\pi_t - \pi^*) + \gamma_2(y_t - y_t^*) + \gamma_3 \Delta xr_t + \gamma_4 \Delta xr_{t-1} + \gamma_5 i_{t-1} + \varepsilon_t \quad \text{…….. (6)}$$

where: i_t is the short-term nominal interest rate in period t; r^* is the real interest rate; $\pi_t - \pi^*$ is the "inflation gap" which represents the difference between the actual inflation π_t and the inflation target π^*; y_t is the actual output and y^*_t is the potential output, xr is the log level of the real effective exchange rate, and Δ is the first difference operator. γ_1, γ_2, γ_3, γ_4, γ_5 are the policy parameters, and ε_t is the stochastic innovation.

Equation (6) usually referred to as the Augmented Taylor Rule; where it is tailored for each individual country case.

[19] The rules with the unemployment gap appear more attractive as the natural rate of unemployment seemed easier to measure. During the mid–1990s, it was a common belief that NAIRU was 6 percent flat. The productivity growth of the late 1990s and arrival of the so-called New Economy have begun, only with a substantial delay, to challenge this belief (see Ball and Tchaidze, 2002).

B- Uses and Abuses of the Taylor rule

Taylor rules have been widely used in theoretical and empirical papers, with the latter examining the rules both from descriptive and prescriptive points of view.

The focus of research in theoretical papers has been on: whether simple rules solve the time inconsistency bias (McCallum, 1999a); or they are optimal (McCallum, 1999a; Svensson, 2003; Woodford, 2001; etc.)[20]; and on how they perform in different macroeconomic models (Taylor, 1999; Isard, Laxton and Eliasson, 1999)[21].

As for the empirical papers, those with a *descriptive* point of view include analysis of various specifications and estimations of the Taylor rule (Clarida, Gali and Gertler, 1998; Kozicki, 1999; Judd and Rudebusch 1998; etc.). These studies examine particular historical episodes and address two questions: to what extent are simple instrument rules good empirical descriptions of central bank behavior; and what is the average response of the policy instrument to movements in various fundamentals?[22]

Empirical papers with a *prescriptive* point of view suggest what the interest rate should be (McCallum, 1999a and 1999b; Bryant, Hooper, and Mann, 1993; Taylor, 1999), or how it should be set. Commonly, these suggestions are based on rules that are either the outcome of theoretical papers or the result of estimating "good/successful" periods of monetary policy.

The potential abuses in *prescriptive* papers are mainly related to the choice of the benchmark rules, whether based on theory or empirical evidence. The following part provides a brief description of the problems that might arise when choosing such rules.

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20 One could derive versions of the Taylor rule as a solution to an optimization problem, where policymakers are minimizing a loss function expressed in terms of the weighted average of inflation and output gap variances (see for example, Woodford, 2001).

21 In terms of stabilizing inflation around an inflation target, without causing unnecessary output gap variability.

22 The two questions commonly get mixed, though they are somewhat independent from each other. Properly formulated, the second question would sound as follows: given the way the monetary authorities are operating, what is the consequential response of the interest rate to movements in inflation and the output gap?

Theoretical Choice of a Benchmark Rule Policy: advice based on rules from theoretical models comes from rules simulated or derived in a model or class of models considered representative of the economy. There are potential problems with this approach as documented in the literature and surveyed below:

• Svensson (2003) and Woodford (2001) warn that commitment to simple rules may not always be optimal, as a simple policy rule may be a solution too simple for a task as complex as that of a central bank[23].

• Simple policy rules may not be robust across different models. Due to uncertainty about the true model of the economy and/or potential output levels, the most recent theoretical efforts have concentrated on suggesting a set of robust simple rules that could be used as a basis for policy advice, as in Giannoni and Woodford (2003a and 2003b), Svensson and Woodford (2004), Walsh (2004), etc. Isard, Laxton and Eliasson (1999) show that several classes of Taylor type rules perform very poorly in moderately nonlinear models.

• Several recent papers show that, when the central bank follows Taylor type rules in sticky price models of the type that fit the U.S. data well, the price level may not be determined, and there could be several paths for the instrument and multiple equilibria, all coming from the same model with the same rule (Benhabib, Schmitt-Grohe, and Uribe, 2001; Carlstrom and Fuerst, 2001; etc.).

• How policymakers should respond to the presence of measurement errors is a question with no firm answer yet. While some researchers advocate a more cautious approach, with smaller response coefficients (Orphanides, 2001), others advocate a more aggressive approach (i.e., with larger coefficients) to policymaking (Onatski and Stock, 2002). Finally, some studies have argued in favor of "certainty equivalence," which implies no changes in policymakers' behavior and response coefficients (Swanson, 2004).

• Most theoretical papers talk about inflation in rather generic terms. Thus, when it comes to policy prescriptions, it is not clear what particular measure should be used − Consumer Price Index (CPI), core CPI, CPI less food and energy (most volatile items), GDP deflator, etc.

• Even after a particular index is chosen, there are more choices to make: annual or quarterly; if annual, is it the average of quarterly numbers or a growth rate over the four quarters? Is the growth in CPI calculated as a log difference or a ratio? Even though the

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[23] Svensson (2003, p. 429): "Monetary policy by the world's more advanced central banks these days is at least as optimizing and forward-looking as the behavior of the most rational private agents. I find it strange that a large part of the literature on monetary policy still prefers to represent central bank behavior with the help of mechanical instrument rules."

differences between these various calculations could be minimal in a case of low and stable inflation, one should be aware of these caveats. Similar issues arise when it comes to measuring the output gap.

• Any formula-based recommendation is bound to ignore the judgmental element, which reflects policymakers' account of other developments not reflected in the output gap or inflation behavior.

Empirical Choice of a Benchmark Rule: Policy advice based on rules from empirical papers comes, usually, from estimating a period that is considered "good" or "successful" in combating inflation, promoting output growth, or both. Like the theoretical approach this empirical approach brings with it several problems:

• Rogoff (2003) notes that, it is not clear how much credit policymakers deserve for the exceptionally good performance of many economies in the last 15 years or so. He notes that the achievement of price stability globally may be due not only to good policymaking but also to the favorable macroeconomic environment. The main cause that he identifies is globalization, which through increased competition, has put a downward pressure on prices.

• Stock and Watson (2003) also argue that improvements in the conduct of monetary policy after 1979 are only partially responsible for reducing the variance of output during business cycle fluctuations. This could have been caused by "improved ability of individuals and firms to smooth shocks because of innovation and deregulation in financial markets" (Stock and Watson, 2003, p. 46). They also note that during this period, macroeconomic shocks were "unusually quiescent".

• Even if one finds empirically a Taylor rule, it does not imply that it is the basis of the monetary policy decision making. The empirical relationship found may be a reflection of something else – a long-term relationship among the nominal interest rate, inflation, and the output gap[24], or a reflection of a completely different kind of monetary policy[25].

• Also as Svensson and Woodford (2004, p. 24) note, "Any policy rule implies a 'reaction function,' that specifies the central bank's instrument as a function of predetermined endogenous or exogenous variables observable to the central bank at the time that it sets

[24] As the definition of the rule (see equation (5)) shows, one may view the Taylor rule as a more sophisticated version of an equilibrium relationship among the three variables (also known as a Fisher equation, $i = r + \pi$).
[25] Minford, Perugini and Srinivasan (2002) and Auray and Feve (2003 and 2004) demonstrate that money supply rules may be observationally equivalent to Taylor rules.

the instrument." They warn that this "implied reaction function" should not, in general, be confused with the policy rule itself.

• When making policy prescriptions, can one really impose the implied response coefficients and targets of one economic or policy regime on another, without accounting for changes in the structure of the economy? Greenspan particularly has warned about this abuse on several occasions, including in January 2004 in his speech to the American Economic Association (AEA) meetings: "Such rules suffer from much of the same fixed-coefficient difficulties we have with our large-scale models."

• Even though there may be no changes in the economy, there may be changes in the attitude of policymakers. Such changes could be reflected in a shifting of targets for real interest rate or inflation (which, in terms of Taylor rules, translate into a different constant), or there may be changes in the weights that policymakers assign to inflation variance and output gap variance (which, in terms of Taylor rules, translates into different inflation and output gap response coefficients).

• Coefficients might not be estimated with a very high degree of precision, and standard errors could be quite large. Once the size of the confidence intervals is taken into account, the policy recommendations on how the instrument should be set could become blurred.

• While coefficients may be estimated for very particular measures of inflation and/or the output gap (for example, CPI less food and energy and Hodrick-Prescott (HP) detrended log output), it is the values only that get "remembered", when policy recommendations are made. These coefficients may be coupled with different measures (for example, GDP deflator and linearly detrended log output, which in general results in larger values for the output gap than the HP detrending), without taking into account that the coefficients would have been different, in the sense that, these alternative measures been used for the estimation.

• As mentioned above, any formula-based recommendation is bound to ignore the judgmental element, which is an important factor behind policy decisions. So; using Taylor rule as a mix of rule-based and discretionary monetary policy implementation regime represents the best choice in many economists` point of view (Feldstein 1999).

C- Estimating Taylor Rules

The rules are usually estimated using either ordinary least squares (OLS), if they are backward looking (see, for example, Orphanides, 2001), or instrumental variables and generalized method of moments (GMM) if they are forward looking (see, for example, Clarida, Gali, and Gertler, 2000), and it is not obvious that the following econometric problems are addressed properly, or always taken into consideration:

• The most obvious econometric question is how to deal with high serial correlation of the variables. The common recipe is to use Newey-West standard errors and serial correlation robust estimators in order to account for heteroschedasticity, and instrumental variables to account for the forward-looking rules. What is worth noting, however, is that while papers estimating Taylor rules commonly treat interest rates as stationary series, most term structure and money demand papers treat interest rates of various maturity as I(1) series[26], which would call for different econometric techniques.

• The estimates are not very robust to differences in assumptions or estimation techniques. Jondeau, Le Bihan, and Galles (2004) show that, over the baseline period 1979–2000, alternative estimates of the Fed's reaction function using several GMM estimators[27] and a maximum likelihood estimator yield substantially different parameter estimates. Estimation results may also not be robust with respect to sample periods, to different sets of instrumental variables, or to the order of lags (when lags of variables are used as instruments).

• In addition, estimation of the Taylor rules very often requires inputs from separate estimation exercises, such as an evaluation of the output gap. These procedures are subject to the same kinds of problems, and, hence, the level of uncertainty around coefficients doubles.

• As in other empirical papers, making policy recommendations based on rules estimated from a short sample is not advised. This caveat applies especially to countries that have short periods of stable data.

• The alternative use of long samples often ignores the possibility of changes in the parameters of the rule—response coefficients or real interest rate or inflation targets. For

[26] King and Kurmann (2002) analyze the term structure of the U.S. interest rates, and Baba, Hendry, and Starr (1992) analyze the U.S. money demand. Both papers find that U.S. interest rates are stationary in first differences, and therefore non-stationary in levels, I(1) series. However, Mehra (1993) finds in money demand studies that U.S. interest rates are stationary series, and Clarida, Gali, and Gertler (2000, p. 154) note that they treat interest rates as stationary series, "an assumption that we view as reasonable for the postwar U.S., even though the null of a unit root in either variables is often hard to reject."

[27] For example: two-step, iterative, and continuously updating.

example, one should make a distinction between the monetary regime of the Fed during Paul Volcker's chairmanship and that during Greenspan's chairmanship. While, in both periods, the Fed was committed to price stability, it is doubtful that inflation targets were the same[28]. A former Fed Governor, Janet Yellen (Federal Reserve Board, 1995, pp. 43–4), confirms this implicitly when she says that the Taylor rule seems to be a good description of the Fed's behavior since 1986, but not of its behavior from 1979 when Volcker was appointed chairman, to 1986[29].

• A rather important but still commonly overlooked caveat has been given by Orphanides (2001, p. 964). He finds that real-time policy recommendations differ considerably from those obtained with ex-post revised data, and that estimated policy reaction functions based on such data provide misleading descriptions of historical policy and obscure the behavior suggested by information available to the Fed in real time[30].

• The illusionary effects of a stronger or weaker response to movements in certain fundamentals that arise due to their horizon misspecification are documented by Orphanides (2001). It showed that the policy reaction function, which has forward-looking behavior but includes forecasts of less than four quarters ahead, has higher estimates for the lag of the federal funds rate and for the output gap, but lower estimate for inflation, compared with the specification with forecasts of four quarters ahead.

• Another illusionary effect, which is caused by monetary policy inertia, is documented by Rudebusch (2002). He argues that a policy rule with interest rate smoothing is difficult to distinguish from a rule with serially correlated policy shocks[31]. While in the former persistent deviations from the output gap and inflation response occur because policymakers are deliberately slow to react, in the latter these deviations reflect policymakers' response to other persistent influences. Rudebusch proposes to distinguish between the two by analyzing the interest rate term structure.

Finally; economists should carefully estimate Taylor rules in practice, taking into consideration the above issues, otherwise they will end up with misleading results.

[28] In fact, one may wonder whether the Fed had a constant inflation target during Volcker's chairmanship (see Tchaidze, 2004).

[29] "It seems to me that a reaction function in which the real funds rate changes by roughly equal amounts in response to deviations of inflation from a target of 2 percent and to deviations of actual from potential output describes tolerably well what this Committee has done since 1986."(Federal Reserve Board, 1995 p. 43–4).

[30] Orphanides (2003a) shows, contrary to other researchers who claim that U.S. monetary policy in the 1970s was "bad," leading to high inflation, that policy was "good" but based on "bad," misleading data.

[31] Such a phenomenon has been documented in the literature before. See Griliches (1967) and Blinder (1986).

IV. Taylor Rule Applications: The Case of Egypt

In this section; the entire theoretical basis previously discussed are considered while estimating the Taylor Rule in case of Egypt.

During the study period, Egypt switched between different regimes while implementing both monetary and the exchange rate policies, so the starting point will be reviewing Egypt's monetary policy historical background. This guides the paper through both building up and interpreting the model.

The paper, then, estimates both the central bank reaction function and the augmented Taylor rule models using the E-views econometric package, and interprets the output.

Thus, this section will be presented as follows:

A- Monetary policy in Egypt: An overview during 1990 to 2007

B- Constructing the model

- **1-** The data
- **2-** Methodology: the models
  - **i-** The first model: The central banks` reaction function
  - **ii-** The second model: The Augmented Taylor rule

<u>**A-** Monetary policy in Egypt: an overview during 1990 to 2007</u>

This section presents a brief historical review for the main components of the Central Bank of Egypt's monetary policy framework. The review considers the recent developments in the ultimate objective of the CBE monetary policy, the intermediate and operational targets that were selected to achieve that objective and the monetary instruments adopted to affect those targets. In addition, the paper reviews the exchange rate developments. In this context, we divide Egypt's` monetary policy framework into three components:

- <u>*First*</u>: <u>the ultimate (principle) target of the monetary policy</u>

During 1990 through 2003, with the exception of 1996/1997, the CBE has continually focused on achieving two main objectives, namely, price stability and exchange rate stability. The monetary policy, however, exhibited overt inconsistencies, particularly during 1992/1993-1996/1997. In 1992/1993, besides price and exchange rate stability, the CBE planned to achieve ostensibly conflicting objectives; while the CBE aimed at controlling the monetary expansion through implying a *contractionary policy*, it also called for a cut of the interest rate on the Egyptian pound to encourage investment and promote economic growth thereby implying an *expansionary stance* (CBE 1992/1993).

At the second stage of the economic reform program 1993/1994, the thrust of the monetary policy shifted to the promotion of growth in the productive sectors as a means of stimulating aggregate productivity (CBE 1993/1994). The CBE primary objective shifted back to the expansionary monetary control and output growth recipe during the 2-year period 1994/1995 to 1995/1996. In 1996/1997, the CBE reverted once more to the objective of economic growth via monetary stabilization.

In 2003 and going forward ,the CBE announced it ultimate target to be price stability, stated by the Law 88 for year 2003 regarding the central bank, the banking sector and foreign exchange.

- *Second:* CBE intermediate and operational targets

Alternatively, throughout the period 1990/1991 until 2004/2007, the different proximate targets of monetary policy seemed fairly consistent. The CBE intermediate target entailed the control of the annual growth rate of domestic liquidity measured in terms of the broad money supply, M2. Similarly, during the entire period under consideration, save 2004/2005, the two operational target components, management of nominal interest rates and the control of banks' excess reserves in domestic currency at the CBE, remained unchanged. Starting from June 2005; the overnight interest rate on interbank transactions was designated as the operational target.

- *Third:* CBE monetary policy instruments

To achieve its targets, the CBE depended mostly on a number of indirect, market-based instruments such as the required reserve ratio, reserve money and open market operations along with a host of interest rates including the discount rate, Treasury-bill rate, and loan and deposit interest rates. The choice of indirect instead of direct instruments was motivated by the initiation of the monetary policy reform act as part of the country's overall economic reform program signed with the IMF.

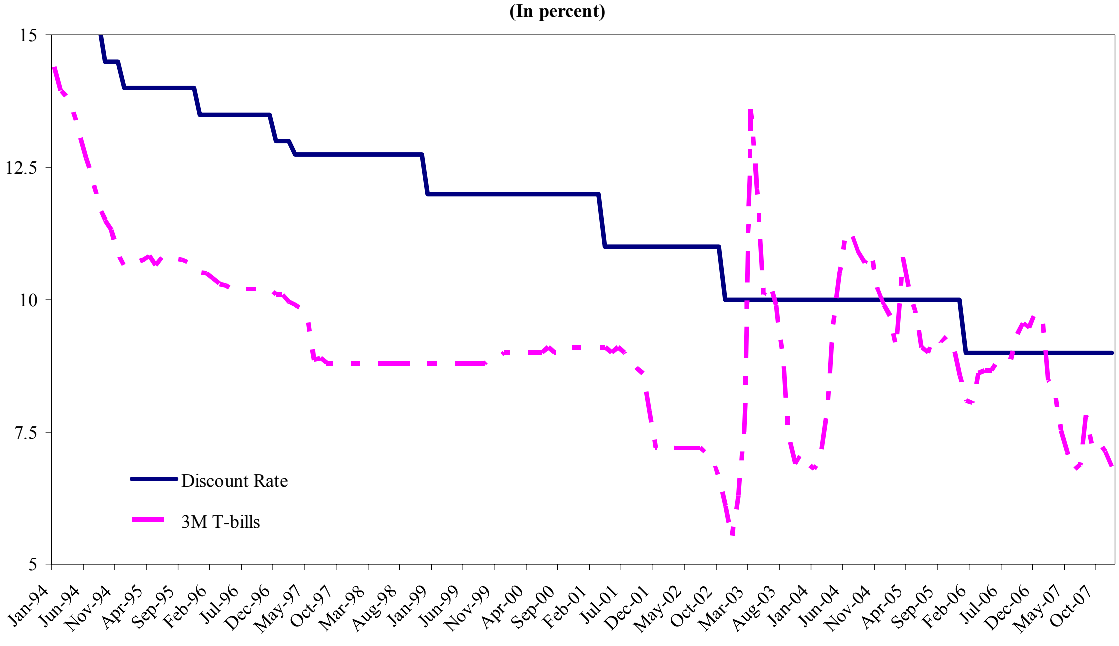
* Direct instruments: (e.g., quantitative and administrative determination of interest rates using credit and interest rate ceilings) were abolished for the private and the public sectors starting 1992 and 1993, respectively. Consequently, public enterprises were allowed to deal with all banks without prior permission from a lending public bank (Hussein and Noshy 2000).

* Indirect instruments (where the CBE started to exercise since 1991 with the advice of the IMF, under the structural reform program):

- The discount rate: the CBE use the discount rate as a monetary policy instrument during 1990 to 2007. During that period, the discount rate was lowered gradually from 19.8 percent in 1992 to approximately 9 percent by the beginning of 2006 and continue to hold tell the end of 2007, with the hope of promoting investment[32].

To reduce the rigidity in the discount rate, the CBE linked it to the interest rate on Treasury Bills. This resulted in a steady decline in the interest rate on Treasury Bills, which decreased starting 1992 through 1998 (See Figure 1). The interest rate on Treasury Bills began to recover once again in 2002 only to attain a maximum in the following year.

Figure 1: Discount Rate And 3-M T-bills Rate
(In percent)



Source: CBE data.

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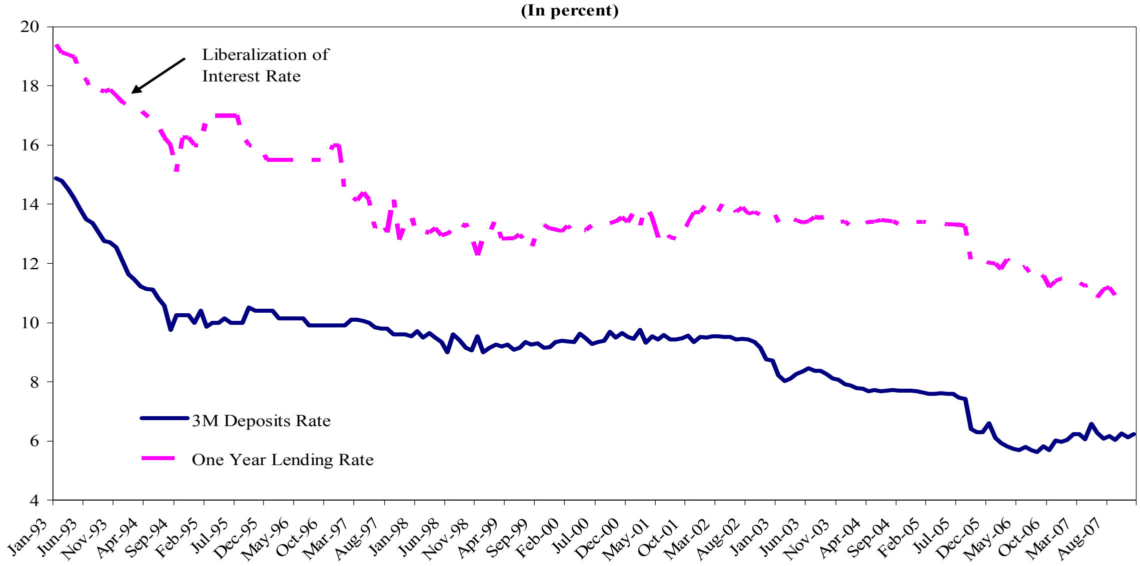
[32] The discount rate is typically considered a poor operational monetary policy instrument because it is usually subjected to strong administrative control. Thus, shocks in the discount rate do not always account for variation in the monetary stance (Bernanke and Mihov 1998). In Egypt; the discount rate characterized with rigidity, where it used to held unchanged for long periods. Rageh (2005)

- <u>The interest rates on loans and on deposits</u>: by January 1991; the CBE had liberalized the interest rates on loans and on deposits. Banks were given the freedom to set their loan and deposit interest rates subject to the restriction that the 3-month interest rate on deposits should not fall below 12 percent per annum. This restriction was cancelled thereafter in 1993/1994 (See figure 2).

Figure 2: Domestic Interest Rates
(In percent)

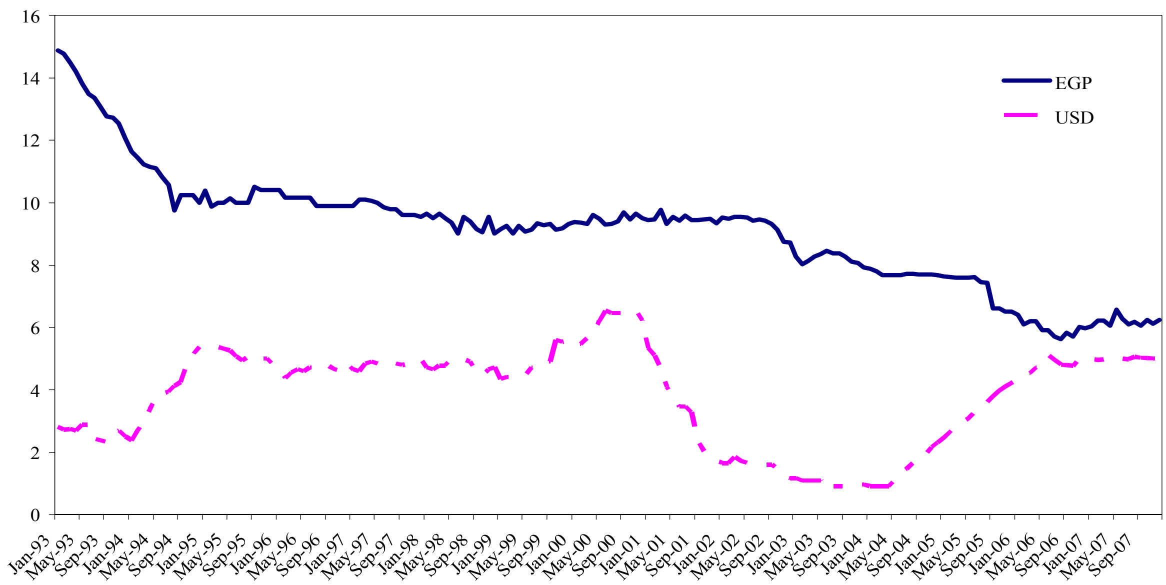


Source: CBE data.

- Due to the continuous decrease in the discount rate, interest rates on loans (one year or less) also fell during the period 1995-1999 before they started to rise slightly again in 2000. The decline in the interest rate on loans led to a reduction in the returns on deposits held in domestic currency. The domestic currency deposits, however, were not significantly affected by the fall in the interest rate since the interest rate on the Egyptian pound deposits remained relatively higher than the equivalent rates paid on foreign currencies[33] (See figure 3) (El-Asrag 2003).

[33] Showing a 5 percent average spread on the 3-month EGP-USD deposit rates during the period 1995-99, derived from CBE data.

Figure 3: 3M Deposits Rate
(In percent)



Source: CBE data.

- <u>Open market operations</u> are the most important instrument that affects the short run nominal interest rate through their capacity to absorb and manage excess liquidity in the economy and to sterilize the effect of increases in international reserves. Open market operations in Egypt are working through a number of tools including REPOs, reverse REPOs, and final purchase of Treasury Bills and government bonds, foreign exchange swaps and debt certificates (Abu El Eyoun 2003).

In 1997/1998, the CBE increased its dependence on an alternative instrument, the repurchasing operations of Treasury Bills (repos), to provide liquidity and to stimulate economic growth. The volume of these operations increased, reaching LE 209 billion in 1999/2000. The reliance on repos, however, started to decrease in 2000/2001 reaching a minimum in 2002/2003.

In 2003/2004, the CBE introduced the reverse repos of Treasury Bills and permitted outright sales of Treasury Bills between the CBE and banks through the market mechanism. In August 2005, the CBE notes were introduced instead of the Treasury Bills reverse repos as an instrument for the management of the monetary policy.

The use of open market operations became consistent with the liberalization of the interest rates once the CBE resorted to the market as a means of financing government debt. The primary dealers system, which became effective in July 2004, increased the importance of the open market operations as an instrument of monetary policy.

- The domestic and foreign currency required reserve ratios represented another key instrument of monetary policy. During the period 1990-2007, the domestic and foreign required reserve ratios ranged between approximately 14-15 percent and 10-15 percent, respectively (CBE data). The domestic required reserve ratio alone has not been significant instrument, as the Egyptian economy usually showed an excess liquidity climate.

- Exchange rate developments

Apart from the modifications in the structure of the indirect monetary policy instruments, the CBE undertook a number of notable reforms in the exchange rate system. At the beginning of the 1990s, Egypt officially implemented a managed float regime, with the exchange rate acting as a nominal anchor for monetary policy. Yet, in reality, the country had adopted a fixed exchange rate regime with the authorities setting the official exchange rate without regard for market forces. This resulted in a highly stable exchange rate for the Egyptian pound against the US dollar and a black market for foreign exchange (El-Asrag 2003). In February 1991, a dual exchange rate regime, which included a primary restricted market and a secondary free market, was introduced to raise foreign competitiveness and to simplify the exchange rate system. The two markets were unified in October 1991. From then and up until 1998, the Egyptian pound was freely traded in a single exchange market with limited intervention by the authorities to keep the exchange rate against the US dollar within the boundaries of an implicit band (ERF and IM 2004).

The appreciation of the real exchange rate during the 1990s was probably the key factor behind the liquidity shortage. Following the liberalization and unification of the foreign exchange rate in 1991, the nominal exchange rate remained within excessively tight bounds (between LE 3.2-3.4 per dollar).

The second half of the 1990s was characterized by a tight monetary stance. El-Refaay (2000) detects that tightness based on the observed slowdown in the growth rate of M2 and of reserve money.

By 1997, the Egyptian economy had started to feel the crunch of a liquidity crisis owing to internal and external shocks that led to a shortage in both domestic and foreign (i.e. US dollar) currencies. The internal shocks were prompted by a large increase in bank lending, particularly to the private sector. A significant part of the bank credit extended to the private sector in the 1990s was directed to real estate investments. In the absence of matching demand, the relative increase in the supply of housing units made it difficult for the real estate investors to repay their bank loans. The supply-demand mismatch raised the rates of loan default and instigated a liquidity shortage in the banking system. The liquidity crisis was intensified by the large fiscal debt, which was sparked by the government's initiation of several huge projects at the same time including Toshka Project, Al-Salam

Canal, North West Gulf of Suez Development Project and East of Port Said Project (Hussein and Noshy 2000).

The financing of these projects greatly depended on bank deposits. The strain on bank deposits increased with the accumulation of a large government debt to public and private construction firms. Moreover, external shocks, including the fall in oil, tourism and Suez Canal revenues and the decrease of workers' remittances from abroad by the end of the 1990s exacerbated the liquidity problem.

The nominal exchange rate rigidity in conjunction with high real interest rates caused a real appreciation in the value of the Egyptian pound that not only depleted the economy's foreign competitiveness but also triggered significant market speculation. The foreign exchange market instability and the increase in the importation bill— financed through bank loans—created a shortage of US dollars in the economy (Hussein and Noshy 2000).

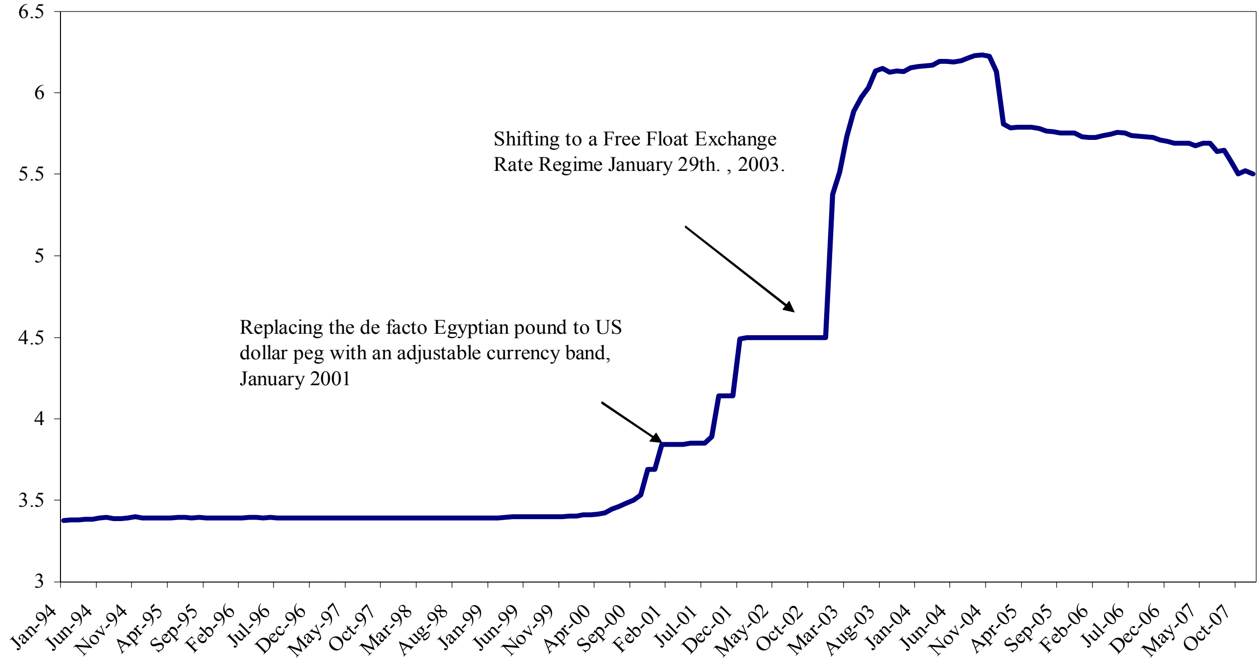
The move to an exchange rate peg during the 1990s was accompanied by accommodating changes in the monetary policy. However; it was impossible to pursue an active monetary policy with a fixed exchange rate regime.

In January 2001; Egypt replaced the de facto Egyptian pound to US dollar peg with an adjustable currency band, where the Egyptian pound gradually lost about 48 percent of its value against the US dollar over the period 2001-2003. (ERF and IM 2004)

On January 29, 2003, the adjustable peg was swapped with a floating exchange rate regime (See figure 4). Under the free float, banks were permitted to determine the buy and sell prices of exchange rates. The CBE was barred from intervention in setting the foreign exchange rate, except to correct for major imbalances and sharp swings (El-Asrag 2003).

The move from the managed float system to a flexible exchange rate regime denotes a transformation from an implicit policy rule to a non-committal absence of a monetary policy rule (Bartley 2001 and Mundell 2000). Accordingly, the liberalization of the pound marks the demise of an implicit dual-component monetary rule system with intricate price stability and exchange rate stability rules.

Figure 4: Nominal Exchange Rate
(EGP per USD)



Source: CBE data.

Despite the liberalization of the pound in 2003, the CBE has continued to maintain exchange rate stability as one of its key objectives during the following years, 2004 till 2007. Suspecting that further going; the CBE might still choose to keep a tight grip on the foreign exchange market.

In theory, efficient monetary policymaking, however, tolerates intervention in the foreign exchange market only by means of policy measures. So far, the CBE has a good record on that account. For instance, the fears of dollarization that followed the liberalization of the pound, prompted the CBE to tighten monetary policy through an increase in the rate of interest (CBE 2004/2005).

Starting from 2006 and going forward; the main objective of the CBE has been to keep inflation low and stable. That objective was cast within the context of a general program to move eventually toward anchoring monetary policy by inflation-targeting once the fundamental machinery needed for its implementation is installed (CBE 2005).

Meanwhile, in the transition period, the CBE intends to meet its inflation stabilization objective through the management of the short-term interest rates and the control of other factors that affect the inflation rate including shocks to credit and to money supply (CBE 2005).

In view of the recent changes in policymaking initiated by the CBE, we anticipate that the upcoming period shall witness important actions to conduct monetary policy on objective and methodical bases.

Believing that good measurement of monetary policy and of the stance within the last 15 years or so should provide a suitable inferential point of departure en route toward the support of those actions.

Précising; the above narrative establishes the importance of price stability as the principle objective of the CBE, showing that since the beginning of the 1990s till 2005; the reserves have played a key role as monetary instrument under the control of the CBE for achieving that objective. While, starting from 2005 and going forward (the launching of the corridor system); the short-run interest rates became the operational target of the CBE, consistently with the preparation for adapting the inflation targeting regime.

B- Constructing the model

1- The data

• The output gap: for the actual output; the industrial production (from the CAPMAS) is used (on a quarterly basis[34]) as a proxy for the actual GDP, as it represents the largest compound of the GDP (around 18 percent during 2007)[35]. For the potential output, we applied the HP filter technique to derive the potential output from the selected actual output series[36].

• The central bank policy rate (nominal interest rate): From the mid-1980s to 2007, the CBE used different rates of interest as policy instruments. For example; the discount rate, the 3-month deposit rate, the Treasury Bills rate and the interbank overnight rate. To maintain a sufficient number of degrees of freedom, it would not be practically feasible to take account of all these interest rates concurrently in a VAR model. We picked the 3-month deposit rate (from the Central Bank of Egypt) to represent the interest rate component of the CBE operating procedure[37].

• The inflation rate: we selected the year-on-year monthly inflation rate based on the Consumer Price Index (CPI) (from the CAPMAS), rather than any other inflation index as the Whole Price Index (WPI) for two reasons. First: most of the related studies use the CPI while estimating the interest rate rule. Second: the CAPMAS stopped the WPI series in November 2007; on the other hand, it started to issue a new series regarding the Producer Price Index (PPI) instead.

• The long-run equilibrium real interest rate: this constant value is calculated as follows: *first*: derived the long-run path of the 3-month domestic deposit rate using the HP filter technique, second: we calculated the simple average of the derived long-run path to get the natural rate of return.

• The exchange rate: for this variable, we followed the other related studies to use the real effective exchange rate (REER) of the Egyptian pound[38] (an increase means an appreciation), while estimating the interest rate rule in Egypt.

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[34] The quarterly series is converted to a monthly one using the E-views frequency conversion technique (Quadratic-match average).

[35] Source: Central Bank of Egypt web-site

[36] Although the limitation of the HP filter technique, regarding the constant parameter (λ) which controls the smoothness of the trend component (λ = 14400 for monthly data), but it gave better results than other techniques as Nadaraya-Watson detrending technique.

37 It represents the most consistent series, while the Treasury Bills and the interbank overnight rate policy instruments were introduced in different periods; the selected time horizon for analyzing the movement in those instruments differs accordingly.

[38] Source: A study preformed by the Monetary Policy Unit stuff under the supervision of Mr. Ahmed Noshy (Assistance Sub-governor of research and development section, Central Bank of Egypt).

Table 1 in appendix A, show the data spread sheet. Also, Figures 1 to 3 in the mean appendix, represent the movements in both CPI inflation rate and 3-month deposits rate, industrial production and its potential detrended series, and nominal exchange rate and REER, respectively.

Table 2: Data description

Variable	Description
I	3-month Deposit rate (%)
CPI	Consumer Price Index Inflation rate (y-on-y) (%)
IP	Industrial Production (in million EGP)
YPOTEN	Potential Industrial Production (Output) using hp-trending
LREER	Log Real Effective Exchange rate using CPI (%)
DV_REER	Dummy Variable (DV_REER= 1 starting from 2003:01, and zero otherwise)
YGAP	The output gap (IP – YPOTEN)

2- Methodology: the models

i- The first model: The central banks` reaction function

In this context, we estimated the central bank reaction function in the case of both closed and open economy, using the vector autoregression (VAR) technique to show the short-run relation between the variables. This relation can be shown by the impulse response function derived from the VAR, to exam the effect of the inflation, output gap and the exchange rate shocks on the interest rate. In addition, the variance decomposition is derived to show how much variation in the nominal interest rate as a monetary policy instrument is attributed to the different shocks.

Equations (1)-(4) illustrated in part three and the relevant parametric restrictions were employed to estimate the parameters of an un-structural VAR for each of both closed and open economy models described above in part three. The VAR estimates are obtained using monthly data for Egypt during the period 1997-2007.

The paper follows the academic literature that has tried to identify monetary policy shocks. Thus, in common with previous research, the paper use variables those are in levels.[39]

[39] For more details see Christiano *et al.* (1998), Favero (2001) and Leeper *et al.* (1996) for reviews of the literature.

The central banks` reaction functions in a closed economy

Table 2 in appendix C; reports the un-structural VAR parameter estimates and their standard errors obtained from the closed economy model. The un-structural VAR specification was fit with 8 lags in levels of the 3-month deposits rate, CPI and the output gap[40].

The closed economy VAR Model representation:

===

I = C(1,1)*I(-1) + C(1,2)*I(-2) + C(1,3)*I(-3) + C(1,4)*I(-4) + C(1,5)*I(-5) + C(1,6)*I(-6) + C(1,7)*I(-7) + C(1,8)*I(-8) + C(1,9)*CPI(-1) + C(1,10)*CPI(-2) + C(1,11)*CPI(-3) + C(1,12)*CPI(-4) + C(1,13)*CPI(-5) + C(1,14)*CPI(-6) + C(1,15)*CPI(-7) + C(1,16)*CPI(-8) + C(1,17)*YGAP(-1) + C(1,18)*YGAP(-2) + C(1,19)*YGAP(-3) + C(1,20)*YGAP(-4) + C(1,21)*YGAP(-5) + C(1,22)*YGAP(-6) + C(1,23)*YGAP(-7) + C(1,24)*YGAP(-8) + C(1,25)

CPI = C(2,1)*I(-1) + C(2,2)*I(-2) + C(2,3)*I(-3) + C(2,4)*I(-4) + C(2,5)*I(-5) + C(2,6)*I(-6) + C(2,7)*I(-7) + C(2,8)*I(-8) + C(2,9)*CPI(-1) + C(2,10)*CPI(-2) + C(2,11)*CPI(-3) + C(2,12)*CPI(-4) + C(2,13)*CPI(-5) + C(2,14)*CPI(-6) + C(2,15)*CPI(-7) + C(2,16)*CPI(-8) + C(2,17)*YGAP(-1) + C(2,18)*YGAP(-2) + C(2,19)*YGAP(-3) + C(2,20)*YGAP(-4) + C(2,21)*YGAP(-5) + C(2,22)*YGAP(-6) + C(2,23)*YGAP(-7) + C(2,24)*YGAP(-8) + C(2,25)

YGAP = C(3,1)*I(-1) + C(3,2)*I(-2) + C(3,3)*I(-3) + C(3,4)*I(-4) + C(3,5)*I(-5) + C(3,6)*I(-6) + C(3,7)*I(-7) + C(3,8)*I(-8) + C(3,9)*CPI(-1) + C(3,10)*CPI(-2) + C(3,11)*CPI(-3) + C(3,12)*CPI(-4) + C(3,13)*CPI(-5) + C(3,14)*CPI(-6) + C(3,15)*CPI(-7) + C(3,16)*CPI(-8) + C(3,17)*YGAP(-1) + C(3,18)*YGAP(-2) + C(3,19)*YGAP(-3) + C(3,20)*YGAP(-4) + C(3,21)*YGAP(-5) + C(3,22)*YGAP(-6) + C(3,23)*YGAP(-7) + C(3,24)*YGAP(-8) + C(3,25)

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[40] The Hannan-Quinn (HQ) information criterion was used to choose the VAR lag length for both the closed and open economy models.

Figure 5: Impulse response functions

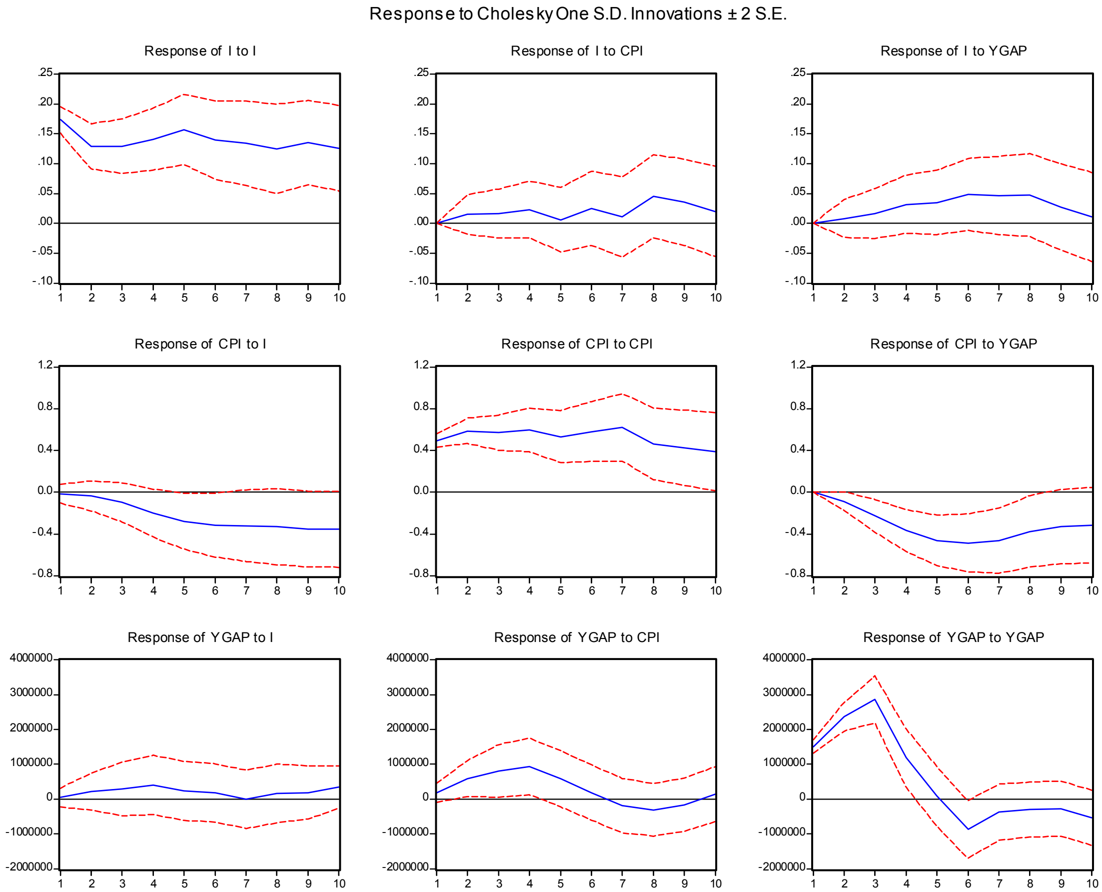


Figure 5 above, shows the impulse response functions of the 3-month deposits rate, CPI inflation rate, and output gap. Compromises two important findings:

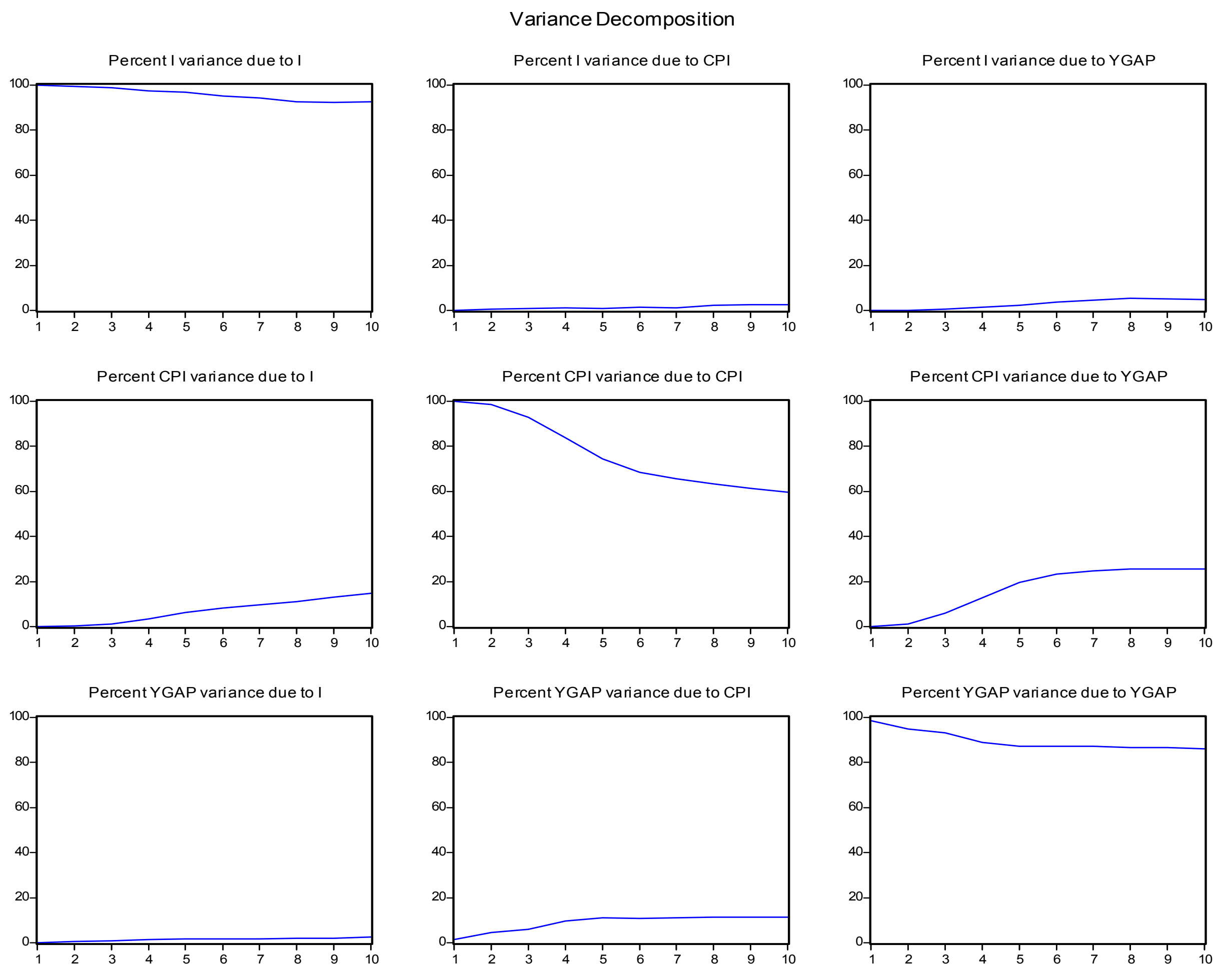
1- The response of CPI to both the interest rate and output gap shocks will have a continuous negative impact. Alternatively, a weak[41] positive continuous impact of interest rate to a CPI shock is determined.

2- No long-run impact of interest rate on the output gap, as the model implies very weak effects for the interest rate shock on output gap during the sample period, which will die after six months.

On the other hand, the model shows a significant response of the output-gap to a price shock, which will also; vanish after six periods (no long-run impact).

[41] Doesn't exceed 5 percent.

Figure 6: Variance decomposition



In addition, figure 6; regarding the variance decomposition shows that: about 15, 30 percent of the variation in CPI is attributed to the nominal interest rate and output gap respectively. On the other hand; only 10 percent of the variation in the output gap is due to CPI, and otherwise is negligible variation.

So; the derived closed economy un-structured VAR model, is not capable of emulating the anticipated theoretical responses of other significant variables, particularly output gap, to policy innovations. We found that the impact of monetary policy shocks on the size and on the direction of change in output gap and in prices was either negligible or insignificant. This may be attributed to neglecting other significant variables as the exchange rate effect, as Egypt represents an open economy.

The central banks` reaction functions in an open economy

Table 4 in appendix A; reports the un-structural VAR parameter estimates and their standard errors obtained from the open economy model. The un-structural VAR specification was fit with 2 lags in levels of the 3-month deposits rate, CPI, the output gap, and log level of the real effective exchange rate (REER). We introduced a dummy variable[42] as an exogenous variable to offset the impact of the structural change which took place in January 2003 in the Egyptian exchange rate policy[43].

The open economy VAR Model representation:
===

I = C(1,1)*I(-1) + C(1,2)*I(-2) + C(1,3)*CPI(-1) + C(1,4)*CPI(-2) + C(1,5)*YGAP(-1) + C(1,6)*YGAP(-2) + C(1,7)*LREER(-1) + C(1,8)*LREER(-2) + C(1,9) + C(1,10)*DV_REER

CPI = C(2,1)*I(-1) + C(2,2)*I(-2) + C(2,3)*CPI(-1) + C(2,4)*CPI(-2) + C(2,5)*YGAP(-1) + C(2,6)*YGAP(-2) + C(2,7)*LREER(-1) + C(2,8)*LREER(-2) + C(2,9) + C(2,10)*DV_REER

YGAP = C(3,1)*I(-1) + C(3,2)*I(-2) + C(3,3)*CPI(-1) + C(3,4)*CPI(-2) + C(3,5)*YGAP(-1) + C(3,6)*YGAP(-2) + C(3,7)*LREER(-1) + C(3,8)*LREER(-2) + C(3,9) + C(3,10)*DV_REER

LREER = C(4,1)*I(-1) + C(4,2)*I(-2) + C(4,3)*CPI(-1) + C(4,4)*CPI(-2) + C(4,5)*YGAP(-1) + C(4,6)*YGAP(-2) + C(4,7)*LREER(-1) + C(4,8)*LREER(-2) + C(4,9) + C(4,10)*DV_REER

[42] It takes a value of one starting from January 2003 till the end of the sample period, and zero otherwise.

[43] In January 2003, the government announced a shift in the exchange rate regime from managed float to a free float exchange rate moving according to the market forces.

Figure 7: Impulse response functions

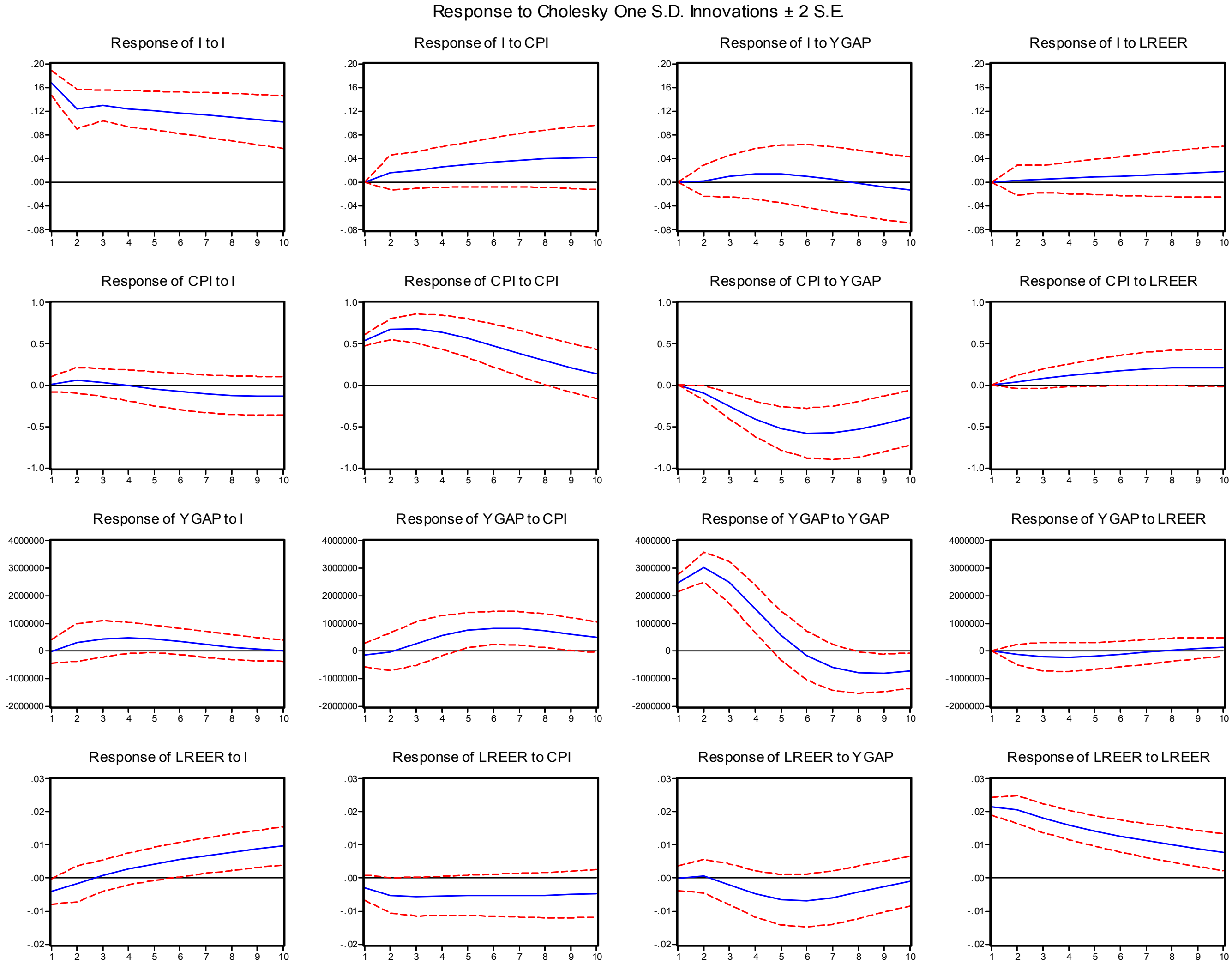


Figure 7 shows the impulse response functions of the 3-month deposits rate, CPI inflation rate, output gap, and REER. The output findings are reflected in the following table:

Table 3: The Interpretation of the Impulse Response Functions of the Open Economy VAR Model

		Variables Reaction			
		Interest rate	**CPI**	**Output gap**	**REER**
Shocks	**Interest rate**	-	(-ve) endless reaction	Small (+ve) reaction dies after 9 periods	Small endless (+ve) reaction after 3 periods
	CPI	Small endless (+ve) reaction	-	(+ve) reaction after 2 periods	(-ve) endless reaction
	Output gap	Small (+ve) reaction dies after 7 periods	(-ve) endless reaction	-	Small (-ve) reaction dies after 10 periods
	REER	Small endless (+ve) reaction	Small endless (+ve) reaction	Negligible reaction	-

Source: derived by the author.

Similarly; the derived open economy un-structured VAR model is not capable to emulate the anticipated theoretical responses of important variables, particularly output gap, to interest rate shocks. Where we found that the impact of monetary policy shocks on the size and on the direction of change in output gap and in prices is either negligible or ambiguous

Figure 8: Variance decomposition

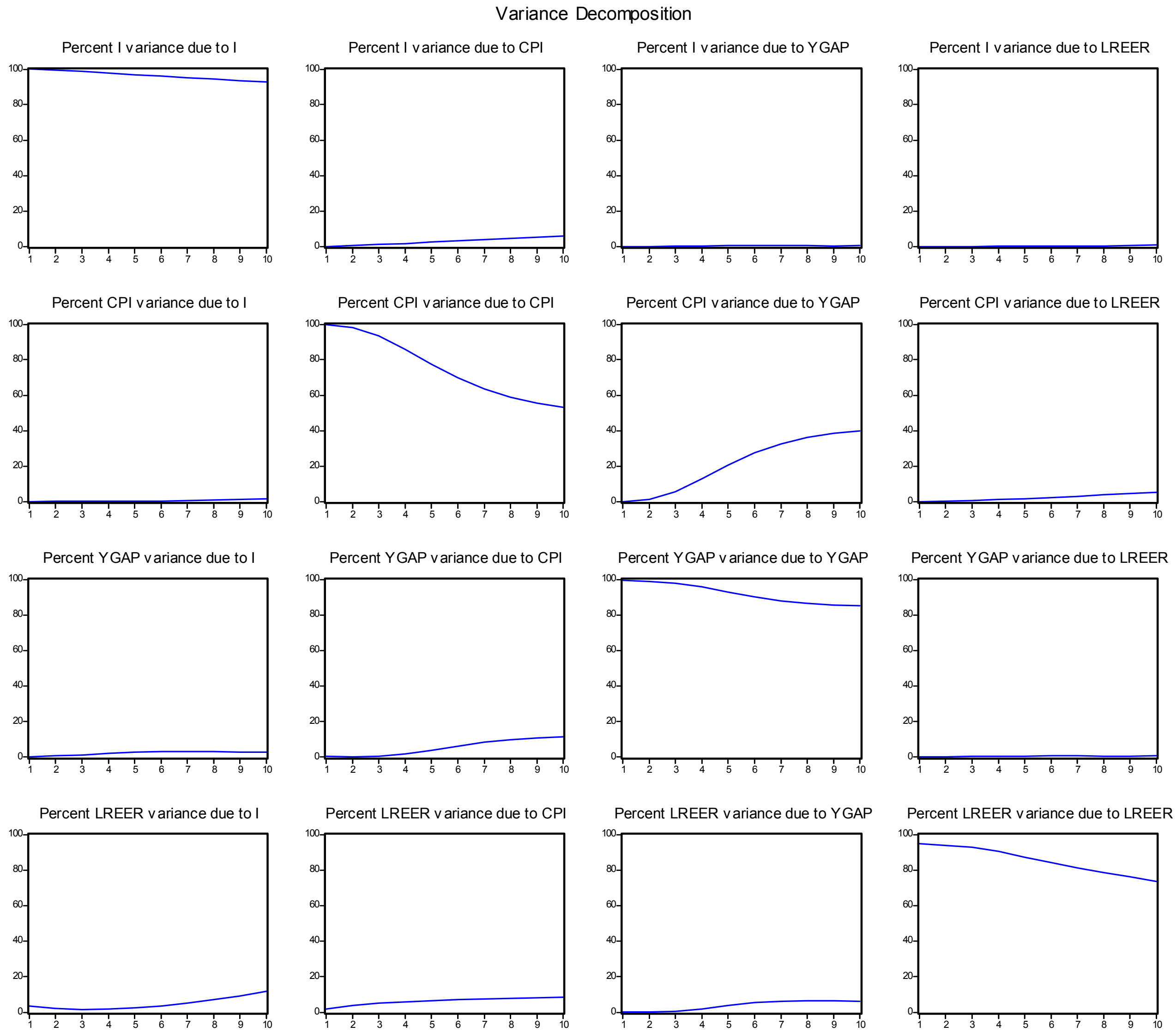


Figure 8; for the variance decomposition reflects tiny variation in the included variables due to each other, except for the output gap which resulted in around 40 percent variation in CPI.

Similarly, the open economy model decisively shows that monetary policy shocks in Egypt virtually have no real effect. Also; the monetary policy shocks would only have a relatively small effect on the rate of inflation and the REER. This might be attributed to the poor quality of Egypt database.

ii- The second model: The Augmented Taylor rule

The Augmented Taylor rule equation discussed in part three is evaluated whether it can to be used as a robust rule for conducting monetary policy in case of Egypt or not, using two approaches:

$$i_t = r^* + \pi_t + \gamma_1(\pi_t - \pi^*) + \gamma_2(y_t - y_t^*) + \gamma_3 \Delta xr_t + \gamma_4 \Delta xr_{t-1} + \gamma_5 i_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots(6)$$

- The backward-looking Taylor rule: where the above Augmented Taylor rule equation (6) is estimated using a simple GMM regression technique in order to derive the policy parameters, to see whether the existing discretionary framework can be resulted in a rule-based policy or not?

Table 4: Augmented Taylor Rule estimation output using GMM

Dependent Variable: D_I
Method: Generalized Method of Moments
Date: 03/15/09 Time: 21:08
Sample(adjusted): 1997M10 2007M12
Included observations: 123 after adjusting endpoints
Kernel: Bartlett, Bandwidth: Fixed (4), Prewhitening
Simultaneous weighting matrix & coefficient iteration
Convergence achieved after: 99 weight matrices, 100 total coef iterations
Instrument list: D_I(-2 TO -8) YGAP(-1 TO -8) D_LREER(-1 TO -8) CPI(-1 TO -8)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI	0.012626	0.003522	3.584886	0.0005
YGAP	4.16E-09	1.93E-09	2.151940	0.0335
D_LREER	-1.716109	0.680082	-2.523385	0.0130
DV_REER	-0.110847	0.023609	-4.695094	0.0000
D_I(-1)	-0.295654	0.099111	-2.983062	0.0035
C	-0.040031	0.015953	-2.509311	0.0135
R-squared	0.125728	Mean dependent var		-0.029878
Adjusted R-squared	0.088366	S.D. dependent var		0.176162
S.E. of regression	0.168198	Sum squared resid		3.310016
Durbin-Watson stat	1.924052	J-statistic		0.119035

Table 5 belwo; shows the detailed estimation output of equation (6) using GMM estimation technique.

Table 5: The illustrated GMM output of the Augmented Taylor Rule

Variable		Coefficient	t-statistics	Std. error	Prob.
Natural rate of return	**r***	8.36	Predetermined constant described above		
Inflation Rate	π_t	0.0126	3.584886	0.003522	0.0005
Inflation gap	$(\pi_t-\pi^*)$	-0.9874	The coefficient has been derived from the π_t coef.[44]		
Output gap	$(y_t - y_t^*)$	4.16E-09	2.151940	1.93E-09	0.0335
LREER	Δx_t	-1.716	-2.523385	0.680082	0.0130
Lagged LRRER	Δx_{t-1}	The study ignore it as it is totally insignificant			
Lagged nominal interest rate	i_{t-1}	-0.2957	-2.983062	0.099111	0.0035
Dummy variable	**DV**	-0.1108	-4.695094	0.023609	0.0000
Constant	**C**	-0.040031	-2.509311	0.015953	0.0135
	R^2	0.125728			
	DW	1.924052			
	J-statistics	0.119035			

Source: derived by the author.

From the above results; although the model gave significant variables with the same predetermined theoretical signs (Mohanty and Klau 2004), but it's obvious from the R^2 that the model explains only about 12 percent from the total change in the nominal interest rate. In addition; some of the coefficients values are relatively low, especially the output gap coefficient which is approximately equal to zero. This implies that output gap has negligible effect on the nominal interest rate[45].

Note that; E-views produces the J-statistic[46] which allow to determine whether the model has instruments that are orthogonal to the regressors (it does not, however, state whether we have weak instruments which is also potentially important). The correct J-test is given by multiplying the J-statistic reported in E-views estimation output times the number of observations, 123*0.119035= 14.641305. This test is distributed as a Chi-square with (n-s) degrees of freedom where n is the number of instruments and s is the number of coefficients to estimate. In this case, n=31 and s=6, so our test is χ^2 (25) which has a critical value at the 10% level of 16.473. Thus these instruments are good to be used at 90 percent confidence.

Consequently, this model implies that; during the sample period (1997:01 till 2007:12), the data can't infer a rule-based regime in case of Egypt. So, only a discretionary regime can be figured out in case of Egypt during this period. This may be attributed to different reasons. One important reason is the poor quality of Egypt data. Also, the central bank of Egypt

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44 In equation (6); $\pi_t + \gamma_1(\pi_t - \pi^*) = \pi_t + \gamma_1\pi_t - \gamma_1\pi^* = (1+\gamma_1)\pi_t - \gamma_1\pi^*$, assume $(1+\gamma_1) = \theta$, then $\gamma_1 = \theta - 1$.

45 As interpreted from the previous impulse response functions.

46 The J-statistic can be used to carry out hypothesis tests from GMM estimation; see E-views help topics. A simple application of the J-statistic is to test the validity of over-identifying restrictions when you have more instruments than parameters to estimate. Under the null hypothesis that the over-identifying restrictions are satisfied, the J-statistic times the number of regression observations is asymptotically chi- square (X^2) distribution with degrees of freedom equal to the number of over-identifying restrictions.

during the study period engaged in achieving different contradicted targets (as stabilizing the exchange rate, inflation rate, and domestic output) at the same time.

In addition, during the period January 1997 to June 2005, there was no the so-called policy rate in Egypt. Only with the introduction of the corridor system[47] in June 2005 the overnight interbank rate[48] started to play a key role as a policy rate. As a result, if a study can use the overnight interbank rate since June 2005 forward, it might get better consistent results[49].

- <u>The forward-looking Taylor rule:</u> where the nominal interest rate is going to be calculated, using the estimated structural parameters derived from the above equation (6), under different scenarios regarding the target inflation (once at 4 percent and another at 7 percent[50]) to see whether the CBE can relay on Taylor rule as a guidance for policymakers discretionary decisions in the future or not. The paper picks up a random date to calculate the above scenarios (July 2007) by substituting the selected data in the estimated augmented Taylor rule equation above. Before proceeding, it should be noted that consequently to the low interpretation power of the above model (R^2 = 12 percent), the following scenarios might be ambiguous.

Table 6: the forward looking Taylor rule scenario

Actual Inflation rate in July 2007	Targeted Inflation rate in July 2007	Actual Nominal Interest rate in July 2007	Expected Nominal Interest rate in July 2007
7.62 percent	4 percent 7 percent	6.1 percent	2.24 percent 5.21 percent

Source: derived by the author.

The above results revels unrealistic output, since the used model is explaining only around 12 percent from the total change in the nominal interest rate.

Finally; the paper shows that during the sample period, it couldn't deduct a rule based regime in case of Egypt, which may be attributed to the poor quality of data. In addition, the absence of a true policy rate[51] to be used in the study, may have affected the model.

[47] It specifies both an overnight deposit and lending rates, in which the overnight interbank rate moves freely in between them according to market forces.
[48] Introduced in December 2001 (CBE data).
[49] The paper couldn't use the overnight interbank rate as a policy rate- instead of the 3-month deposits rate- while estimating the interest rate rule in case of Egypt; since the CBE started to use the overnight interbank rate as a policy rate only in June 2005 by announcing the application of the Corridor system. So the number of observations available will be 31 observations, which is too few to build up a comprehensive model. But; we performed this exercise with taking into consideration the short sample estimation restrictions. For the estimation output, check appendix B page 192.
[50] These rates are arbitrarily selected.
[51] Reacting to market forces, as the overnight interbank rate starting from June 2005.

V. Conclusion and Policy Implications

> "Having looked at monetary policy from both sides now, I can testify that central banking in practice is as much art as science. Nonetheless, while practicing this dark art, I have always found the science quite useful."[52] Alan S. Blinder

During the thesis work, the main intend was examining the validity of using Taylor rule as a robust rule for conducting monetary policy in case of Egypt (during the period 1997 – 2007), through testing the trueness of two main hypotheses:
First, is the presence of a real significant effect of the monetary policy (expressed by the policy rate) on the real economy (represented by output and inflation).
Second, we could deduct an interest rate rule during the period of the study in case of Egypt.

In this contest, the study passed several stages before concluding the results of the in hand exercise. *First*, the paper highlighted both the foundation and theoretical background of the interest rate rules. In which, it tried to draw the road map for building up a country's own interest rate rule, through providing the perquisite theoretical infrastructure and enhanced it with the main quantitative issues to be regarded while applying the exercise practically. *Second*, the final step before the empirical exercise on Egypt was to highlight the historical background for conducting monetary policy in Egypt during the period of the study. Where, it provided the study with the necessary guidelines -regarding the characteristics of the Egyptian economy- while building up the model.

After building up the model for Egypt during 1997 to 2007; using the acquired perquisite knowledge; the study concluded the following:

- The study results reveal that; the impact of monetary policy shocks on real output was negligible and ambiguous, respectively. In addition, the study concludes that policy shocks have a slight impact only on both the inflation rate and exchange rate with almost no real effect. Naturally, this does not mean that the monetary policy is not important. What it means, however, is that the effect of monetary policy on the level of real output and on the rate of economic growth in the long run is limited by its capacity to achieve long-run price stability. This supports the Egyptian case; where during the period under consideration, the Central Bank of Egypt has targeted a mix of conflicting targets as stabilizing inflation, exchange rate and promoting output growth, which dispersed the Central Bank of Egypt from its real objective (price stability).
- We estimated the Augmented Taylor-type interest rate feedback rule à la Taylor (2001) as part of a system for output gap, inflation, exchange rate and nominal interest rate

[52] Blinder 1997, p. 17.

determination. The estimation model zoomed in on the period from 1997 to the end of 2007. The study findings disclose that the discretionary monetary regime in Egypt during the period of the study was inconsistent with rule-like policy outcomes. This might be attributed to a bundle of factors, mainly the absence of a true policy rate during the period of the study, may have affected the model output, in addition to the poor quality of data

Based on the previous conclusions, our recommendations are expressed in the following:

The paper sheds light on the prospects for monetary decision making by a policy rule as a substitute for the current discretionary decision making regime, since Egypt has a long history of monetary policy making by discretion rather than by rules.

The disadvantages of such a system are well known. Discretionary policy in Egypt usually has had limited success—at least since the 1990's—in achieving a mix of occasionally conflicting economic and monetary objectives including inflation and output stabilization, motivating real GDP growth, interest rate smoothing, and exchange rate stability. Counterfactual policy oriented scenarios suggest *that it might be possible to improve the capacity of the CBE in achieving a successful monetary policy, initially by focusing on a single main target (stabilizing inflation) at a time*, which was settled by the Law 88 for year 2003 regarding the CBE work. As well as, *following a constrained discretionary regime* through abiding by policy intervention measures that can appropriately influence the responses of the short-term nominal interest rate to deviations of inflation from its target value and of real output from its trend.

Despite; failing to show a significant rule based monetary regime during the sample period, but in line with the mainstream literature, *we support forward implementation of the constrained discretion framework by the CBE that finds a middle ground between the pure discretion and the strict rules approaches supported by Taylor 1993, using the Overnight Interbank Rate as a proxy of the policy rate*. It also permits the decision makers to remain committed to some target via a policy rule but at the same time allows sufficient flexibility to respond to unanticipated adverse shocks to the economy and to disturbances in the money markets.

The literature shows that constrained discretion is closely related to the inflation-targeting framework, which involves the idea of employing a policy rule. Similarly, since the Central Bank of Egypt is building up the perquisite infrastructure for adopting inflation targeting, the use of the constrained discretion regime would enhance both the credibility and transparency of the Central Bank of Egypt.

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Appendices

Appendix A: Statistical Appendix

Table 1: Data spread sheet

obs	I	CPI	IP	LREER	YPOTEN	DV_REER
1997M01	9.900000	5.682159	19679168	107.6100	21485013	0.000000
1997M02	10.10000	5.401670	20888811	90.78000	21629396	0.000000
1997M03	10.10000	5.546175	21862941	90.23000	21773654	0.000000
1997M04	10.05000	5.365045	22601558	88.85000	21917609	0.000000
1997M05	10.00000	4.874126	23104662	90.39000	22061091	0.000000
1997M06	9.850000	4.756596	23372253	90.18000	22203978	0.000000
1997M07	9.800000	3.614362	23098539	88.25000	22346218	0.000000
1997M08	9.800000	3.784377	23124448	88.56000	22487841	0.000000
1997M09	9.675000	3.683959	23144186	88.68000	22628931	0.000000
1997M10	9.600000	3.955979	23079148	89.60000	22769614	0.000000
1997M11	9.600000	3.929093	23145503	87.65000	22910054	0.000000
1997M12	9.550000	3.985773	23264644	86.54000	23050434	0.000000
1998M01	9.650000	3.755670	23515446	86.12000	23190954	0.000000
1998M02	9.500000	3.784732	23681003	86.25000	23331831	0.000000
1998M03	9.650000	3.392834	23840188	85.37000	23473302	0.000000
1998M04	9.500000	3.590081	24207470	85.60000	23615630	0.000000
1998M05	9.350000	3.866250	24193064	84.34000	23759101	0.000000
1998M06	9.000000	4.084345	24011438	83.64000	23904046	0.000000
1998M07	9.550000	4.268824	22998081	83.60000	24050822	0.000000
1998M08	9.400000	4.347874	22980397	83.77000	24199796	0.000000
1998M09	9.150000	4.693135	23293874	85.79000	24351262	0.000000
1998M10	9.050000	4.402520	24744069	88.46000	24505428	0.000000
1998M11	9.550000	3.763398	25115703	86.79000	24662429	0.000000
1998M12	9.000000	3.574549	25214331	88.24000	24822417	0.000000
1999M01	9.150000	3.835778	24458856	87.56000	24985575	0.000000
1999M02	9.250000	3.736612	24447297	85.90000	25152113	0.000000
1999M03	9.200000	3.818856	24598554	85.25000	25322206	0.000000
1999M04	9.250000	3.259852	25139646	85.21000	25495978	0.000000
1999M05	9.070000	2.797232	25446276	84.37000	25673504	0.000000
1999M06	9.140000	2.877062	25745460	83.59000	25854834	0.000000
1999M07	9.340000	2.874662	26145620	85.55000	26040001	0.000000
1999M08	9.270000	2.864574	26348596	85.59000	26229034	0.000000
1999M09	9.310000	2.413766	26462811	86.66000	26421964	0.000000
1999M10	9.100000	2.323486	25966756	86.34000	26618835	0.000000
1999M11	9.200000	3.022472	26294578	85.31000	26819691	0.000000
1999M12	9.330000	3.192456	26924769	85.34000	27024533	0.000000
2000M01	9.380000	2.921020	28587579	83.96000	27233323	0.000000
2000M02	9.400000	3.001734	29274821	83.27000	27446018	0.000000
2000M03	9.300000	2.994031	29716744	83.69000	27662668	0.000000
2000M04	9.600000	2.901081	29518248	82.16000	27883450	0.000000
2000M05	9.500000	2.806113	29765860	82.36000	28108685	0.000000
2000M06	9.300000	2.542375	30064481	84.14000	28338806	0.000000
2000M07	9.300000	2.793719	30688490	82.73000	28574362	0.000000

2000M08	9.400000	2.616509	30883339	82.28000	28816020	0.000000
2000M09	9.700000	2.525662	30923410	82.39000	29064597	0.000000
2000M10	9.500000	2.523029	30594001	81.69000	29321052	0.000000
2000M11	9.600000	2.346795	30485541	85.64000	29586471	0.000000
2000M12	9.500000	2.257233	30383328	87.52000	29862032	0.000000
2001M01	9.400000	2.588115	30048575	90.27000	30148973	0.000000
2001M02	9.500000	2.331869	30137948	90.28000	30448570	0.000000
2001M03	9.700000	2.159416	30412659	87.75000	30762089	0.000000
2001M04	9.300000	2.321497	31242641	88.13000	31090779	0.000000
2001M05	9.500000	2.150785	31610580	87.83000	31435859	0.000000
2001M06	9.400000	2.231617	31886408	87.02000	31798565	0.000000
2001M07	9.600000	2.224573	31913121	87.48000	32180139	0.000000
2001M08	9.400000	2.137199	32122481	90.68000	32581834	0.000000
2001M09	9.400000	2.134686	32357482	96.48000	33004881	0.000000
2001M10	9.500000	2.296943	32748335	95.28000	33450482	0.000000
2001M11	9.500000	2.211814	32936964	93.95000	33919791	0.000000
2001M12	9.300000	2.452894	33053577	100.2900	34413915	0.000000
2002M01	9.500000	2.440900	32399379	99.07000	34933893	0.000000
2002M02	9.500000	2.603561	32896060	99.03000	35480669	0.000000
2002M03	9.500000	2.763987	33844823	99.59000	36055011	0.000000
2002M04	9.600000	2.431026	36152036	101.9800	36657508	0.000000
2002M05	9.500000	2.752789	37325190	103.6500	37288594	0.000000
2002M06	9.400000	2.748340	38270653	106.8400	37948670	0.000000
2002M07	9.500000	2.578397	39499420	106.1800	38638137	0.000000
2002M08	9.400000	2.657302	39606251	106.6000	39357422	0.000000
2002M09	9.300000	2.973431	39102141	105.8500	40107008	0.000000
2002M10	9.300000	2.806953	35586031	105.6700	40887398	0.000000
2002M11	8.800000	3.125061	35660837	105.3900	41699023	0.000000
2002M12	8.700000	2.953064	36925497	108.0000	42541949	0.000000
2003M01	8.200000	2.938006	41881667	130.4600	43415818	1.000000
2003M02	8.000000	3.092843	43649797	133.4500	44319887	1.000000
2003M03	8.100000	3.559995	44731542	138.1800	45253303	1.000000
2003M04	8.300000	3.955869	43709962	142.6700	46215168	1.000000
2003M05	8.400000	3.940271	44481639	147.7200	47204547	1.000000
2003M06	8.500000	4.012240	45629634	147.0300	48220331	1.000000
2003M07	8.400000	4.399014	48399600	147.9100	49261224	1.000000
2003M08	8.400000	4.864397	49365991	146.3700	50325747	1.000000
2003M09	8.300000	5.089427	49774461	150.4800	51412363	1.000000
2003M10	8.100000	5.721468	49017821	150.3300	52519468	1.000000
2003M11	8.100000	6.023064	48765838	150.4800	53645343	1.000000
2003M12	7.900000	6.398865	48411325	153.8700	54788029	1.000000
2004M01	7.900000	7.938897	44887490	151.3700	55945224	1.000000
2004M02	7.800000	9.809130	46628008	148.7700	57114187	1.000000
2004M03	7.700000	10.89319	50566089	147.0600	58291407	1.000000
2004M04	7.700000	12.21451	63293833	143.1400	59472645	1.000000
2004M05	7.700000	11.87607	66682962	144.4800	60653126	1.000000
2004M06	7.700000	11.70988	67325577	145.0800	61828340	1.000000

2004M07	7.700000	11.98275	56542950	142.8700	62994195	1.000000
2004M08	7.700000	11.13971	58201584	144.2100	64146983	1.000000
2004M09	7.700000	11.91432	63622749	143.4000	65282545	1.000000
2004M10	7.700000	12.59543	81332209	144.7100	66396312	1.000000
2004M11	7.700000	11.67080	87884116	147.8500	67483598	1.000000
2004M12	7.700000	11.35190	91804233	146.7800	68540755	1.000000
2005M01	7.600000	9.501208	92977070	136.5900	69565551	1.000000
2005M02	7.600000	6.902727	91720223	137.2600	70557369	1.000000
2005M03	7.600000	5.683212	87918202	135.9200	71517220	1.000000
2005M04	7.600000	4.740345	74485553	135.7600	72447584	1.000000
2005M05	7.600000	5.047005	70907276	132.4400	73352077	1.000000
2005M06	7.600000	4.732136	70097918	130.9100	74234460	1.000000
2005M07	7.500000	4.311475	77530186	129.4600	75098323	1.000000
2005M08	7.400000	4.702966	78154133	130.4600	75946969	1.000000
2005M09	6.600000	3.726638	77442467	129.7100	76783870	1.000000
2005M10	6.600000	3.078059	71988438	128.0400	77612650	1.000000
2005M11	6.500000	3.383240	71160609	125.3800	78436979	1.000000
2005M12	6.500000	3.147965	71552229	125.4900	79260139	1.000000
2006M01	6.400000	3.439875	75361673	126.1600	80084904	1.000000
2006M02	6.100000	3.978373	76543412	125.6100	80913513	1.000000
2006M03	6.200000	3.659037	77295820	126.5100	81747878	1.000000
2006M04	6.200000	4.376750	75627212	127.9100	82589607	1.000000
2006M05	5.900000	5.394632	77014721	129.2900	83439999	1.000000
2006M06	5.900000	7.259240	79466663	126.1700	84299868	1.000000
2006M07	5.900000	8.413265	86306559	124.4300	85169586	1.000000
2006M08	5.900000	8.910243	88394725	123.9600	86049183	1.000000
2006M09	5.900000	9.530787	89054682	121.6100	86938775	1.000000
2006M10	5.900000	11.79900	85569418	118.0200	87838634	1.000000
2006M11	6.000000	12.14564	85410716	119.0200	88749185	1.000000
2006M12	5.900000	12.42737	85861566	118.7000	89670691	1.000000
2007M01	6.100000	12.29106	87624419	116.8000	90603186	1.000000
2007M02	6.200000	12.57798	88767530	117.9600	91546438	1.000000
2007M03	6.200000	12.78162	89993352	118.6000	92500008	1.000000
2007M04	6.200000	11.47932	91397959	119.3100	93463266	1.000000
2007M05	6.200000	9.885497	92717148	119.3800	94435404	1.000000
2007M06	6.100000	8.430162	94046993	119.2100	95415475	1.000000
2007M07	6.100000	7.619987	94532233	118.9800	96402410	1.000000
2007M08	6.100000	7.942455	96524833	118.4200	97395045	1.000000
2007M09	6.000000	9.145284	99169533	116.2400	98392088	1.000000
2007M10	6.000000	7.342648	1.02E+08	114.6900	99392185	1.000000
2007M11	6.000000	6.654368	1.06E+08	117.5300	1.00E+08	1.000000
2007M12	6.000000	6.711510	1.11E+08	115.9600	1.01E+08	1.000000

Figure 1: CPI inflation rate (y-on-y) and 3-month deposit rate

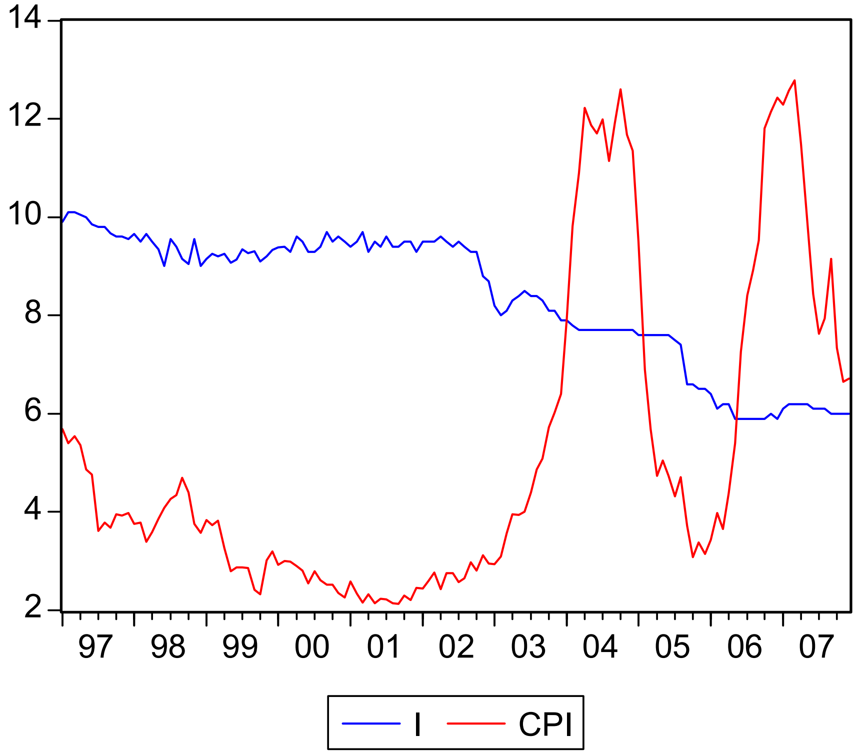


Figure 2: Industrial production (actual and hp-trended) series

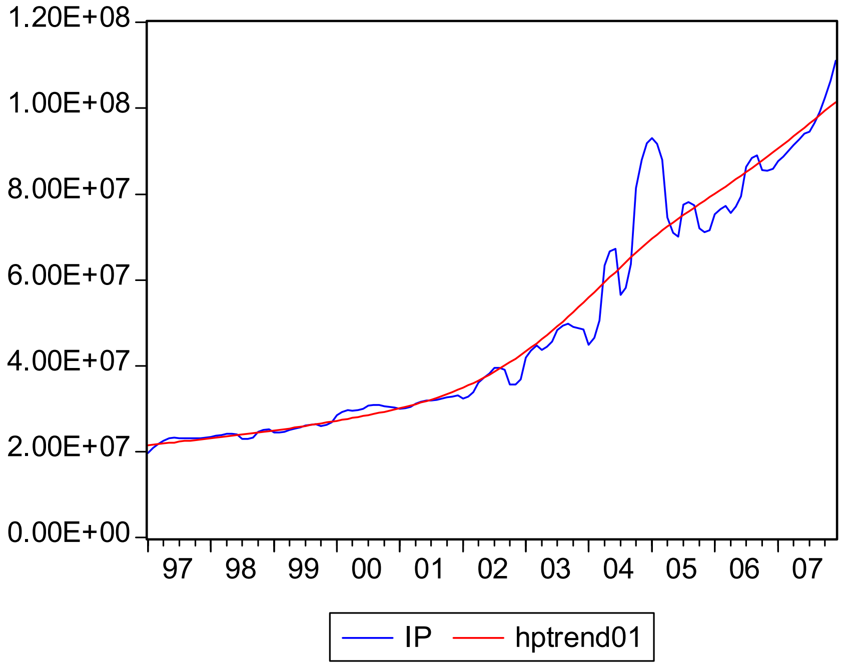
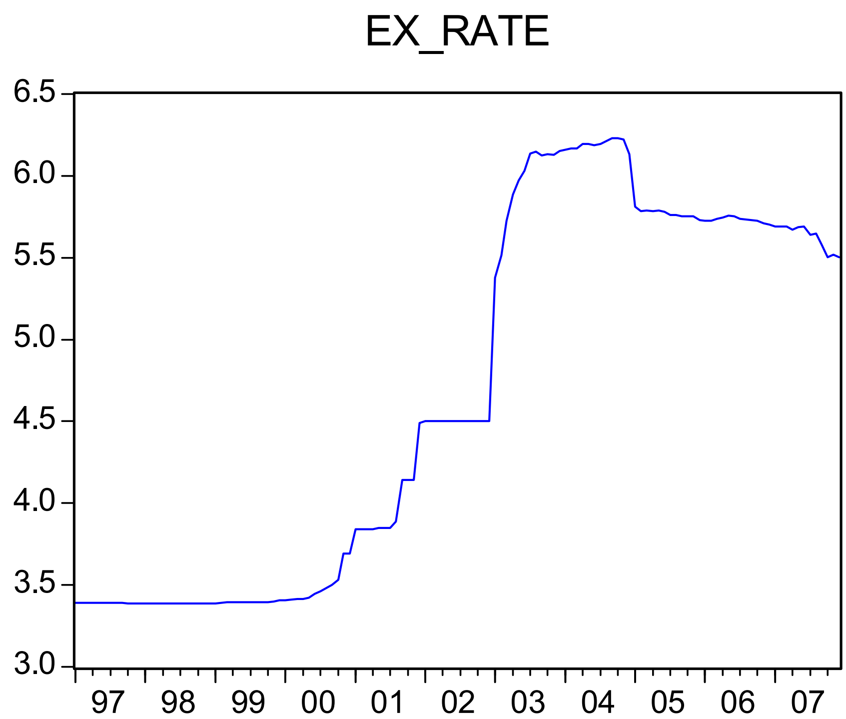
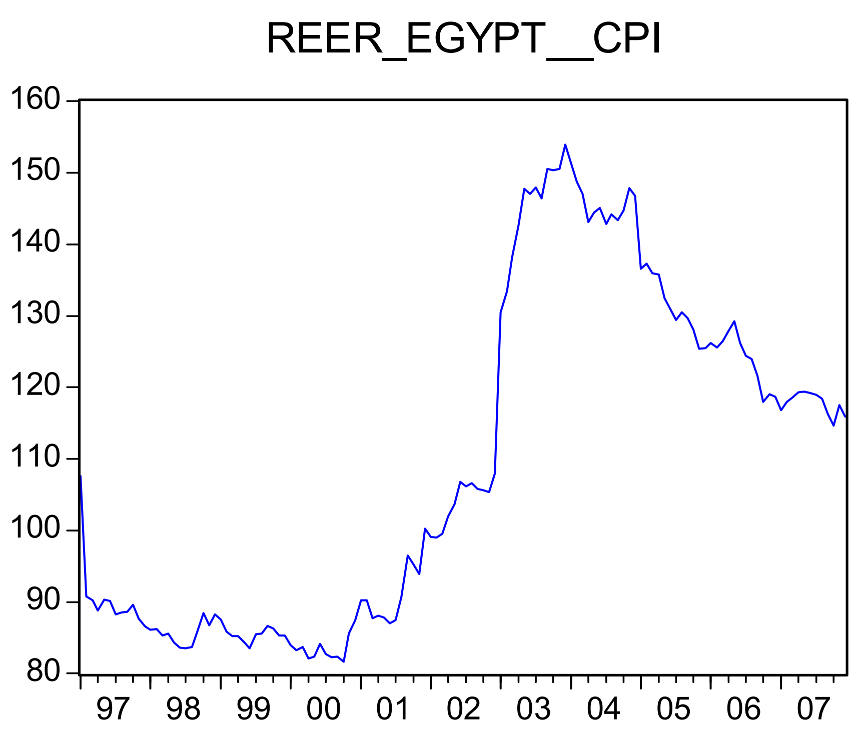


Figure 3: Nominal Exchange rate and REER Movements





<u>Testing for stationarity</u>: using both the Correlogram, and the Augmented Dickey Fuller (ADF) test.

1- CPI inflation rate:

Date: 11/13/08 Time: 11:12
Sample: 1997M01 2007M12
Included observations: 132

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>.|********</td><td>.|********</td><td>1</td><td>0.977</td><td>0.977</td><td>128.88</td><td>0.000</td></tr>
<tr><td>.|*******|</td><td>****|. |</td><td>2</td><td>0.933</td><td>-0.472</td><td>247.34</td><td>0.000</td></tr>
<tr><td>.|*******|</td><td>*|. |</td><td>3</td><td>0.876</td><td>-0.145</td><td>352.46</td><td>0.000</td></tr>
<tr><td>.|****** |</td><td>*|. |</td><td>4</td><td>0.805</td><td>-0.187</td><td>442.08</td><td>0.000</td></tr>
<tr><td>.|****** |</td><td>.|* |</td><td>5</td><td>0.732</td><td>0.116</td><td>516.76</td><td>0.000</td></tr>
<tr><td>.|***** |</td><td>**|. |</td><td>6</td><td>0.651</td><td>-0.251</td><td>576.27</td><td>0.000</td></tr>
<tr><td>.|**** |</td><td>*|. |</td><td>7</td><td>0.563</td><td>-0.068</td><td>621.13</td><td>0.000</td></tr>
<tr><td>.|**** |</td><td>.|. |</td><td>8</td><td>0.475</td><td>0.022</td><td>653.27</td><td>0.000</td></tr>
<tr><td>.|*** |</td><td>*|. |</td><td>9</td><td>0.383</td><td>-0.114</td><td>674.31</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|* |</td><td>10</td><td>0.294</td><td>0.086</td><td>686.83</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|* |</td><td>11</td><td>0.214</td><td>0.079</td><td>693.50</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|* |</td><td>12</td><td>0.142</td><td>0.085</td><td>696.48</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|** |</td><td>13</td><td>0.091</td><td>0.319</td><td>697.71</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>*|. |</td><td>14</td><td>0.052</td><td>-0.145</td><td>698.12</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>15</td><td>0.021</td><td>-0.016</td><td>698.18</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|* |</td><td>16</td><td>0.004</td><td>0.079</td><td>698.19</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|* |</td><td>17</td><td>-0.002</td><td>0.126</td><td>698.19</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>18</td><td>0.003</td><td>-0.052</td><td>698.19</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>19</td><td>0.019</td><td>-0.026</td><td>698.24</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>20</td><td>0.042</td><td>0.023</td><td>698.52</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|* |</td><td>21</td><td>0.074</td><td>0.092</td><td>699.40</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|. |</td><td>22</td><td>0.112</td><td>-0.030</td><td>701.42</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|. |</td><td>23</td><td>0.150</td><td>-0.023</td><td>705.08</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|* |</td><td>24</td><td>0.194</td><td>0.171</td><td>711.21</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>25</td><td>0.236</td><td>0.033</td><td>720.40</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>**|. |</td><td>26</td><td>0.272</td><td>-0.215</td><td>732.71</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>*|. |</td><td>27</td><td>0.302</td><td>-0.109</td><td>748.04</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>28</td><td>0.320</td><td>-0.023</td><td>765.43</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>*|. |</td><td>29</td><td>0.325</td><td>-0.062</td><td>783.55</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>30</td><td>0.324</td><td>0.062</td><td>801.72</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>31</td><td>0.316</td><td>0.045</td><td>819.19</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|* |</td><td>32</td><td>0.304</td><td>0.083</td><td>835.50</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>33</td><td>0.285</td><td>-0.038</td><td>850.01</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>34</td><td>0.257</td><td>-0.037</td><td>861.94</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>35</td><td>0.224</td><td>-0.006</td><td>871.09</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|. |</td><td>36</td><td>0.183</td><td>0.008</td><td>877.28</td><td>0.000</td></tr>
</table>

Null Hypothesis: CPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.939326	0.0132
Test critical values:	1% level	-4.032498	
	5% level	-3.445877	
	10% level	-3.147878	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CPI)
Method: Least Squares
Date: 11/13/08 Time: 11:20
Sample (adjusted): 1997M07 2007M12
Included observations: 126 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI(-1)	-0.086869	0.022052	-3.939326	0.0001
D(CPI(-1))	0.460318	0.084715	5.433692	0.0000
D(CPI(-2))	0.028585	0.092367	0.309476	0.7575
D(CPI(-3))	0.184869	0.097616	1.893833	0.0607
D(CPI(-4))	-0.163026	0.103426	-1.576252	0.1176
D(CPI(-5))	0.319562	0.094802	3.370845	0.0010
C	0.143718	0.111540	1.288490	0.2001
@TREND(1997M01)	0.004469	0.001790	2.496274	0.0139

R-squared	0.367923	Mean dependent var	0.015515
Adjusted R-squared	0.330426	S.D. dependent var	0.681564
S.E. of regression	0.557707	Akaike info criterion	1.731421
Sum squared resid	36.70238	Schwarz criterion	1.911502
Log likelihood	-101.0795	F-statistic	9.812283
Durbin-Watson stat	2.024407	Prob(F-statistic)	0.000000

Referring to the above results, it seems that at 95 percent level of confidence, the CPI inflation rate series is stationary (Integrated of order zero “I(0)”).

2- 3-month deposit rate:

Date: 11/13/08 Time: 11:34
Sample: 1997M01 2007M12
Included observations: 132

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|*******|	.|*******|	1	0.975	0.975	128.43	0.000
.|*******|	.|. |	2	0.952	0.017	251.73	0.000
.|*******|	.|. |	3	0.927	-0.035	369.68	0.000
.|*******|	.|. |	4	0.903	-0.023	482.26	0.000
.|*******|	.|. |	5	0.877	-0.030	589.33	0.000
.|*******|	.|. |	6	0.853	0.023	691.45	0.000
.|****** |	.|. |	7	0.829	-0.012	788.66	0.000
.|****** |	.|. |	8	0.807	0.028	881.52	0.000
.|****** |	*|. |	9	0.782	-0.061	969.53	0.000
.|****** |	.|. |	10	0.760	0.021	1053.2	0.000
.|****** |	.|. |	11	0.736	-0.036	1132.4	0.000
.|***** |	.|. |	12	0.711	-0.034	1207.0	0.000
.|***** |	*|. |	13	0.684	-0.061	1276.6	0.000
.|***** |	.|. |	14	0.658	-0.008	1341.4	0.000
.|***** |	*|. |	15	0.629	-0.063	1401.2	0.000
.|***** |	.|. |	16	0.600	-0.013	1456.1	0.000
.|**** |	.|. |	17	0.574	0.046	1506.8	0.000
.|**** |	.|. |	18	0.549	-0.013	1553.5	0.000
.|**** |	*|. |	19	0.520	-0.094	1595.7	0.000
.|**** |	.|. |	20	0.491	-0.017	1633.8	0.000
.|**** |	.|* |	21	0.468	0.097	1668.7	0.000
.|*** |	.|. |	22	0.444	-0.032	1700.4	0.000
.|*** |	*|. |	23	0.415	-0.116	1728.3	0.000
.|*** |	.|* |	24	0.392	0.109	1753.4	0.000
.|*** |	.|. |	25	0.369	-0.022	1775.9	0.000
.|*** |	*|. |	26	0.343	-0.071	1795.6	0.000
.|** |	.|. |	27	0.319	0.020	1812.7	0.000
.|** |	.|. |	28	0.296	0.002	1827.6	0.000
.|** |	.|* |	29	0.280	0.141	1841.1	0.000
.|** |	.|. |	30	0.268	0.065	1853.5	0.000
.|** |	.|. |	31	0.254	-0.039	1864.8	0.000
.|** |	.|. |	32	0.240	-0.048	1875.0	0.000
.|** |	*|. |	33	0.222	-0.097	1883.8	0.000
.|** |	.|* |	34	0.207	0.070	1891.6	0.000
.|* |	*|. |	35	0.190	-0.076	1898.1	0.000
.|* |	.|. |	36	0.172	-0.026	1903.6	0.000

Date: 11/13/08   Time: 11:34
Sample: 1997M01 2007M12
Included observations: 131

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
**|. |	**|. |	1	-0.200	-0.200	5.3721	0.020
.|. |	.|. |	2	0.040	0.000	5.5914	0.061
.|. |	.|. |	3	0.017	0.026	5.6295	0.131
.|* |	.|* |	4	0.101	0.114	7.0253	0.135
*|. |	.|. |	5	-0.083	-0.044	7.9729	0.158
.|. |	.|. |	6	-0.003	-0.036	7.9740	0.240
*|. |	*|. |	7	-0.096	-0.114	9.2704	0.234
.|* |	.|* |	8	0.176	0.141	13.665	0.091
*|. |	.|. |	9	-0.122	-0.045	15.779	0.072
.|. |	.|. |	10	0.056	0.030	16.229	0.093
.|. |	.|. |	11	-0.019	-0.002	16.280	0.131
.|. |	*|. |	12	-0.042	-0.089	16.544	0.168
.|. |	.|. |	13	0.050	0.059	16.915	0.203
.|. |	.|. |	14	0.013	0.023	16.940	0.259
.|. |	.|. |	15	-0.006	0.036	16.946	0.322
*|. |	*|. |	16	-0.140	-0.186	19.904	0.225
.|* |	.|. |	17	0.086	0.045	21.024	0.225
.|. |	.|. |	18	-0.014	-0.006	21.056	0.277
.|. |	.|. |	19	-0.018	0.002	21.106	0.331
*|. |	.|. |	20	-0.069	-0.029	21.859	0.348
.|* |	.|. |	21	0.069	-0.007	22.617	0.365
.|. |	.|. |	22	0.009	0.038	22.630	0.423
.|. |	.|. |	23	-0.026	-0.049	22.742	0.476
.|. |	.|* |	24	0.024	0.093	22.832	0.530
.|* |	.|. |	25	0.075	0.033	23.759	0.533
.|. |	.|. |	26	-0.030	0.010	23.910	0.581
*|. |	*|. |	27	-0.105	-0.151	25.766	0.532
.|. |	.|. |	28	0.063	0.022	26.444	0.549
**|. |	**|. |	29	-0.189	-0.190	32.545	0.296
.|. |	.|. |	30	0.046	0.011	32.903	0.327
.|. |	.|* |	31	0.016	0.078	32.948	0.372
.|** |	.|** |	32	0.233	0.253	42.494	0.102
*|. |	.|. |	33	-0.132	-0.020	45.570	0.071
.|* |	.|. |	34	0.094	0.005	47.143	0.066
*|. |	*|. |	35	-0.059	-0.074	47.771	0.074
.|* |	.|. |	36	0.114	-0.001	50.165	0.059

Null Hypothesis: _M_DEPOSIT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.904820	0.6464
Test critical values:	1% level	-4.029595	
	5% level	-3.444487	
	10% level	-3.147063	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(_M_DEPOSIT)
Method: Least Squares
Date: 11/13/08 Time: 11:37
Sample (adjusted): 1997M02 2007M12
Included observations: 131 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
_M_DEPOSIT(-1)	-0.051314	0.026939	-1.904820	0.0590
C	0.528468	0.284658	1.856503	0.0657
@TREND(1997M01)	-0.001945	0.000955	-2.036342	0.0438

R-squared	0.031491	Mean dependent var	-0.029771
Adjusted R-squared	0.016358	S.D. dependent var	0.172434
S.E. of regression	0.171018	Akaike info criterion	-0.671465
Sum squared resid	3.743621	Schwarz criterion	-0.605621
Log likelihood	46.98098	F-statistic	2.080925
Durbin-Watson stat	2.339649	Prob(F-statistic)	0.129017

Null Hypothesis: D(_M_DEPOSIT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.95904	0.0000
Test critical values:	1% level	-3.481217	
	5% level	-2.883753	
	10% level	-2.578694	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(_M_DEPOSIT,2)
Method: Least Squares
Date: 11/13/08 Time: 11:37
Sample (adjusted): 1997M03 2007M12
Included observations: 130 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(_M_DEPOSIT(-1))	-1.200268	0.085985	-13.95904	0.0000
C	-0.037546	0.015048	-2.495157	0.0139

R-squared	0.603537	Mean dependent var	-0.001538
Adjusted R-squared	0.600440	S.D. dependent var	0.267408
S.E. of regression	0.169031	Akaike info criterion	-0.702204
Sum squared resid	3.657150	Schwarz criterion	-0.658088
Log likelihood	47.64326	F-statistic	194.8548
Durbin-Watson stat	2.007741	Prob(F-statistic)	0.000000

Referring to the above results, it seems that at 95 percent level of confidence, the 3-month deposit rate series is non-stationary (Integrated of order one" I(1)").

3- Real Effective Exchange rate (REER):

Date: 11/28/08 Time: 13:47
Sample: 1997M01 2007M12
Included observations: 132

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|********	.|********	1	0.990	0.990	132.42	0.000
.|********	*|. |	2	0.977	-0.187	262.34	0.000
.|*******|	*|. |	3	0.962	-0.068	389.28	0.000
.|*******|	*|. |	4	0.945	-0.101	512.68	0.000
.|*******|	*|. |	5	0.926	-0.078	632.05	0.000
.|*******|	.|. |	6	0.906	0.001	747.27	0.000
.|*******|	.|. |	7	0.886	-0.015	858.27	0.000
.|*******|	.|. |	8	0.865	0.001	965.04	0.000
.|****** |	*|. |	9	0.842	-0.146	1067.0	0.000
.|****** |	*|. |	10	0.817	-0.095	1163.7	0.000
.|****** |	.|. |	11	0.790	-0.033	1254.9	0.000
.|****** |	*|. |	12	0.761	-0.091	1340.4	0.000
.|****** |	.|* |	13	0.733	0.093	1420.3	0.000
.|***** |	*|. |	14	0.704	-0.074	1494.6	0.000
.|***** |	.|* |	15	0.676	0.066	1563.7	0.000
.|***** |	.|. |	16	0.648	-0.041	1627.6	0.000
.|***** |	*|. |	17	0.617	-0.162	1686.1	0.000
.|**** |	*|. |	18	0.583	-0.111	1738.9	0.000
.|**** |	.|. |	19	0.549	-0.029	1786.0	0.000
.|**** |	.|. |	20	0.513	-0.005	1827.6	0.000
.|**** |	.|* |	21	0.479	0.115	1864.3	0.000
.|*** |	*|. |	22	0.445	-0.079	1896.0	0.000
.|*** |	.|* |	23	0.412	0.087	1923.5	0.000
.|*** |	.|. |	24	0.380	-0.057	1947.1	0.000
.|*** |	.|* |	25	0.349	0.087	1967.3	0.000
.|** |	.|. |	26	0.319	-0.042	1984.3	0.000
.|** |	.|. |	27	0.288	-0.039	1998.3	0.000
.|** |	.|. |	28	0.257	-0.037	2009.5	0.000
.|** |	.|. |	29	0.225	-0.025	2018.2	0.000
.|* |	.|. |	30	0.195	0.025	2024.8	0.000
.|* |	.|. |	31	0.165	0.017	2029.5	0.000
.|* |	*|. |	32	0.136	-0.059	2032.8	0.000
.|* |	.|. |	33	0.107	-0.052	2034.9	0.000
.|* |	.|. |	34	0.079	-0.023	2036.0	0.000
.|. |	.|* |	35	0.052	0.097	2036.5	0.000
.|. |	*|. |	36	0.024	-0.110	2036.6	0.000

Date: 11/28/08 Time: 13:48
Sample: 1997M01 2007M12
Included observations: 131

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|* |	.|* |	1	0.155	0.155	3.2344	0.072
.|* |	.|* |	2	0.107	0.085	4.7693	0.092
.|* |	.|* |	3	0.109	0.084	6.3950	0.094
.|* |	.|* |	4	0.099	0.066	7.7316	0.102
.|. |	.|. |	5	0.026	-0.013	7.8241	0.166
.|. |	.|. |	6	0.022	-0.002	7.8904	0.246
.|. |	.|. |	7	0.009	-0.010	7.9011	0.341
.|* |	.|* |	8	0.140	0.137	10.668	0.221
.|* |	.|* |	9	0.126	0.094	12.919	0.166
.|. |	.|. |	10	0.061	0.013	13.446	0.200
.|* |	.|* |	11	0.117	0.074	15.434	0.163
.|. |	*|. |	12	-0.048	-0.123	15.766	0.202
.|. |	.|. |	13	0.058	0.047	16.261	0.235
.|. |	*|. |	14	-0.045	-0.072	16.567	0.280
.|. |	.|. |	15	-0.017	-0.003	16.607	0.343
.|* |	.|* |	16	0.121	0.140	18.836	0.277
.|* |	.|* |	17	0.138	0.093	21.746	0.195
.|. |	.|. |	18	0.035	-0.013	21.930	0.235
.|. |	.|. |	19	0.039	-0.041	22.161	0.276
*|. |	*|. |	20	-0.073	-0.132	22.999	0.289
.|. |	.|. |	21	0.054	0.063	23.456	0.320
*|. |	*|. |	22	-0.094	-0.103	24.861	0.304
*|. |	.|. |	23	-0.058	0.028	25.401	0.330
*|. |	*|. |	24	-0.090	-0.106	26.731	0.317
.|. |	.|. |	25	-0.004	0.004	26.734	0.369
.|. |	.|. |	26	0.017	0.009	26.780	0.421
.|. |	.|. |	27	0.033	0.009	26.964	0.466
.|. |	.|. |	28	-0.027	0.002	27.083	0.514
.|. |	.|. |	29	-0.038	-0.041	27.327	0.554
*|. |	.|. |	30	-0.065	-0.051	28.064	0.567
.|. |	.|. |	31	-0.054	0.029	28.567	0.592
.|. |	.|. |	32	0.012	0.022	28.590	0.640
.|. |	.|. |	33	-0.054	-0.000	29.113	0.661
*|. |	*|. |	34	-0.075	-0.124	30.121	0.658
.|. |	.|* |	35	0.039	0.096	30.398	0.690
.|. |	.|. |	36	0.002	-0.013	30.399	0.732

Null Hypothesis: REER_EGYPT__CPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.380165	0.8624
Test critical values:	1% level	-4.029595	
	5% level	-3.444487	
	10% level	-3.147063	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER_EGYPT__CPI)
Method: Least Squares
Date: 11/28/08 Time: 13:49
Sample (adjusted): 1997M02 2007M12
Included observations: 131 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REER_EGYPT__CPI(-1)	-0.024874	0.018023	-1.380165	0.1699
C	1.919762	1.530559	1.254288	0.2120
@TREND(1997M01)	0.013128	0.011184	1.173805	0.2427

R-squared	0.015019	Mean dependent var	0.063740
Adjusted R-squared	-0.000372	S.D. dependent var	3.222680
S.E. of regression	3.223278	Akaike info criterion	5.201309
Sum squared resid	1329.859	Schwarz criterion	5.267154
Log likelihood	-337.6858	F-statistic	0.975855
Durbin-Watson stat	1.456259	Prob(F-statistic)	0.379656

Null Hypothesis: D(REER_EGYPT__CPI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.92822	0.0000
Test critical values:	1% level	-3.481217	
	5% level	-2.883753	
	10% level	-2.578694	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER_EGYPT__CPI,2)
Method: Least Squares
Date: 11/28/08 Time: 13:50
Sample (adjusted): 1997M03 2007M12
Included observations: 130 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REER_EGYPT__CPI(-1))	-0.844499	0.077277	-10.92822	0.0000
C	0.181826	0.248860	0.730636	0.4663

R-squared	0.482674	Mean dependent var	0.117385
Adjusted R-squared	0.478632	S.D. dependent var	3.928558
S.E. of regression	2.836647	Akaike info criterion	4.938387
Sum squared resid	1029.960	Schwarz criterion	4.982503
Log likelihood	-318.9952	F-statistic	119.4261
Durbin-Watson stat	1.963008	Prob(F-statistic)	0.000000

Referring to the above results, it seems that at 95 percent level of confidence, the real effective exchange rate series is non-stationary (Integrated of order one” I(1)”).

4- Industrial production:

Date: 11/28/08 Time: 13:41
Sample: 1997M01 2007M12
Included observations: 132

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|*******|	.|*******|	1	0.967	0.967	126.16	0.000
.|*******|	*|. |	2	0.930	-0.059	243.97	0.000
.|*******|	.|. |	3	0.896	0.007	354.02	0.000
.|*******|	.|* |	4	0.870	0.109	458.56	0.000
.|*******|	.|. |	5	0.848	0.041	558.68	0.000
.|****** |	.|. |	6	0.828	0.019	654.90	0.000
.|****** |	.|. |	7	0.806	-0.029	746.79	0.000
.|****** |	.|. |	8	0.783	-0.009	834.22	0.000
.|****** |	.|. |	9	0.759	-0.018	917.04	0.000
.|****** |	.|. |	10	0.734	-0.036	995.08	0.000
.|***** |	.|. |	11	0.709	-0.005	1068.6	0.000
.|***** |	.|. |	12	0.687	0.014	1138.1	0.000
.|***** |	.|. |	13	0.670	0.060	1204.8	0.000
.|***** |	.|. |	14	0.654	0.007	1269.0	0.000
.|***** |	.|. |	15	0.638	-0.014	1330.4	0.000
.|***** |	*|. |	16	0.615	-0.084	1388.1	0.000
.|***** |	.|. |	17	0.591	-0.015	1441.8	0.000
.|**** |	.|. |	18	0.568	-0.001	1491.8	0.000
.|**** |	.|. |	19	0.551	0.061	1539.2	0.000
.|**** |	.|. |	20	0.535	-0.010	1584.4	0.000
.|**** |	.|. |	21	0.519	-0.023	1627.3	0.000
.|**** |	*|. |	22	0.498	-0.063	1667.2	0.000
.|**** |	.|. |	23	0.476	-0.012	1704.0	0.000
.|*** |	.|. |	24	0.455	0.003	1737.9	0.000
.|*** |	.|. |	25	0.438	0.048	1769.7	0.000
.|*** |	.|. |	26	0.423	-0.004	1799.5	0.000
.|*** |	.|. |	27	0.407	-0.022	1827.4	0.000
.|*** |	*|. |	28	0.387	-0.082	1852.8	0.000
.|*** |	.|. |	29	0.365	-0.026	1875.6	0.000
.|*** |	.|. |	30	0.342	-0.015	1896.0	0.000
.|** |	.|. |	31	0.325	0.060	1914.4	0.000
.|** |	.|. |	32	0.306	-0.032	1931.0	0.000
.|** |	*|. |	33	0.286	-0.058	1945.6	0.000
.|** |	*|. |	34	0.257	-0.170	1957.5	0.000
.|** |	*|. |	35	0.224	-0.072	1966.7	0.000
.|* |	*|. |	36	0.189	-0.058	1973.3	0.000

Date: 11/28/08 Time: 13:43
Sample: 1997M01 2007M12
Included observations: 131

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|*** |	.|*** |	1	0.423	0.423	23.945	0.000
.|. |	*|. |	2	0.065	-0.138	24.516	0.000
****|. |	****|. |	3	-0.487	-0.571	56.810	0.000
**|. |	.|*** |	4	-0.209	0.405	62.775	0.000
*|. |	*|. |	5	-0.082	-0.075	63.710	0.000
.|* |	***|. |	6	0.133	-0.352	66.188	0.000
.|* |	.|**** |	7	0.094	0.460	67.424	0.000
.|* |	.|. |	8	0.098	-0.052	68.795	0.000
.|* |	*|. |	9	0.126	-0.143	71.047	0.000
.|. |	.|. |	10	-0.033	-0.028	71.201	0.000
*|. |	*|. |	11	-0.144	-0.104	74.224	0.000
***|. |	*|. |	12	-0.331	-0.098	90.294	0.000
*|. |	.|* |	13	-0.120	0.073	92.421	0.000
.|. |	.|. |	14	0.015	-0.040	92.455	0.000
.|** |	.|. |	15	0.251	0.007	101.93	0.000
.|* |	*|. |	16	0.088	-0.063	103.09	0.000
.|. |	.|. |	17	0.001	-0.022	103.09	0.000
*|. |	.|. |	18	-0.184	-0.024	108.29	0.000
.|. |	.|** |	19	-0.011	0.273	108.31	0.000
.|* |	.|. |	20	0.084	0.039	109.41	0.000
.|** |	.|. |	21	0.260	0.044	120.10	0.000
.|* |	*|. |	22	0.085	-0.112	121.26	0.000
.|. |	.|. |	23	-0.022	-0.035	121.33	0.000
**|. |	.|. |	24	-0.197	-0.004	127.65	0.000
*|. |	*|. |	25	-0.106	-0.077	129.50	0.000
*|. |	.|. |	26	-0.057	-0.004	130.05	0.000
.|. |	.|. |	27	0.034	0.024	130.25	0.000
.|. |	*|. |	28	0.032	-0.084	130.42	0.000
.|. |	.|. |	29	0.037	-0.013	130.65	0.000
.|. |	*|. |	30	0.024	-0.067	130.75	0.000
.|. |	.|* |	31	-0.038	0.124	130.99	0.000
*|. |	.|. |	32	-0.071	0.039	131.87	0.000
*|. |	.|. |	33	-0.090	0.043	133.30	0.000
.|. |	*|. |	34	0.001	-0.074	133.30	0.000
.|. |	.|. |	35	0.058	0.008	133.91	0.000
.|* |	.|* |	36	0.134	0.118	137.20	0.000

Null Hypothesis: IP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 7 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.884147	0.6568
Test critical values:	1% level	-4.033727	
	5% level	-3.446464	
	10% level	-3.148223	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IP)
Method: Least Squares
Date: 11/28/08 Time: 13:43
Sample (adjusted): 1997M09 2007M12
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IP(-1)	-0.036077	0.019148	-1.884147	0.0621
D(IP(-1))	0.835132	0.081819	10.20712	0.0000
D(IP(-2))	0.126576	0.090178	1.403620	0.1632
D(IP(-3))	-1.223829	0.091086	-13.43596	0.0000
D(IP(-4))	0.977535	0.117870	8.293324	0.0000
D(IP(-5))	0.078208	0.089859	0.870343	0.3859
D(IP(-6))	-0.687268	0.089990	-7.637146	0.0000
D(IP(-7))	0.506684	0.082161	6.166940	0.0000
C	-6018.176	338850.8	-0.017761	0.9859
@TREND(1997M01)	30252.67	12948.13	2.336450	0.0212

R-squared	0.729514	Mean dependent var	708804.7
Adjusted R-squared	0.708159	S.D. dependent var	3123275.
S.E. of regression	1687264.	Akaike info criterion	31.59232
Sum squared resid	3.25E+14	Schwarz criterion	31.81976
Log likelihood	-1948.724	F-statistic	34.16256
Durbin-Watson stat	1.930754	Prob(F-statistic)	0.000000

Null Hypothesis: D(IP) has a unit root		
Exogenous: Constant		
Lag Length: 6 (Automatic based on SIC, MAXLAG=12)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.915017	0.0465
Test critical values: 1% level	-3.483751	
5% level	-2.884856	
10% level	-2.579282	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IP,2)
Method: Least Squares
Date: 11/28/08 Time: 13:44
Sample (adjusted): 1997M09 2007M12
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IP(-1))	-0.425390	0.145930	-2.915017	0.0043
D(IP(-1),2)	0.268005	0.124434	2.153789	0.0333
D(IP(-2),2)	0.373775	0.124527	3.001551	0.0033
D(IP(-3),2)	-0.878868	0.125827	-6.984714	0.0000
D(IP(-4),2)	0.117033	0.081230	1.440762	0.1523
D(IP(-5),2)	0.188167	0.081611	2.305665	0.0229
D(IP(-6),2)	-0.513173	0.082005	-6.257846	0.0000
C	319696.2	178581.8	1.790195	0.0760

R-squared	0.750372	Mean dependent var	36895.90
Adjusted R-squared	0.735308	S.D. dependent var	3339078.
S.E. of regression	1717897.	Akaike info criterion	31.61344
Sum squared resid	3.42E+14	Schwarz criterion	31.79539
Log likelihood	-1952.033	F-statistic	49.81295
Durbin-Watson stat	1.912889	Prob(F-statistic)	0.000000

Referring to the above results, it seems that at 95 percent level of confidence, the industrial production series is non-stationary (Integrated of order one" I(1)").

Table 2- Closed economy Un-structural VAR output

Vector Autoregression Estimates
Date: 02/27/09 Time: 14:15
Sample (adjusted): 1997M09 2007M12
Included observations: 124 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	I	CPI	YGAP
I(-1)	0.742146	-0.085746	885422.0
	(0.09806)	(0.27917)	(856296.)
	[7.56867]	[-0.30715]	[1.03401]
I(-2)	0.187949	-0.205538	-744019.4
	(0.12187)	(0.34697)	(1064282)
	[1.54219]	[-0.59238]	[-0.69908]
I(-3)	0.121455	-0.209924	878784.4
	(0.12239)	(0.34845)	(1068807)
	[0.99236]	[-0.60246]	[0.82221]
I(-4)	0.068697	0.160933	-812807.6
	(0.12169)	(0.34645)	(1062685)
	[0.56453]	[0.46452]	[-0.76486]
I(-5)	-0.163499	0.281380	189457.8
	(0.12240)	(0.34849)	(1068932)
	[-1.33573]	[0.80743]	[0.17724]
I(-6)	-0.047301	0.209889	15047.73
	(0.12115)	(0.34492)	(1057997)
	[-0.39043]	[0.60851]	[0.01422]
I(-7)	-0.026662	-0.091208	302514.2
	(0.11973)	(0.34088)	(1045603)
	[-0.22268]	[-0.26756]	[0.28932]
I(-8)	0.114416	-0.138022	-217045.1
	(0.09587)	(0.27295)	(837229.)
	[1.19343]	[-0.50567]	[-0.25924]
CPI(-1)	0.027771	1.207057	618561.7
	(0.03418)	(0.09731)	(298486.)
	[0.81248]	[12.4041]	[2.07233]
CPI(-2)	-0.028642	-0.213570	-798840.6
	(0.05279)	(0.15029)	(460979.)

	[-0.54260]	[-1.42109]	[-1.73292]
CPI(-3)	0.008275	0.153125	667233.6
	(0.05390)	(0.15344)	(470668.)
	[0.15354]	[0.99792]	[1.41763]
CPI(-4)	-0.056715	-0.217500	-722292.2
	(0.05529)	(0.15742)	(482859.)
	[-1.02572]	[-1.38166]	[-1.49587]
CPI(-5)	0.077645	0.276085	53029.68
	(0.05524)	(0.15726)	(482360.)
	[1.40570]	[1.75563]	[0.10994]
CPI(-6)	-0.069858	-0.202321	180279.1
	(0.05667)	(0.16135)	(494906.)
	[-1.23268]	[-1.25395]	[0.36427]
CPI(-7)	0.120274	-0.374708	-77656.41
	(0.05810)	(0.16541)	(507375.)
	[2.07012]	[-2.26530]	[-0.15306]
CPI(-8)	-0.084812	0.323814	431191.6
	(0.03924)	(0.11173)	(342703.)
	[-2.16118]	[2.89828]	[1.25821]
YGAP(-1)	5.30E-09	-5.72E-08	1.568297
	(1.1E-08)	(3.0E-08)	(0.09248)
	[0.50035]	[-1.89872]	[16.9578]
YGAP(-2)	2.34E-10	8.96E-09	-0.528901
	(1.8E-08)	(5.0E-08)	(0.15427)
	[0.01322]	[0.17807]	[-3.42841]
YGAP(-3)	4.20E-09	2.14E-08	-1.319937
	(1.6E-08)	(4.6E-08)	(0.14017)
	[0.26195]	[0.46825]	[-9.41692]
YGAP(-4)	-3.52E-09	-3.54E-08	1.944946
	(2.1E-08)	(6.0E-08)	(0.18362)
	[-0.16758]	[-0.59099]	[10.5920]
YGAP(-5)	5.82E-09	2.56E-08	-0.741205
	(2.1E-08)	(5.9E-08)	(0.18099)
	[0.28102]	[0.43433]	[-4.09522]
YGAP(-6)	-4.37E-09	2.11E-08	-0.820422

	(1.6E-08)	(4.6E-08)	(0.14041)
	[-0.27163]	[0.46081]	[-5.84312]
YGAP(-7)	-4.47E-09	1.93E-08	1.086242
	(1.8E-08)	(5.1E-08)	(0.15517)
	[-0.25177]	[0.38214]	[7.00039]
YGAP(-8)	8.12E-10	-6.62E-08	-0.501480
	(1.1E-08)	(3.0E-08)	(0.09293)
	[0.07632]	[-2.18570]	[-5.39642]
C	0.009517	0.890731	-5874837.
	(0.24420)	(0.69525)	(2132565)
	[0.03897]	[1.28117]	[-2.75482]
R-squared	0.986356	0.981658	0.938925
Adj. R-squared	0.983048	0.977212	0.924119
Sum sq. resids	2.993354	24.26276	2.28E+14
S.E. equation	0.173885	0.495054	1518501.
F-statistic	298.2018	220.7692	63.41523
Log likelihood	54.93261	-74.80536	-1926.909
Akaike AIC	-0.482784	1.609764	31.48241
Schwarz SC	0.085821	2.178369	32.05101
Mean dependent	8.256976	5.198762	-14738.57
S.D. dependent	1.335528	3.279402	5512509.

Determinant resid covariance (dof adj.)	1.68E+10
Determinant resid covariance	8.56E+09
Log likelihood	-1945.785
Akaike information criterion	32.59331
Schwarz criterion	34.29912

Table 3: Lag length

VAR Lag Order Selection Criteria
Endogenous variables: I CPI YGAP
Exogenous variables: C
Date: 03/21/09 Time: 22:59
Sample: 1997M01 2007M12
Included observations: 120

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2510.670	NA	3.14e+14	41.89450	41.96418	41.92280
1	-2020.791	947.0983	1.04e+11	33.87986	34.15860	33.99306
2	-1990.988	56.13004	7.35e+10	33.53313	34.02094*	33.73123
3	-1989.322	3.053256	8.31e+10	33.65537	34.35225	33.93838
4	-1965.058	43.27230	6.45e+10	33.40096	34.30689	33.76886
5	-1945.225	34.37609	5.40e+10	33.22042	34.33542	33.67322
6	-1926.445	31.61292	4.60e+10	33.05742	34.38148	33.59513
7	-1909.311	27.98574	4.03e+10	32.92185	34.45497	33.54446
8	-1885.469	37.74986	3.17e+10	32.67448	34.41667	33.38199*
9	-1877.101	12.83080	3.23e+10	32.68502	34.63626	33.47743
10	-1863.849	19.65776*	3.04e+10*	32.61415*	34.77445	33.49146
11	-1858.355	7.873868	3.26e+10	32.67259	35.04196	33.63480
12	-1854.141	5.829237	3.58e+10	32.75236	35.33079	33.79947

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 4- Open economy Un-structural VAR output

Vector Autoregression Estimates
Date: 02/27/09 Time: 14:24
Sample (adjusted): 1997M03 2007M12
Included observations: 130 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	I	CPI	YGAP	LREER
I(-1)	0.740336	0.308701	1749274.	0.012564
	(0.09018)	(0.29063)	(1321301)	(0.01190)
	[8.20930]	[1.06219]	[1.32390]	[1.05556]
I(-2)	0.214779	-0.388932	-1082040.	0.004535
	(0.09170)	(0.29551)	(1343507)	(0.01210)
	[2.34224]	[-1.31613]	[-0.80538]	[0.37466]
CPI(-1)	0.031498	1.246750	261136.5	-0.004476
	(0.02693)	(0.08679)	(394566.)	(0.00355)
	[1.16963]	[14.3656]	[0.66183]	[-1.25937]
CPI(-2)	-0.021396	-0.293044	-9951.484	0.003315
	(0.02718)	(0.08760)	(398274.)	(0.00359)
	[-0.78711]	[-3.34515]	[-0.02499]	[0.92386]
YGAP(-1)	1.08E-09	-3.80E-08	1.233349	2.41E-10
	(5.5E-09)	(1.8E-08)	(0.08008)	(7.2E-10)
	[0.19685]	[-2.15812]	[15.4017]	[0.33406]
YGAP(-2)	3.22E-09	-9.12E-09	-0.500348	-1.48E-09
	(5.6E-09)	(1.8E-08)	(0.08168)	(7.4E-10)
	[0.57790]	[-0.50739]	[-6.12585]	[-2.01545]
LREER(-1)	0.160953	1.797362	-6034535.	0.953519
	(0.59146)	(1.90607)	(8665700)	(0.07806)
	[0.27213]	[0.94297]	[-0.69637]	[12.2144]
LREER(-2)	-0.070385	-0.627939	2536542.	-0.063979
	(0.55584)	(1.79129)	(8143849)	(0.07336)
	[-0.12663]	[-0.35055]	[0.31147]	[-0.87209]
C	-0.037505	-4.367806	8575453.	0.340719
	(0.86972)	(2.80281)	(1.3E+07)	(0.11479)
	[-0.04312]	[-1.55837]	[0.67298]	[2.96815]
DV_REER	-0.216895	-0.370045	2077591.	0.086597
	(0.13731)	(0.44249)	(2011744)	(0.01812)

	[-1.57963]	[-0.83627]	[1.03273]	[4.77838]
R-squared	0.985657	0.973572	0.806163	0.989877
Adj. R-squared	0.984581	0.971590	0.791625	0.989118
Sum sq. resids	3.378573	35.08828	7.25E+14	0.058857
S.E. equation	0.167794	0.540742	2458414.	0.022147
F-statistic	916.2826	491.1769	55.45291	1303.863
Log likelihood	52.79326	-99.33363	-2092.213	316.0501
Akaike AIC	-0.658358	1.682056	32.34173	-4.708462
Schwarz SC	-0.437778	1.902635	32.56231	-4.487883
Mean dependent	8.334346	5.173747	19587.92	4.674777
S.D. dependent	1.351308	3.208129	5385577.	0.212304

Determinant resid covariance (dof adj.)	23062842
Determinant resid covariance	16744200
Log likelihood	-1819.030
Akaike information criterion	28.60046
Schwarz criterion	29.48277

Table 5: Lag length

VAR Lag Order Selection Criteria
Endogenous variables: I CPI YGAP LREER
Exogenous variables: C DV_REER
Date: 03/21/09 Time: 23:01
Sample: 1997M01 2007M12
Included observations: 120

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2267.104	NA	3.45e+11	37.91841	38.10424	37.99387
1	-1722.923	1033.944	51868104	29.11539	29.67289*	29.34179
2	-1689.650	61.00170	38940141	28.82749	29.75666	29.20483*
3	-1683.393	11.05323	45930820	28.98989	30.29072	29.51816
4	-1651.630	53.99742	35490693	28.72717	30.39966	29.40637
5	-1624.396	44.48265	29656483	28.53993	30.58409	29.37007
6	-1600.864	36.86557	26451236	28.41441	30.83023	29.39549
7	-1578.606	33.38735	24200844	28.31010	31.09760	29.44212
8	-1552.448	37.49275	20853963	28.14081	31.29997	29.42376
9	-1530.458	30.05389	19377548	28.04096	31.57179	29.47485
10	-1508.956	27.95177*	18279972*	27.94927*	31.85176	29.53409
11	-1498.058	13.44199	20744856	28.03429	32.30845	29.77005
12	-1491.019	8.211286	25343346	28.18366	32.82948	30.07034

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix B: Estimating the Augmented Taylor as exercised in part IV but with using the Overnight Interbank rate as a Policy Rate

Using the overnight interbank rate as a policy rate June 2005- December 2007:
The same exercise performed in part four for estimating the augmented Taylor rule eq. 6, is attempted again but with only two different:

$$i_t = r^* + \pi_t + \gamma_1(\pi_t - \pi^*) + \gamma_2(y_t - y_t^*) + \gamma_3 \Delta xr_t + \gamma_4 \Delta xr_{t-1} + \gamma_5 i_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots (6)$$

First: the overnight interbank rate is used as the policy rate instead of the 3-month deposits rate.
Second: the sample period is from 2005:06 to 2007:12 instead of 1997:01 to 2007:12.

Table 1: Data description

Variable	Description
ON	Overnight interbank rate - end of month (%)
CPI	Consumer Price Index Inflation rate (y-on-y) (%)
IP	Industrial Production (in million EGP)
YPOTEN	Potential Industrial Production (Output) using hp-trending
LREER	Log Real Effective Exchange rate using CPI (%)
DV_REER	Dummy Variable (DV_REER= 1 starting from 2003:01, and zero otherwise)
YGAP	The output gap (IP – YPOTEN)

Table 2: Augmented Taylor Rule estimation output using GMM

Dependent Variable: D_ON
Method: Generalized Method of Moments
Date: 12/23/09 Time: 22:04
Sample(adjusted): 2005M11 2007M12
Included observations: 26 after adjusting endpoints
Kernel: Bartlett, Bandwidth: Fixed (2), Prewhitening
Simultaneous weighting matrix & coefficient iteration
Convergence achieved after: 90 weight matrices, 91 total coef iterations
Instrument list: D_ON(-1 TO -4) YGAP(-1 TO -5) D_LREER(-1 TO -5) CPI(-1 TO -5)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI	0.024074	0.001189	20.24970	0.0000
YGAP	1.15E-08	1.22E-09	9.418394	0.0000
D_LREER	-2.001339	0.346160	-5.781539	0.0000
DV_REER	-0.820231	0.140633	-5.832412	0.0000
D_ON(-1)	1.064623	0.015416	69.05901	0.0000
D_LREER(-1)	-2.181386	0.410984	-5.307717	0.0000
R-squared	0.405421	Mean dependent var		8.763462
Adjusted R-squared	0.256776	S.D. dependent var		0.359510
S.E. of regression	0.309935	Sum squared resid		1.921198
Durbin-Watson stat	2.614464	J-statistic		0.290865

Table 2 above; shows the detailed estimation output of equation (6) above using GMM estimation technique.

From the above results; although the model gave significant variables with the same predetermined theoretical signs (Mohanty and Klau 2004), but with taking into consideration the short sample estimation restrictions, this output can't be documented. Nevertheless; we still believe that using the overnight interbank rate as a policy rate, while estimating Taylor rule for a longer sample, will result in a significant output and a reliable interest rate rule.

However; it's obvious from the R^2 that the model explains only about 40 percent from the total change in the nominal interest rate[53]. In addition; some of the coefficients values are relatively low, especially the output gap coefficient which is approximately equal to zero. This implies that output gap has negligible effect on the nominal interest rate[54].

[53] Compared to R^2 with 12 percent in the augmented Taylor rule derived in part four.
[54] Same conclusion as the augmented Taylor rule derived in part four using the 3-month deposit interest rates.

Table 3: Data spread sheet

obs	ON	CPI	LREER	IP	YPOTEN	DV_REER
2005M06	9.550000	4.732136	130.9100	70097918	74234460	1.000000
2005M07	9.560000	4.311475	129.4600	77530186	75098323	1.000000
2005M08	9.710000	4.702966	130.4600	78154133	75946969	1.000000
2005M09	9.420000	3.726638	129.7100	77442467	76783870	1.000000
2005M10	9.270000	3.078059	128.0400	71988438	77612650	1.000000
2005M11	9.170000	3.383240	125.3800	71160609	78436979	1.000000
2005M12	8.910000	3.147965	125.4900	71552229	79260139	1.000000
2006M01	8.400000	3.439875	126.1600	75361673	80084904	1.000000
2006M02	8.530000	3.978373	125.6100	76543412	80913513	1.000000
2006M03	8.570000	3.659037	126.5100	77295820	81747878	1.000000
2006M04	8.250000	4.376750	127.9100	75627212	82589607	1.000000
2006M05	8.190000	5.394632	129.2900	77014721	83439999	1.000000
2006M06	8.200000	7.259240	126.1700	79466663	84299868	1.000000
2006M07	8.060000	8.413265	124.4300	86306559	85169586	1.000000
2006M08	8.680000	8.910243	123.9600	88394725	86049183	1.000000
2006M09	8.990000	9.530787	121.6100	89054682	86938775	1.000000
2006M10	9.180000	11.79900	118.0200	85569418	87838634	1.000000
2006M11	9.590000	12.14564	119.0200	85410716	88749185	1.000000
2006M12	8.890000	12.42737	118.7000	85861566	89670691	1.000000
2007M01	9.230000	12.29106	116.8000	87624419	90603186	1.000000
2007M02	8.810000	12.57798	117.9600	88767530	91546438	1.000000
2007M03	8.840000	12.78162	118.6000	89993352	92500008	1.000000
2007M04	8.790000	11.47932	119.3100	91397959	93463266	1.000000
2007M05	8.760000	9.885497	119.3800	92717148	94435404	1.000000
2007M06	8.790000	8.430162	119.2100	94046993	95415475	1.000000
2007M07	8.750000	7.619987	118.9800	94532233	96402410	1.000000
2007M08	8.750000	7.942455	118.4200	96524833	97395045	1.000000
2007M09	8.750000	9.145284	116.2400	99169533	98392088	1.000000
2007M10	8.750000	7.342648	114.6900	1.02E+08	99392185	1.000000
2007M11	8.750000	6.654368	117.5300	1.06E+08	1.00E+08	1.000000
2007M12	8.750000	6.711510	115.9600	1.11E+08	1.01E+08	1.000000