

Monetary Policy and Performance of the Oil-Exporting Gulf Cooperation Council Countries

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Abstract

Price stability is the goal of the monetary policy of the oil-exporting Gulf Cooperation Council (GCC) countries. Estimation results for the period 1992:1 to 2009:3 indicate that the GCC countries, with the exception of Qatar and UAE during a few quarters of 2007 and 2008, heavily sterilize the impact of the changes in foreign reserves on the domestic base money and the goal of price stability in general is maintained.

Key words: GCC; sterilization and offsetting coefficients; 2SLS; 3SLS

JEL classification: E51; E52; E58

1. Introduction

The Gulf Cooperation Council (GCC) countries consist of the six oil-exporting countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE). These countries account for 40% of the world's proven oil reserves (e.g., Bentour and Razzak, 2009). Another common feature of the GCC countries except Kuwait is that their exchange rates are fixed against the US dollar. All of them heavily (even excessively) depend on imports for consumption and capital goods. Thus, when the US dollar depreciates against the major currencies, these countries face the risk of imported inflation. The stated main monetary policy objective of these countries is price stability. Thus, the performance of the monetary policy will be judged on how the objective of price stability is met against external shocks such as oil price shocks.

The recent accumulation of foreign reserves in many countries (especially some Asian countries) has become a hot topic of discussions among policy makers and academicians (e.g., Aizenman and Glick, 2009; Ouyang et al., 2010). Some of the GCC countries are the largest oil producers of the world. There is no doubt that oil

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price is the main determinant of these countries' foreign reserves. As shown below, the recent soaring of the oil price has led to a soaring of the foreign reserves of these countries. Further, most economic activities of these countries evolve around this hydrocarbon sector. Thus, the economies of these countries remain vulnerable to oil price shocks. Any rise in the oil price creates fear of inflationary pressure. For example, Kamar and Naceur (2007) have argued for the GCC countries that the recent oil price increase is expected to increase the stock of net foreign assets that would increase the monetary base and money supply and ultimately would put pressure on inflation. However, they offer no empirical evidence to support their presumption. The purpose of the paper is to provide empirical evidence that the central banks of these countries do actively engage in neutralizing the effects of such external shocks to maintain their monetary policy objective of price stability.

The GCC countries engage in liberal capital flows (e.g., Fasano, 2003; Khan 2009). In other words, these countries are highly financially integrated with the world. These countries present themselves as classic examples of the impossible trinity dilemma or "trilemma." According to Obstfeld et al. (2004, 2005, and 2010), a macroeconomic policy regime can choose at most two elements of the trilemma: (i) full freedom of cross-border capital movements, (ii) a fixed exchange rate, and (iii) an independent monetary policy. The most appropriate definition of monetary independence for the GCC countries would be the definition used by Frankel et al. (2004) "as the ability of countries to set their own nominal interest rates" (p. 705). Thus, with the fixed exchange rates and unrestricted capital flows, the domestic interest rates of the GCC countries follow the comparable US interest rates. Fasano (2003) reported similar nominal short-term interest rates across GCC countries that follow comparable US interest rates with a spread.

As such, the GCC countries cannot use monetary policy for the purpose of taming business cycles; this should not be confused with the monetary policy goal of price stability. As mentioned above, the performance of the monetary policy of these countries would be to evaluate on the basis of how these countries deal with the external shocks that could be inflationary or deflationary. The most important issue is related to the oil price and international reserves of the GCC countries. The central banks of the GCC countries seem to routinely sterilize or neutralize the impact of international reserves on the domestic reserve base money so that the impact of monetary base on price level is prevented. This policy is now widely used in some Asian and Latin American countries (e.g., Aizenman and Glick, 2009; Ouyang et al., 2010). Sterilization seems to be the main monetary policy of the central banks of the GCC countries. However, the extent of the sterilization differs among these countries. This was more pronounced, especially for Qatar and the UAE, during the recent oil boom of 2006–2008.

It is surprising that there is no empirical study examining the extent of sterilization by these countries. Thus, the main objective of the paper is to estimate the extent of sterilization coefficients of the GCC countries to determine whether these countries neutralize the effect of international reserve accumulation on the monetary base to stabilize local prices.

The rest of the paper is organized as follows. Section 2 discusses the exchange rate arrangement and developments of some important macroeconomic variables of the GCC countries for last two decades. Section 3 derives an empirical specification model that seems to fit the GCC economies to estimate the extent of sterilization. Empirical results, along with the sources of data and the definitions of the variables used in the study, are presented in Section 4. A brief evaluation of the monetary policy objective in light of the empirical results obtained is presented in Section 5. Section 6 concludes the paper.

2. Exchange Rate, Oil Price, and International Reserves

The currencies of Bahrain, Qatar, Saudi Arabia, and the UAE during 1980–2002 were officially pegged to the Special Drawing Rights (SDR) basket of the International Monetary Fund (IMF) but were effectively pegged to the US dollar. The currency of Oman has officially been pegged to the US dollar since 1986 and Kuwait's currency is now pegged to an undisclosed basket of currencies. All GCC countries except Kuwait have formally pegged their currencies to the US dollar since 2003.

Arguments to keep the exchange rate fixed are quite simple and straightforward. These are purely oil-based economies and oil is traded in dollars. This implies the US dollar is the main foreign trade and investment denominating currency. Apart from the problem of day-to-day managing of the exchange rate, they do not want to see frequent fluctuations of their fortune with the fluctuations of their currencies. Moreover, the central banks of the GCC countries consider the US monetary policy stance quite compatible with their internal price level stability. Of course, this is the conventional view of the advantages of the fixed exchange rate that it reduces transaction costs; it lowers exchange rate risk which discourages investment and trade. Khan (2009) has suggested that the use of a US dollar peg as an external anchor for monetary policy has served the GCC countries well.

Table 1 presents annual average growth rates of some important monetary variables for periods 1992–2000 and 2001–2009. It shows clearly the distinctive features of the two periods for all GCC countries. During the period 1992–2000, their exchange rates appreciated against the major currencies. Growth rates of international reserves and the monetary base (*MB*) were modest, and consumer price index (CPI) inflation rates were very low.

The surge in the oil price that started in 2003 strengthened all macroeconomic indicators of the GCC countries. Most pronounced was the international reserves (net foreign assets, *NFA*, of the central banks), which ballooned following the oil price surge. Table 1 shows the marked differences in the annual average growth rates of international reserves of the GCC countries for the periods 1992–2001 and 2002–2009. Note that one should read carefully the marked differences in average growth rates of *NFA* and *MB* between the two periods. As indicated in the notes to Table 1, the average growth rates of the *MB* and *NFA* for the period 2001–2009 include some large abnormal growth rates of these variables in 2007 that surely

inflated the average growth rates of these variables. Their currencies also depreciated during this period, and they experienced higher inflation rates. However, for most of the GCC countries, except Qatar and the UAE, their average annual inflation rates were quite low even during the period 2001–2009 compared to most of the OECD countries.

Table 1. Annual Average Growth Rates (%) of Important Monetary Variables of the GCC Countries

	Bahrain		Kuwait		Oman	
	1992–2000	2001–2009	1992–2000	2001–2009	1992–2000	2001–2009
NEER	-1.62	2.73	-0.43	2.55	-1.50	1.73
<i>NFA</i>	2.51	14.03 (50.5)	3.16	30.21 (74.6)	0.65	27.63 (92.4)
<i>MB</i>	4.02	29.53 (107)	5.98	46.51 (202)	3.79	28.56 (70)
CPI	0.43	2.23	1.79	3.97	0.07	3.72
	Qatar		Saudi Arabia		UAE	
	1992–2000	2001–2009	1992–2000	2001–2009	1992–2000	2001–2008
NEER	-3.13	2.06	-1.65	2.05	-2.66	1.33
<i>NFA</i>	7.19	38.42 (80)	-0.54	33.14 (74.3)	9.98	20.25 (181)
<i>MB</i>	5.98	46.52 (202)	2.12	9.80 (56.8)	13.87	35.12 (207)
CPI	2.35	7.15	0.20	3.20	2.33	6.36

Notes: NEER is nominal effective exchange rate, *NFA* is net foreign assets (international reserves), and *MB* is the monetary base. Highest annual growth rate during the period 2001–2009 is in parentheses, which occurred in 2007 for all countries and for all variables except for Saudi Arabia, which experienced the highest growth rate in *NFA* in 2005 and in *MB* in 2008.

Figure 1 shows the trends in the oil price and international reserves for the period 1990:1 to 2009:3. The oil price index has double line width for clarity. Even for the tiny country Bahrain with relatively limited oil and gas resources, international reserves increased from \$1.8 billion in 2003 to \$5.5 billion in early 2008. For Qatar it rose from \$1.7 billion in early 2003 to \$16 billion in early 2008, then fell with the fall of oil price and increased with the increase in oil price. Saudi Arabia's international reserves increased from \$47 billion in 2003 to a staggering \$441 billion at the end of 2008.

Any rise in the oil price that leads to a surge in international reserves creates fear of inflationary pressure (e.g., Kamar and Naceur, 2007; Bentour and Razzak, 2009). Given the exchange rate arrangements of the GCC countries, such fear is easy to understand. The IMF (2006) classifies the central banks of the GCC countries as quasi-currency board regimes. The money stock of a purely currency board country at time t , M_t , can be written as:

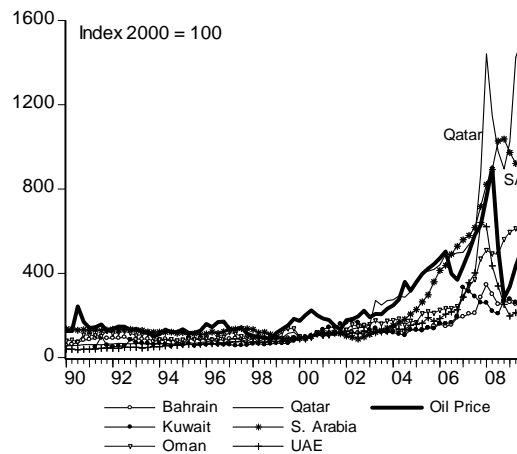
$$M_t = mm \times MB_t, \quad (1)$$

where mm is the money multiplier and MB is the monetary base. The money stock of a currency board country is related to its overall balance of payments position; this is because a currency board issues only domestic currency against foreign exchange at a fixed exchange rate. Thus, (1) can be written as:

$$M_t = mm \times BP_t, \quad (2)$$

where BP is the balance-of-payments surplus or international reserves. Equation (2) shows that the money stock of a currency board country will increase as long as that country runs a balance-of-payments surplus or it accumulates international reserves. The adjustment process from the balance-of-payments to money stock is automatic for a currency board (e.g., Humpage and McIntire, 1995).

Figure 1. Oil Price and International Reserves of the GCC Countries, 1990:1–2009:3



One would suspect that under the fixed exchange rate, the central banks of the GCC countries would face similar automatic adjustments. However, unlike a currency board, the central banks of the GCC countries can offset or sterilize the expansionary or contractionary monetary effects of the international reserves on its monetary base and money supply in order to pursue their main monetary policy objective of price stability while maintaining the fixed exchange rate.

3. Sterilization as Monetary Policy of the GCC Countries

As mentioned above, with fixed exchange rate and unrestricted capital flows, the GCC countries cannot have an independent monetary policy. The monetary policy of these countries is essentially to manage the liquidity that mainly fluctuates with international reserves due to capital inflows.

To see how it works, we look at a typical balance sheet (Table 2) of a central bank of a GCC country. From Table 2, net domestic assets can be defined as $NDA \equiv DA - (TS + GS + K + Net)$ and net foreign assets as $NFA \equiv FA - FL$. This means, from Table 2, NDA can be written as:

$$NDA = MB - NFA. \quad (3)$$

In the case of full sterilization or neutralization of capital inflows, there will be no change in the base money ($\Delta MB = 0$), which implies $\Delta NDA = -\Delta NFA$. In the case of partial sterilization, the change in monetary base would be non-zero. The balance sheet in Table 2 shows the different ways a monetary authority can manage or sterilize by changing the components of NDA so that the impact of capital flows (NFA) on MB is minimal.

Table 2. A Typical Balance Sheet of a Central Bank in the GCC Countries

Assets	Liabilities and equity
Foreign Assets (FA)	Monetary Base (MB)
Domestic Assets (DA)	Time and Saving Deposits (TS)
Claims on Central Government	Central Government Deposits (GS)
Claims on Banking Institutions	Foreign Liabilities (FL)
	Capital Accounts (K)
	Other (Net)

Source: International Financial Statistics.

Relative to the central banks in the other GCC countries, the Central Bank of Bahrain uses more varied indirect monetary instruments, such as open market operations using treasury bills and government development bonds, foreign exchange swap operations, and repos with the commercial banks to manage short-term liquidity. The Central Bank of Kuwait has increasingly been using indirect monetary policy instruments such as open market operations and direct deposit-taking to manage liquidity. Oman relies mainly on indirect monetary instruments such as repo facilities and central bank certificates of deposit for liquidity management. Qatar mostly relies on trading on treasury bills and bonds, reserve requirements, and loans-to-deposit ratio. The Saudi Arabia Monetary Agency uses indirect monetary instruments such as repo operations in government bonds and foreign exchange swaps with banks. The UAE mostly relies on trading of treasury bills and bonds and central government deposits.

3.1 Specification of the Extent of Sterilization

Equation (3) shows that in the case of full sterilization one would expect an estimated coefficient of -1 in a regression of ΔNDA on ΔNFA . However, changes in NFA cannot be treated as exogenous. Sterilization policy or changes in NDA itself induces offsetting capital flows. Thus, sterilization policy implicitly involves a trade-off between control over MB and control over foreign exchange reserves. The

final changes in NFA become an endogenous variable and a regression of ΔNFA on ΔNDA would give the extent of the capital flow offsetting effect.

Most of the empirical studies in estimating the extent of sterilization have used the single equation approach in which ΔNDA is treated as regressand and ΔNFA is treated as a regressor (e.g., Herring and Marston, 1977; Obstfeld, 1983; Takagi, 1991; Aizenman and Glick, 2009; for recent review and references see Ouyang et al., 2010). Here we follow Ouyang et al. (2010) who used a simultaneous equation model consisting of two endogenous variables ΔNDA and ΔNFA .

Brissimis et al. (2002) used a simultaneous equation model where other determinants of ΔNDA and ΔNFA are explicitly derived from a theoretical framework by minimizing a simple loss function of the monetary authority subject to a number of economy-wide constraints. Ouyang et al. (2010) have modified this model and applied it to China. In this paper, we further modify the model to suit the economic environment of the GCC countries.

Thus, the estimated monetary reaction and the balance of payments functions are based on the following model. The goal of a monetary authority is to minimize the loss function:

$$L_t = (\Delta p_t)^2, \quad (4)$$

where Δp is the change in the logarithm of price level (or inflation). The loss function of the monetary authority is determined only by changes in the price level. In general, a loss function also includes the loss that may arise from cyclical income. However, as mentioned above, financial and price stability are the monetary policy objectives of the central banks of the GCC countries. Minimizing the loss by including cyclical output is irrelevant for these countries because they cannot pursue the third element of the trilemma mentioned above.

Inflation is considered a monetary phenomenon. Thus, the evolution of inflation can be written as follows:

$$\Delta p_t = \pi_1 \Delta M_t + \pi_2 \Delta p_{t-1} + \pi_3 \Delta s_t, \quad (5)$$

where M_t is the M2 money supply and $\pi_1 > 0$, $0 < \pi_2 < 1$, and $\pi_3 > 0$. Past inflation and depreciation of the nominal exchange rate (s_t) could also influence the current inflation. Note that domestic inflation depends on the imported inflation, which in turn depends on the prices of the foreign goods that the domestic country imports and through the changes in domestic currency in relation to the currencies of its trading partners. The US is not the only trading partner of the GCC countries, which justify the inclusion of $\Delta s_t \neq 0$ in (5). Moreover, the GCC countries' peg, especially Kuwait's peg, is not credible in the sense of Shambaugh (2004), which also justifies the inclusion of $\Delta s_t \neq 0$ in (5). We derive estimable equations keeping Kuwait in mind and then adjust those equations that would be appropriate for other GCC countries.

Money supply is related to monetary base (MB) and the money multiplier (mm) as $M = mm \times MB$, and the change in the money supply can be written as:

$$\begin{aligned}\Delta M_t &= mm_t \times \Delta MB_t + MB_t \times \Delta mm_t \\ &= mm_t \times (\Delta NFA_t + \Delta NDA_t) + MB_t \times \Delta mm_t.\end{aligned}\quad (6)$$

Substituting (6) into (5), the evolution of inflation can be written as:

$$\Delta p_t = \pi_1 [(mm_t (\Delta NFA_t + \Delta NDA_t) + MB_t \Delta mm_t)] + \pi_2 \Delta p_{t-1} + \pi_3 \Delta s_t. \quad (7)$$

The balance of payments can be defines as:

$$\Delta NFA_t = \overline{CA}_t + \Delta NK_t, \quad (8)$$

where CA is the current account, assumed to be autonomous, and ΔNK is the net capital flow. Assuming the current account is autonomous is not far from reality for these countries. Usually the current account depends on changes in the real effective exchange rate ($reer$). Real effective exchange rate data are only available for Bahrain and Saudi Arabia, and they are found to be highly insignificant for these countries. One plausible reason for this is that both exports and imports of these countries move in tandem with the oil price movements. The net capital flow is assumed to depend on uncovered interest differentials:

$$\Delta NK_t = (1/k) \Delta (r_t - r_t^* + s_t - E_t s_{t+1}) = (1/k) [\Delta r_t + \Delta s_t - \Delta (r_t^* + E_t s_{t+1})], \quad (9)$$

where r_t is the domestic interest rate, r_t^* is the foreign interest rate, $E_t s_{t+1}$ is the current expectation of the exchange rate at time $t+1$, and k represents the degree of capital mobility (the degree of substitutability between domestic and foreign assets). As mentioned above, the interest differentials are not zero for the GCC countries (e.g., Fasano, 2003). The interest rate is determined by the change in money supply:

$$\Delta r_t = -\psi_1 \Delta M = -\psi_1 [(mm_t (\Delta NFA_t + \Delta NDA_t) + MB_t \Delta mm_t)], \quad \psi_1 > 0. \quad (10)$$

Using (7) to (10) and ignoring the autonomous current account, we obtain:

$$\begin{aligned}\Delta p_t &= (\pi_1 mm_t + k\pi_3 + \pi_3 \psi_1) \Delta NFA_t + (\pi_1 mm_t + \pi_3 \psi_1) \Delta NDA_t + \\ &\quad (\pi_1 MB_t + \pi_3 \psi_1 MB_t) \Delta mm_t + \pi_2 \Delta p_{t-1} + \pi_3 (r_t^* + E_t s_{t+1}).\end{aligned}\quad (11)$$

We substitute (11) into the loss function (4) and minimize it with respect to ΔNFA_t and ΔNDA_t . After setting $\delta L_t / \delta \Delta NFA_t = 0$ and $\delta L_t / \delta \Delta NDA_t = 0$, we arrive to two reduced-form equations as follows:

$$\begin{aligned}\Delta NFA_t &= [-(\pi_1 mm_t + \pi_3 \psi_1) \Delta NDA_t - (\pi_1 MB_t + \pi_3 \psi_1 MB_t) \Delta mm_t \\ &\quad - (\pi_2) \Delta p_{t-1} - (\pi_3) \Delta (r_t^* + E_t s_{t+1})] / A,\end{aligned}\quad (12)$$

$$\begin{aligned}\Delta NDA_t &= [-(\pi_1 mm_t + k\pi_3 + \pi_3 \psi_1) \Delta NFA_t - (\pi_1 MB_t + \pi_3 \psi_1 MB_t) \Delta mm_t \\ &\quad - (\pi_2) \Delta p_{t-1} - (\pi_3) \Delta (r_t^* + E_t s_{t+1})] / B,\end{aligned}\quad (13)$$

where $A = (\pi_1 mm_t + k\pi_3 + \pi_3 \psi_1) > 0$ and $B = (\pi_1 mm_t + \pi_3 \psi_1) > 0$.

To ensure identification of (12) and (13), $\Delta(r_t^* + E_t s_{t+1})$ is dropped from (12) and Δp_{t-1} is dropped from (13) and the following monetary reaction—equation (14)—and the balance of payments function—equation (15)—are estimated as a system for each of the six GCC countries:

$$\Delta NDA_t = \alpha_0 + \alpha_1 \Delta NFA_t + \alpha_2 \Delta mm_t + \alpha_3 \Delta p_{t-1} + v_{1t}, \quad (14)$$

$$\Delta NFA_t = \beta_0 + \beta_1 \Delta NDA_t + \beta_2 \Delta mm_t + \beta_3 \Delta(r_t^* + E_t s_{t+1}) + v_{2t}. \quad (15)$$

Equation (14) is the money reaction function that contains *NFA* and two other control variables that might be important to the monetary authorities. The anticipated value of the sterilization coefficient (α_1) is between 0 (no sterilization) and -1 (complete sterilization). Values of α_1 between 0 and -1 indicate partial sterilization. The anticipated value of the coefficient of changes in the money multiplier (α_2) is negative because an increase in the money multiplier would induce a contractionary monetary policy to stabilize or curb the overall money supply growth. If the monetary authorities follow countercyclical policy, the past inflation coefficient (α_3) is also expected to be negative.

Equation (15) is the balance of payments function. As mentioned above, sterilization itself induces capital flows and the extent of the offsetting capital flows is captured by the offset coefficient β_1 . The anticipated value of the offset coefficient (β_1) is between 0 (no capital mobility) and -1 (perfect capital mobility). Other variables in (15) are expected to influence the changes in *NFA* as follows. A rise in the money multiplier may indicate either a more restrictive policy towards capital inflows or an increase in the money supply, which reduces interest rates and in turn reduces capital inflows. Thus, the anticipated value of the coefficient of the money multiplier (β_2) is negative. The anticipated value of β_3 is also negative because a rise in the foreign interest rate could lead to capital outflows. The term $\Delta(r_t^* + E_t s_{t+1})$ in (15) is only used for Kuwait and in estimation we assume perfect foresight (that is, $E_t s_{t+1} = \ln s_{t+1}$). For other GCC countries, only Δr_t^* is used (that is, $\Delta E_t s_{t+1}$ is dropped) because the US interest rate is used as the foreign interest rate.

4. Empirical Results

4.1 Data and Definitions

The availability and the quality of data remain a real problem for these countries even though these countries have gone through a huge structural and technological change in the past two decades. Quarterly data for *NFA*, *MB*, and *mm* for all GCC countries are easily available and taken from the International Financial Statistics (IFS) tape. Quarterly CPI data for Bahrain, Kuwait, and Saudi Arabia are mainly taken from the IFS. However, in some cases, the most recent data are taken from their central bank websites. Quarterly CPI data for Oman and Qatar before 2001 are not available. Thus, for these countries quarterly series before 2001

are extrapolated from the annual data (taken either from IFS tape or from their central bank websites) using the method used by Goldstein and Khan (1976). Data for the UAE is most limited. Quarterly CPI data are not available at all. Annual CPI data for the period 1991 to 1999 are taken from the IFS tape and annual data from 2000 to 2008 (the latest data available) are taken from its central bank website. Thus, for the UAE, the quarterly CPI data are interpolated.

Definitions and measurement of the variables used in empirical study are given in Table 3. In defining and measuring these variables we follow previous studies (e.g., Aizenman and Glick, 2009; Ouyang et al., 2010). The stationarity of these variables are checked before estimation. Table 4 presents the Phillips-Perron (PP) unit root test results. We have also confirmed these results with augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shen (KPSS) tests. Results in Table 4 show both predictor variables are stationary (low p-values) for all countries. Other variables are also stationary except in a few cases, but these are found to be stationary based on the KPSS test.

Table 3. Definitions and Measurement of the Variables

Variables	Definitions	Measured as
ΔNDA	The quarterly annual change in NDA	$(NDA_i - NDA_{i-4})/MB_{i-4}$
ΔNFA	The quarterly annual change in NFA	$(NFA_i - NFA_{i-4})/MB_{i-4}$
mm_i	Money multiplier for M2	$M2/MB$
Δmm_i	The quarterly annual percentage change in the money multiplier	$Log(mm_i/mm_{i-4})$
Δp_i	The quarterly annual percentage change in the CPI	$Log(CPI_i/CPI_{i-4})$
Δr_i^*	The quarterly annual change in US 3-month treasury bills	$r_i^* - r_{i-4}^*$

Sources: International Financial Statistics and the central bank websites of individual GCC countries.

4.2 Results from Point Estimates

The simultaneous equations system (14)–(15) is estimated with two-stage-least squares (2SLS) and three-stage-least squares (3SLS) for each of the six countries. Estimations are based on quarterly data for the period 1992:1–2009:3 for all countries except Kuwait and the UAE, which are based on quarterly data for the periods 1993:1–2009:3 and 1992:1–2008:4 respectively. Preliminary estimates show the presence of autocorrelation. Three autoregressive (AR) terms are included to correct serial correlation problems. In the final estimation, the heteroskedasticity and autocorrelation consistent (HAC) covariance estimates are used. Since (14) and (15) are estimated with AR terms, the following instruments are used: lagged values of ΔNDA_i and ΔNFA_i for both equations; constant, Δmm_i , and Δp_{i-1} and their lagged values for (14); and constant, Δmm_i , and Δr_i^* or $\Delta(r_i^* + E_i s_{i+1})$ and their lagged values for (15).

Table 4. PP Unit Roots Test Statistics

Variables	Bahrain	Kuwait	Oman	Qatar	S. Arabia	UAE
ΔNDA_t	-4.50 (0.00)	-6.57 (0.00)	-4.14 (0.008)	-4.28 (0.006)	-1.98* (0.046)	-1.58* (0.107)
ΔNFA_t	-4.52 (0.00)	-3.97 (0.014)	-3.86 (0.019)	-3.46 (0.051)	-1.98* (0.046)	-3.38 (0.061)
Δmm_t	-3.94 (0.015)	-3.01 (0.003)*	-6.38 (0.00)	-3.32 (0.001)*	-5.80 (0.00)	-3.95 (0.014)
Δp_{t-1}	-2.09 (0.036)*	-1.44 (0.19)*	-1.25 (0.19)*	-1.59 (0.104)*	-1.70* (0.084)	-6.66 (0.00)
Δr_t^*	-2.42 (0.016)*	-	-2.43 (0.015)*	-2.42 (0.015)*	-2.42* (0.016)	-2.43 (0.015)*
$\Delta(r_t^* + \ln s_{t+1})$	-	-2.56 (0.011)*	-	-	-	-

Note: P-values are in parentheses. Low p-value means the presence of a unit root is rejected. Results are with intercept and trend if not marked by a superscript. * denotes results under no intercept and trend with KPSS tests that show no unit root at the 5% significance level.

The results using 2SLS are presented in Table 5. The estimated value of the sterilization coefficient α_1 of ΔNFA ranges from -0.97 to -1 for Bahrain, Kuwait, Oman, and Saudi Arabia and they are highly significant. This means the monetary authorities of Bahrain, Kuwait, Oman, and Saudi Arabia have been heavily sterilizing their reserve accumulation for the last two decades. The estimated sterilization coefficients for Qatar and UAE are -0.38 and -0.39 , respectively, and they are highly significant. This implies that the monetary authorities of Qatar and UAE have sterilized over the period on average about one third of their accumulation of foreign reserves on their base money.

The estimated offset coefficients β_1 of ΔNDA are around -1 (-0.96 for Bahrain to -1.21 for the UAE) and they are highly significant. This means almost all of the policy-induced changes in reserves of these countries are offset through balance-of-payments flows. In other words, these countries have witnessed a high degree of capital flows for the last two decades. This is an important result itself because previous researchers of GCC countries only presumed perfect capital mobility without providing any empirical evidence.

As expected, the other most important variable is the money multiplier. Consistent with sterilization and capital flows, the coefficient of the money multiplier (for each country) is highly statistically significant and it has the anticipated negative sign, indicating that the money multiplier is increased to stabilize the money growth. There was a one-to-one (inverse) correspondence between changes in money multiplier and changes in net domestic assets (changes in net foreign assets). Neither past inflation (except Qatar) nor foreign interest rates influence the money reaction and the balance-of-payment functions of any of the GCC countries. The coefficients on past inflations are positive for all countries except the UAE, though they are all insignificant except Qatar. It seems Qatar

followed an accommodative (pro-inflationary) rather than a stabilizing (anti-inflationary) monetary management policy.

Table 5. 2SLS Estimates of the System of Equations, 1992:1–2009:3

	Predictor	Intercept	ΔNFA_t	ΔNDA_t	Δmm_t	Δp_{t-1}	Δr_t^*	AR(1)	AR(2)	AR(3)	\bar{R}^2	D-W
Bahrain	ΔNDA_t	0.12*** (3.30)	-1.03*** (17.0)	-	-1.17*** (18.3)	0.74 (0.91)	-	1.19*** (9.35)	-0.47** (2.53)	0.06 (0.49)	0.887	1.994
	ΔNFA_t	0.12*** (3.38)	-	-0.96*** (17.9)	-1.12*** (18.5)	-	-0.019 (1.18)	1.20*** (9.42)	-0.48*** (2.63)	0.07 (0.61)	0.934	2.013
Kuwait	ΔNDA_t	0.156** (2.20)	-1.01*** (14.8)	-	-1.17*** (11.79)	0.72 (0.70)	-	0.73*** (5.47)	-0.02 (0.10)	0.09 (0.66)	0.919	2.009
	ΔNFA_t	0.195*** (2.67)	-	-0.91*** (13.14)	-1.19*** (20.89)	-	-0.012 (0.72)	0.72*** (5.39)	0.008 (0.05)	0.114 (0.85)	0.978	2.020
Oman	ΔNDA_t	0.115*** (3.60)	-0.972*** (31.6)	-	-1.22*** (25.24)	0.94 (1.37)	-	0.76*** (5.35)	0.052 (0.31)	-0.041 (0.31)	0.991	2.007
	ΔNFA_t	0.134*** (3.13)	-	-1.01*** (29.8)	-1.24*** (28.5)	-	-0.018 (1.38)	0.90*** (7.17)	0.002 (0.011)	-0.053 (0.41)	0.993	2.005
Qatar	ΔNDA_t	-0.09 (1.35)	-0.38*** (2.82)	-	-0.86*** (3.10)	2.16** (2.27)	-	0.56*** (4.06)	0.077 (0.52)	-0.03 (0.23)	0.692	2.003
	ΔNFA_t	0.21** (1.98)	-	-0.99*** (4.85)	-1.75*** (14.26)	-	-0.052 (1.21)	0.92*** (7.09)	-0.067 (0.43)	-0.07 (0.71)	0.905	1.965
Saudi Arabia	ΔNDA_t	0.105** (2.60)	-1.01*** (86.1)	-	-1.25*** (21.47)	0.12 (0.40)	-	0.99*** (7.03)	-0.012 (0.07)	-0.07 (0.59)	0.990	1.947
	ΔNFA_t	0.109** (2.46)	-	-1.01*** (84.22)	-1.26*** (21.47)	-	-0.001 (0.13)	1.03*** (7.83)	-0.019 (0.11)	-0.093 (0.77)	0.990	1.936
UAE	ΔNDA_t	-0.121 (0.36)	-0.39*** (4.98)	-	-0.62*** (4.39)	-0.14 (0.10)	-	0.43*** (3.17)	0.28* (1.93)	0.35** (2.43)	0.550	1.740
	ΔNFA_t	0.26 (1.48)	-	-1.21*** (5.45)	-1.61*** (18.32)	-	-0.025 (1.50)	0.67*** (4.60)	-0.05 (0.299)	0.29** (2.10)	0.926	1.970

Notes: For Kuwait the period is 1993:1–2009:3 and for the UAE the period is 1992:1–2008:4. For Kuwait $\Delta(r_t^* + \ln s_{t+1})$ is used. Absolute t-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Equations were estimated with three autoregressive terms to correct serial correlation, and, in the final estimation, the heteroskedasticity and autocorrelation consistent (HAC) covariance estimates were used.

The correlation coefficient between the residuals of equations (14) and (15) is quite high (about 0.9) for all countries. Thus, we re-estimated the system (14)–(15) with 3SLS and results are presented in Table 6. The adjusted $R^2(\bar{R}^2)$ and the standard error (S.E.) of regressions (not shown) hardly changed across the methods of estimation. Comparing the methods of estimation (2SLS and 3SLS), one can see that the results are highly robust. There are only small changes in the main determinants of the money reaction and the balance-of-payments functions. The estimated sterilization coefficients for Qatar and the UAE are now -0.52 and -0.48, respectively, implying that the monetary authorities of Qatar and the UAE have sterilized on average about half of their accumulation of foreign reserves on their base money over the period. Given the magnitude of the correlation coefficient between residuals of (14) and (15), estimation using 3SLS is more appropriate. Thus we have used 3SLS for results of our rolling regressions.

Table 6. 3SLS Estimates of the System of Equations: 1992:1–2009:3

	Predictor	Intercept	ΔNFA_t	ΔNDA_t	Δmm_t	Δp_{t-1}	Δr_t^*	AR(1)	AR(2)	AR(3)	\bar{R}^2	D-W
Bahrain	ΔNDA_t	0.126*** (3.36)	-1.02*** (23.0)	-	-1.16*** (20.6)	0.26 (0.49)	-	1.20*** (9.97)	-0.48** (2.73)	0.08 (0.67)	0.888	2.011
	ΔNFA_t	0.127*** (3.63)	-	-0.98*** (23.2)	-1.14*** (20.7)	-	-0.003 (0.44)	1.20*** (10.05)	-0.48*** (2.77)	0.08 (0.68)	0.933	2.007
Kuwait	ΔNDA_t	0.173*** (2.67)	-1.03*** (18.53)	-	-1.19*** (13.8)	0.28 (0.49)	-	0.74*** (6.08)	-0.007 (0.04)	0.096 (0.79)	0.915	2.006
	ΔNFA_t	0.196*** (2.64)	-	-0.948*** (16.5)	-1.18*** (22.6)	-	0.002 (0.21)	0.75*** (5.94)	-0.023 (0.15)	0.128 (1.0)	0.979	2.030
Oman	ΔNDA_t	0.124*** (3.89)	-0.97*** (36.2)	-	-1.21*** (28.5)	0.29 (0.55)	-	0.86*** (6.74)	-0.01 (0.06)	-0.004 (0.04)	0.991	2.036
	ΔNFA_t	0.133*** (3.43)	-	-1.02*** (36.1)	-1.24*** (30.5)	-	-0.011 (1.27)	0.86*** (7.31)	0.018 (0.11)	-0.04 (0.32)	0.993	1.959
Qatar	ΔNDA_t	-0.054 (0.75)	-0.52*** (4.62)	-	-1.11*** (4.96)	2.46*** (2.89)	-	0.57*** (4.02)	-0.001 (0.01)	0.109 (0.82)	0.744	1.983
	ΔNFA_t	0.192* (1.96)	-	-1.08*** (5.34)	-1.80*** (16.4)	-	-0.037 (0.87)	0.876*** (7.48)	0.032 (0.24)	-0.12 (1.33)	0.902	1.942
Saudi Arabia	ΔNDA_t	0.107*** (2.75)	-1.01*** (96.95)	-	-1.25*** (23.48)	0.03 (0.34)	-	1.02*** (8.36)	-0.023 (0.15)	-0.084 (0.75)	0.99	1.943
	ΔNFA_t	0.107*** (2.64)	-	-1.01*** (92.97)	-1.25*** (22.62)	-	-0.002 (0.13)	1.03*** (8.10)	-0.026 (0.16)	-0.086 (0.73)	0.999	1.938
UAE	ΔNDA_t	-0.214 (0.28)	-0.48*** (6.92)	-	-0.77*** (6.12)	-0.33 (0.26)	-	0.52*** (4.24)	0.19 (1.41)	0.33** (2.56)	0.508	1.86
	ΔNFA_t	1.37 (0.18)	-	-1.73*** (8.71)	-1.63*** (21.74)	-	-0.01 (0.89)	0.50*** (4.10)	0.13 (0.97)	0.36*** (2.92)	0.914	1.824

Notes: For Kuwait the period is 1993:1–2009:3 and for the UAE the period is 1992:1–2008:4. For Kuwait $\Delta(r_t^* + \ln s_{t+1})$ is used. Absolute t-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Equations were estimated with three autoregressive terms to correct serial correlation, and, in the final estimation, the heteroskedasticity and autocorrelation consistent (HAC) covariance estimates were used.

4.3 Rolling Recursive Estimation Results

Point estimates presented in Tables 5 and 6 may not reveal the behavioral change of the sterilization policy of the central banks of the GCC countries following the recent oil price hikes. To capture any recent changes in the policy, rolling recursive regressions were estimated. In these rolling regressions the initial estimates were obtained using the sample 1992:1 to 2004:1 for all countries except Kuwait. The main reason for choosing this period for the initial estimate is that early 2004 seems to be the point when the recent surges in foreign reserves started. Given our small sample, this also provides minimal degrees of freedom (45) for estimation. Since Kuwait's data start from the first quarter of 1993, the initial estimates of Kuwait use the period 1993:1 to 2005:1 so that all countries have 45 degrees of freedom. After obtaining the initial estimate, the first observation is excluded and an observation is added at the end so that each time we have the same number of degrees of freedom.

Results from rolling regressions based on 3SLS are plotted in Figures 2 to 7. With little variation, the sterilization coefficients for all GCC countries, except Qatar and the UAE, remained stable at around 1 (in absolute value) for the period 2004:1 to 2009:3. However, there were some remarkable changes in the sterilization behavior of Qatar and the UAE. The sterilization coefficient of Qatar remained stable at around -1 until 2007:3. It then started to drop in 2007:4 and reached its lowest point at -0.3 in 2008:4 before rising again. A similar pattern is observed for the UAE. In general, the UAE sterilized less heavily compared to other GCC countries. The sterilization coefficient of the UAE remained stable at around -0.85 until 2006:4. It then started to drop in 2007:1 and reached its lowest point at 0.0 (no sterilization) in 2008:1 before rising again. The ability to track these trends illustrates the importance of the value of recursive estimation.

Figure 2. Sterilization and Offset Coefficients, Bahrain, 2004:1–2009:3

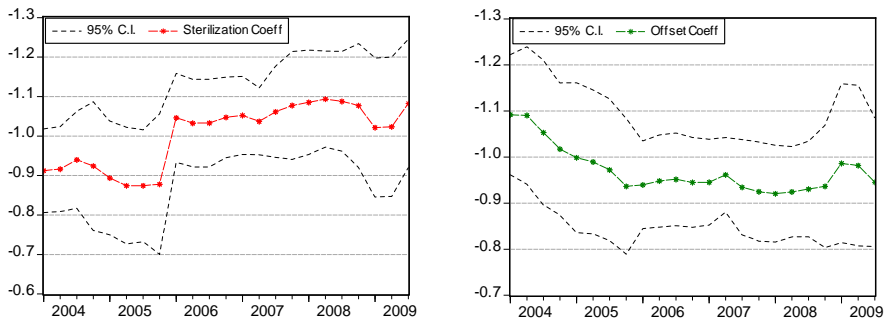


Figure 3. Sterilization and Offset Coefficients, Kuwait, 2005:1–2009:3

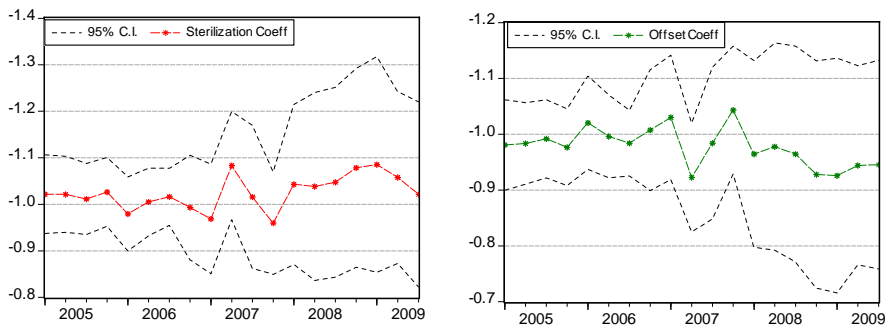


Figure 4. Sterilization and Offset Coefficients, Oman, 2004:1–2009:3

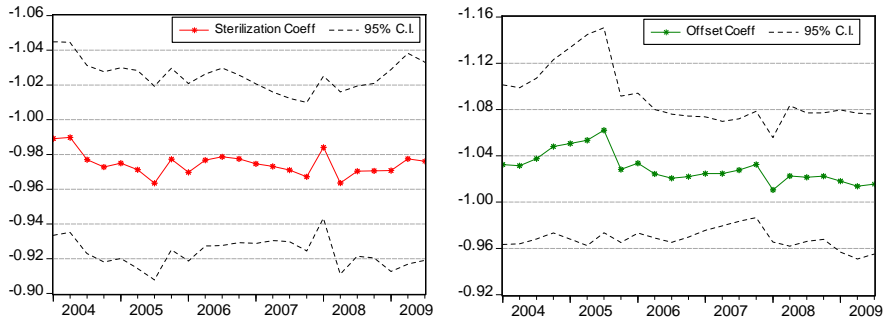


Figure 5. Sterilization and Offset Coefficients, Qatar, 2004:1–2009:3

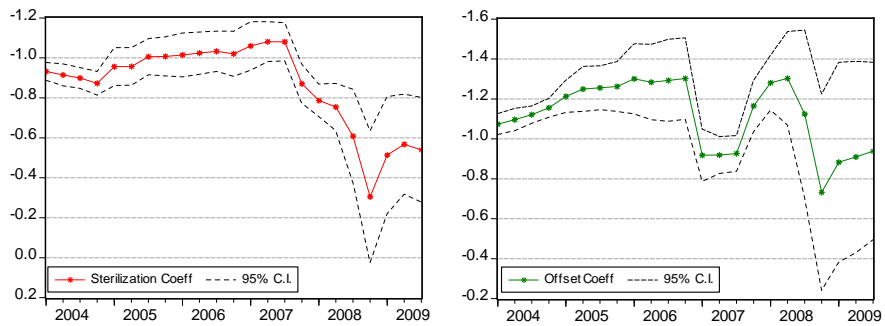


Figure 6. Sterilization and Offset Coefficients, Saudi Arabia, 2004:1–2009:3

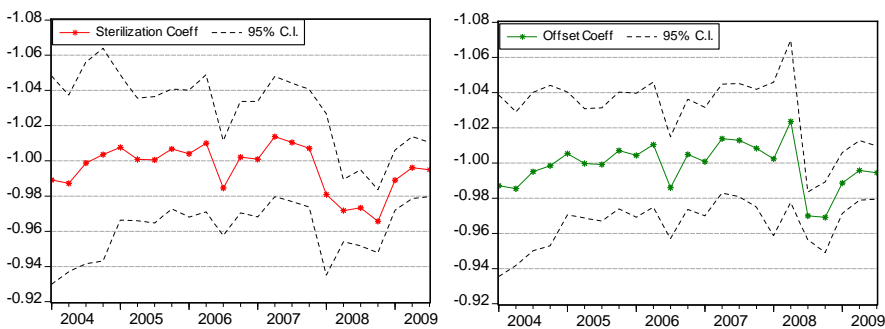
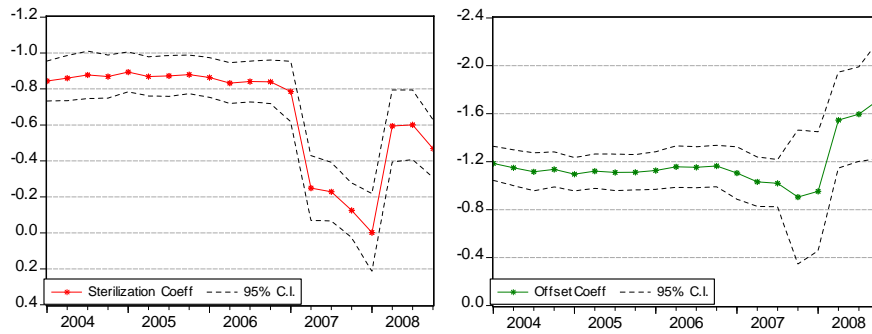


Figure 7. Sterilization and Offset Coefficients, UAE, 2004:1–2008:4

Qatar had 300%, 200%, and 100% (annualized quarterly) growth rates in its foreign exchange reserves in 2008:1, 2008:2, and 2008:3. The UAE had 73%, 86%, and 181% (annualized quarterly) growth rates in its foreign exchange reserves in 2007:2, 2007:3, and 2007:4. These growth rates for both Qatar and the UAE reached beyond the limits of the central banks of Qatar and the UAE to sterilize their massive reserve flows.

The recursive offset coefficients remained stable at around -1 for all GCC countries, except the UAE. This means that the GCC countries do not impose any restriction on capital flows. For the UAE, the offset coefficient also remained quite stable at around -1 until 2007:3, adjusted to -0.9 in 2007:4, then fell to -1.7 in 2008:4. The oil boom led to a construction boom in the UAE and other GCC countries; then the worldwide financial crisis of September 2008 followed with a fall in the oil price and an unprecedented capital flight from the UAE.

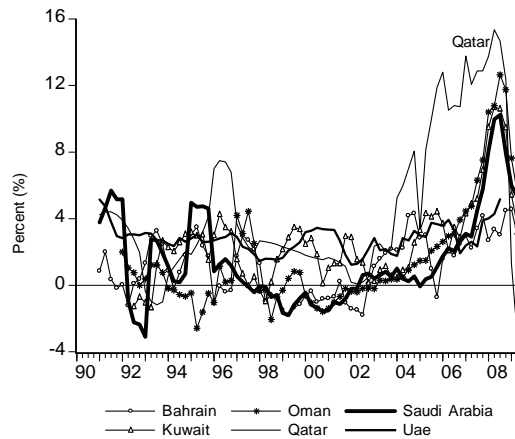
5. An Evaluation of the Monetary Policy of the GCC Countries

Fasano and Iqbal (2003) have pointed out that the fiscal policy of the GCC countries has been directed to achieve economic objectives such as growth and employment while monetary policy is directed at maintaining a stable exchange rate and controlling inflation. Khan (2009) has pointed out that the dollar peg has provided external stability. We now evaluate the role of monetary policy in controlling inflation (internal stability).

Figure 8 plots the inflation rates of the GCC countries for the last two decades to shed perspective on the monetary policy objective of price stability. The figure shows that the price levels of the GCC countries, except Qatar and the UAE (not shown due to data limitations), were quite stable except recent short spikes. The price level trend is quite consistent with their goal of price stability. The monetary performance depicted in Figures 2–7 is also quite consistent. The US dollar started to depreciate in 2002. The inflation rates of the GCC countries did not show any marked differences of the post-depreciation period from the pre-depreciation period

except for short spikes. Thus, the impact of the exchange rate pass-through, if any, seems to be minimal, which supports the claim by the IMF (2008) and Khan (2009) that the impact of exchange rates on inflation of the GCC countries is limited.

Figure 8. Inflation Rates of the GCC Countries



The inflation rate in Qatar shows a marked difference from the other GCC countries. Qatar is an exception in many ways. Qatar shifted its attention from the oil sector to the development of liquefied natural gas from its large reserves of natural gas at the end of 1990s. Since then, its growth in real GDP surged, leading to a sharp increase in per capita income. The local retailers may have taken advantage of this increase in per capita income. This problem was exacerbated by a sudden surge in international reserves that started in 2004 (Figure 1), and the central bank of Qatar failed to sterilize fully the large accumulation of reserves on the monetary base. Figure 5 shows that from a position of full sterilization in the second quarter of 2007, the central bank of Qatar moved to about one-fourth sterilization of international reserves on the monetary base in 2008:1.

The UAE is the other country that experienced high recent inflation. Table 1 shows the annual average inflation rate in the UAE was 6.4% for the period 2001–2008 compared with an average inflation rate of 3.3% for Bahrain, Kuwait, Oman, and Saudi Arabia for the period 2001–2009. The recent limited sterilization may have exacerbated the inflation problem in the UAE. Figure 7 shows that from a position of 90% sterilization at the end of 2006, it moved to zero sterilization in 2008:1.

Finally, the spikes in the inflation rates in 2008 must be explained. Figures 2–7 shows there were no marked differences in the sterilization policies of Bahrain, Kuwait, Oman, and Saudi Arabia. However, the unprecedented oil price increase in 2008 led these countries to undertake large investment and construction projects that led to temporary cost-push inflation.

6. Conclusion

The GCC countries operate under pegged exchange rate systems. IMF economists, led by Fasano (2003), have pointed out (without any empirical evidence) that these countries operate under liberal capital flows. One of the purposes of this paper is to establish the empirical validity of their claim. The estimated offset coefficients, a measure of capital flows, for all the GCC countries are around -1 , implying that these countries do not impose any restrictions on capital flows. The pegged exchange rate and free capital flows also imply that the central banks of these countries have no monetary autonomy. Within these constraints, the monetary policy of these countries is directed mainly toward the management of liquidity to stabilize the price level.

The liquidity of the GCC countries fluctuates mainly with the fluctuations in the oil price and with development projects that induce heavy capital flows in this region. The central banks of this region now increasingly rely on indirect monetary instruments, such as trading treasury bills. Consistent with the goal of price stability, the empirical evidence supports the conclusion that the central banks of the GCC countries heavily sterilize the impact of foreign reserves accumulation on the domestic money base. The estimated sterilization coefficients fluctuate around -1 , indicating full sterilization. The recursive rolling regression results show that the sterilization coefficients are quite stable, even for Qatar and the UAE, for most of the sample period. However, for a few quarters of 2007 and early 2008, Qatar and the UAE failed to sterilize foreign reserve accumulation, which may have exacerbated the inflation problem in those countries in recent years. Qatar and the UAE experienced staggering growth rates of foreign reserves in 2007 and 2008. These growth rates reached beyond the limits of the central banks of Qatar and the UAE to sterilize its massive reserve flows.

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