Deficits, Debt Financing, Monetary Policy and Inflation in Developing Countries: Internal or External Factors?

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Abstract:
This paper focuses on internal and external factors, which influence the inflation rate in developing countries. A monetary model of inflation rate, capable of incorporating both monetary and fiscal policies as well as other internal and external factors, was developed and tested on three developing countries: Egypt, Iran and Turkey. The model performed well on the data of these countries. It was found that government debt and deficits along with other factors are important determinants of inflation. Furthermore, most sources of inflation in these countries are domestic factors.

Keywords: Demand for money, inflation, fiscal and monetary policies, external and internal factors

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I. Introduction

The determinants of inflation rate in developing countries are extremely important for policy makers as when the causes of inflation are correctly specified the appropriate policy change can be easily diagnosed and effectively implemented. Inflation in a small-open economy can be influenced by both internal and external factors. Internal factors include, among others, government deficits, debt financing, monetary policy, institutional economics (shirking, opportunism, economic freedom, risk, etc.) and structural regime changes (revolution, political regime changes, policy constraints, etc.). External factors include terms of trade and foreign interest rate as well as the attitude of the rest of the world (sanctions, risk generating activities, wars, etc.) toward the country. The objective of this paper is to develop and test a model of inflation rate, which takes into account all of these factors. To the best knowledge of the author, no such study for developing or developed countries exists.

The impact of government deficits and debt financing on inflation rate can be thought of through different channels. Higher government deficits result in higher interest rates, which then leads to lower domestic investment. This crowding-out effect of deficits will eventually translate into a lower formation of capital and lead to a lower aggregate supply and a higher price. However, the impact of deficit on interest rates is still debatable. For example, Bradley (1986) lists twenty-one studies on the deficit-interest rate link and finds that only four provided supporting evidence for a positive and
statistically significant impact of the deficit on interest rates. The rest of the studies finds either no evidence of a significant impact or produces mixed results, including the absence of any linkage. The literature on the deficit-interest rate link for a small-open economy under capital mobility is limited to theoretical studies. Empirical studies pertain to either large open, or closed economy models, see Evans (1985), Giannaros et al. (1985), Tanzi (1985), Cebula (1985), Hoelscher (1986) and Bradley (1986).

The second channel in which deficits and debt financing can affect the inflation rate is through the monetization of the deficit/debt. Monetary authority must then act to ensure that the government’s intertemporal budget is balanced, i.e., a situation of fiscal dominance. With fiscal dominance, an increase in government debt will eventually require an increase in seigniorage. King and Plosser (1985) and Grier and Neiman (1987), e.g., found mixed evidence for fiscal dominance in the United States; however, Ashra et al. (2004) find no systematic relationship between money and fiscal deficits in India. It is also believed that the uncertainty as to the time the deficits are financed can influence the rate of inflation. For example, Dornbush et al. (1990) and Drazen and Helpman (1990) find such an uncertainty creates fluctuation in the inflation rate.

The third channel is the wealth effect of deficits/debt financing. When deficits and debts are financed by issuing bonds and bondholders do not consider bonds as future taxes (a non-Ricardian view), the wealth of the nation is perceived to have gone up. A higher wealth effect increases the demand for goods and services and drives prices up. However, Tekin-Koru and Ozmen (2003) find no support for the linkage between the budget deficit and inflation through the wealth effect in Turkey. Instead, they found that
deficit financing leads to a higher growth of interest-bearing broad money, but not currency seigniorage. Finally, institutional economics reduces information costs, encourages capital formation and capital mobility, allows risks to be priced and shared and facilitates cooperation. These institutions improve aggregate economic performance, see North and Thomas (1973), North (1990), Drobak and Nye (1997), Levine (1997) and Klein and Luu (2003). Improvements in aggregated economic performance should lead to a lower inflation rate.

External factors include terms of trade and foreign interest rate besides, among others, sanctions and wars. The countries, especially developing countries, for which the economy depends heavily on the import of capital, are subject to higher prices through the supply effect (cost-push inflation), as the price of imported capital goods goes up. For example, Senhadji (2003) argues that a stylized developing economy relies heavily on imports for the capital formation and since it faces an upward-sloping supply function of foreign loans, its debt accumulation increases with the size of debt and the cost of servicing the debt. If an unfavorable change in the terms of trade increases the cost of the imported capital then the formation of capital will suffer. This in turn suppresses the aggregate supply and causes inflation. The same result can be obtained with a hike in foreign interest rates, as such hikes make the financing of the imported capital (foreign loans) more expensive. Finally, an unfavorable change in the terms of trade can result in an imported inflation. Bahmani-Oskooee (1995), e.g., finds the world price has a positive impact over the long run on the consumer price in Iran and Arize et al. (2004) find inflation in 82 countries responds positively to the volatility of real and nominal exchange rates. Finally, sanctions, wars, etc. clearly generate, through the supply effect, a
higher inflation. For example, Berument and Kilinc (2004) find shocks in the industrial production of Germany, the United States and the rest of the world will affect positively the inflation rate in Turkey. To the best knowledge of the author there is no study so far in the literature that investigates the impact of all the above-mentioned factors on the inflation rate for developing or developed countries.

The purpose of this study is to develop an empirically testable model for three small-open economy countries, i.e., Egypt, Iran and Turkey. Egypt, with more than 90% of the country being desert land, relies mostly on tourism; Iran, on oil exports and Turkey, on agricultural products. The model used in this study is an augmented version of the monetarist model which, contrary to the existing literature, is designed in such a way to incorporate both external and internal factors, which cause inflation in the country. Furthermore, since the model also incorporates government deficits and debt we could test Sargent and Wallace’s (1986) views that (i) the tighter is the current monetary policy, the higher must the inflation rate be eventually and (ii) that government deficits and debt will be eventually monetized over the long run.

It was found that our model is successful in capturing the impact of fiscal instruments, i.e., deficits, debt and debt management, and of monetary instruments on the inflation rate in developing countries. Furthermore, a policy toward a stronger currency is deflationary and most sources of inflation in the countries under study are domestic factors. Finally, it was found Sargent and Wallace’s view on a tight monetary policy leading to higher inflation over the long run is accepted for Egypt and Turkey. Moreover, their view on government deficits and debt being eventually monetized over the long run applies only to Egypt.
The following section deals with the development of the theoretical model. Section III describes the data and the long-run empirical methodology and results. Section IV is devoted to the short-run dynamic models for these countries. The final section provides some concluding remarks. The appendix fully describes the data.

II. The Model

Many studies on inflation rate for both developed and developing countries used different versions of the monetarist approach. For example, for developed countries, see, McGuire (1976), Meltzer (1977) and Korteweg and Meltzer (1978). For developing countries, see, e.g., Harberger (1963), Bomberger and Makinen (1979), Sheehey (1979), Nugent and Glezakos (1979), Saini (1982), Ize and Salas (1985), McNelis (1987), Darrat and Arize (1990), Bahmani-Oskooee and Malixi (1992), Bahmani-Oskooee (1995) and Ashra et al. (2004).

The monetarist approach to inflation determination is based on the quantity equation, which relates the current rates of change of aggregate expenditure, $m + v$, to the nominal value of current income, $\pi + y$, where $m$, $v$, $\pi$ and $y$ are the growth rate of nominal money supply, velocity of money, price and real income, respectively. In this approach, the inflation rate is related to the growth rate of money in excess of the growth rate of income. Along a steady growth path, the fully anticipated rate of price change remains constant. Departures from long-run equilibrium give rise to an excess demand for, or supply of, money and goods. Another approach is based on the equilibrium in the money market where the demand for money is derived from individual optimization and the supply of money is exogenous. Then again, departures from long-run equilibrium give rise to an excess demand for, or supply of, money and goods. Prices should adjust so
that the markets will be cleared again. To avoid an ad-hoc determination the latter approach will be followed in this paper.

For the sake of simplicity, following Hueng (1999) among many others, we assume that labor is supplied inelastically. Consider an economy with a single consumer, representing a large number of identical consumers. The consumer maximizes the following utility function:

\[
E \left\{ \sum_{t=0}^{\infty} \beta^t U(c_t, c^*_t, g_t, k_t m_t, m^*_t) \right\},
\]

where \(c_t\) and \(c^*_t\) are single, non-storable, real domestic and foreign consumption goods, respectively. \(m_t\) and \(m^*_t\) are the holdings of domestic real \((M/p)\) and foreign real \((M^*/p^*)\) cash balances, respectively. \(E\) is the expectation operator, and the discount factor satisfies \(0 < \beta < 1\). \(g\) is the real government expenditure on goods and services and it is assumed to be a “good”. Including government expenditure in preferences is based on the assumption that individuals benefit from government services in their consumption, say, clean and safe roads, foods which have been inspected, etc. provide a higher utility to consumers. Alternatively, following the literature, we can consider \(g\) as public demand for public goods. In fact, allowing consumer preferences to depend on government spending is not new in the literature, see, e.g., Barro (1981), Aschauer (1985), Christiano and Eichenbaum (1992), Baxter and King (1993), Karras (1994), Ahmed and Yoo (1995), Ambler and Cardia (1997), Amano and Wirjanto (1997, 1998), and Cardia, et al. (2003).

Following Kim (2000), variable \(k_t\), which summarizes risk associated to holding domestic money is also included. However, in contrast with Kim, we assume variable \(k\) is
a function of anticipated variables over the long run and policy and political regime changes over the short run. Specifically, we postulate that over the long run:

\[ \log (k_t) = k_0 \text{defgdp}_t + k_1 \text{debtgdp}_t + k_2 \text{fdgdp}_t. \]  

Equation (2) is held subject to a short-run dynamic system, which is a function of a set of variables included in DUM as well as all other predetermined short-run (stationary) variables known to individuals. These variables include the growth of money supply, changes in fiscal variables per GDP, the growth in exchange rate, domestic and foreign inflation as well as changes in interest rates.

The set of seasonal and interventional dummies DUM includes dummy variables which account for wars, sanctions, political and technical changes, innovations as well as policy regime changes which influence services of money. Note that DUM appears only in the short-run dynamic of the system. Variables defgdp, debtgdp and fdgdp are real government deficits per GDP, the government debt outstanding per GDP and the government foreign-financed debt per GDP, respectively. We assume government debt pays the same interest rate as deposits at the bank (i.e., R). In a risky environment agents substitute real or interest-bearing assets for money.

For example, as the government deficit per GDP increases agents perceive higher future taxes or money supply (inflation). At the same time, the higher is the outstanding government debt relative to the size of the economy, the riskier the environment will be perceived. Individuals may hold these bonds to bridge the gap between the future labor income and expenditures, including tax expenditures. Consequently, we hypothesize constant coefficients \( k_0 > 0 \) and \( k_1 > 0 \). Furthermore, an increase in the amount of government debt held by foreign investors/governments may be considered a cause for
future devaluation of the domestic currency. Consequently, demand for domestic money, may fall, implying $k_2 > 0$.

The utility function is assumed to be increasing in all its arguments, except variable $k$ that is decreasing, and is strictly concave and continuously differentiable. The demand for monetary services $S = m$ and $m^*$, following Sidrauski (1967)] will always be positive if we assume $\lim_{s \to 0} U_s(c, c^*, g, k, m, m^*) = \infty$, for all $c$ and $c^*$, where $U_s = \partial U(c, c^*, g, k, m, m^*)/\partial s$. Assume also that the U.S. dollar represents foreign currency and that, following Stockman (1980), Lucas (1982), Guidotti (1993) and Hueng (1999), purchases of domestic and foreign goods are made with domestic and foreign currencies, respectively.

Given $g$, defgdp, debtgdp and fdgdp, the consumer maximizes (1) subject to the following budget constraint:

$$
\tau_t + y_t + (1 + \pi_t)^{-1} m_{t-1} + q_t (1 + \pi^*_t)^{-1} m^*_{t-1} + (1 + \pi_t)^{-1} (1 + R_t) d_{t-1} + q_t (1 + \pi^*_t)^{-1} (1 + R^*_t) d^*_{t-1} = c_t + q_t c^*_t + m_t + q_t m^*_t + d_t + q_t d^*_t, \tag{3}
$$

where $\tau_t$ is the real value of any lump-sum transfers/taxes received/paid by consumers, $q_t$ is the real exchange rate, defined as $E_t p_t^*/p_t$, $E_t$ is the nominal market (non-official/black-market rate in some developing countries) exchange rate (domestic price of foreign currency), $p_t^*$ and $p_t$ are the foreign and domestic price levels of foreign and domestic goods, respectively, $y_t$ is the current real endowment (income) received by the individual, $m^*_{t-1}$ is the foreign real money holdings at the start of the period, $d_t$ is the one-period real domestically financed government debt which pays $R$ rate of return and $d^*_t$ is the real foreign issued one-period bond which pays a risk-free interest rate $R^*_t$. Assume further that $d_t$ and $d^*_t$ are the only two storable financial assets.
Define \( U_c = \partial U(c, c^*, g, k, m, m^*) / \partial c \), \( U_{c^*} = \partial U(c, c^*, g, k, m, m^*) / \partial c^* \), \( U_m = \partial U(c, c^*, g, k, m, m^*) / \partial m \), \( U_{m^*} = \partial U(c, c^*, g, k, m, m^*) / \partial m^* \) and \( \lambda_t \) = the marginal utility of wealth at time \( t \). Maximizing the preferences with respect to \( m, c, m^*, c^*, d \) and \( d^* \), and subject to budget constraint (3) for the given output and fiscal variables, will yield the first-order conditions:

\[
U_{ct} + \lambda_t = 0 \tag{4}
\]

\[
U_{c^*t} + \lambda_t q_t = 0 \tag{5}
\]

\[
U_{mt} + \lambda_t - \beta \lambda_{e t+1} (1 + \pi_{t+1})^{-1} = 0 \tag{6}
\]

\[
U_{m^*t} + \lambda_t q_t - \beta \lambda_{e t+1} q_{e t+1} (1 + \pi_{t+1})^{-1} = 0 \tag{7}
\]

\[
\lambda_t - \beta \lambda_{e t+1} (1 + R_t) (1 + \pi_{t+1})^{-1} = 0 \tag{8}
\]

\[
\lambda_t q_t - \beta \lambda_{e t+1} q_{e t+1} (1 + R^*_{t}) (1 + \pi_{t+1}^*)^{-1} = 0. \tag{9}
\]

Note that \( x_{e t+1} = E (x_{t+1} \mid I_t) \) is the conditional expectations of \( x_{t+1} \), given current information \( I_t \). From (4) and (5) we can write:

\[
U_{ct} / U_{c^*t} = 1/q_t. \tag{10}
\]

Equation (10) indicates that the marginal rate of substitution between domestic and foreign goods is equal to their relative price. Solving (5), (7) and (9) yields:

\[
U_{c^*t} (1 + R^*_{t})^{-1} + U_{m^*t} = U_{c^*t}. \tag{11}
\]

Equation (11) implies that the expected marginal benefit of adding to foreign currency holdings at time \( t \) must equal the marginal utility from consuming foreign goods at time \( t \). Note that the holdings of foreign currency directly yield utility through its services \( (U_{m^*t}) \). Furthermore, from (9) and (5) we have \( -U_{ct} = \beta \lambda_{e t+1} q_{e t+1} (1 + R^*_{t}) (1 + \pi_{t+1}^*)^{-1} \) which implies that the expected real foreign currency invested in foreign bonds has a forgone
value of \(-U_{c,t}\). Consequently, the total marginal benefit of holding money at time \(t\) is
\[U_{c,t} + U_{m,t}.
\]

Similarly, from (4), (6) and (8), we have:
\[U_{ct} (1 + r_t)^{-1} + U_{mt} = U_{ct}. \tag{12}
\]
Equation (12) implies that the expected marginal benefit from adding to domestic currency holdings at time \(t\) must equal the marginal utility of consuming domestic goods at time \(t\).

To construct a parametric demand for real balances, assume the utility has an instantaneous function as:
\[U(c_t, c_t^*, g_t, k_t, m_t, m_t^*) = (1 - \alpha_1)^{-1} (c_t^{\alpha_1} c_t^{*\alpha_2} g_t^{\alpha_3})^{1-\alpha_1}
+ \xi_k t^{\eta_1} (1 - \eta_1)^{-1} (m_t^{\eta_1} m_t^{*\eta_2})^{1-\eta_1}, \tag{13}
\]
where \(\alpha_1, \alpha_2, \alpha_3, \alpha, \eta_1, \eta_2, \eta\) and \(\xi\) are positive parameters and \(0.5 < \alpha < 1, 0.5 < \eta < 1\). The latter assumption \(0.5 < \alpha < 1, 0.5 < \eta < 1\) is needed to ensure a standard demand for money. Since none of the following results is sensitive to the magnitude of \(\alpha_1, \alpha_2, \alpha_3, \eta_1\) and \(\eta_2\) for the sake of simplicity we assume these parameters are all equal to one.

A few words on the parametric function (13) are worth mentioning. This utility is in the general class of utility functions used by Fischer (1979). However, here the utility function includes the consumption of public and foreign goods as well as the holding of foreign real balances. Furthermore, it allows individuals to get satisfaction from the consumption of domestic and foreign goods as well as public goods even in the absence of money, but with money the satisfaction will obviously increase. It seems, in specification (13), variable \(k_t\), which summarizes risk associated with holding domestic money also affects the holding of foreign money. This is, in fact, true since when the risk
associated with holding domestic currency rises individuals can also substitute foreign currency besides interest-bearing assets or other real assets. Perhaps a more accurate specification for the second expression of (13) would be $\xi(1-\eta)^{-1}(m_0/k_0)^{\eta_1}m^*_t^{\eta_2}(1-\eta)$.

This specification was also tried and the final result, i.e., Equation (16) below, was obtained in the exact functional form, but we needed to impose an extra restriction [i.e., $\eta_1<\eta(1-\eta)^{-1}$] in order to determine the sign of the coefficients theoretically. With this extra restriction, coefficients have the same sign as Equation (16) below. The derivation process is available upon request.

Using (10) and (13) we have:

$$c_t^* = c_t q_t^{-1}.$$  \hfill (14)

Using (11), (13) and (14) we have:

$$m_t^* = \left(\frac{R^*_t}{1+R^*_t}\right)^{-1/(\eta)}(c_t^{1-2\alpha}g_t^{1-\alpha}q_t^{\alpha})^{-1/\eta}(\xi^{1/\eta}k_t^{1/\eta}m_t^{(1-\eta)/\eta})$$ \hfill (15)

Using (12), (13), (14) and (15), and assuming the domestic real consumption ($c_t$) is some constant proportion ($\omega$) of the domestic real income ($y_t$), where for simplicity we assume $\omega=1$, we will have:

$$m_t = \left(i^*\right)^{-1/(\eta)}y_t^{(2\alpha-1)/\eta}x_t^{(1-\eta)/\eta}k_t^{(\alpha+1)/\eta}q_t^{(1-\eta)/\eta},$$ \hfill (16)

log($m_t$) = $m_0 + m_1 i_t + m_2 \log(y_t) + m_3 \log(g_t) + m_4 \log(k_t) + m_5 \log(q_t) + m_6 i^*_t$.

Where, $i^*_t = \log(R^*_t/1+R^*_t)$, $i_t = \log(R_t/1+R_t)$ and,

$m_0 = -1/(1-2\eta) \log(\xi)>0$, $m_1 = -\eta/(2\eta-1)<0$, $m_2 = (1-2\alpha)/(1-2\eta)>0$, $m_3 = (1-\alpha)/(1-2\eta)<0$, $m_4 = -\eta/(2\eta-1) <0$, $m_5 = (\alpha-\eta)/(1-2\eta)<0$, $m_6 = (1-\eta)/(1-2\eta)<0$. 
Equilibrium in the money market requires \( \frac{M_{st}}{p_t} = \frac{M_{dt}}{p_t} = m_t \), where \( M_{st} \) and \( M_{dt} \) are nominal money supply (M1) and money demand, respectively. This implies that

\[
\log(p_t) = \log(M_{st}) - \log(m_t) \tag{17}
\]

Substitute \( \log(q_t) = \log(E_t) + \log(p_t^*) - \log(p_t) \) and (2) in (16) and the resulting equation in (17) to get:

\[
\log(p_t) = \beta_0 + \beta_1 \log(M_{st}) + \beta_2 i_t + \beta_3 i_t^* + \beta_4 \log(E_t) + \beta_5 \log(p_t^*) + \beta_7 \log(p_t) + \beta_8 \log(\text{defgdp})
+ \beta_9 \log(\text{debtgdp}) + \beta_{10} \log(\text{fdgdp}) + \beta_{11} \log(\text{trend}) + u_t \tag{18}
\]

where an \( \log \) before a variable means the logarithm of that variable and \( u_t \) is a disturbance term assumed to be white noise with zero mean. \( \beta \)s are the parameters to be estimated and are defined as:

\[
\beta_0 = -\frac{m_0}{m_7}, \text{ where } m_7 = 1 - m_5 = (1 - \alpha - \eta)/(1 - 2\eta) > 0,
\]

\[
\beta_1 = m_7^{-1} > 0, \beta_2 = -m_1 m_7 > 0, \beta_3 = -m_2 m_7 < 0, \beta_4 = -m_5 m_7 = ?, \beta_5 = -m_6 m_7 > 0,
\]

\[
\beta_6 = -m_5 m_7 = ?, \beta_7 = -m_3 m_7 > 0, \beta_8 = -m_4 m_7 k_0 > 0, \beta_9 = -m_4 m_7 k_1 > 0,
\]

\[
\beta_{10} = -m_4 m_7 k_2 > 0. \text{ To capture technological changes we also added a linear trend to the equation. Equation (18) is a long-run relationship between the inflation rate and its determinants. Note that according to this model } \beta_4 = \beta_6. \text{ However, we will not put this restriction in our estimation so that we can distinguish between imported inflation which is purely exogenous to the country and exchange rate which is a policy variable, but we added the error term } u_t \text{ which is assumed to be white noise.}
\]

According to the model, a higher money supply and a higher interest rate (tight monetary policy) increase the price level over the long run. This confirms the theoretical model of Sargent and Wallace’s (1986, p. 160) view that “[…] given the time path of
fiscal policy and given that government interest-bearing debt can be sold only at a real interest rate exceeding the growth rate n, the tighter is current monetary policy, the higher must the inflation rate be eventually.” A higher real income results in a higher real demand for money and a lower price level. We cannot determine theoretically the impact of the exchange rate and the foreign price level on the domestic price level. A higher government spending results in a higher price level. The impact of deficit, outstanding government debt and debt financed externally, for a given output level, on the price level according to our model is positive. Consequently, these fiscal variables, according to our theoretical model are inflationary. Note that since real government expenditure is considered a “good”, in fact, a public good, its level influences the price, while deficits and debt are measures for future taxes and inflation and so their proportions to GDP may influence the price level.

III. Data, Long-Run Empirical Methodology and Results

The model is tested for three developing countries, Egypt (1975Q1-1999Q3), Iran (1970Q1-2002Q4) and Turkey (1970Q1-2003Q3). All observations are quarterly and the sample period for each country is chosen according to the availability of the data. The sources of data, unless specified, are the *International Financial Statistics* (IFS) online. Some of the variables were available on an annual basis and, therefore, quarterly observations were interpolated, using the statistical process developed by RATS. This procedure keeps the final value fixed within each full period. The appendix gives the description and the sources of the variables. $lp$ is the logarithm of Consumer Price Index (CPI), $lM_s$ is the logarithm of nominal M1, $i$ is the logarithm of $(R/(1+R))$, where $R$ is the discount rate at the annual rate, in decimal points, for Egypt and Turkey. For Iran,
because of the abolition of fixed-predetermined interest rates, the domestic interest rate is irrelevant. Note that the only reason the discount rate was chosen, as a measure for the domestic interest rate, is because of its data availability in the sample period. Quarterly data on other more relevant interest rates is only available for a very short part of the sample period. For instance, Treasury Bills rates are available from 1997Q1 for Egypt and from 1985Q4 for Turkey.

Variable y is the real GDP, which is the nominal GDP divided by CPI. Variable g is the real (nominal deflated by CPI) government expenditures on goods and services, E is the nominal market exchange rate (the black market rate for part of the sample period, see the description of dummy variables in Section IV), which is equal to the domestic currency in terms of $US for all three countries. Foreign rate i* is the logarithm of (R*/1+R*), where R* is the LIBOR (3-month London interbank) rate at the annual rate, in decimal points, for all three countries. Note that in Iran the rate on foreign deposits in the domestic banking system is LIBOR, see Kia (2003). For the sake of consistency and comparison purposes, we also assume LIBOR as a measure for foreign interest rate for Egypt and Turkey. Following Bahmani-Oskooee (1995), among others, the industrial countries unit value export price index was used as a measure for the foreign price p*.

Variables defgdp, debtgdp and fdgdp are deficits, outstanding debt and foreign debt per GDP, respectively. For Turkey, data on outstanding debt is available, but for Egypt and Iran this variable is calculated, see data appendix.

We used Augmented Dickey-Fuller and non-parametric Phillips-Perron tests to investigate the stationarity property of the variables. According to the test results, all variables are integrated of degree one (non-stationary). They are, however, first-
difference stationary. For the sake of brevity, these results are not reported, but are available upon request.

We analyze a p-dimensional vector autoregressive model with Gaussian errors of the form

\[ X_t = A_1 X_{t-1} + \ldots + A_k X_{t-k} + \mu + \phi \text{DUM}_t + u_t, \quad u_t \sim \text{iid}(0, \Sigma), \]  

(19)

where \( X_t = [l_{p_t}, lM_{s_t}, i_t, ly_t, lE_t, lg_t, defgdp_t, debtgdp_t, fkgdp_t] \), \( \mu \) is \( p \times 1 \) constant vector representing a linear trend in the system.

The p-dimensional Gaussian \( X_t \) is modeled conditionally on long-run exogenous variables \( i^*_t, l_{p^*_t} \) and the short-run set of \( \text{DUM}_t = (Q_{1t}, \ldots, Q_{4t}, \text{intervention dummies and other regressors that we can consider fixed and non-stochastic}) \), where \( Q \)’s are centered quarterly seasonal dummy variables. Parameters \( A_1, \ldots, A_k, \phi, \text{ and } \Sigma \) are assumed to vary without restriction. The error correction form of the model is

\[ \Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \mu + \phi \text{DUM}_t + u_t, \]  

(20)

where \( \Delta \) is the first difference notation, the first \( k \) data points \( X_{t-1}, \ldots, X_{0} \) are considered fixed and the likelihood function is calculated for given values of these data points. Parameters \( \Gamma_1, \ldots, \Gamma_{k-1} \) and \( \Pi \) are also assumed to vary without restriction. However, the hypotheses of interest are formulated as restriction on \( \Pi \).

Note that the set of dummy variables that constitutes the set of \( \text{DUM} \) affects only the short-run dynamic of the system. Except \( Q \)’s these dummy variables vary for each country. They account for institutional and policy regime changes, which could affect inflation rate in these countries, see the next section for a complete description of these dummy variables.
In determining a long-run relation between the domestic price level and its
determinants, conditional on the foreign price level and the interest rate, we need to test
whether the domestic price level contributes to the cointegrating relation. If $\Pi$ has a
reduced rank we want to test whether some combinations of $X_t$ have stationary
distributions for a suitable choice of initial distribution, while others are non-stationary.
Consequently, we need to find the rank of $\Pi$, i.e., $r$.

In determining the lag length one should verify if the lag length is sufficient to get
white noise residuals. As it was recommended by Hansen and Juselius (1995, p. 26), set
$p=r$ in Equation (19) and test for autocorrelation. LM(1) and LM(4) will be employed to
confirm the choice of lag length. The order of cointegration ($r$) will be determined by
using Trace and $\lambda_{\text{max}}$ tests developed in Johansen and Juselius (1991). Following Cheung
and Lai (1993), both tests were adjusted in order to correct a potential bias possibly
generated by a small sample error. Tables 1 to 3 report the result of $\lambda_{\text{max}}$ and Trace tests
as well as the identified long-run relationships in space.

According to diagnostic tests reported in these tables, the lag length 4 for Egypt
and Iran and 5 for Turkey was sufficient to ensure that errors are not autocorrelated.
According to normality test results (not reported, but available upon request), the errors
are not normally distributed for Iran and Turkey data. However, as it was mentioned by
Johansen (1995a), a departure from normality is not very serious in cointegration tests,
see also, e.g., Hendry and Mizon (1998). For Egypt, (Table 1) both $\lambda_{\text{max}}$ and Trace tests
reject $r \leq 4$ at 5% level while we cannot reject $r \leq 5$, implying that $r=5$. As for Iran and
Turkey, however, tables 2 and 3, both $\lambda_{\text{max}}$ and Trace test results reject $r \leq 3$ at 5% level while we cannot reject $r \leq 4$, implying that $r=4$.\footnote{1}

Tables 1 to 3 about here

Since we found more than one cointegrating relationship we need to identify the estimated cointegrating vectors. Namely, in order for the estimated coefficients of cointegrating equations to be, in fact, economically meaningful, identifying restrictions must be imposed to ensure the uniqueness of both $\beta$ and $\alpha$. Following, e.g., Johansen and Juselius (1991) and Johansen (1995b), among many others, we can test for the existence of possible economic hypotheses among the cointegrating vectors in the system. The bottom panel of tables 1 to 3 reports the identified relationships for each country. As the Chi-squared in each table indicates, restrictions are jointly accepted, the system is identified and according to Theorem 3 of Johansen (1995b), the rank condition is satisfied. For the sake of brevity, the rank conditions are not reported, but are available upon request.

Figures 1 to 3 plot the calculated values of the recursive test statistics for the long-run identified relationships for Egypt, Iran and Turkey, respectively. Note that these statistics are recursive likelihood-ratios normalized by the 5% critical value. Thus, calculated statistics that exceed unity imply the rejection of the null hypothesis and suggest unstable cointegrating vectors. The broken line curve (BETA\_Z) plots the actual disequilibrium as a function of all short-run dynamics including seasonal dummy variables, while the solid line curve (BETA\_R) plots the “clean” disequilibrium that corrects for short-run effects. We hold up the first fifteen years for the initial estimation.
As the figures show, all these identified equations appear stable over the long run when the models are corrected for short-run effects.

Figures 1 to 3 about here

Having established that the long-run equations are stable, we will analyze the identified long-run equations in all three countries.

(A) Long-Run Price Determination

The first row of the bottom panel in tables 1 to 3 reports the identified long-run price determination.

(i) Monetary policy: According to our theoretical model, we would expect both the level of money supply and interest rate to have a positive influence on the price level over the long run. Based on our estimation result for Iran and Turkey, the supply of money has a positive impact on the price level, though it is not statistically significant for Iran. For Egypt, however, while the money supply is not statistically significant, it reduces the price level. To the best knowledge of the author, there is no study for Egypt, but the result for Iran is consistent with Bahmani-Oskooee’s (1995) finding, though he uses M2.

Our result for Turkey confirms Baydur and Süslü’s (2004) finding, i.e., the tight monetary policy in Turkey over the period 1989 to 1995 resulted in a rise in the general price level because of an outflow of foreign resources. However, their analysis is mostly a short-term study, while our finding (Table 3) is a long-run conclusion. The impact of the level of interest rate on the price level is positive and consistent with our model. However, the estimated coefficient for Egypt is not statistically significant. Note that the

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1 Since unrestricted cointegrated equations, when \( r \) is more than one, are meaningless they were not
impact of the domestic interest rate on the price level, due to the abolishment of interest rates, is not relevant for Iran in our sample period. Consequently, Sargent and Wallace’s view that “[…] the tighter is current monetary policy, the higher must the inflation rate be eventually” cannot be rejected at least for Turkey among these three countries.

Considering the exchange rate as a monetary instrument, a depreciation of the domestic currency in all these countries leads to an increase in the price level. The positive impact of the exchange rate on the price level confirms the finding of Bahmani-Oskooee (1995). So far, we found the domestic monetary policy, including the exchange rate policy, has been a major contributor to inflation over the long run in these countries, especially in Turkey. Note that according to our model, the coefficients of the exchange rate and of the foreign price should be the same. However, when we imposed this restriction, either the rank condition was violated (case of Turkey and Iran) or the joint restriction was not accepted. Consequently, we left these coefficients unrestricted.

(ii) Fiscal policy: The long-run estimated coefficient of the log of real government expenditures is positive, as our model predicts, and statistically significant for Egypt and Iran. However, this coefficient is statistically insignificant for Turkey. To the best knowledge of the author, no study has dealt with the impact of the government expenditures on the price level for these countries and so comparison is not possible.

The long-run estimated coefficient of deficits per GDP for Egypt is negative, but is statistically insignificant. This coefficient is estimated to be positive for Iran and Turkey, and statistically significant. This result confirms our theoretical model. The result on Turkey is consistent with the finding of Tekin-Koru and Ozmen (2003). The estimated reported but are available upon request.
coefficient of government debt per GDP is statistically significant for all three countries, but it has a positive sign only for Egypt, confirming our theoretical model. This implies that a higher government debt in Egypt is associated with a riskier environment while in Turkey and Iran the opposite is true [see Equation (2)]. The estimated coefficient of externally financed government debt per GDP is not statistically significant for any of these countries over the long run. However, as we will see later in this paper the situation is different over the short run. So far, we found both monetary and fiscal policies have an effective impact on inflation rate in Egypt, Iran and Turkey. More interestingly, our finding indicates that, in Turkey, not only the money supply, but also the level of interest rate, when government debt and deficits exist, cause inflation over the long run.

(iii) External factors: Foreign interest rate, contrary to what our theoretical model predicts, has a negative impact on the price level in these countries. However, the estimated coefficient is not statistically significant for Turkey. One possible explanation for this result is that as foreign interest rate increases demand for foreign deposits/bonds will go up and the demand for goods and services, therefore, will fall with a depressing impact on price. The estimated long-run coefficient of foreign price is statistically significant for Egypt and Turkey and is positive for Egypt and Iran (i.e., imported inflation exists for these countries), but it is negative for Turkey. The negative impact of the foreign price on the domestic inflation rate in Turkey could be the result of the impact of the foreign price on the aggregate supply over the long run. This is due to the fact that the foreign price, according to our estimated long-run aggregate demand equation (third identified equation in the bottom panel of Table 3), has a positive impact on the demand
price in Turkey. Our result for Iran confirms Bahmani-Oskooee’s (1995) finding that imported inflation is a source of inflation in Iran.

In general, so far we found domestic factors, controlled by monetary and fiscal authorities, can be very effective in curbing inflation in developing countries, at least for Egypt, Iran and Turkey. Finally, the impact of real GDP as expected theoretically is negative and statistically significant for all three countries. This result confirms the findings of Bahmani-Oskooee (1995) for Iran and Neyapti (2004) for Turkey.

(B) A Long-Run Demand for Money

The second row of the bottom panel in tables 1 to 3 reports a long-run demand for money. Restricting the log of the price level to one might result in an estimate of a long-run demand for real balances among our cointegrating relationships. Note that according to our model the demand for real balances should be a function of the real exchange rate. Here in the cointegration system we have nominal exchange rate and foreign price. Consequently, this restricted equation is not equivalent to the long-run demand for real balances of Equation (16). For the sake of identification, we are restricted to this equation.

The estimated coefficient of the domestic interest rate, not relevant for Iran, has a correct sign for Turkey (see Table 3) and is statistically significant. However, for Egypt, it is not statistically significant and has a wrong sign. This is also true for the scale variable (log of real income) for Egypt. The scale variable for Iran and Turkey has a correct sign, but is statistically significant only for Iran. The coefficient of the nominal exchange rate and the foreign price is statistically significant for all three countries, but has a positive sign for Iran and a negative sign for Egypt and Turkey. Note that we could
not determine the sign of the real exchange rate in Equation (16). Furthermore, the
estimated identifying equation reported in tables 1 to 3, as explained above, is not an
exact estimate of Equation (16).

The estimated coefficient of foreign interest rate is statistically significant for all
three countries, but has a wrong sign for Turkey and Egypt implying that as the foreign
rate goes up agents substitute domestic money for foreign money in their portfolios. The
estimated coefficient of the real government expenditures has a correct sign and is
statistically significant for Iran and Turkey, but it has a wrong sign for Egypt and is not
statistically significant. The estimated coefficient of deficits per GDP and debt financed
externally per GDP is not statistically significant for any of these countries. The
estimated coefficient of debt per GDP while not statistically significant for Egypt, is
statistically significant for both Iran and Turkey. But this coefficient is positive for Iran
and negative for Turkey. This result implies that for two different economic systems, a
traditional one in Turkey and a non traditional one in Iran, the government debt is
perceived differently in demanding money if we can really consider this long-run
restricted equation a demand-for-money relationship.

(C) Long-Run Aggregate Demand and Supply

The third identified equation for Egypt and Iran, third row of the bottom panel of
tables 1 and 2, resembles an aggregate supply relationship. To obtain an identified
system, we needed to restrict the government expenditures and the foreign financed debt
for Egypt and Iran, respectively. For Egypt, a higher exchange rate (a lower value for
domestic currency) and an increase in the foreign price (imported inflation) and in the
domestic interest rate result in an upward shift in the aggregate supply over the long run.
Since the estimated coefficient of the real government expenditures in Iran is negative and is statistically significant, we can conclude that as government expenditures increase, the aggregate supply will shift to the right. Consequently, an increase in real government expenditures in Iran will raise the output over the long run. As for external factors, the estimated coefficient of foreign interest rate is negative and statistically significant for both Egypt and Iran implying that a higher foreign interest rate leads to higher economic activities in these countries. This may be due to the fact that as foreign interest rates go up foreign financing becomes more expensive and investors/governments rely more on domestic resources. Note that the coefficient of foreign financed debt is statistically significant and positive (a depressing effect) for Egypt.

We also checked Sargent and Wallace’s (1996) view that government deficits and debt will be eventually monetized over the long run. However, with this hypothesis, we could get an identified system only for Egypt. As the fourth identified equation, Table 1, bottom panel, fourth row shows, the hypothesis is accepted as all fiscal variables have positive and statistically significant estimated coefficients. We also checked this hypothesis as an independent long-run relationship for Iran and Turkey. For both countries (for Iran, $\chi^2 (2)=16.28$, p-value=0.00 and for Turkey, $\chi^2 (3)=17.27$, p-value=0.00) the hypothesis was rejected. Consequently, Sargent and Wallace’s view that government deficits and debt will be eventually monetized over the long run applies only to Egypt.

The final identified equation for Egypt (Table 1) and the third identified equation for Turkey (Table 3) may resemble an aggregate demand relationship. The coefficient of both money supply and interest rate is statistically significant in both countries.
Interestingly, while an expansionary monetary policy depresses the aggregate demand in Egypt it stimulates the aggregate demand in Turkey, everything else being equal. However, the estimated coefficient of domestic interest rate is positive for both countries implying that a higher domestic interest rate results in an upward shift in aggregated demand in both countries over the long run. Consequently, Sargent and Wallace’s view that “[…] the tighter is current monetary policy, the higher must the inflation rate be eventually” cannot be rejected again for Egypt and Turkey. The estimated coefficient of the nominal exchange rate is statistically significant in both countries, but it is negative for Egypt and positive for Turkey. This implies that a devaluation of currency in Egypt does not improve the balance of trade while it does in Turkey, indicating, perhaps, the Marshall-Lerner condition may not be satisfied in Egypt. The estimated coefficient of the foreign interest rate is negative and is statistically significant for both countries indicating that as the cost of external borrowing increases aggregate demand falls in these countries over the long run.

The estimated coefficient of the foreign price is statistically significant in both countries and as one would expect theoretically, the aggregate demand shifts to the right in Turkey, but the reverse is true for Egypt. Considering the estimated aggregate supply equation above for Egypt, it seems the imported inflation (the impact of the foreign price) in Egypt influences the domestic price level through the aggregate supply rather than through the aggregate demand. The estimated coefficient of the real government expenditures is statistically significant in both countries, but the increase in government expenditures is expansionary in Turkey, as one would expect, but has a depressing effect in Egypt. For the sake of identification, we needed to allow the government deficits and
outstanding debt to influence the aggregate demand in Egypt. While the estimated coefficient of government deficits was found to be statistically insignificant, the estimated coefficient of the outstanding debt is statistically significant and is negative. As it was found earlier in this paper, a higher government debt in Egypt is associated with a riskier environment and so agents will increase their demand for interest-bearing assets as the outstanding debt increases and, everything else being the same, the demand for goods and services will fall.

**D) Long-Run Exchange Rate Relationship**

The last identified equation for Iran (Table 2) and Turkey (Table 3) may resemble an exchange rate determination in these countries. Note that variable $E$ is the market-determined exchange rate. The estimated coefficient of the domestic price level, as one would expect theoretically, is positive and statistically significant for both countries. The estimated coefficient of the domestic interest rate, not relevant for Iran, is statistically significant for Turkey and has a positive sign, indicating that a higher interest rate over the long run causes a depreciation of the domestic currency. One possible explanation is that perhaps the financial capital is not as mobile as to help the inflow of capital to cause the value of currency to go up as the interest rate increases.

The estimated coefficient of the level of the real income is statistically significant in both countries, but has a negative sign for Iran and a positive sign for Turkey. This implies that as the income in Turkey goes up the demand for imports, and so the demand for U.S. dollars, goes up, and causes the currency to depreciate, but this is not necessarily true for Iran for which crude oil is the major export. In Iran, a higher income could be due to a higher oil price which by itself would help to appreciate the value of the domestic
currency in terms of the U.S. dollars, noting that U.S. is a net importer of crude oil and so the value of its currency falls as oil price rises. This result is consistent with Bahmani-Oskooee’s (1996) finding if we normalize Case 2 of his Table 1 on market exchange rate.

The estimated coefficients of foreign price and interest rate are statistically significant for both countries. As one would expect theoretically, the estimated coefficient of foreign interest rate is positive and the estimated coefficient of foreign price is negative for both countries. Finally, the estimated coefficient of debt financed externally is statistically significant for both countries. However, it seems as the level of the foreign-financed debt in Iran increases its currency appreciates over the long run, but the reverse is true for Turkey.

IV. Short-Run Dynamic Models of Inflation Rate

Having established in the previous section that long-run and identified relationships to describe the price level and its determinants for each country exist, we need to specify the ECM (error correction model) that is implied by our cointegrating vectors. Following Granger (1986), we should note that if small equilibrium errors can be ignored, while reacting substantially to large ones, the error correcting equation is non linear. All possible kinds of non linear specifications, i.e., squared, cubed and fourth powered of the equilibrium errors (with statistically significant coefficients) as well as the products of those significant equilibrium errors were included.

In estimating ECMs, several concerns are important. First, to avoid biased results, we allow for a lag profile of four quarters. Second, having too many coefficients can also lead to inefficient estimates. To guard against this problem and ensure parsimonious estimations, we select the final ECMs on the basis of Hendry’s General-to-Specific
approach. Tables (4) to (6) assemble the results from estimating ECMs for Egypt, Iran and Turkey, respectively.

In these tables, White is White’s (1980) general test for heteroskedasticity, ARCH is five-order Engle’s (1982) test, Godfrey is five-order Godfrey’s (1978) test, REST is Ramsey’s (1969) misspecification test, Normality is Jarque-Bera’s (1987) normality statistic, $L_i$ is Hansen’s (1992) stability test for the null hypothesis that the estimated $i$th coefficient or variance of the error term is constant and $L_c$ is Hansen’s (1992) stability test for the null hypothesis that the estimated coefficients as well as the error variance are jointly constant. None of these diagnostic checks is significant. According to Hansen’s stability test result, all of the coefficients, individually or jointly, are stable. Both level and interactive combinations of the dummy variables included in the set DUM were tried for the impact of these potential shift events in the models. As it was mentioned in the previous section, DUM also appeared in the short-run dynamic of the system in our cointegration regression.

Tables 4 to 6 about here

(A) Short-Run Dynamic of Inflation Rate in Egypt

For the dummy variables included in the set of DUM which account for regime/institutional changes, we consider six major changes that have characterized Egypt during our sample period (see The Middle East and North Africa, 2004). (i) On March 26, 1979, Egypt signed a peace treaty with Israel under U.S. auspices. Dummy variable peace = 1 since 1979Q2, and = 0, otherwise, accounts for this political change. (ii) In February 1991, new market related currency exchange arrangements as a prelude to a single unified rate, with full convertibility no later than February 1992, were
introduced. The arrangements allowed for the determination, by the commercial banks, of a free-market rate of exchange, although an ‘official’ Central Bank rate continued to be set at not more than 5% less than the commercial bank rate. This two-tier system resulted in an effective devaluation of nearly 40% compared with the official rate in the previous year. Dummy variable flex = 1 since 1991Q1, and = 0, otherwise, was developed to account for this policy regime change.

(iii) A new sales tax of between 5% and 30% was introduced on most goods and services in May 1991. Dummy variable price = 1 for 1991Q2, and = 0 otherwise, accounts for a jump in price for this fiscal policy change. (iv) In late 1994, price subsidies were eliminated or substantially reduced throughout the public sector, and schedules existed for the removal of the remaining subsidies. This fiscal policy resulted in a hike in price level in late 1994 and early 1995. Dummy variable pricesub = 1 for the period 1994Q4 and 1995Q1, and = 0 otherwise, accounts for this policy change.

(v) In July 1993, the government’s declared aim was to reduce Egypt's maximum import tariff from 80% (to which the maximum tariff had been cut from 100% earlier in 1993) to 50% over a four-year period. In February 1994, the maximum import tariff actually lowered from 80% to 70%. In January 1996, as part of its drive to stimulate industrial investment, the government cut import tariffs on capital goods from 20%-40% to 10%, and thirteen free-trade zones were approved. To account for this policy regime change, dummy variable tariff was constructed. It is zero up to 1993Q1 and is equal to 0.25 in 1993Q2, increases linearly to 1 in 1996Q1 and remains 1 for the rest of the period. (vi) In mid-1998, Egypt was admitted to the Common Market for Eastern and
Southern Africa (COMESA). Dummy variable common = 1 since 1998Q2 and = 0 otherwise, was constructed to account for this event.

According to our estimation results reported in Table 4, the error-correction term is significant for only the error term generated from the first identified equation, see Table 1. None of the other equilibrium errors was found to be statistically significant. Interestingly, the error term is non linear implying that individuals in Egypt may ignore a small deviation from equilibrium, but react drastically to a large deviation. According to a positive estimated coefficient of money supply growth, this variable is a determinant of the inflation rate in Egypt over the short run. The change in interest rate has a negative estimated coefficient implying that a tight monetary policy reduces the inflation rate over the short run. Since the estimated coefficient of real GDP is positive, as the growth of real GDP increases the inflation rate in Egypt increases. The growth in the depreciation of the domestic currency (the growth of exchange rate) results in a higher inflation rate in Egypt, as the estimated coefficient of this variable is positive. Since the estimated coefficient of the foreign inflation rate is positive, the imported inflation rate is also a major cause of the inflation rate in Egypt over the short run as it is over the long run, see Table 1.

As the estimated coefficient of the change in deficits per GDP indicates, this variable affects negatively the inflation rate after a quarter, and after three quarters it will raise the inflation rate, but again after a year, it causes the inflation rate to fall. The overall coefficient (the sum of these coefficients) is negative. This finding confirms our long-run result, even though the long-run coefficient was found to be statistically insignificant (Table 1). As the estimated coefficient of the debt per GDP indicates, this
fiscal policy variable causes the inflation rate to go up after three quarters, but after a year it has a depressing effect on the inflation rate with an overall negative impact on the inflation rate over the short run. However, as we found earlier over the long run (Table 1), this fiscal variable has a positive impact on the inflation rate over the long run.

As for institutional and other changes, the introduction of a single market determined exchange rate, finalized in February 1992, helped to reduce the inflation rate because the growth of real government expenditures was found, since then, to lower inflation rate. This is due to the negative estimated coefficient of the real growth in government expenditures after the introduction of this policy, see the coefficient of \((\Delta \log)\) (flex) in Table 4. Furthermore, since the intercept flex is also negative we can conclude that the inflation rate fell in general when this policy went into effect. However, the introduction of a new sales tax in May 1991 as well as the elimination of price subsidies in late 1994 resulted in an increase in the inflation rate, as the estimated coefficient of these dummy variables is positive. Finally, the estimated coefficient of foreign financing after the peace agreement with Israel is negative implying that the treaty helped the foreign financing of debt to have a negative impact on inflation. None of the other policy regime and institutional changes has any impact on the inflation rate in Egypt. The overall conclusion is that the sources of inflation in Egypt are mostly internal and include both fiscal and monetary policies.

(B) Short-Run Dynamic of Inflation Rate in Iran

For the dummy variables included in the set of DUM which account for regime/institutional changes, we consider seven major policy regime changes that have characterized Iran [see various publications of the Central Bank of the Islamic Republic
of Iran, including *Economic Trends*, and Kia, (2003)]: (i) The revolution of April 1979. (ii) The first formal U.S. sanctions against Iran ordered by President Carter in April 1980, following the break in diplomatic relations between the two countries. (iii) The Islamization of the banking system that began in March 1984. (iv) The Iraq-Iran war over the period 1980-1988. (v) The unification of official and market-determined foreign exchange rates since late March 1993. (vi) The introduction of inflation targeting by the Central Bank over the period March 1995 through March 1998, and (vii) the introduction of the first privately owned financial institution in September 1997. Accordingly, we use the following dummy variables to represent these potential policy regime shifts and exogenous shocks: $Rev = 1$ from 1979Q2-2001Q4, and $= 0$, otherwise, $san = 1$ since 1980Q2 and $= 0$, otherwise, $Zero = 1$ from 1984Q1-2001Q4, and $= 0$, otherwise, $War = 1$ from 1980Q4-1988Q3, and $= 0$, otherwise, $Ue = 1$ from 1993Q1, and $= 0$, otherwise, $Inflation = 1$ from 1995Q2-1998Q1, and $= 0$, otherwise, and $Private = 1$ from 1997Q3-2001Q4, and $= 0$, otherwise.

According to our estimation results reported in Table 5, the error-correction term is significant for only the error term generated from the first identified equation, see Table 2. None of the other equilibrium errors was found to be statistically significant. Furthermore, as the growth of real GDP increases the inflation rate increases. The growth of money supply does not have any impact on the inflation rate in Iran over the short-run as none of the estimated coefficients of this variable was found to be statistically significant. The only external factor effect on the inflation rate over the short run is the foreign interest rate since, according to the estimated positive coefficient of the foreign interest rate, as it increases the inflation rate will increase in Iran. Over the long run,
however, we found (Table 2) the foreign interest rate has a depressing impact on the price level in Iran.

As for the fiscal variables, the estimated coefficient of the growth of real government expenditures is statistically significant only during the increase in oil price in late 1973 and early 1974, implying that it caused the inflation rate to increase. Furthermore, the impact of the oil price increase in that period, as the estimated coefficient of dummy variable oil indicates, is an upward pressure on the inflation rate. The change in the deficits per GDP affects negatively, similar to Egypt, the inflation rate after a quarter. Furthermore, as the estimated coefficient of this variable after the imposition of sanctions indicates, the change in the government deficit per GDP resulted in a further reduction in the inflation rate. According to the estimated coefficient of the debt financed externally per GDP, as this variable increases, and as our theoretical model indicates, the demand for real balances falls and the inflation rate increases but, after a second quarter, the inflation rate falls with an overall coefficient (the sum of two coefficients) estimated to be positive. The impact of the externally financed debt after the imposition of sanctions is an upward pressure on the inflation rate.

As for institutional and other changes, the estimated coefficient of lagged inflation rate after the revolution is positive after one and three quarters indicating that the revolution resulted in a higher inflation rate in Iran. No other institutional or other change was found to have any impact on the inflation rate. During the third and fourth quarters of the year (second and third Iranian quarters), the inflation rate was found to be lower in Iran as the estimated coefficient of seasonal dummy variable Q3 and Q4 is negative. Dummy variables Nor 1973Q1, Nor 1977Q2 and Nor 1978Q4 reflect mostly oil price
shocks. The estimated coefficients of these dummy variables are all positive, indicating the oil price shocks created a higher inflation rate in Iran.

To conclude, the sources of inflation in Iran are both external and internal factors. The foreign interest rate and sanctions are external factors. Fiscal policy, as an internal factor, could be the most effective tool over the short run to fight inflation in Iran. The government debt financed externally, while reducing the price level over the long run, creates more uncertainty over the short run and causes the inflation rate to increase.

(C) Short-Run Dynamic of Inflation Rate in Turkey

For the dummy variables included in the set of DUM which account for regime/institutional changes, we consider five major policy regime changes that have characterized Turkey (see The Middle East and North Africa, 2004): (i) In 1984Q4 the government introduced a value-added tax to replace the previous unwieldy system of production taxes. (ii) Two U.S. credit rating agencies downgraded Turkey's credit rating, which resulted in a run of foreign currencies. The value of the lira was officially devalued by 12% against the US dollar; however, the currency continued to plummet. Interest rates rose to 150% - 200% as the government and the Central Bank desperately tried to bring the financial markets under control. In April 1994, the government announced a program of austerity measures to reduce the budget deficit, lower inflation and restore domestic and international confidence in the economy. The program included a freezing of wages, price increases of up to 100% on state monopoly goods, as well as longer-term restructuring measures such as the closure of loss-making state enterprises and an accelerated privatization process.
(iii) In July 1995, the new government approved a raise in the minimum wage and salary increases of 50% for state workers and pensioners. The government stated that the main aspects of its economic program were: a commitment to a free-market economy, lower inflation and a steady growth rate, lower taxation for producers, greater efforts to attract foreign investment, an acceleration in the privatization program and an emphasis on investment in infrastructure projects. (iv) In January 2000, as part of the anti-inflation program, a new exchange rate substitution policy took effect under which the managed peg used since 1994 was abandoned in favor of a peg set according to a pre-determined devaluation rate (20% in 2000), itself set against a basket of the US dollar and the euro.

(v) In February 2001, following a public clash between the President and the Prime Minister, the financial system went into near-meltdown in Turkey's worst economic crisis in recent years. A massive flight of capital forced the government to float the lira and accept an immediate devaluation of the currency. Consequential consumer price increases sparked widespread protest demonstrations, amidst rumors that another military takeover was imminent. The interest rate rose to the equivalent of 4,000% annually. On February 22, the government ended the crawling peg with the US dollar and allowed the lira to float freely, with the result that its value fell by 36% over two days. Accordingly, we use the following dummy variables to represent these potential policy regime shifts and exogenous shocks: \( v_{tax} = 1 \) from 1984Q4 and = 0, otherwise, \( f_{crisis} = 1 \) for 1994Q2 and = 0, otherwise, \( p_{wd} = 1 \) for 1995Q2-1995Q3 and = 0, otherwise, \( M_{EX} = 1 \) for 1994Q4-1999Q4 and = 0, otherwise, \( P_{EX} = 1 \) for 2000Q1-2000Q4 and = 0, otherwise, \( f_{lex} = 1 \) since 2001Q1 and = 0, otherwise.
According to our estimation results reported in Table 6, the error-correction term is significant for only the error term generated from the first identified equation (the overall price level) and the third identified equation (aggregate demand), see Table 3. None of the other equilibrium errors was found to be statistically significant. Interestingly, the error term from the long-run overall price is non linear implying that individuals in Turkey may ignore a small deviation from equilibrium, but react drastically to a large deviation. However, the coefficient of both the linear and non-linear error terms is positive, indicating that a deviation from the equilibrium price over the long term may cause further deviation from equilibrium. The error term generated from the aggregate demand relationship, however, brings the system back to equilibrium.

As for the monetary policy effect, according to the estimation result reported in Table 6, the money supply growth is a determinant of the inflation rate in Turkey over the short run, but only after the introduction of the value-added tax in 1984. The estimated coefficient of the change in interest rate is negative after three quarters and is positive after four quarters. Namely, a higher interest rate (a tight monetary policy) reduces the inflation rate after three quarters, but will cause it to go up after four quarters. The coefficient of the growth of exchange rate is negative, implying that a depreciation in the value of domestic currency reduces the inflation rate. None of the fiscal policy variables was found to have any impact on the short-run dynamic. Consequently, it seems the inflation in Turkey is a monetary phenomenon over the short run.

The estimated coefficient of the real growth of GDP is positive after a quarter and negative after two quarters with an overall positive effect. Consequently, as the growth of real GDP increases, the inflation rate in Turkey increases first and then falls. However,
during the managed exchange rate period of 1994-1999 and the current flexible exchange rate period (since 2001), the real growth of GDP resulted in a higher inflation rate in Turkey, as the coefficient of the growth rate became steeper, after two quarters and four quarters, respectively, in these periods. No other policy regime or institutional change was found to influence the inflation rate in Turkey. The financial crisis of 1994 had a positive shock on the inflation rate.

As for external factors, the imported inflation has a negative impact on the inflation rate. The coefficient of the foreign inflation rate is negative after two quarters. This result is similar to our long-run estimation result. In general, the inflation rate is higher during the last quarter of the year as the positive estimated coefficient of our seasonal dummy indicates. Dummy variable Nor 1980Q1, which accounts for the outlier in the data, has a positive estimated coefficient. To the best knowledge of the author, no event reflects this outlier.

The overall conclusion is that the sources of inflation in Turkey are all internal factors. They arise mostly from the monetary policy, including the exchange rate policy. The effect of external factors is actually deflationary both over the short and the long run.

V. Conclusions

This paper focuses on internal and external factors, which influence the inflation rate in developing countries. A monetary model of inflation rate, capable of incorporating both monetary and fiscal policies as well as other internal and external factors, was developed and tested on three developing countries: Egypt, Iran and Turkey. These countries have different economic structures. Egypt, with more than 90% of the country
being desert land, relies mostly on tourism; Iran, on oil exports and Turkey, on agricultural products. The model tested on the data of these countries and the estimation results proved the validity of the model as it is unique in this literature. Therefore, the first contribution of this paper is the development of the model. It should, however, be mentioned that since these countries have different economic structures and cultures some of the coefficients have different signs.

For instance, we found over the long run, a higher exchange rate (lower value of domestic currency) leads to a higher price in all these countries. So a policy regime that leads to a stronger currency can help to lower inflation in all three countries. However, a higher money supply can only lead to a higher price level in Turkey over the long run, but it has no significant impact in Egypt or Iran. This is also true for the domestic interest rate. Consequently, the reduction in the growth of the money supply is a very important tool in fighting inflation in Turkey, but not the other two countries.

It is also found that the fiscal policy is very effective in Egypt and Iran to fight inflation as the increase in the real government expenditures cause inflation in these countries, but no apparent impact in Turkey. Furthermore, government deficits in Iran and Turkey are inflationary over the long run, but not in Egypt. More interestingly, it was found, for the debt management policy, that, while a higher outstanding government debt in Egypt is considered by economic agents as a higher risky environment (i.e., demand for real balances falls), it is considered a higher asset in Iran and Turkey (i.e., demand for real balances increases) over the long run. Therefore, a high debt per GDP in Egypt is inflationary, but is deflationary in Iran and Turkey. As for the foreign financing of the government debt, we found no price impact in any of these countries over the long run. In
general, we found the major factors affecting inflation in developing countries, at least for Egypt, Iran and Turkey over the long run, are internal rather than external factors. For example, the foreign interest rate has a deflationary effect in these countries over the long run. Imported inflation exists only for Egypt.

Moreover, we found that over the short run the money supply growth and the interest rate as well as the exchange rate policy can effectively influence the inflation rate in Egypt. Fiscal variables like deficits per GDP and debt per GDP negatively affect the inflation rate in Egypt. As for the external factors, imported inflation is also a major cause of inflation in Egypt over the short run.

We found that the introduction of a single market determined exchange rate, finalized in February 1992, among institutional and policy regime changes which affect the short-run dynamic of the system, helped to reduce the inflation rate in Egypt. However, the introduction of a new sales tax in May 1991 as well as the elimination of price subsidies in late 1994 resulted in an increase of the inflation rate in Egypt. Finally, the peace treaty with Israel helped the foreign financing of debt in having a negative impact on inflation.

The overall conclusion over the short run for Iran is that the sources of inflation are both external and internal factors. The external factors include the foreign interest rate and sanctions. The fiscal policy as an internal factor has been the most effective tool over the short run to fight inflation in Iran. The government debt financed externally, while reducing the price level over the long run, creates more uncertainty over the short run and causes the inflation rate to increase.
The money supply growth is a determinant of the inflation rate in Turkey over the short run, but only after the introduction of a value-added tax in 1984. An increase in the interest rate while over the long run leads to a higher price level will reduce the inflation rate over the short run in Turkey. None of the fiscal policy variables was found to have any impact on the short run dynamic of the inflation rate. Consequently, it seems the inflation in Turkey is a monetary phenomenon even over the short run. The policy regime changes over the managed exchange rate period of 1994-1999 had an upward pressure on the short-run dynamic of inflation in Turkey similar to the current flexible exchange rate period (since 2001). Another domestic shock to inflation was found to be the financial crisis of 1994. The overall conclusion is that the sources of inflation in Turkey are all internal factors. They arise mostly from the monetary policy, including the exchange rate policy. The world effect is actually deflationary both over the short and the long run.
Data Appendix

The data are not seasonally adjusted and are from the *International Financial Statistics* (IFS) online, compiled by IMF. Data on outstanding debt (Debt) for Egypt and Iran were not available and therefore were constructed according to the following formulas:

\[
\text{Debt}_t = \text{Debt}_{t-1}[1 + \text{R}_{t-1}(\text{interest rate on debt})] + \text{gc}_t (\text{government spending on goods and services and transfer payments}) - \text{T}_t (\text{government tax revenues}) - \Delta \text{MB}_t (\text{change in monetary base})
\]

\[= \text{Debt}_{t-1} + \text{deficits}_t (\text{R}_{t-1} \text{Debt}_{t-1} + \text{gc}_t - \text{T}_t) - \Delta \text{MB}_t.\]

It was assumed that Debt_0 (debt at the first observation) is zero. Some missing data for all three countries were taken from the *World Development Indicator* (WDI). Some missing observations for Turkey were also taken from the State Institute of Statistics of Turkey (SIS) or *IMF – Economic and Financial Data for Turkey*. When some observations within a series were missing they were interpolated. Data series on GDP, government deficits and expenditures as well as debt financed externally and outstanding government debt (for Turkey) are only available yearly. Quarterly observations were, consequently, interpolated using the statistical process developed by RATS. This procedure keeps the final value fixed within each full period.

Information on institutional and policy changes in Egypt and Turkey were taken from *The Middle East and North Africa* (2004) and for Iran, from various Central Bank publications, including *Economic Trends*, as well as from Kia (2003).
References


Figure 1: Recursive Likelihood Ratio Tests for Egypt
Test of known beta eq. to beta(t)

Figure 2: Recursive Likelihood Ratio Tests for Iran
Test of known beta eq. to beta(t)

Figure 3: Recursive Likelihood Ratio Tests for Turkey
Test of known beta eq. to beta(t)
Table 1* Long-Run Test Results for Egypt
Tests of the Cointegration Rank

<table>
<thead>
<tr>
<th>$H_0 = r$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Diagnostic tests** p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{max}$</td>
<td>94.75</td>
<td>75.43</td>
<td>61.23</td>
<td>46.46</td>
<td>42.31</td>
<td>26.67</td>
<td>11.26</td>
<td>7.71</td>
<td>1.04</td>
<td>LM(1) 0.26</td>
</tr>
<tr>
<td>$\lambda_{max}$</td>
<td>61.29</td>
<td>55.50</td>
<td>49.42</td>
<td>43.97</td>
<td>37.52</td>
<td>25.54</td>
<td>18.96</td>
<td>12.25</td>
<td>1.04</td>
<td>LM(4) 0.77</td>
</tr>
<tr>
<td>Trace</td>
<td>366.90</td>
<td>272.14</td>
<td>196.70</td>
<td>135.46</td>
<td>89.00</td>
<td>46.69</td>
<td>20.01</td>
<td>8.75</td>
<td>1.04</td>
<td>Lag length = 4</td>
</tr>
<tr>
<td>Trace</td>
<td>221.56</td>
<td>182.45</td>
<td>146.75</td>
<td>114.96</td>
<td>86.96</td>
<td>62.61</td>
<td>42.20</td>
<td>25.47</td>
<td>12.39</td>
<td></td>
</tr>
</tbody>
</table>

Identified Long-Run Relationships for $r=5$. Null: Restrictions are accepted: $\chi^2 (2) = 3.38$, p-value = 0.18

<table>
<thead>
<tr>
<th>Normalized</th>
<th>lMs</th>
<th>lp</th>
<th>i</th>
<th>ly</th>
<th>IE</th>
<th>i*</th>
<th>lp*</th>
<th>lg</th>
<th>defgdp</th>
<th>debtgdp</th>
<th>fdgdp</th>
<th>trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>lp (St. Error)</td>
<td>-0.74 (0.75)</td>
<td>-</td>
<td>3.40 (3.22)</td>
<td>-12.26 (4.31)</td>
<td>7.87 (1.32)</td>
<td>-6.19 (0.70)</td>
<td>7.67 (2.28)</td>
<td>25.94 (2.95)</td>
<td>-2.45 (6.72)</td>
<td>2.74 (1.20)</td>
<td>0.50 (31.17)</td>
<td>Restrict ed = 0</td>
</tr>
<tr>
<td>lMs (St. Error)</td>
<td>-</td>
<td>Restrict ed = 1</td>
<td>0.02 (0.15)</td>
<td>-0.34 (0.20)</td>
<td>-0.26 (0.06)</td>
<td>0.38 (0.04)</td>
<td>-0.64 (0.11)</td>
<td>0.19 (0.12)</td>
<td>-0.15 (0.30)</td>
<td>0.01 (0.05)</td>
<td>0.19 (1.58)</td>
<td>0.01 (0.002)</td>
</tr>
<tr>
<td>lp (St. Error)</td>
<td>Restrict ed = 0</td>
<td>-</td>
<td>3.32 (0.65)</td>
<td>4.42 (0.75)</td>
<td>0.58 (0.24)</td>
<td>-1.34 (0.17)</td>
<td>2.36 (0.53)</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restricted = 0</td>
<td>21.95 (6.25)</td>
<td>0.01 (0.01)</td>
</tr>
<tr>
<td>lMs (St. Error)</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>6.24 (0.48)</td>
<td>0.13 (0.06)</td>
</tr>
<tr>
<td>lp (St. Error)</td>
<td>-0.55 (0.13)</td>
<td>-</td>
<td>2.25 (0.29)</td>
<td>-0.70 (0.22)</td>
<td>-0.23 (0.08)</td>
<td>-0.08 (0.04)</td>
<td>-0.38 (0.13)</td>
<td>-0.45 (0.20)</td>
<td>0.03 (0.49)</td>
<td>-0.53 (0.08)</td>
<td>Restrict ed = 0</td>
<td>0.06 (0.01)</td>
</tr>
</tbody>
</table>

a = means accept the null of $r=5$.

(1) Both $\lambda_{max}$ and Trace tests have been multiplied by the small sample correction factor ($N - kp)/N$, see Cheung and Lai (1993).
(2) The source is Osterwald-Lenum (1992), Table 2, p. 469.
(3) The source is Johansen (1995a), Table 15.4, p. 216.
* The sample period is 1975Q1-1999Q3. The model includes constant, trend and seasonal dummies. lMs is the log of nominal money supply, i and i* are the log[R/(1+R)] and log[R*/(1+R*)], respectively, where R and R* are domestic and foreign interest rates in decimal points, respectively, ly is the log of real GDP, IE is the log of nominal exchange rate (domestic currency per US$), lp and lp* are the log of domestic CPI and an index of industrial countries exports unit values, respectively. lg is the log of real government expenditures on goods and services, defgdp and debtgdp are deficits and outstanding debt per GDP, respectively. fdgdp is the amount of foreign financed debt per GDP and trend is a linear time trend.
** LM(1) and LM(4) are one and four-order Lagrangian Multiplier test for autocorrelation, respectively [Godfrey (1988)].
Table 2* Long-Run Test Results for Iran

Tests of the Cointegration Rank

<table>
<thead>
<tr>
<th>$H_0=r$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Diagnostic tests**</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{max}$ (1)</td>
<td>99.33</td>
<td>71.42</td>
<td>65.05</td>
<td>43.62</td>
<td>31.09*</td>
<td>19.75</td>
<td>10.35</td>
<td>1.27</td>
<td>LM(1)</td>
<td>0.18</td>
</tr>
<tr>
<td>$\lambda_{max}$ 95(2)</td>
<td>55.50</td>
<td>49.42</td>
<td>43.97</td>
<td>37.52</td>
<td>31.46</td>
<td>25.54</td>
<td>18.96</td>
<td>12.25</td>
<td>LM(4)</td>
<td>0.62</td>
</tr>
<tr>
<td>Trace (1)</td>
<td>341.89</td>
<td>242.56</td>
<td>171.12</td>
<td>106.07</td>
<td>62.45*</td>
<td>31.37</td>
<td>11.62</td>
<td>1.27</td>
<td>Lag length = 4</td>
<td></td>
</tr>
<tr>
<td>Trace 95(3)</td>
<td>182.45</td>
<td>146.75</td>
<td>114.96</td>
<td>86.96</td>
<td>62.61</td>
<td>42.20</td>
<td>25.47</td>
<td>12.39</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Identified Long-Run Relationships for $r=4$. Null: Restrictions are accepted: $\chi^2(1) = 0.02$, p-value = 0.89

<table>
<thead>
<tr>
<th>Normalized</th>
<th>IMs</th>
<th>Ip</th>
<th>ly</th>
<th>IE</th>
<th>iy*</th>
<th>lp*</th>
<th>lg</th>
<th>defgdp</th>
<th>debtgdp</th>
<th>fdgdp</th>
<th>trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ip (St. Error)</td>
<td>0.05</td>
<td>-0.88</td>
<td>1.19</td>
<td>-0.42</td>
<td>0.17</td>
<td>1.38</td>
<td>6.70</td>
<td>-0.66</td>
<td>-0.25</td>
<td>Restrict ed = 0</td>
<td></td>
</tr>
<tr>
<td>(St. Error)</td>
<td>0.17</td>
<td>0.35</td>
<td>0.15</td>
<td>0.11</td>
<td>0.32</td>
<td>0.28</td>
<td>0.94</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMs (St. Error)</td>
<td>-</td>
<td>7.35</td>
<td>4.57</td>
<td>-0.62</td>
<td>6.80</td>
<td>-2.63</td>
<td>-4.24</td>
<td>2.62</td>
<td>0.28</td>
<td>-0.28</td>
<td></td>
</tr>
<tr>
<td>(St. Error)</td>
<td>Restrict ed = 1</td>
<td>0.64</td>
<td>0.28</td>
<td>0.26</td>
<td>0.72</td>
<td>0.39</td>
<td>2.30</td>
<td>0.20</td>
<td>3.52</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>lp (St. Error)</td>
<td>Restrict ed = 0</td>
<td>-</td>
<td>0.37</td>
<td>1.40</td>
<td>-0.34</td>
<td>2.21</td>
<td>-0.02</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>-0.04</td>
<td></td>
</tr>
<tr>
<td>(St. Error)</td>
<td>0.06</td>
<td>0.002</td>
<td>0.06</td>
<td>0.15</td>
<td>0.002</td>
<td></td>
<td></td>
<td></td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE (St. Error)</td>
<td>Restrict ed = 0</td>
<td>0.71</td>
<td>-0.26</td>
<td>0.24</td>
<td>-1.58</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>Restrict ed = 0</td>
<td>-0.06</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>(St. Error)</td>
<td>0.01</td>
<td>0.04</td>
<td>0.05</td>
<td>0.11</td>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a * means accept the null of $r=4$.

(1) Both $\lambda_{max}$ and Trace tests have been multiplied by the small sample correction factor $(N - kp)/N$, see Cheung and Lai (1993).

(2) The source is Osterwald-Lenum (1992), Table 2, p. 469.

(3) The source is Johansen (1995a), Table 15.4, p. 216.

* The sample period is 1970Q1-2002Q4. See footnote to Table 1 for mnemonics and other information.

** LM(1) and LM(4) are one and four-order Lagrangian Multiplier test for autocorrelation, respectively [Godfrey (1988)].
Table 3* Long-Run Test Results for Turkey

Tests of the Cointegration Rank

<table>
<thead>
<tr>
<th>$H_0 = r$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Diagnostic tests** p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{\text{max}}$ (1)</td>
<td>93.44</td>
<td>71.01</td>
<td>54.72</td>
<td>45.05</td>
<td>35.30</td>
<td>19.22</td>
<td>13.19</td>
<td>8.69</td>
<td>4.18</td>
<td>LM(1) 0.02</td>
</tr>
<tr>
<td>$\lambda_{\text{max}}$ 95(2)</td>
<td>61.29</td>
<td>55.50</td>
<td>49.42</td>
<td>43.97</td>
<td>37.52</td>
<td>31.46</td>
<td>25.54</td>
<td>18.96</td>
<td>12.25</td>
<td>LM(4) 0.07</td>
</tr>
<tr>
<td>Trace (1)</td>
<td>344.82</td>
<td>251.38</td>
<td>180.36</td>
<td>125.64</td>
<td>80.59</td>
<td>45.28</td>
<td>26.06</td>
<td>12.87</td>
<td>4.18</td>
<td>Lag length = 5</td>
</tr>
<tr>
<td>Trace 95(3)</td>
<td>221.56</td>
<td>182.45</td>
<td>146.75</td>
<td>114.96</td>
<td>86.96</td>
<td>62.61</td>
<td>42.20</td>
<td>25.47</td>
<td>12.39</td>
<td></td>
</tr>
</tbody>
</table>

** LM(1) and LM(4) are one and four-order Lagrangian Multiplier test for autocorrelation, respectively [Godfrey (1988)].

Identified Long-Run Relationships for r=4. Null: Restrictions are accepted: $\chi^2 (1) = 0.00$, p-value = 1.00

<table>
<thead>
<tr>
<th>Normalized</th>
<th>IMs</th>
<th>lp</th>
<th>i</th>
<th>ly</th>
<th>IE</th>
<th>i*</th>
<th>lp*</th>
<th>lg</th>
<th>defgdp</th>
<th>debtgdp</th>
<th>fdgdp</th>
<th>trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>lp (St. Error)</td>
<td>0.81 (0.06)</td>
<td>-</td>
<td>0.16 (0.06)</td>
<td>-0.37 (0.10)</td>
<td>0.31 (0.06)</td>
<td>-0.01 (0.03)</td>
<td>-0.37 (0.12)</td>
<td>0.07 (0.04)</td>
<td>3.45 (0.46)</td>
<td>-0.85 (0.15)</td>
<td>-0.77 (1.86)</td>
<td>Restriction = 0</td>
</tr>
<tr>
<td>IMs (St. Error)</td>
<td>-</td>
<td>Restriction = 1</td>
<td>-1.47 (0.12)</td>
<td>0.07 (0.26)</td>
<td>-0.22 (0.09)</td>
<td>0.56 (0.08)</td>
<td>-1.00 (0.37)</td>
<td>-1.33 (0.09)</td>
<td>-0.40 (0.99)</td>
<td>-2.35 (0.31)</td>
<td>-0.10 (3.62)</td>
<td>0.08 (0.01)</td>
</tr>
<tr>
<td>lp (St. Error)</td>
<td>0.63 (0.03)</td>
<td>-</td>
<td>0.32 (0.04)</td>
<td>-0.51 (0.07)</td>
<td>0.57 (0.03)</td>
<td>-0.21 (0.02)</td>
<td>0.80 (0.08)</td>
<td>0.43 (0.03)</td>
<td>Restricted = 0</td>
<td>Restricted = 0</td>
<td>Restricted = 0</td>
<td>-0.03 (0.01)</td>
</tr>
<tr>
<td>IE (St. Error)</td>
<td>Restriction = 0</td>
<td>0.44 (0.08)</td>
<td>0.20 (0.10)</td>
<td>1.75 (0.27)</td>
<td>-</td>
<td>0.47 (0.09)</td>
<td>-3.85 (0.32)</td>
<td>Restricted = 0</td>
<td>12.13 (1.08)</td>
<td>Restricted = 0</td>
<td>17.72 (4.57)</td>
<td>0.07 (0.01)</td>
</tr>
</tbody>
</table>

a = means accept the null of r=4.
(1) Both $\lambda_{\text{max}}$ and Trace tests have been multiplied by the small sample correction factor (N – kp)/N, see Cheung and Lai (1993).
(2) The source is Osterwald-Lenum (1992), Table 2, p. 469.
(3) The source is Johansen (1995a), Table 15.4, p. 216.
* The sample period is 1970Q1-2003Q3. See footnote to Table 1 for the mnemonics and other information.
Table 4: Error Correction Model for Egypt
Dependent Variable = ∆lp

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>p-value for Hansen’s (1992) stability L4 test</th>
</tr>
</thead>
<tbody>
<tr>
<td>∆lMs,t-1</td>
<td>0.15</td>
<td>0.06</td>
<td>0.18</td>
</tr>
<tr>
<td>∆i,t-4</td>
<td>-0.14</td>
<td>0.05</td>
<td>0.19</td>
</tr>
<tr>
<td>∆ly,t-1</td>
<td>0.46</td>
<td>0.07</td>
<td>1.00</td>
</tr>
<tr>
<td>∆IE,t-4</td>
<td>0.05</td>
<td>0.02</td>
<td>1.00</td>
</tr>
<tr>
<td>∆lp*,t-1</td>
<td>0.14</td>
<td>0.07</td>
<td>0.15</td>
</tr>
<tr>
<td>(∆lg)(flex),t-1</td>
<td>-0.53</td>
<td>0.14</td>
<td>0.07</td>
</tr>
<tr>
<td>Adefgdp,t-1</td>
<td>-0.50</td>
<td>0.17</td>
<td>1.00</td>
</tr>
<tr>
<td>Adefgdp,t-3</td>
<td>0.79</td>
<td>0.17</td>
<td>1.00</td>
</tr>
<tr>
<td>Adefgdp,t-4</td>
<td>-0.44</td>
<td>0.19</td>
<td>1.00</td>
</tr>
<tr>
<td>Adebtgdp,t-3</td>
<td>0.15</td>
<td>0.05</td>
<td>1.00</td>
</tr>
<tr>
<td>Adebtgdp,t-4</td>
<td>-0.21</td>
<td>0.06</td>
<td>1.00</td>
</tr>
<tr>
<td>(∆fdgdp)(peace),t-2</td>
<td>-4.95</td>
<td>1.46</td>
<td>1.00</td>
</tr>
<tr>
<td>(ECP)3,t-1</td>
<td>-0.0004</td>
<td>0.00004</td>
<td>1.00</td>
</tr>
<tr>
<td>flex</td>
<td>-0.02</td>
<td>0.01</td>
<td>1.00</td>
</tr>
<tr>
<td>psub</td>
<td>0.04</td>
<td>0.01</td>
<td>1.00</td>
</tr>
<tr>
<td>price</td>
<td>0.07</td>
<td>0.02</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Hansen’s (1992) stability L4 test on the variance = 0.45 p-value = 0.06
Joint (coefficients and the error variance)
Hansen’s (1992) stability Lc test = 3.15 p-value = 1.00

1 The sample period is 1975Q1-1999Q3. Mean of dependent variable=0.03. Δ means the first difference, ∆lp is the change in the log of CPI, ∆lp* is the change in the log of an index of industrial countries exports unit values, ∆lMs is the change in the log of nominal money supply, Δi is the change in the log[R/(1+R)], where R is the nominal interest rate in decimal points. ΔIE is the change in the log of the nominal exchange rate (domestic currency per $US), and Δly is the change in the log of real GDP. Δlg is the change in real government expenditures, Adefgdp, Adebtgdp and ∆fdgdp are the change in deficits, outstanding debt and foreign financed debt per GDP, respectively. ECP is the error-correction term generated from the first identified long-run relationship in the cointegration space, normalized on the log of domestic price (see Table 1). None of the other error correction terms were statistically significant. Dummy variable peace is equal to 1 since 1979Q2 when Egypt signed a peace treaty with Israel and to zero, otherwise. Dummy variable flex is equal to 1 since 1991Q1 and to zero, otherwise. Dummy variable price is equal to 1 in 1991Q2 and is zero otherwise, psub is equal to 1 from 1994Q4 to 1995Q1. The estimation method is Ordinary Least Squared. $\bar{R}^2=0.53$, $\sigma=0.02$, DW=2.18, Godfrey(5)=0.31 (significance level=0.92), White=87.69 (significance level=0.99), ARCH(5)=1.04 (significance level=0.96), RESET=0.24 (significance level=0.87) and Normality, $\chi^2=1.28$ (significance level=0.53). Note that $\bar{R}^2$, $\sigma$ and DW, respectively, denote the adjusted squared multiple correlation coefficient, the residual standard deviation and the Durbin-Watson statistic. White is White’s (1980) general test for heteroskedasticity, ARCH is five-order Engle’s (1982) test, Godfrey is five-order Godfrey’s (1978) test, REST is Ramsey’s (1969) misspecification test, Normality is Jarque and Bera’s (1987) normality statistic, Lc is Hansen’s (1992) stability test for the null hypothesis that the estimated coefficient or variance of the error term is constant and Lc is Hansen’s (1992) stability test for the null hypothesis that the estimated coefficients as well as the error variance are jointly constant.
Table 5: Error Correction Model for Iran
Dependent Variable = $\Delta p$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>p-value for Hansen’s (1992) stability $L_i$ test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta y_{t-1}$</td>
<td>0.28</td>
<td>0.05</td>
<td>1.00</td>
</tr>
<tr>
<td>$\Delta i^*_{t-1}$</td>
<td>0.06</td>
<td>0.02</td>
<td>1.00</td>
</tr>
<tr>
<td>$(\Delta p)(rev)_{t-1}$</td>
<td>0.38</td>
<td>0.07</td>
<td>1.00</td>
</tr>
<tr>
<td>$(\Delta p)(rev)_{t-3}$</td>
<td>0.36</td>
<td>0.06</td>
<td>1.00</td>
</tr>
<tr>
<td>$(\Delta g)(oil)_{t-4}$</td>
<td>0.36</td>
<td>0.10</td>
<td>1.00</td>
</tr>
<tr>
<td>$\Delta defgdpt_{t-1}$</td>
<td>-0.97</td>
<td>0.24</td>
<td>1.00</td>
</tr>
<tr>
<td>$(\Delta defgdtp)(san)_{t-4}$</td>
<td>-2.12</td>
<td>0.36</td>
<td>1.00</td>
</tr>
<tr>
<td>$\Delta fdgdpt_{t-1}$</td>
<td>5.52</td>
<td>1.22</td>
<td>1.00</td>
</tr>
<tr>
<td>$\Delta fdgdpt_{t-2}$</td>
<td>-3.00</td>
<td>0.86</td>
<td>1.00</td>
</tr>
<tr>
<td>$(\Delta fdgdtp)(san)_{t-2}$</td>
<td>63.66</td>
<td>17.11</td>
<td>1.00</td>
</tr>
<tr>
<td>ECP_{t-1}</td>
<td>-0.003</td>
<td>0.0005</td>
<td>1.00</td>
</tr>
<tr>
<td>oil</td>
<td>0.08</td>
<td>0.03</td>
<td>1.00</td>
</tr>
<tr>
<td>Q3</td>
<td>-0.05</td>
<td>0.01</td>
<td>1.00</td>
</tr>
<tr>
<td>Q4</td>
<td>-0.03</td>
<td>0.01</td>
<td>1.00</td>
</tr>
<tr>
<td>Nor 1973Q1</td>
<td>0.09</td>
<td>0.03</td>
<td>1.00</td>
</tr>
<tr>
<td>Nor 1977Q2</td>
<td>0.11</td>
<td>0.02</td>
<td>1.00</td>
</tr>
<tr>
<td>Nor 1978Q4</td>
<td>0.06</td>
<td>0.02</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Hansen’s (1992) stability $L_i$ test on the variance = 0.26, p-value = 0.18
Joint (coefficients and the error variance) Hansen’s (1992) stability $L_i$ test = 2.57, p-value = 1.00

1 The sample period is 1970Q1-2002Q4. Mean of dependent variable=0.04. $\Delta$ means the first difference, $\Delta y$ is the change of the log of real GDP, $\Delta i^*$ is the change in log[R*/(1+R*)], $\Delta p$ is the change in the log of CPI and $\Delta E$ is the change in the log of market exchange rate (rials per $US). $\Delta g$ is the change in real government expenditures. $\Delta defgdp$, and $\Delta fdgdp$ are the change in the log of deficits and foreign financed debt per GDP, respectively. ECP is the error correction term generated from the long-run price determination (see the first identified equation in Table 2). None of the other error correction terms were statistically significant. Dummy variable rev is equal to 1 since 1979Q2 and to zero, otherwise. Dummy variable oil is equal to 1 for the period 1973Q4-1974Q1, and to zero, otherwise. Dummy variable san is equal to 1 since 1980Q2 and to zero, otherwise. Q3 and Q4 are equal to 1, in the third and fourth quarters of the year, respectively, and to zero, otherwise. Nor 1973Q1, Nor 1977Q2 and Nor 1978Q4 are equal to 1 in the quarters indicated to eliminate the outliers in the data. The estimation method is Ordinary Least Squared. $\bar{R}^2=0.70$, $\alpha=0.02$, $DW=1.98$, Godfrey(5)=0.52 (significance level=0.79), White=99.66 (significance level=1.00), ARCH(5)=7.65 (significance level=0.18), RESET=0.19 (significance level=0.90) and Normality, $\chi^2=4.98$ (significance level=0.08). For other information see footnote of Table 4.
Table 6: Error Correction Model for Turkey
Dependent Variable = Δlp

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>p-value for Hansen’s (1992) stability L₄ test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δlpₜ₋₁</td>
<td>0.65</td>
<td>0.09</td>
<td>1.00</td>
</tr>
<tr>
<td>(Δlp) (vtax)ₜ₋₁</td>
<td>-0.27</td>
<td>0.09</td>
<td>1.00</td>
</tr>
<tr>
<td>(ΔMs) (vtax)ₜ₋₁</td>
<td>0.15</td>
<td>0.03</td>
<td>1.00</td>
</tr>
<tr>
<td>(ΔMs) (vtax)ₜ₋₂</td>
<td>0.13</td>
<td>0.03</td>
<td>1.00</td>
</tr>
<tr>
<td>Δᵢₜ₋₃</td>
<td>-0.07</td>
<td>0.04</td>
<td>1.00</td>
</tr>
<tr>
<td>Δᵢₜ₋₄</td>
<td>0.08</td>
<td>0.04</td>
<td>1.00</td>
</tr>
<tr>
<td>Δlyₜ₋₁</td>
<td>0.12</td>
<td>0.05</td>
<td>1.00</td>
</tr>
<tr>
<td>Δlyₜ₋₂</td>
<td>-0.11</td>
<td>0.06</td>
<td>0.17</td>
</tr>
<tr>
<td>(Δly) (mex)ₜ₋₂</td>
<td>0.22</td>
<td>0.09</td>
<td>1.00</td>
</tr>
<tr>
<td>(Δly) (flex)ₜ₋₄</td>
<td>0.82</td>
<td>0.26</td>
<td>1.00</td>
</tr>
<tr>
<td>ΔlEₜ₋₂</td>
<td>-0.13</td>
<td>0.036</td>
<td>1.00</td>
</tr>
<tr>
<td>Δlp*ₜ₋₂</td>
<td>-0.26</td>
<td>0.09</td>
<td>0.15</td>
</tr>
<tr>
<td>ECPₜ₋₁</td>
<td>0.35</td>
<td>0.10</td>
<td>1.00</td>
</tr>
<tr>
<td>(ECP)²ₜ₋₁</td>
<td>0.08</td>
<td>0.03</td>
<td>1.00</td>
</tr>
<tr>
<td>ECdₜ₋₁</td>
<td>-0.07</td>
<td>0.02</td>
<td>1.00</td>
</tr>
<tr>
<td>fcrisis</td>
<td>0.22</td>
<td>0.03</td>
<td>0.15</td>
</tr>
<tr>
<td>Q₄</td>
<td>0.03</td>
<td>0.01</td>
<td>0.08</td>
</tr>
<tr>
<td>Nor 1980Q1</td>
<td>0.18</td>
<td>0.03</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Hansen’s (1992) stability L₄ test on the variance = 0.23 1.00 (p-value)
Joint (coefficients and the error variance) Hansen’s (1992) stability L₄ test = 3.67 0.20 (p-value)

1 The sample period is 1970Q1-2003Q3. Mean of dependent variable = 0.10. Δ means the first difference, Δlp is the change in the log of CPI, ΔMs is the change in the log of nominal money supply, Δi is the change in the log[R/(1+R)], where R is the nominal interest rate in decimal points, Δly is the change in the log of real GDP, ΔlE is the change in the log of market exchange rate (liras per $US) and Δlp* is the change in the log of index of industrial countries exports unit values. ECP is the error-correction term generated from the first identified long-run relationship in the cointegration space, normalized on the log of CPI (see Table 3). ECd is the error-correction term generated from the third identified long-run relationship in the cointegration space, normalized on the log of real demand for money. The other error correction term was not statistically significant. Dummy variable vtax is equal to 1 since 1984Q4 and to zero, otherwise. Dummy variable mex is equal to 1 for the period of 1994Q4-1999Q4 and to zero, otherwise. Dummy variable flex is equal to 1 since 2001Q1 and to zero, otherwise. fcrisis is equal to 1 for 1994Q2 and to zero, otherwise. Q4 is a dummy variable equal to 1, in the fourth quarter of the year, and to zero, otherwise. Nor 1980Q1 is equal to 1 in the first quarter of 1980 to eliminate the outliers in the data. The estimation method is the Ordinary Least Squared. $R^2=0.74$, $σ=0.03$, DW=1.92, Godfrey(5)=0.31 (significance level=0.93), White=129.99 (significance level=0.99), ARCH(5)=4.72 (significance level=0.45), RESET=0.36 (significance level=0.78) and Normality, $χ^2=1.62$ (significance level=0.45). For other information see footnote of Table 4.