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The Effect of Devaluation on Output in the Egyptian Economy: A Vector Autoregression Analysis

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Abstract

The objective of this paper is to analyze the relationship between exchange rate changes and output in the Egyptian economy. This is the first such study that we know of for Egypt. Employing a Vector Autoregression model, the paper conducts the study using annual data for Egypt over the period 1982-2004. The results of the study indicate that devaluations have an initial contractionary effect on output in Egypt. This contractionary effect lasts for a period of as long as four years before the expected positive effect of the devaluation starts to materialize. Moreover, the study clarifies that real exchange rate variations explain a considerable part of real output changes in Egypt. This suggests that it could be somewhat risky for the government to largely allow market forces to determine the value of the Egyptian pound in the current period. Intervention may still be needed to correct undesirable movements in the exchange rate. This could continue at least until the economy makes a full transition to the new flexible exchange rate system in which monetary policy assumes a bigger role in stabilizing the economy.

JEL Classification Codes: C32, E32, F31, O24.

1. Introduction

It is widely believed that exchange rate fluctuations and their direct and indirect effects play an important role in determining macroeconomic performance. This made dealing with exchange rate problems one of the crucial issues that face policy makers in developing countries. The International Monetary Fund (IMF) has also often recommended currency devaluations as the essence of Structural Adjustment Packages (SAP) for countries suffering from balance of payments' deficits and international reserve shortages. As a result, the subject of devaluations and their effects on economic activity has, for many years, attracted a lot of attention in economic literature.

According to economic theory, the devaluation of a country's currency triggers an "expenditure switching" mechanism. Devaluation increases the prices of foreign goods relative to those of domestic goods. The rise in the price of foreign output directs domestic demand away from imports and towards domestic output thereby stimulating import substitution production. Also, the decline in the prices of the country's goods in terms of foreign currencies improves its international competitiveness, thus boosting exports.

This results in an improvement in the country's trade balance and acts as a solution for shortages of international reserves. The expansionary effect of devaluation[1] on aggregate demand is thus believed to increase output and reduce unemployment (Krugman & Obstfeld, 2003).

Contrary to the traditional view, however, substantial research supported by empirical evidence has shown that a devaluation can result in a contractionary impact on output[2]. There are many reasons why a devaluation can decrease an economy's output growth. Among them, for instance, is the rise in the prices of the imported intermediate goods as a result of the devaluation which adversely affects production (Gylfason & Schmid (1983), Hanson (1983),

Gylfason & Risager (1984), Solimano (1986), Van-Wijnbergen (1986), Gylfason & Radetzki (1991)). Devaluations also often cause increases in the general price level, thus lowering international competitiveness, decreasing real income and reducing aggregate demand (Dunn & Mutti, 2000) Moreover, devaluations produce income redistribution effects[3] in favor of groups with low marginal propensities to consume such as exporters and firm owners whose profits increase and away from groups with high marginal propensity to consume such as workers whose real wages decline. This results in a decline in aggregate expenditure and slows economic activity (Diaz-Alejandro (1963), Cooper (1971), Krugman & Taylor (1978)). Devaluations also often create expectations of future devaluations that weaken the domestic and foreign investors' confidence in the economy (Kamin & Rogers (1997) and Berument & Pasaogullari (2003)). Furthermore, counter-inflationary macroeconomic policies used to control the inflationary effects of devaluation reduce aggregate demand and output (Kamin & Rogers, 1997).

According to empirical evidence, there have been situations in which devaluations led to a deterioration in the trade balance. For example, in 1972, the US trade balance declined following a dollar devaluation in 1971. This phenomenon which was labelled the "J-curve", stimulated additional research on the effect of devaluation on the trade balance and the balance of payments (Bahmani-Oskooee, 1985). It was noticed that the time path of the current account after devaluation resembles the letter "J". This is because the current account of the balance of payments tends to decline immediately after devaluation for a period which is often less than a year. Krueger (1983) maintained that the trade balance deteriorates initially because in the short run it primarily includes transactions of goods in transit and under contract. However, as time passes, the relative price changes caused by devaluation start to improve the trade balance by affecting export and import volumes. Magee (1973) introduced the "pass-through" analysis; the idea that, even in the absence of settled contracts, the degree of pass-through is low in the period that immediately follows devaluation. Exchange rate pass-through is the percentage by which import prices rise when the home currency depreciates by one percent. Limited exchange rate pass-through reduces the effect of a nominal exchange rate on the real exchange rate which implies that the quantities of exports and imports remain unchanged for some time. Estimating the time path through which exports and imports respond to price changes, Junz and Rhomberg (1973) affirmed that 50 percent of the full effect of price changes is revealed during the first three years following devaluation, while it takes almost five years for 90 percent of the full effect to materialize. Several studies agreed on the existence of the "J-curve" phenomenon; for instance, (Bahmani-Oskooee (1985), Onafowora (2003), Bahmani-Oskooee & Ratha (2004)).

The contractionary effect of devaluation can be particularly evident in developing countries because of (i) their low import and export demand elasticities with respect to a change in the real exchange rate that result in a slow adjustment in their current accounts[4], (ii) their heavy dependence on imports of intermediate and capital goods which raises costs of production following devaluations, (iii)

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[1] Studies that support the expansionary effect of devaluation include Krueger (1978), Gylfason and Schmid (1983), Kamin (1988), Risager and Tyler (1996), Domac (1997) and Magendzo (2002).

[2] Studies that support the contractionary effect of devaluation include Cooper(1971), Edwards (1986, 1989a), Krugman and Taylor (1978), Morley (1992), Agenor et al. (1993), Kamin and Klau (1998), Bahmani-Oskooee (1998).

[3] The income redistribution effects come as part of the absorption approach introduced by Meade and Tinbergen and further developed by Alexander (1952, 1959), Machlup (1955), Diaz-Alejandro (1963), Cooper (1971), Tsiang (1961) and Krugman and Taylor (1978).

[4] The Marshall-Lerner condition states that assuming a country's current account is initially zero, a real currency depreciation causes a surplus in the current account if the sum of the relative price elasticities of import and export demand exceed unity, i.e. demand for imports and exports is sufficiently elastic with respect to the real exchange rate (Krugman & Obstfeld, 2003).

their large external debt denominated in foreign currencies that increases in terms of domestic currency as a result of devaluation causing bankruptcies, reducing the economy's net wealth and leading to a reduction in expenditure (Cooper (1971), Gylfason & Risager (1984), Van-Wijnbirgen (1986), Acar (2000)) (iv) the fact that their domestic price levels are more likely to rise after devaluation causing a wage-price spiral which negatively affects output and reduces competitiveness (Hanson (1983), Gylfason & Risager (1984), Solimano (1986), Van-Wijnbergen (1986) and Gylfason & Radetzki (1991)) and (v) their high vulnerability to loss of capital caused by weakened confidence in the economy following a devaluation.

In spite of the wide interest in the question of whether devaluations have an expansionary or contractionary effect on output, most of the empirical studies done on developing countries have been concerned with Latin American and South East Asian countries during the 1990s[5].On the other hand, the empirical research on this topic that focused on Middle Eastern and African countries has been extremely limited. Taye (1999) applied a macro-simulation approach to a macroeconomic model for Ethiopia. His results indicated that devaluation has a positive impact on the current account because of the reduction in imports, while it decreases output and employment. On the other hand, Risager and Tyler (1996) reached the opposite conclusion based on a simulation model which they applied to Jordan. Domaç (1997) employed an econometric approach in an application to the Turkish economy over the period 1960-1990. His empirical findings showed that an unanticipated increase in the exchange rate by 10% increased the real output growth by 1.5%. However, he found anticipated devaluations to be statistically insignificant. Kandil and Mirzaie (2003) used a sample of 11 Middle Eastern countries over the period 1971-2000. Their results showed that unanticipated devaluations have a significant influence on output and inflation that varies according to every country's specific circumstances. On the other hand, anticipated devaluations were found to have only a limited effect on output growth and inflation.

It is worth noting that this paper presents the first study that we know of that empirically tests the relation between exchange rate fluctuations and output in Egypt. Analyzing this relation has gained special importance because of the Egyptian government's decision in January 2003 to float the Egyptian pound and the subsequent depreciation of the pound. The government's decision to switch to a floating exchange rate regime implies that the exchange rate of the Egyptian pound will be freely determined by market forces. This will most likely render its fluctuations much more pronounced than they have been before the float. As a result, investigating the relation between exchange rate changes and economic activity becomes crucial in light of the above debate of whether devaluations have expansionary or contractionary effects on the economy. The rest of the paper is structured as follows: section 2. discusses the methodology used and the choice of variables; section 3. deals with the construction of the real effective exchange rate for Egypt used in the paper; section 4. comments on the time series statistical properties of the VAR model; section 5. presents the VAR model estimation results; section 6. deals with the structural analysis (innovation accounting) in the VAR model and finally section 7. concludes and gives policy recommendations.

2. Methodology and Choice of Variables

This paper employs the Vector Autoregression (VAR) technique to test the effect of devaluation on output in the Egyptian economy. This technique was presented by Sims (1980) as a means of overcoming the limitations of the traditional structural approach in modeling macroeconomic variables. Charmeza and Deadman (1997) mentioned the simultaneity bias in a simultaneous equation model caused by the possible existence of a feedback relationship between one or more of the independent variables on the one hand and the dependent variable on the other as one of those limitations. This results in biased coefficients and standard errors estimated by OLS. Charemza and Deadman (1997)

[5] Examples of such studies include Upadhyaya & Upadhayay (1999) that focused on Asian countries.; Bird and Rajan (2000) that focused on Thailand; Rogers & Wang (1995) and Kamin & Rogers (1997) that focused on Mexico; and Hoffmaister & Vegh (1996) that focused on Uruguay.

also stated that the traditional multi-equation modeling has been criticized for two main assumptions namely (i) the zero restriction assumptions imposed on some variables as a solution for the identification problem, and (ii) A priori division of variables into exogenous and endogenous variables. Both of those assumptions are often based mostly on the econometrician's judgment rather than economic theory justifications.

The VAR model on the other hand is a nonstructural approach in the sense that no particular relationships are imposed on the variables based on economic theory. Thus, the only prior information required for analysis is the set of interacting variables within the economic system and the sufficient number of lags that could capture the interrelationships among them and eliminate autocorrelation in the error terms (Pindyck & Rubinfeld, 1998). In the VAR model, all variables are dealt with symmetrically as endogenous variables and every endogenous variable is a function of the lagged values of all endogenous variables which avoids the simultaneity bias problem (Moursi & El-Mossallamy, 2003). Moreover, the unrestricted VAR models can easily be estimated using the OLS method, because the right hand side consists of similar predetermined variables in each equation, as well as serially uncorrelated errors with constant variances (Pindyck & Rubinfeld, 1998).

According to Kamin and Rogers (1997), the relation between the real exchange rate and output could be affected by reverse causation running from output to the real exchange rate and spurious correlations with other external factors. Considering the reverse causation between output and the real exchange rate, real depreciations are often found to accompany macroeconomic contractions, while real appreciations often accompany macroeconomic expansions. Some economists suggested that for example in the case of expansions, the increase in aggregate demand that affects domestic prices causes an appreciation in the real exchange rate. As for the spurious correlation, Berument and Pasaogullari (2003) stated that devaluations are often applied as a response to adverse external or internal shocks, such as an increase in capital outflow, a deterioration in the terms of trade or a rise in international interest rates. These shocks, in turn, contract economic activity causing a decline in output, even before the devaluation is applied.

As a result, in order to accomplish the task of the thesis of testing the effect of devaluation on output, the dynamic nonstructural VAR model is more appropriate to investigate the interrelationship between the real exchange rate and the real output in Egypt. There are three main justifications for this choice. First, the interdependence between the variables that could be dealt with by utilizing the VAR model because all variables are handled symmetrically as endogenous variables. Second, the VAR techniques used for structural analysis namely the impulse response functions and the forecast error variance decompositions are very efficient in clarifying the dynamics of the system. Third, the recent trend in empirical studies dealing with the effect of devaluation on output is to employ more sophisticated techniques in time series analysis.

Investigating whether devaluations are contractionary, Edwards (1986) considered the important effect of monetary and fiscal policies on economic activity in developing countries. Thus, the variables in his model included the ratio of government expenditure to nominal income and the size of the money market in addition to the terms of trade, the real exchange rate and real output. Edwards' findings however proved that the terms of trade variable has no significant impact on output.

Following Edwards (1986) and dropping the terms of trade variable, the VAR model used in this paper emphasizes the Keynesian demand side approach. As such, the choice of the variables in the VAR reflects the connection between output and variables of macroeconomic policy. Using annual data for Egypt, the model is estimated over the period 1982-2004.[6] The decision to use annual data comes as a result of the unavailability of high frequency fiscal policy and output data in Egypt. The VAR used includes four variables namely real output (RGDP); the real effective exchange rate index (REER); the broad money growth rate (M2GR) as a stance for monetary policy; and the overall fiscal deficit as a percentage of GDP, both in nominal terms, as a stance for fiscal policy (Fiscdef). All of the variables are in natural logarithmic form except the rate of growth.

[6] It should be noted that the limited number of observations should be taken into consideration, because utilizing a sophisticated technique such as the VAR method requires including a large number of observations in order to obtain more reliable results.

A critical component of the traditional view of exchange rate is the assumption that a nominal devaluation must lead to a real devaluation[7]. This mechanism is achieved through the improvement of the domestic relative price of exports to imports which triggers an expenditure-switching mechanism. Hence, the real effective exchange rate (REER) index is used in the VAR system. The REER is defined as a country's real exchange rate against a basket of its major trading partners' currencies weighed by their trading shares (Mahroos et al., 2004).As such it gives a more efficient and accurate account of the position and the degree of competitiveness of the economy[8]. This stems from the fact that the REER considers the discrepancy of price levels between a country and all its trading partners. Moreover, the REER gives the overall value of the currency taking into consideration the country's major trading partners and their respective trade shares (Mahroos et al., 2004).

According to Edwards (1986), a nominal is translated into a real devaluation if it is accompanied by the appropriate macroeconomic policies. In particular, fiscal and monetary policies must be consistent with the adopted exchange rate regime in order to maintain sustainable equilibrium (Edwards, 1989b). As such, appropriate stances for monetary and fiscal policies have to be included in the VAR model because of their crucial role in sustaining a real devaluation and controlling its possible inflationary consequences.

In Egypt, the overall fiscal deficit as a percentage of GDP (Fiscdef) is the most suitable stance for fiscal policy for which data is available. Thus, Fiscdef is included in the VAR used in the paper. The overall fiscal deficit as a percentage of GDP is indicative of the adopted fiscal policy, since it reflects the net value based on the difference between the government's total revenues and expenditures[9].

With regards to monetary aggregates, there is no clear-cut decision on which variable to use as a stance for monetary policy. Broad money or domestic liquidity (M2) includes money supply (M1)[10] and quasi money[11]. The substantial amount of quasi money in Egypt can justify utilizing (M2) to account for monetary changes in empirical analyses (Noureldin, 2004). Thus, the broad money growth rate (M2GR) is incorporated in the VAR system as a stance for monetary policy. It is worth noting that the VAR was also estimated using the rate of growth of reserve money[12] as the stance for monetary policy. The results did not change which also indicates the robustness of the VAR.

Hence, the unrestricted reduced form of the VAR model can be described as:

$$X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-2} + \ldots\ldots + A_\rho X_{t-\rho} + e_t$$

where

X_t = [RGDP REER M2GR Fiscdef]' is a (n×1) vector containing each of the n variables included in the VAR.

A_0 = (n×1) vector of intercept terms

A_i = (n×n) matrices of coefficients

e_t = (n×1) vector of error terms.

More information on the definitions of the variables and the sources of the data can be found in Appendix A.

3. Constructing the REER Index for Egypt Used in the Study

A leading paper was recently published by the Information and Decision Support Center (IDSC), namely Mahroos et al. (2004) that clarified different methods to calculate the nominal and real

---

7 Among the assumptions for this to be true is complete exchange rate pass-through and the assumption that aggregate demand increases caused by nominal devaluations do not fuel domestic inflation (Krugman & Obstfeld, 2003).

8 This represents a focus on the net export channel through which exchange rate changes affect output.

9 Ahmed Kouchouk (Economic Adviser at the Ministry of Finance), telephone interview, 10 Feb. 2006

10 The money supply (M1) includes the currency in circulation outside the banking system and the local currency demand deposits.

11 The quasi money includes time and saving deposits in local currency and foreign currency

12 The reserve money (M0) is the monetary base or the high-powered money. It includes the money in circulation outside the CBE and the banks' deposits at the CBE in local currency (The Financial Monthy, 2006). This variable is utilized to manage the domestic liquidity as an intermediate operational target of the monetary policy.

effective exchange rates for Egypt. The paper also investigated the effect of changes in one or more variables on the values of the nominal and real effective exchange rates.

For the purpose of this paper, the annual REER index was calculated by means of a software developed by the (IDSC) study taking the year 2000 as the base year[13]. Applying a geometric average formula[14], the REER index is computed taking all Egypt's trading partners into consideration. Moreover, the sum of the import and export shares of the trading partners is used as weights due to the importance of both import and export sides to account for the impact of exchange rate changes on output. The choice to use the CPI to calculate the REER has been determined by data availability for Egypt and its trading partners. Thus, the REER index is constructed based on the following formula:

$$REER_t = \prod_{i=1}^{m} (E_{i,t}\, P^*_{i,t}/P_t)^{w_{i,t}}$$

REER: the Real Effective Exchange Rate at time t

m: number of all the trading partners included in the computation.

$E_{i,t}$: the nominal exchange rate of Egypt calculated as domestic per foreign currency[15].

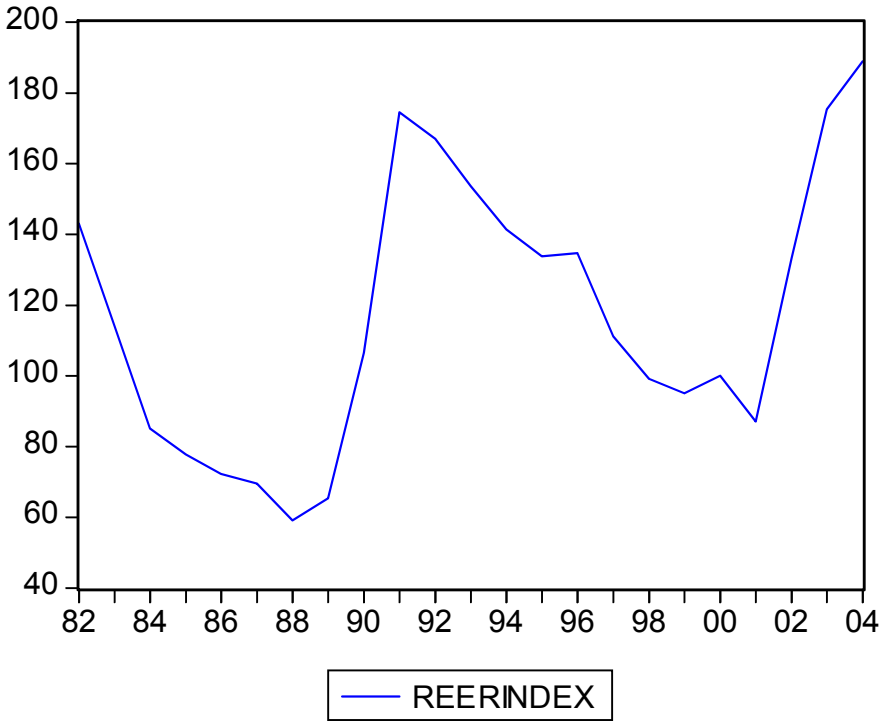
P_t: the Consumer Price Index in Egypt at time t.

$P^*_{i,t}$: the trading partner's Consumer Price Index at time t.

$w_{i,t}$: the total of imports and exports trade weights at time t, where, $\sum^{m} w_{i,t} = 1$, $0 \leq w_{i,t} \leq 1$

It should be noted that a rise in the REER thus calculated indicates a real depreciation which implies an increase in Egypt's international competitiveness. The annual REER index for Egypt calculated by this study and used in the empirical analysis is illustrated in figure (1).

Figure 1: The Real Effective Exchange Rate Index in Egypt (REER) (2000=100) (1982 – 2004)



Source: The REER index calculated by means of the REER software version [1.1] developed by the Information and Decision Support Center (IDSC).

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[13] Full acknowledgement is granted to Professors Wafiq Younan and Tarek Morsy as well as Ms. Mai El-Mossallamy, Ms. Shorouk Idrees and Ms. Shaimaa Ramadan for their valuable comments and for providing the authors with the software for constructing the REER.

[14] Mahroos et. al. (2004) and Ellis (2001) recommend using the geometric average to construct the REER asserting that the preference is based on both theoretical and statistical reasons.

[15] Ei,t = the nominal exchange rate of Egypt is obtained from the ratio of the domestic exchange rate versus the US dollar to the trading partner's currency versus the US dollar.

It should be emphasized that the trends in the REER seen in the figure do not reflect movements in the nominal exchange rate. The official nominal rate (that was used in REER calculations) has been fixed over most of the period. However, as pointed out by Mohieldin and Kouchouk (2002, 2003) the main stages of foreign exchange system arrangements in Egypt over the last five decades can be identified as:

First: A period of a multiple exchange rate system that led to a steady appreciation of the Egyptian pound before May 1987.

Second: A period that witnessed the creation of a new "free" bank foreign exchange market and a number of depreciations of the exchange rate between May 1987 and February 1991.

Third: A period that started with the unification of the exchange rate and its adoption as a nominal anchor in February 1991 as part of the Economic Reform and Structural Adjustment Program (ERSAP) launched by the government in collaboration with the IMF and the World Bank. This period witnessed an appreciation of the real exchange rate by almost 30%. Almost 9% is attributed to nominal exchange rate appreciation while the rest is due to inflation rate differentials between Egypt and its trading partners (Subramanian, 1997).

Fourth: A period of gradual devaluations starting from 2000 that culminated in the floatation of the pound in January 2003.

4. Time Series Statistical Properties of the VAR Model

In spite of Sims' argument that differencing non-stationary variables *I*(1) discards important information about the true data generating process, the majority of macroeconometric literature has always considered non-stationarity of time series as an obstacle that leads to uncertain and misleading (or what is referred to as "spurious") results. This is because there is no tendency for non-stationary variables to return to their long run equilibrium levels (Enders, 1995). Thus, the stationarity of the included variables was examined to ensure the reliability of the estimation of the VAR model. Testing for unit roots using the Augmented Dickey-Fuller (ADF) test, the null hypothesis of the presence of a unit root could not be rejected for any of the variables. Thus, all the variables included in the VAR were found to be non-stationary *I*(1) in levels. All the variables, however, become stationary *I*(0) when first differenced. It should be noted however that due to first differencing, the variables should be interpreted as the rate of growth of real output, the rate of change in the fiscal deficit as a percentage of GDP, the rate of change in the real effective exchange rate and the change in the rate of growth of broad money.

As for the lag structure, based on the Akaike Information criteria (AIC), the Schwarz criteria (SC), Final prediction error (FPE) and Hannan-Quinn information criterion (HQ), the favorable lag length was found to be 3 lags. The selection of this lag length satisfied the conditions of no autocorrelation among residuals, the stability of the VAR model and the joint significance of all the lags in the model.

5. The Estimation Results of the VAR Model

The VAR model incorporates four endogenous variables in their first difference form plus the intercept term using annual data over the period 1982-2004. Three of these variables are in the natural logarithmic form; which are the real output (RGDP), the real effective exchange rate index (REER), and the overall fiscal deficit as a percentage of GDP (FISCDEF), while the growth rate in broad money (M2GR) is calculated using the formula $[(X_t - Xt_{-1})/Xt_{-1}]$. Table (1) illustrates the summary of the VAR model estimation results, whereas the detailed results are shown in table (B.1) in Appendix (B).

Table 1: Vector Autoregression Estimates
Sample (adjusted): 1986 2004
Included observations: 19 after adjustments

	D(REER)	D(Fiscdef)	D(M2GR)	D(RGDP)
R-Squared	0.413598	0.600379	0.919936	**0.751985**
Adjusted R-Squared	-0.759205	-0.198862	0.759808	**0.255956**
Sum Seqs. Resids.	0.491393	1.784001	0.016085	0.000818
SE Equation	0.286180	0.545283	0.051776	0.011674
F-Statistic	0.352658	0.751187	5.745008	1.516011
Log-Likelihood	7.762201	-4.486816	40.24622	68.54845
Akaike AIC	0.551347	1.840717	-2.868023	-5.847205
Schwarz SC	1.197542	2.486913	-2.221828	-5.201010
Mean dependent	0.046753	-0.048695	-0.001095	0.043805
S.D. dependent	0.215765	0.498009	0.105646	0.013534
Determinant resid covariance (dof adj.)		3.63E-10		
Determinant resid covariance		3.61E-12		
Log likelihood		142.4676		
Akaike information criterion		-9.522901		
Schwarz criterion		-6.938121		

* The letter D that precedes each variable indicates that it is used in its first difference form.

Considering the targeted variable (RGDP), the coefficient of determination R^2 indicates that the incorporated variables capture almost 75% of the variations in the first difference of real output. However, the low adjusted R^2 is due to the limited number of observations[16]. The coefficients resulting from the VAR estimation do not provide a complete picture, due to the simultaneous movements of the variables. Thus, the innovation accounting analysis of the VAR model is essential for getting implications and making policy recommendations.

Conducting structural analysis requires imposing a causal ordering on the variables in the VAR that is referred to as the Choleski decomposition. The causal ordering chain should be set such that the first variable in the causal chain is regarded as the one affecting all the other variables in the model or the "policy" variable. On the other hand, the last variable in the chain is the targeted variable on which the impact is tested. As such, the D(REER) is placed as the first variable in the causal chain; while the D(RGDP) is placed as the last one.

Testing for causality and block exogeneity is recommended to determine the ordering of the two remaining variables. This is due to the absence of any definite prior information about the correct order in which these two variables should be included in the VAR. The above tests, however, did not provide a conclusive answer as to the direction of causality between D(Fiscdef) and D(M2GR). It was therefore necessary to make a decision based on the behavior of these variables in the case of Egypt. Considering the fiscal and monetary policies in Egypt, it is worth noting that a large portion of the overall fiscal deficit is financed domestically through the issuance of Treasury Bills which definitely affects the growth rate of broad money. Moreover, during the 1980s, the budget deficit was heavily monetized.

Based on this argument, the causal ordering chain used in the innovation accounting is D(REER) → D(Fiscdef) → D(M2GR)→ D(RGDP).

It is worth noting that the VAR results have been found to be robust to the ordering of the fiscal and monetary policies stances, since reversing their ordering in the causal ordering chain did not have any substantial effect on the results.

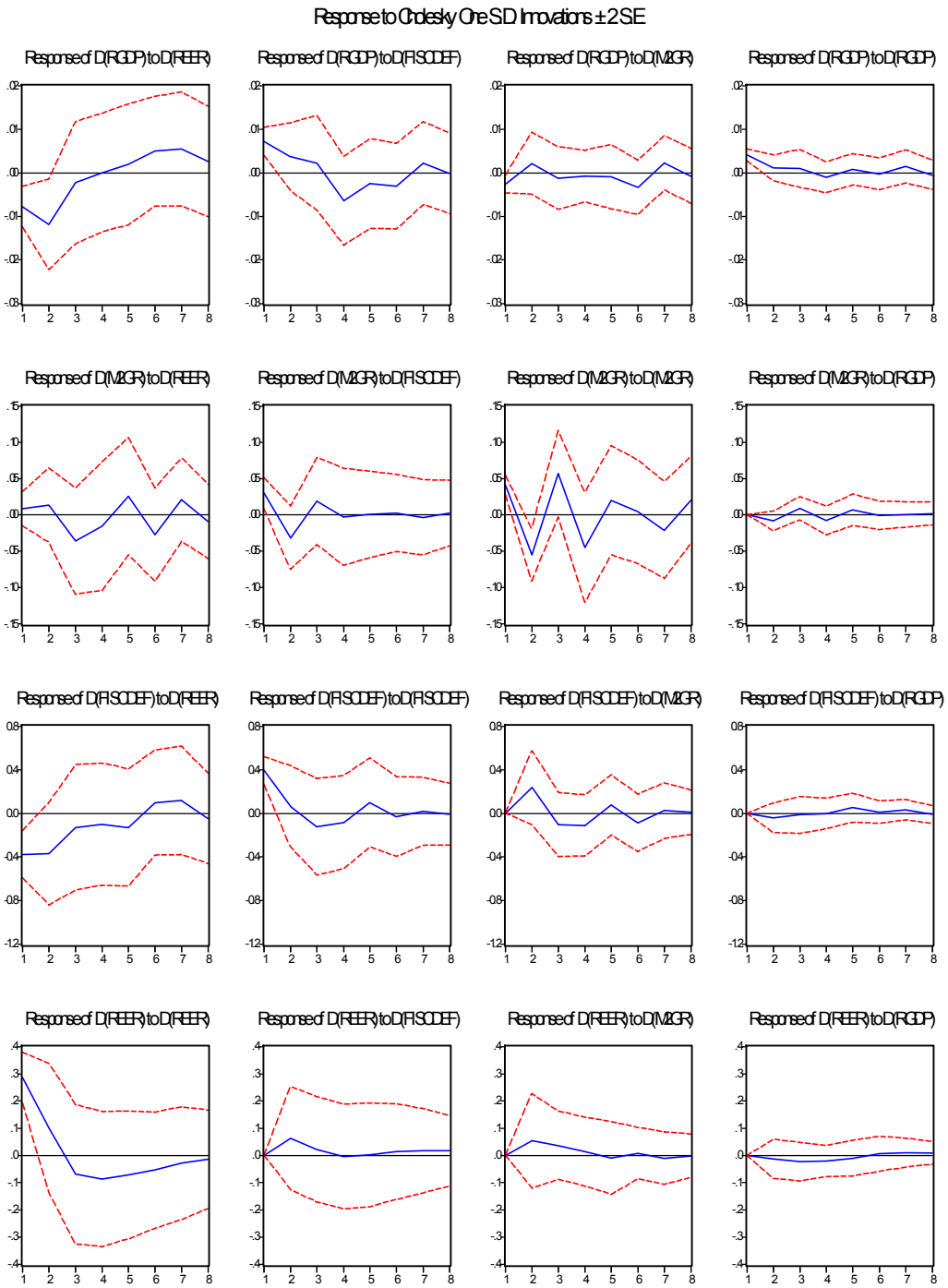
[16] According to Hsing and Chen (2004): " It is expected to have a lower value of R2 when the difference form is used." P.79

6. Innovation Accounting

6.1. The Impulse Response Functions (IRFs):

Impulse response functions (IRFs) show the dynamic behavior of a variable as given by its time path in response to exogenous random shocks given to this and other variables. This makes it possible to compare the predictions of the model with those of economic theory. Figure (2) illustrates the impulse response functions (IRFs) of the VAR model for a period of 8 years. Each panel in the figure depicts the dynamic effect of a one standard deviation innovation on each of the four variables.

Figure 2: The Impulse Response Functions (IRFs)



As seen in the figure, all the variables in the VAR model converge to their pre-shock long-run level. This confirms the stability of the system estimated in the analysis. It is also worth noting that using the variables in their first differences allows the investigation of the impact of sustained shocks on the variables. This is because a one time shock to the variable in its first difference form is considered a permanent shock to the level of the variable.

Considering the effect of devaluation on output, the upper left panel in figure (2) shows that the response of output to a change in D(REER) has a J-curve like shape. This means that a positive shock to D(REER) i.e. a devaluation results in an initial decrease in the rate of growth of real output after which the effect becomes positive. This initial effect lasts for as long as four years which is much longer than the period of about a year over which devaluations are generally thought to have a possible contractionary effect on output. This result is consistent with those of other empirical analyses for developing countries. Based on the above findings, successive short run shocks to the real exchange rate are likely to result in a sustained negative impact on real output, as well as delaying the expected positive effect. This conclusion agrees with Kamin and Rogers' (1997) findings for Mexico that:" sustained real devaluations have been associated with persistent high inflation and contraction in economic activity." (p.26)

In accordance with economic theory, expansionary fiscal policy (a positive shock to D(Fiscdef)) increases the rate of growth of output in the first year. This increase is followed by a gradual decrease which could be explained by the usual need to reverse the fiscal policy after a certain period of time. With regards to the effect of monetary policy, there is no clear effect on D(RGDP) from a positive shock to D(M2GR). This could be explained by the fact that the exchange rate was fixed over most of the period under study. This, in turn, renders the monetary policy ineffective as a stabilization tool.

Devaluations increase money supply and this is shown by the response of the D(M2GR) to a positive shock in D(REER). It is worth noting, however, that while the contractionary effect of devaluation on output lasts, the price of imports rises and cause an inflationary effect on the economy. This, in turn, may require a decrease in the growth rate of broad money until the positive effect of the devaluation on the economy's activity starts to materialize and inflationary pressures recede.

As shown in figure (2), a positive shock to D(REER) (devaluation) slows the growth of overall fiscal deficit as a percentage of GDP. This could imply that the benefit to the government from greater revenues from import duties, Suez Canal and exports of oil and gas has outweighed the expected increase in external debt service obligations and the cost of imported basic goods (Galal, 2003).

Considering the response of D(M2GR) to D(Fiscdef), after a lag, expansionary fiscal policy has a negative effect on the broad money growth rate. This may be explained by the fact that the overall fiscal deficit in Egypt is financed by the issuance of Treasury Bills which reduces the broad money growth rate. A somewhat surprising result, however, has to do with the response of the real effective exchange rate to a positive shock to D(Fiscdef). According to economic theory, expansionary fiscal policy should result in a (REER) appreciation rather than depreciation.

6.2. The Forecast Error Variance Decompositions (VDCs)

The forecast error variance decomposition for each variable reveals the proportion of the movement in this variable due to its own shocks versus the shocks in other variables. Hence, while the IRFs show the direction of the dynamic response of the variables to different innovations, the VDCs provide the magnitude of the response to the shocks. Results are reported in table (2) at various forecast horizons over a period of 8 years. Table (2) gives the forecast error variance decomposition for the 4 variables included in the estimated VAR. However, since D(RGDP) is the target variable, the discussion will focus on analyzing its variance decomposition.

The variance decomposition of D(RGDP) reveals that changes in the real effective exchange rate is the predominant source of variation in the rate of growth of output. The high explanatory power of the innovations in D(REER) is sustained over the entire forecast horizon. As seen in table (2), D(REER) explains 44.8% of the forecast error variance for the change in the rate of growth of output in

the first year. This percentage increases considerably to reach 68.1% and 67% at two and three year forecast horizons respectively.

The change in the overall fiscal deficit as a percentage of GDP represents the second source of variation in D(RGDP) with a percentage of 37.8% and 21.9% in the first and second year forecast horizons respectively. Again, the contribution of D(FISCDEF) remains fairly stable over the whole forecast horizon. The obtained results support real sector data during the 1980s where real GDP growth was mainly a function of government investment before the ERSAP. The third source of variation in the growth of real output sequence is its own shocks with a percentage of 12.2% in the first year that declines to reach a value of 5% in the eighth year. Finally, the results also prove the ineffectiveness of the monetary policy in affecting real output under a fixed exchange rate system since D(M2GR) accounts for a small percentage of the variation in the D(RGDP) sequence.

Table 2: The VAR model Forecast Error Variance Decompositions

Variance Decomposition of D(RGDP):

Period	S.E.	D(REER)	D(FISCDEF)	D(M2GR)	D(RGDP)
1	0.286180	44.85939	37.88845	5.036540	12.21562
2	0.314684	68.10985	21.93362	3.920352	6.036180
3	0.325940	67.01694	22.60794	4.298676	6.076444
4	0.338384	58.72514	31.67466	3.949178	5.651021
5	0.346362	57.91505	32.38585	4.068140	5.630958
6	0.351039	57.40292	31.12814	6.444349	5.024590
7	0.352925	58.66619	29.33186	6.995080	5.006870
8	0.353769	59.16638	28.84938	6.998488	4.985752

Variance Decomposition of D(M2GR):

Period	S.E.	D(REER)	D(FISCDEF)	D(M2GR)	D(RGDP)
1	0.545283	2.701060	33.24086	64.05808	0.000000
2	0.703947	3.561289	27.15171	68.26281	1.024189
3	0.734148	13.15320	18.80858	66.75606	1.282158
4	0.754043	12.72092	15.78137	69.95452	1.543192
5	0.777454	16.05401	14.65551	67.56616	1.724322
6	0.789022	19.91553	13.98801	64.44868	1.647789
7	0.798972	21.44677	13.33314	63.65840	1.561683
8	0.800509	21.32020	12.97471	64.17757	1.527520

Variance Decomposition of D(FISCDEF):

Period	S.E.	D(REER)	D(FISCDEF)	D(M2GR)	D(RGDP)
1	0.051776	47.89471	52.10529	0.000000	0.000000
2	0.083543	56.33876	32.08651	11.23502	0.339704
3	0.109265	54.95005	32.38502	12.30728	0.357648
4	0.119521	53.85215	31.91586	13.89097	0.341021
5	0.124028	53.52258	31.69885	14.00601	0.772565
6	0.127092	53.50764	30.93203	14.79391	0.766423
7	0.130552	54.36932	30.21012	14.51477	0.905793
8	0.132497	54.49427	30.10515	14.47401	0.926568

Variance Decomposition of D(REER):

Period	S.E.	D(REER)	D(FISCDEF)	D(M2GR)	D(RGDP)
1	0.011674	100.0000	0.000000	0.000000	0.000000
2	0.017214	92.86280	4.047213	2.924754	0.165229
3	0.017580	91.09829	4.227946	4.002114	0.671649
4	0.018780	91.16871	3.937484	3.881703	1.012104
5	0.019079	91.39077	3.760084	3.790246	1.058902
6	0.020246	91.38031	3.821175	3.743178	1.055337
7	0.021251	91.08100	4.012412	3.790729	1.115855
8	0.021430	90.83059	4.218528	3.776982	1.173901

Choleski Ordering: D(REER) D(FISCDEF) D(M2GR) D(RGDP)

As can be seen, the results reflect the considerable role that fiscal policy played in affecting the growth of real output over the study period as well as the limited role played by monetary policy. This results from the adoption of a fixed exchange rate system in Egypt over most of this period. This impact of monetary policy on real economic activity will definitely become much more pronounced as a result of the adoption of a more flexible exchange rate regime since 2003.

Finally, it is worth noting that the predominant source of variation in the real effective exchange rate sequence over the entire forecast horizon is its own shocks. This finding confirms the exogenous nature of the REER as a policy variable.

7. Conclusions and Policy Recommendations

Despite the traditional view supporting the expansionary effect of devaluation, a considerable amount of research continued to investigate the relationship between devaluations and output. However, the results obtained from those studies have so far been mixed and inconclusive. This shows the need to conduct further studies on the subject especially ones that take into consideration the individual countries' particular economic circumstances. In view of the absence of any studies investigating the relation between exchange rate changes and output in Egypt, the goal of this paper was to carry out such a study. Towards that end, the paper conducts a quantitative analysis to investigate the relationship between real output and real exchange rate changes in Egypt over the period 1982-2004.

The findings of the paper suggest the importance of changes in the real exchange rate as a major determinant of the variations in the rate of growth of output in Egypt. The results also support the presence of an initial contractionary effect of devaluation on output that lasts for as long as four years before the expected positive effect starts to materialize.

The large influence of the real exchange rate changes on output was shown by the finding that real exchange rate variations explain as much as 45-68% of the changes in the rate of growth of output. This suggests that it may be somewhat risky for the government to largely allow market forces to determine the value of the Egyptian pound in the current period. Intervention may still be needed to correct undesirable movements in the real exchange rate. This is especially recommended in the current period until the economy makes a full transition to the newly-adopted flexible exchange rate system in which monetary policy assumes a bigger role in stabilizing the economy. This increased role will definitely require a carefully developed monetary policy and a strengthening of the institutional capacity of the Central Bank of Egypt.

The long lag with which devaluations were found to produce an expansionary effect on output indicates that currency depreciations cannot be used as a quick remedy for recessions. Consecutive short-run depreciations of the currency should also be avoided because they result in a sustained negative impact on real output that delays the expected positive effect. The results also point out the need for efforts to be made to shorten the period over which the contractionary effect continues.

A possible reason for the slow adjustment of output is the fact that Egyptian exports and imports are not very responsive to the changes in the relative prices caused by devaluations. Increasing the response of exports requires hard work to develop Egypt’s export sector, diversify and improve the quality of its products and, above all, remove the bureaucratic obstacles that have for years weighed heavily on it.

On the other hand, the slow adjustment of the volume of Egyptian imports in response to changes in relative prices has manifested itself in the inflationary wave that hit the economy after the float of the Egyptian pound. The inability of the Egyptian economy to reduce its imports in response to the higher domestic currency prices is mainly explained by Egypt’s heavy reliance on imported production needs. According to the external trade report of the Ministry of Foreign Trade(2005), between 2000-2004, intermediate inputs, capital goods and raw materials have constituted about 40%, 12-17% and 14% of total imports respectively. Taken together, the share of the imports that are directly related to production reaches as much as 65-70% of the total amount of imports. Furthermore, the

limited substitution between domestic and imported inputs increases the economy's dependence on the foreign ones. Thus, the rise in the inflation rate in the aftermath of the floatation decision was largely caused by the increase in the prices of imported inputs thereby increasing the costs of production and causing a general price upsurge. According to the IMF country report (2005), the inflation rate in Egypt in 2004 speeded up after devaluation reaching an annual rate of almost 12% and 17% based on the CPI and the WPI respectively. Besides having a negative impact on the trade balance due to the increase in the import bill, the increase in the prices of imported inputs raises costs of production which could decelerate the production process. Moreover, the resulting increase in the price level reduces real incomes and depresses aggregate demand. This points to the need for Egypt to decrease its reliance on imported production needs as an important factor in containing the contractionary effect on output.

Another possible cause for the short-run contractionary effect of devaluation in Egypt has to do with foreign currency liabilities of firms that increase in value in terms of domestic currency pushing some firms to bankruptcy. According to the Financial Monthly report of the Ministry of Finance, foreign currency credit represents 14.5% of GDP in 2004. This indicates that the balance sheets of banks could be subjected to problems that arise from the sudden movements in the exchange rate system. Reliance on foreign currency loans, particularly the existence of dollarization, can be a direct result of the lack of development of financial markets in Egypt. In a recent study by El-Refaie (2001) that compared the Egyptian financial market to other emerging markets, the Egyptian market was found to be "less than fully developed". This indicates the necessity of increasing the depth of the financial market as a needed measure to cushion the effect of depreciations on the economy.

As for external debt, although its share in the total debt declined gradually in Egypt since the year 2000, the external debt balance still represents a considerable percentage of GDP estimated at 37.8% in the fiscal year 2003/04 as per the CBE annual report. This indicates that the increased burden on the economy due to currency depreciations is quite considerable and should be taken into consideration.

The final recommendation of the thesis has to do with data availability. The lack of data, especially high frequency fiscal and real sector data, put many limitations on this study. Making data available increases the ability of researchers to make more precise recommendations that should be extremely helpful for policy makers in making sound economic decisions.

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Appendix A
Data Definitions and Sources

The Real Output (RGDP)
This variable was obtained through deflating the time series of output (L.E. million) by the GDP deflator taking year 2000 as the base year. Both series were obtained from International Financial Statistics (online, November 2005)

The Real Effective Exchange Rate (REER)
This index was constructed by means of a software developed by the information and Decision Support Center (IDSC) taking 2000 as a base year. The export and import shares of Egypt's trading partners were obtained from the IMF Direction of Trade Statistics (various issues). The nominal Exchange rates and the consumer price indices of Egypt and its trading partners were obtained from the IMF International Financial Statistics CD-ROM (Feb.2004).

The Fiscal Deficit as a percentage of GDP (Fiscdef)
This variable is incorporated as a stance for fiscal policy in Egypt. The data was obtained from the CBE economic review (various issues).

The Broad Money Growth Rate (M2GR)
This variable is incorporated as a stance for monetary policy in Egypt. The data was obtained from International Financial Statistics (online, November 2005).

Appendix B
The VAR Model Estimation Results

Table B.1: Vector Autoregression Detailed Estimates
Sample (adjusted): 1986 2004
Included observations: 19 after adjustments Standard errors in ( ) & t-statistics in [ ]

	D(REER)	D(FISCDEF)	D(M2GR)	D(RGDP)
D(REER(-1))	0.409595 (0.48696) [0.84113]	-1.767350 (0.92785) [-1.90478]	0.123318 (0.08810) [1.39971]	-0.037380 (0.01986) [-1.88178]
D(REER(-2))	-0.438506 (0.61066) [-0.71809]	-0.873517 (1.16353) [-0.75074]	-0.079399 (0.11048) [-0.71867]	0.017397 (0.02491) [0.69842]
D(REER(-3))	0.141607 (0.51899) [0.27285]	-0.162385 (0.98888) [-0.16421]	-0.069295 (0.09390) [-0.73798]	-0.019956 (0.02117) [-0.94261]
D(FISCDEF(-1))	0.134611 (0.27332) [0.49251]	-0.037849 (0.52077) [-0.07268]	0.068292 (0.04945) [1.38105]	-0.000994 (0.01115) [-0.08914]
D(FISCDEF(-2))	-0.007321 (0.22011) [-0.03326]	-0.158470 (0.41939) [-0.37786]	-0.023245 (0.03982) [-0.58372]	0.003130 (0.00898) [0.34861]
D(FISCDEF(-3))	0.140512 (0.22446) [0.62600]	0.396459 (0.42768) [0.92699]	0.034597 (0.04061) [0.85194]	-0.007411 (0.00916) [-0.80945]
D(M2GR(-1))	1.100473 (2.16119) [0.50920]	5.058135 (4.11790) [1.22833]	-1.463057 (0.39101) [-3.74175]	0.069866 (0.08816) [0.79250]
D(M2GR(-2))	1.222536 (3.27097) [0.37375]	7.505750 (6.23246) [1.20430]	-0.970684 (0.59179) [-1.64025]	0.112785 (0.13343) [0.84528]
D(M2GR(-3))	0.758147 (2.18311) [0.34728]	2.775014 (4.15967) [0.66712]	-0.193879 (0.39497) [-0.49086]	-0.001959 (0.08905) [-0.02200]
D(RGDP(-1))	-3.135082 (8.76950) [-0.35750]	-10.05591 (16.7093) [-0.60182]	-2.072192 (1.58660) [-1.30606]	0.272913 (0.35772) [0.76292]
D(RGDP(-2))	0.026207 (6.73972) [0.00389]	3.473943 (12.8418) [0.27052]	0.821025 (1.21937) [0.67332]	0.174645 (0.27492) [0.63525]
D(RGDP(-3))	-2.935164 (6.70796) [-0.43756]	-9.725425 (12.7813) [-0.76091]	-0.040802 (1.21362) [-0.03362]	-0.427416 (0.27363) [-1.56203]
C	0.352386 (0.52990) [0.66500]	0.867378 (1.00967) [0.85907]	0.044723 (0.09587) [0.46649]	0.045137 (0.02162) [2.08815]
R-squared	0.413598	0.600379	0.919936	**0.751985**
Adj. R-squared	-0.759205	-0.198862	0.759808	**0.255956**
Sum sq. resids	0.491393	1.784001	0.016085	0.000818
S.E. equation	0.286180	0.545283	0.051776	0.011674
F-statistic	0.352658	0.751187	5.745008	1.516011
Log likelihood	7.762201	-4.486816	40.24622	68.54845
Akaike AIC	0.551347	1.840717	-2.868023	-5.847205
Schwarz SC	1.197542	2.486913	-2.221828	-5.201010
Mean dependent	0.046753	-0.048695	-0.001095	0.043805
S.D. dependent	0.215765	0.498009	0.105646	0.013534
Determinant resid covariance (dof adj.)		3.63E-10		
Determinant resid covariance		3.61E-12		
Log likelihood		142.4676		
Akaike information criterion		-9.522901		
Schwarz criterion		-6.938121		