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Money-Price Relationship in Gulf Cooperation Council (GCC) Countries

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Starting from 2013, the monetary policy of the GCC countries will be governed by a single central bank. Examination of optimal monetary policy in these countries requires the analysis of the differences in monetary dynamics among these countries. This paper investigates the money-price relationship in GCC countries. The paper contributes to the literature by empirically examining the contemporaneous short-run relationship as indicated by economic theory. We propose and implement an alternative test of endogeneity to analyze the contemporaneous short-run relation. We also conduct Granger causality tests of dynamic long-run relationship between money and price level to be able to make comparisons between previous studies in the literature. The empirical results indicate that the short-run relationship is identical in all countries but the long-run relationship is significantly different. These results have many policy implication for the monetary union of GCC countries. The central bank of the union should take into account the differences in the dynamic long-run relationship and the monetary dynamics are suitable for the union since the contemporaneous relationship is identical in all countries.

1 Introduction

The Gulf Cooperation council (GCC) economies, namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates (UAE) are heading towards monetary unification and single monetary policy. The target date is 2013. The relationship between money supply and aggregate prices in an integral part of transmission of monetary policy. Achieving price stability is one of the main objectives of central banks and central banks can impact the price level through the money-price relationship. Thus, successful implementation of monetary policy requires a good understanding of the relation between monetary

aggregates and price level. In this study, we investigate this relation by analyzing the contemporaneous relationship between money and price level in the GCC countries using a new methodology. This methodology has not been implemented in the analysis of money-price relationship before. Previous studies of money-price relationship analyze the dynamic long-run relationship using time-series methods which is an approximation for the theoretical arguments. Our results have important policy implications for the upcoming monetary union of GCC countries since the country specific features will be incremental in effective monetary policy implementation.

There are counter views about money-price relationship. The widely accepted Quantity Theory of Money (QTM) argues that inflation is caused by exogenous changes in money supply. This view is called the "monetarist" view. On the other side of the debate, the "structuralist" view argues that inflation is developed by pressures from economic growth in economics with institutional rigidities. In response, monetary and fiscal authorities choose to expand the money supply. Thus, this view indicates that money supply expansion is a consequence of structural inflation.

The "monetarist view" argues that the money supply is the chief determinant of the demand side if short-run economic activity. Led by Milton Friedman the monetarist approach states that an increase in money supply causes an increase in the price level and output. In other words, monetary policy can affect the real economy. Friedman argues that the government should seek to promote economic stability, but only by controlling the rate of growth of the money supply.

Alternatively, Post Keynesians have developed the view that pressures emerging endogenously within financial markets are the basic determinant both of fluctuations in money supply growth and of credit availability. The orthodox monetary approach presents a direct contradiction to the endogenous money hypothesis. Moore (1988) explains it as the following:

In the orthodox monetary approach, the central bank plays a central role on controlling the growth money supply. It assumes that the central bank can increase or reduce the quantity of the monetary base, which consists of its liabilities, at its discretion. Monetarists believed that the

central bank could exogenously control the base to achieve the targeted money supply levels.

Many central bank (CB) practioners indicated that their practical experiences are in contrast with the orthodox approach of the monetarists. King (1994) indicates that " In the United Kingdom, money is endogenous ... broad money is created by the banking system." Also, Goodhart (1994) mentions that " All most all those who have worked in a CB believe that (the monetarist) view is totally mistaken." Thus, the Post Keynesian approach of money supply endogeneity has many anectodial evidence.

The question of whether inflation is a monetary phenomenon has been extensively analyzed theoretically and empirically. Several studies in the literature investigate money-price relationship empirically: Belrs and Jones (1993) for Algeria; Pradhan and Subramanian (1998) for India; Sun and Ma (2004) for China and Pinga and Nelson (2001) for 26 countries. Vymyatnina (2006) conducts the analysis from a post-Keynesian perspective for Russia. To the best of our knowledge, there are no studies that investigates money-price relationship for the GCC countries.

Many studies in the literature analyze the issue of monetary union between GCC countries. Most of these studies examine the suitability of monetary union by comparing the costs and benefits for each country. Mostly inflation, real GDP growth, fiscal imbalances, current accounts, debt structure, trade volume etc. (Sturm and Siegfried, 2005; Pattanaik, 2007; Dar and Presley, 2001; Jadresic, 2002; Iqbal and Fasano, 2003; Fasano and Schaechter, 2003; Fasano and Iqbal, 2002, 2003; Hebous, 2006; Laabas and Limam, 2002; and Ibrahim, 2004). Besides these descriptive studies, several studies focus on the differences in the responses of the GCC countries to similar macroeconomic shocks. Abu-Bader and Abu-Qarn (2006) use bivariate SVARs of total output and prices to extract AD and AS shocks for the GCC countries. They conclude that transitory demand shocks are symmetric and permanent supply shocks are asymmetric among GCC countries. Louis et al. (2008) implement a structural VAR model and show that demand and supply shocks are symmetrical between GCC countries and suggest that a monetary union is feasible. Mehanna and Hassan examine GCC countries over three time periods and conclude that GCC countries are

still out of phase and not harmonized in terms of trade, monetary policy and economic development. Despite its importance for optimal monetary policy, money-price relation in GCC countries is not investigated in the literature.

Several studies investigate optimal policy for the upcoming monetary union of the GCC countries. Considering increased economic integration among GCC countries, Khan (2009) examines the costs and benefits of alternative exchange rate regimes for the GCC. He concludes that the dollar peg is the best option following the establishment of a GCC monetary union when current structural characteristics of the GCC countries are taken into account. Kandil and Trabelsi (2010) investigate the feasibility of the GCC monetary union by analyzing the co-movements of shocks across countries. They find that most GCC countries are not integrated enough and suggest structural policy changes to increase economic integration. Rosmy, Bali and Osman (2008) test the suitability of monetary union in GCC countries using the symmetry of shocks based on a bivariate SVAR. The authors conclude that the monetary union is feasible and the US dollar, rather than the Euro, is more appropriate as an anchor for the new currency. US dollar is preferred because AD shocks are symmetrical with the US while there is no symmetry with major countries of the EURO area.

We analyze the contemporaneous short-run relationship between monetary aggregates and price level by conducting endogeneity tests using different measures of money supply: M1, M2 and reserve money. We implement the C-statistic endogeneity test as suggested by Baum et. al. (2007) to examine the contemporaneous short-run relationship between the two variables. This methodology has not been implemented before for the analysis of money-price relationship. To be able to make comparisons between previous studies in the literature, we also examine the dynamic long-run relationship using Granger causality tests as in Pinga and Nelson (2001).

Table I summarizes the empirical results. First, we conclude that in all analyzed countries monetary aggregates are endogenous. This result indicates that there is a bidirectional contemporaneous short-run relationship between money and price in GCC countries. Second, the dynamic long-run relationship between money and price level differs significantly among GCC countries. As a result, the findings of this

study indicates that after monetary unification the newly established central bank of GCC should take into account this diversity among countries while conducting monetary policy. But the contemporaneous short-run relationship does not pose a challenge for monetary unification.

Table I. Summary of causality evidence in individual countries

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
	Contemporaneous short-run Relationship					
	Endogenous	Endogenous	Endogenous	Endogenous	Endogenous	-
	Dynamic long-run Relationship					
LMB	Monetarist	Monetarist	Bidirectional	Monetarist	No causality	-
LM1	Bidirectional	Structuralist	Structuralist	No causality	Mixed results[a]	-
LM2	Structuralist	Monetarist	Monetarist	Structuralist	Structuralist	-

Notes: [a] Structuralist for 12-24 lags and monetarist for 25-36 lags. LMB, LM1 and LM2 are log values of monetary base, M1 and M2 respectively.

The rest of the paper is organized as the following. Section 2 presents theoretical and empirical studies about money-price relationship. Section 3 describes the economic characteristics of the GCC countries. Section 4 outlines the dataset. Section 5 explains the econometric methodology implemented in this paper. Sections 6 illustrates the empirical results of the contemporaneous short-run and dynamic long-run results respectively. Section 7 concludes.

2 Money and Price Relationship in the literature: theory and empirical evidence

Since Friedman (1963) stated that "inflation is always and everywhere a monetary phenomenon" both theoretical and empirical studies extensively analyzed the relationship between money and prices. Empirical studies like Lucas (1980), Dwyer and Hafer (1988) and McCandless and Weber (1995) examine different group of countries and conclude that there is a strong positive correlation between money growth and inflation. In a recent study, Basco et al. (2009) investigate the Argentinean high inflation experience and find that strong positive

money-price relationship exists during high inflation periods and this relationship weakens under low inflation. US economy is investigated by Browne and Cronin (2010). They use a cointegrating VAR framework and show that both commodity and consumer prices are proportional to the money supply in the long run.

McCallum (2001) and Meyer (2001) construct a theoretical framework based on the standard New Keynesian setup to examine the long-run relationship between money and inflation. Both studies conclude that inflation is "pinned down" by the nominal money-growth indicating the strong positive relationship. Nelson (2003) compares several theoretical and empirical arguments about money-price relationship in the literature. He concludes that "The proposition that inflation is always and everywhere a monetary phenomenon remains valid in present-day models, and can be applied both to the analysis of inflation dynamics and of the determination of steady-state inflation." To sum up, several theoretical and empirical studies in the literature support the strong positive relationship between monetary aggregates and price level.

3 Characteristics of the GCC countries

In this section we provide a brief description of the GCC countries and describe our motivation to investigate the endogeneity of money in these countries. As stated in Hebous (2006), the GCC aims at supporting the economic integration among its six members since its establishment in 1981. The GCC formed a customs union in 2003 and the GCC members agreed on launching a common currency by 2010 at the Muscat summit in December 2001.

Even though joining a monetary union has many benefits like promoting trade, reducing country risk and lowering transaction costs, there are major shortcomings for the member country. One of the major costs is that a member country loses its ability to conduct a national monetary policy that best fits its economic conditions. Hebous (2006) argues that although the GCC states have similar economic structures, share a common language and cultural similarities, there are significant challenges of the monetary union. To name a few, the choice of the future exchange rate regime and the convergence criteria might cause serious problems for the union.

In 2004, the GCC countries had agreed on the convergence criteria which sets limits on the size of budget deficit, inflation rate, interest rates, foreign reserves and ratio of public debt to GDP similar to the Eurozone criteria. As presented in Table II the GCC countries have significantly different macroeconomic conditions. Thus, the capacity of the countries to meet the criteria differ significantly. Especially, smaller countries face more difficulties to meet the criteria. At the end of 2009, all GCC countries were almost within the convergence system although the UAE and Oman have pulled out of the project for different reasons,

Table II displays the main economic indicators of the GCC states. The graphs that present the time-series behavior of key economic indicators are displayed in the Appendix. The GDP for the GCC members as a whole is about 1023 billion US dollars in 2009. Additionally, when the GCC union is established, it will be the largest monetary union after the Euro Area. The total GDP of GCC increased from 3.4 % of EU GDP to 8 % in 2008. GDP varies significantly among these countries. For example, Saudi Arabia is the biggest economy with a GDP of 469.43 billion which constitutes 43.74 percent of the GCC GDP. The second largest economy is UAE with a 24.43 percent share in the total GDP for all members, while the smallest economy is Bahrain (1.98) percent. The GDP growth rates are relatively high in the GCC region, for example 10 and 9.4 percent in Kuwait and Qatar respectively. Saudi Arabia is the largest country with 67.3 % of all 37 million GCC population. All GCC countries are oil-dependent economies. The share of oil production in GDP is highest in Qatar (60.8 percent) and lowest in Bahrain (28.5 percent).

The rate of inflation significantly varies among the member states and the average inflation rate of the GCC region as a whole is relatively low (5.76 percent). The percentage of government expenditure in GDP is similar in most of the states except for Saudi Arabia where 23.29 percent of GDP is government expenditures. Key macroeconomic variables and monetary policy in the GCC are described in detail in the Appendix.

Table II.Main Economic Indicators in the GCC in 2006

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates
Inflation	2.01	3.08	3.2	11.83	2.21	12.73
GDP(billion$) (1)	21.24	158.09	59.95	102.3	469.43	262.15
GDP share in the GCC GDP (percent)	1.98	14.73	5.58	9.53	43.74	24.43
GDP annual growth (percent)	7.03	9.97	6.27	9.4	5.31	8.91
Share of total imports and exports in GDP	173.6	85	111	109	107	184
Petroleum production/GDP	28.5	59.3	51.3	60.8	55.1	38.7
Oil Export/Aggregate Exports	79.2	94.5	75.9	47.5	88	46.7
Oil Revenue Government Revenue	85.2	91.1	74.1	60.0	76.2	77
Central government Non oil fiscal balance (in percent of non oil gdp) (2)	-33.9	-55.1	-42.8	-24.6	-60.8	-28.4
Central government fiscal balance (in percent of GDP) (2)	8	26.9	22.6	12.2	33.0	21.7
Share in the GCC Petroleum Production**	1.2	15.3	4.1	6.3	58.2	16.1
Share in the GCC Petroleum Reserves**	n.a	14.7	3.9	6.7	58.4	1.6
Share in the GCC Natural Gas Production**	5.0	5.1	10.2	26.8	31.5	21.4
Share in the GCC Natural Gas Reserves**	0.2	4.2	2.3	60.6	17.4	15.3
Population (Mill)	0.779	3.443	2.769	1.098	24.897	4.764

Data Source:
(1) World Economic Outlook , October,2009
(2) IMF Regional Economic Outlook (Middle East and Central Asia), October 2009
(3) Web pages of the Central Banks
(4) BP http://www.bp.com historical data , 2007.
Notes: ** Bahrain is not available in the BP. GCC Outlook June 2008 presents share of Bahrain as %1.2.

To sum up, the GCC countries have many economic similarities and differences. All GCC states are open and highly oil-dependent economies which implement a fixed exchange rate regime pegged to the US dollar. The member states are integrated at many levels with the establishment of a customs union in 2003 and the agreement to introduce a single currency by 2010. For a successful implementation of the monetary union the dynamics behind the monetary systems of each countries should be understood. Specifically, money-price relationship should be investigated thoroughly in the GCC countries since monetary policy implications highly depend on the supply mechanisms of money.

4 Data

The data are from the International Financial Statistics (IFS). The frequency of the data is monthly. Compared to the previous studies in the literature that use quarterly data, we use higher frequency which should produce more accurate results. We are constrained by the availability of monetary aggregates and CPI data for all countries. The period of study for each country are listed in the Appendix table A.1.

Variables are:
• Consumer price index (CPI)
• Monetary base (MB) : Reserve money in the IFS
• Narrow and broad money aggregates (M1 and M2):
M1 is money in the IFS and M2 is money plus quasi money.
Log levels of the variables are used for the analysis.

5 Econometric methodology

Previous empirical studies on the money-price relationship implement different causality techniques (Granger causality tests, cointegration and error correction models etc.). All of these methods test the causality between price level and different monetary aggregates from a time series perspective. In other words, the relationship between lagged values of price level and money is analyzed using these methods. Although the quantity theory of money indicates a contemporaneous short-run relationship and theoretical studies of endogeneity of money do not restrict the relationship to only lagged values of the price level, the contemporaneous short-run relationship is neglected in the literature. This is mainly caused by the fact that there are many different methods

of time-series econometrics to test causality between lagged values of variables. But these methods have several significant limitations. First of all, the results highly depend on lag selection. Second, in some cases (like cointegration tests), they only measure whether two variables move together over time. Thus, they do not directly test causality but they are only approximate tests of relationships. Third, the causality tests do not present the sign of the correlation between two variables. In other words, whether the relationship is negative or positive cannot be identified by the causality tests. Finally and most importantly, they do not investigate contemporaneous short-run relationship between variables and limited to causality between a variable and lagged values of other variables. In this paper, we propose and implement a direct test of contemporaneous short-run relationship between money and price level (endogeneity test).

5.1 Endogeneity test of contemporaneous short-run relationship

In the econometric theory literature endogeneity is explained as the case when the independent variable is correlated with the error term in a regression model. From an econometric theory perspective, the existing causality studies do not make a clear distinction between exogeneity and causality. Thus, the presence of causal relationship from price level to money supply is neither necessary nor a sufficient condition for testing the endogenous money hypothesis. As recommended by Baum et. al. (2007), we propose a test of overidentifying restrictions, C-statistic test, to the test endogeneity of money hypothesis. Details of the test are presented in the Appendix.

The proposed IV GMM methodology to investigate the contemporaneous short-run relationship between price level and money can be summarized as the following:

- Step I: Determine the valid instrumental variables
- Step II: Run the GMM regression with the instruments
- Step III: Check the validity of the instruments using Sargan-Hansen and underidentification tests
- Step III: Conduct the C-statistic endogeneity tests and determine whether money is endogenous
- Step IV: Determine whether the relationship is bidirectional by analyzing the coefficients of the IV GMM regression results and the endogeneity tests

5.2 Dynamic long-run (Time-series) relation

To investigate the dynamic long-run relationship, we implement the Granger causality tests to all GCC countries as in Pinga and Nelson (2001). As in Shanmugam et al. (2003), we first test for unit roots using the Phillips-Perron test (Phillips and Perron, 1998). This test is implemented because the test is designed to ensure that serial correlation does not affect the asymptotic distributions. Also, it is shown that the Phillips-Perron test has more power than the augmented Dickey-Fuller test. (Davidson and McKinnon, 1993). The optimal length of the unit root test is determined by the Newey-West methodology.

Granger (1969) developed the methodology to test causality between two related economic time series by applying distributed lag models. The Granger causality test identifies whether the current value of a variable can be explained by a regression containing the lagged values of itself and the related variable. In this paper, the Granger causality test of money-price relationship can be presented by the following regressions:

$$P_t=f(P_{t-1}, P_{t-2}, \dots , P_{t-l,} M_{t-1,} M_{t-2,} \dots M_{t-l})$$

H_0= coefficients of the lagged M's are jointly insignificant.

$$M_t=f(M_{t-1,} M_{t-2,} \dots M_{t-l} ,P_{t-1}, P_{t-2}, \dots , P_{t-l})$$

H_0= coefficients of the lagged P's are jointly insignificant.

where P is the price level and M is the monetary aggregates. t and l denote time period and number of lag length respectively.

Using the F-test of joint significance a rejection of the null hypothesis concludes that there is a causality relationship. As presented in Batten and Thornton (1985) causality tests are sensitive to the choice of lag lenghts thus we study lags of one to thirty six.

6 Empirical Results

6.1 Short-run (Contemporaneous) relationship

In this section, we implement the proposed IV methodology explained in section 3.1 to investigate endogeneity of money. Table III presents the IV regression results of eq.1 for each GCC country. Table IV shows the C-statistic of endogeneity of alternative monetary aggregates. First, we determine the appropriate instruments and test the validity of the instruments using the Hansen J statistic and underidentification tests. For all of the countries and for all alternative monetary aggregates, analysis of the Hansen J statistics indicate that we accept the null hypothesis that the instruments are valid instruments i.e., uncorrelated with the error term. We conclude that the excluded instruments are correctly excluded from the estimated equation. The underidentification tests of all regression specifications reject the null hypothesis that the regression equations are underidentified. Thus, we conclude that the IV regressions that we run for all countries are valid and we can proceed with the endogeneity tests.

Table III. IV regression results all countries dependent variable: LCPI, independent variable: monetary aggregates (2 step GMM estimation)

Country		β_0	β_1	Hansen J Statistic	Underidentification Test	Number of Observations
Bahrain	LMB	-2.380 (7.94)***	0.366 (22.86)***	0.81 P-lue=0.67	71.38 P-value=0.00	361
	LM1	-3.286 (9.50)***	0.401 (22.37)***	4.02 P-lue=0.13	71 P-value=0.00	361
	LM2	-1.183 (6.05)***	0.274 (29.15)***	0.05 P-lue=0.98	71.69 P-value=0.00	361
Kuwait	LMB	-4.815 (15.66)***	0.456 (29.66)***	1.65 P-alue=0.2	132.83 P-value=0.00	423
	LM1	-4.427 (15.74)***	0.421 (31.56)***	1.32 Pvalue=0.25	132.8 P-value=0.00	423
	LM2	-3.318 (17.07)***	0.344 (40.58)***	2.54 P-lue=0.11	153.1 P-value=0.00	424
Oman	LMB	0.583 (3.11)***	0.201 (21.63)***	3.17 P-lue=0.21	23.52 P-value=0.00	90
	LM1	-0.351 (1.31)	0.240 (18.68)***	1.14 P-alue=0.57	28.33 P-value=0.00	90
	LM2	-0.674 (3.57)***	0.242 (28.15)***	0.58 P-lue=0.75	27.94 P-value=0.00	90
Qatar	LMB	-7.176 (7.24)***	0.520 (11.27)***	0.76 P-lue=0.38	38.97 P-value=0.00	108
	LM1	-7.598 (4.78)***	0.530 (7.36)***	0.7 P-lue=0.40	24.5 P-value=0.00	147
	LM2	-2.245 (3.75)***	0.278 (10.90)***	1.11 P-lue=0.29	38.1 P-value=0.00	169
Saudi Arabia	LMB	-1.637 (6.00)***	0.251 (22.72)***	1.95 P-value=0.38	80.06 P-value=0.00	340
	LM1	0.350 (2.41)**	0.165 (29.09)***	0.32 P-lue=0.85	116.06 P-value=0.00	333
	LM2	0.674 (4.43)***	0.149 (25.71)***	0.97 P-lue=0.62	113.81 P-value=0.00	340
UAE	The Price index of UAE is only annual from 2000-2008. Thus there are not enough observations to conduct endogeneity tests.					

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.
Instruments: Bahrain: 3,4,5 lags of LCPI; Kuwait: 4,5 lags of LCPI for LMB and LM1, 3,4 lags of LCPI for LM2 ; Oman: 3,4,5 lags of LCPI; Qatar: 4,5 lags of LGDPdef ; Saudi Arabia: 3,4,5 lags of LCPI; UAE:.

Table IV. Endogeneity tests for all countries (Monetary Aggregates)

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
LMB	79.25*** P-value = 0.00	214.47*** P-value = 0.00	21.69*** P-value = 0.00	27.94*** P-value = 0.00	148.02*** P-value = 0.00	-
LM1	79.67*** P-value = 0.00	151.1*** P-value = 0.00	22.86*** P-value = 0.00	71.62*** P-value = 0.00	162.91*** P-value = 0.00	-
LM2	82.49*** P-value = 0.00	60.61*** P-value = 0.00	23.47*** P-value = 0.00	79.82*** P-value = 0.00	147.56*** P-value = 0.00	-

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.

Table IV conducts the endogeneity tests. The null hypothesis of the C-statistic endogeneity test is that the tested variable is exogenous. So, rejecting the null hypothesis indicates that the variable is endogenous. Table IV shows that for all of the countries the null hypothesis is rejected at one-percent significance level. As a result, we conclude that money is endogenous in all GCC countries. In table III, the coefficient of monetary aggregates, β_1 is significant. Thus, there is bidirectional relationship between price level and monetary aggregates in GCC countries.

6.2 Long-run (Time-Series) relationship

Granger tests of causality between money and prices are performed on time series data for GCC countries. The unit root tests presented in Table V show that the logarithm of variables are not stationary but the first differences of the logarithm of the variables are stationary. Thus, we conduct the Granger causality test using the first differences of the logarithms of the variables as in Pinga and Nelson (2001).

Table V. Unit Root Tests Phillips Perron

	Bahrain		Kuwait		Oman		Qatar[b]		Saudi Arabia	
Variable	Test Statistic	Lag	Test Statistic	Lag	Test Statistic	Lag	Test Statistic	Lag	Test Statistic	Lag
LCPI	-8.82***	9	-1.13	0	8.4	3	-2.06[c]	9	1.54	9
DLCPI	-21.49***	10	-21.24***	1	-6.89***	6	-18.59***	12	-17.05***	9
LMB	-0.83	4	-1.32	5	-2.44	15	-2.25	20	-2.23	9
DLMB	-27.62***	1	-27.44***	0	-36.71***	2	-9.08***	9	-28.04***	11
LM1	-0.3	14	-0.63	4	-3.28**	1	-1.19	7	-2.17	12
DLM1	-29.27***	4	-24.87***	5	-24.07***	7	-11.48***	7	-27.09***	13
LM2	-1.47	10	-1.32	12[a]	-2.42	2	-1.4	7	-2.34	14
DLM2	-30.56***	1	-10.86	11	-21.71***	5	-12.27***	7	-28.14	15

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Newey West lags.
[a] Augmented Dickey Fuller test results. Phillips Peron test has identical results. Augmented Dickey Fuller test is implemented because the Newey-West Bandwith is extremely wide (467 lags).
[b] Quarterly data is used because of lack of monthly CPI data for Qatar.
[c] GDP deflator is used to measure the price level.

Table VI displays the Granger causality results at alternative lag lenghts. The first column of the table presents the hypothesis that is tested. For example, DLCPI→DLMB indicates that the null hypothesis of the test is log difference of CPI, DLCPI, does not Granger cause log difference of monetary base, DLMB. Thus, a rejection of the null hypothesis validates the existence of causality from DLCPI to DLMB.

The Granger Causality tests of Bahrain reject the null hypothesis and confirm the following relationships: DLMB→DLCPI, DLCPI→DLM1, DLM1→DLCPI, DLCPI→DLM1. For Kuwait, DLMB→DLCPI, DLCPI→DLM1 and DLM2→DLCPI relationships are found. Tests of Oman present the following causality relationships: DLCPI→DLMB, DLMB→DLCPI, DLCPI→DLM1, DLCPI→DLM2, DLM2→DLCPI. For Qatar, a weak causality is found for DLMB→DLCPI and DLCPI→DLM2. Finally, for Saudi Arabia, Granger causality tests presents that DLM1→DLCPI , DLCPI→DLM1 and DLCPI→DLM2.

Table VI. Standard Granger causality tests as in Malaysia (2003) paper

		Bahrain	Kuwait	Oman	Qatar[a]	Saudi Arabia
Variable	Lag	Test Statistic	Test Statistic	Test Statistic	Test Statistic	Test Statistic
DLCPI →DLMB	1-12	15.2	12.51	14.02	14.19	14.32
		(0.29)	(0.41)	(0.30)	(0.29)	(0.28)
	13-24	14.48	6.02	10.74	6.38	9.56
		(0.27)	(0.92)	(0.55)	(0.90)	(0.66)
	25-36	10.48	5.15	29.13***	18.13	5.63
		(0.57)	(0.95)	(0.00)	(0.11)	(0.93)
DLMB →DLCPI	1-12	21.8**	9.61	5.85	19.46*	14.02
		(0.04)	(0.65)	(0.92)	(0.08)	(0.30)
	13-24	22.55**	25.97***	26.82***	18.13	6.04
		(0.03)	(0.01)	(0.01)	(0.11)	(0.91)
	25-36	34.37***	13.9	27.71***	14.92	14.02
		(0.00)	(0.31)	(0.01)	(0.25)	(0.30)
DLCPI →DLM1	1-12	22.89**	18.59*	26.56***	10.58	10.67
		(0.03)	(0.10)	(0.01)	(0.56)	(0.56)
	13-24	15.51	11.74	12.25	7.87	26.5***
		(0.22)	(0.47)	(0.43)	(0.80)	(0.01)
	25-36	11.61	33.21***	12.03	12.31	11.5
		(0.48)	(0.00)	(0.44)	(0.42)	(0.49)
	1-12	19.82*	4.94	17.75	13.23	14.56
		(0.07)	(0.96)	(0.12)	(0.35)	(0.27)

Table VI. Standard Granger causality tests as in Malaysia (2003) paper (continued)

DLM1 → DLCPI	13-24	11.97 (0.45)	3.39 (0.99)	8.78 (0.72)	4.12 (0.98)	13.54 (0.33)
	25-36	12.18 (0.43)	3.65 (0.99)	19.96* (0.07)	10.71 (0.55)	25.14*** (0.01)
DLCPI →DLM2	1-12	36.38*** (0.00)	7.58 (0.82)	7.04 (0.86)	11.39 (0.50)	21.46** (0.04)
	13-24	34.49*** (0.00)	7.91 (79)	10.82 (0.55)	20.14* (0.06)	23.41** (0.02)
	25-36	21.06** (0.05)	2.05 (0.99)	30.69*** (0.00)	17.65 (0.13)	18.46 (0.10)
DLM2 → DLCPI	1-12	11.62 (0.48)	65.7*** (0.00)	25.31*** (0.01)	12.45 (0.41)	11.29 (0.50)
	13-24	15.88 (0.2)	3.13 (0.99)	9.87 (0.63)	12.69 (0.59)	17.54 (0.13)
	25-36	8.53 (0.74)	0.94 (1)	21.54** (0.04)	17.02 (0.30)	17.11 (0.15)

Notes: P-values in parenthesis below coefficients.
* significant at 10%; ** significant at 5%; *** significant at 1%. [a]Quarterly data is used because of lack of monthly CPI data for Qatar. GDP deflator is used to measure the price level.

As a result, the Granger causality tests of GCC countries have two main results. First, the money-price relationship significantly differs among GCC countries. Second, the relationship might be different for different monetary aggregates. As a result, we conclude that the dynamic long-run relationship of money and price varies significantly among countries and a unified monetary policy should take into account this differences in the dynamic long-run relationship.

7 Conclusion

Understanding the relationship between money and price level is incremental for efficient implementation of monetary policy. The GCC countries are set to form a monetary union in 2013. Starting from 2013, GCC countries will have a single currency and will be governed by central monetary policy. Thus, it is essential to understand the differences in monetary dynamics in GCC countries. Especially, money-price relationship is significant since achieving price stability is one of the main objectives of central banks and central banks can impact the price level through the money-price relationship.

The relationship between the price level and monetary aggregates in GCC countries is not investigated before. In this study, we contribute to the literature by analyzing the contemporaneous short-run relationship using an econometric technique which is not been implemented for the analysis of money-price relationship. We also investigate the dynamic long-run relationship. We conclude that the contemporaneous short-run relation between money and price is identical in all GCC countries but the dynamic long-run relationship differs significantly among countries. These empirical results have significant policy implications. As a result, the empirical results of the paper indicate that the monetary dynamics of the GCC countries are suitable for monetary unification since all GCC countries have the same money-price relationship. But one can argue that after monetary unification the central bank should take into account the differences in the dynamic long-run relation between monetary aggregates and the price level.

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Appendix

A. Econometric Methodology

As shown in Hayashi (2000), a regressor is endogenous if it is not predetermined (i.e., not orthogonal to the error term), that is, if it does not satisfy the orthogonality condition. Following this argument, we test whether money is endogenous using the C statistic (also known as a GMM distance or difference-in-Sargan statistic). Under the null hypothesis that the specified endogenous regressors can actually be treated as exogenous, the test statistic is distributed as chi-squared with degrees of freedom equal to the number of regressors tested. The endogeneity test is, like the C statistic, defined as the difference of two Sargan-Hansen statistics: one for the equation with the smaller set of instruments, where the suspect regressor(s) are treated as endogenous, and one for the equation with the larger set of instruments, where the suspect regressors are treated as exogenous. Also like the C statistic, the estimated covariance matrix used guarantees a nonnegative test statistic. Under conditional homoskedasticity, this endogeneity test statistic is numerically equal to a Hausman test statistic; see Hayashi (2000, 233-234).

Specifically, the C statistic endogeneity test of money can be represented by the following steps:

1) Estimate the linear equation in which CPI is the dependent variable and monetary aggregates is the explanatory variable using Instrumental Variables (IV) regression methods. The linear equation is defined as,

$$LCPI_t=\beta_0 + \beta_1 LM2_t+ \varepsilon_t \qquad (1)$$

where $LCPI_t$ is log level of consumer price index and LM2 is log level of monetary aggregate, M2. This equation is estimated because by definition of endogeneity, the test is defined for the explanatory variables. If money (for example LM2) is endogenous then the coefficient of LBCPI, γ_1, in the following regression is significant and there is a contemporaneous short-run two-way (feedback) relationship between the two variables.

$$LM2_t=\gamma_0 + \gamma_1 LCPI_t+ \varsigma_t \qquad (2)$$

The Generalized Method of Moments (GMM) methodology is implemented to carry out the IV estimation and endogeneity tests. GMM makes use of the orthogonality conditions to allow for efficient estimation in the presence of heteroskedasticity of unknown form as stated by Hansen (1982). In general GMM methodology can be described as an estimator of the following equation,

$$y_i=X_i\beta+u_i \qquad (3)$$

where error term u_i is distributed with mean zero and the covariance matrix Ω. The set of instrumental variables is denoted by Z; this is the full set of variables that are assumed to be exogenous; i.e., $E(Z_iu_i)=0$.

As explained in Baum et al. (2007), the assumption that the valid instruments, Z, are exogenous indicate the following moment condition,

$$g_i(\hat{\beta}) = Z_i'\hat{u}_i = Z_i'(y_i - X_i\hat{\beta}) \qquad (4)$$

The exogeneity of the instruments means that the moment conditions, or orthogonality conditions, will be satisfied at the true value of β:

$$E\{g_i(\beta)\}=0 \qquad (5)$$

Using the orthogonality conditions displayed in eq.5 the GMM objective function can be presented as,

$$J(\hat{\beta}) = n\bar{g}(\hat{\beta})'Wn\bar{g}(\hat{\beta}) \qquad (6)$$

The GMM estimator for β is the $\hat{\beta}$ that minimizes $J(\hat{\beta})$. Deriving and solving the first order conditions,

$$\frac{\partial J(\hat{\beta})}{\partial \hat{\beta}}$$

yields the following GMM estimator:

$$\hat{\beta}_{GMM} = (X'ZWZ'X)^{-1}X'ZWZ'y \qquad (8)$$

Using eq.8, the coefficients of the IV regression are computed and the endogeneity test statistic of money (C statistic) is calculated.

To conduct IV methodology, valid instruments for $LM2_t$ should be determined. Usually lagged values of the dependent variables can be used as instruments. The validity of the instruments can be tested using the Sargan (1958) statistic.[1] To be able to conduct a robust IV regression, it is also essential to test that we are using all possible instruments in other words whether there are any redundant instruments. To be able to test that all of the instruments are needed (valid) we need to implement the underidentification test of Anderson (1951).[2]

The calculated statistics indicate that the instruments that we use do not cast considerable doubts. The Anderson (1951)'s underidentification statistic shows that the model is identified. In other words, the instruments are "relevant" in the sense that they are correlated with (assumed) endogenous regressors. The Sargan (1958)-Hansen (1982)'s J statistic for overidentifying restrictions does not reject the null hypothesis that our instruments are uncorrelated with the error term (and that excluded instruments are correctly excluded from the estimated equation).

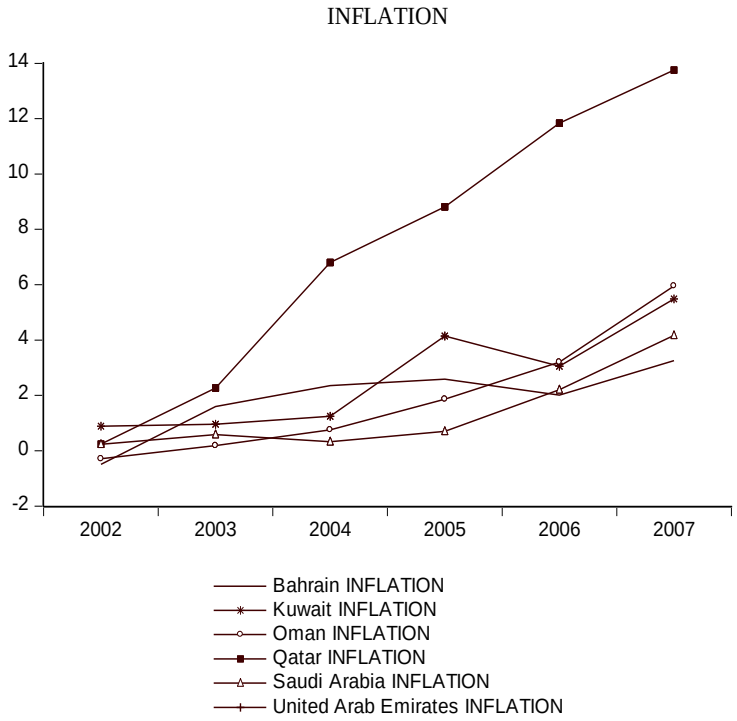
2) After the IV regression, the C statistic should be calculated using the GMM results. The null hypothesis of the test is that the specified endogenous regressors can actually be treated as exogenous. Thus, if we reject the null hypothesis than the test concludes that the regressor, money, is endogenous.

[1] The Sargan-Hansen test is a test of overidentifying restrictions. The joint null hypothesis is that the instruments are valid instruments, i.e., uncorrelated with the error term, and the excluded instruments are correctly excluded from the estimated equation. Thus, if the null hypothesis is accepted then the instruments are valid meaning that they satisfy the condition that they are uncorrelated with the error term and correlated with the endogenous variable.

[2] The underidentification test is an LM test of whether the equation is identified, i.e., that the excluded instruments are relevant, meaning correlated with the endogenous regressors.

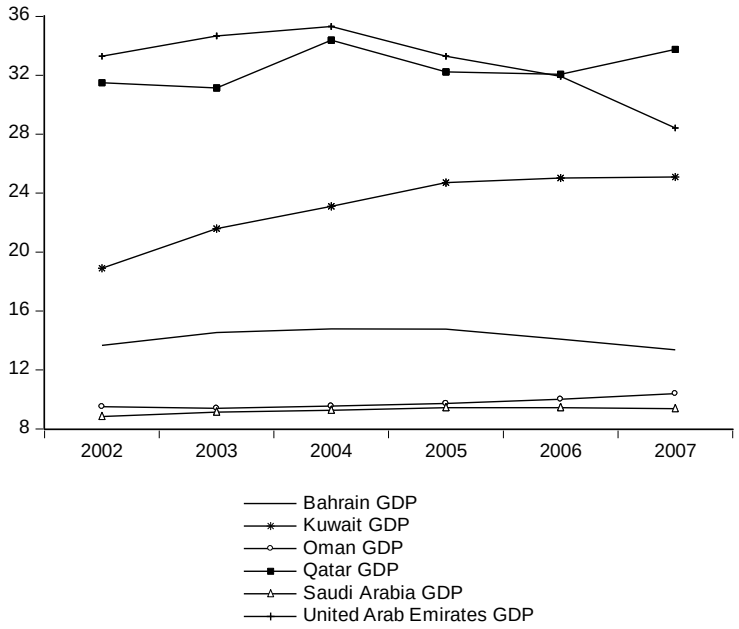
B. Time Series Behavior of Key Macroeconomic Variables

Time series behavior of key macroeconomic and monetary variables are presented in this section. First graph below displays inflation rates in the GCC. Qatar has the highest rate and the remaining GCC have lower inflation rates. Inflation rates of all GCC are increasing after 2006.

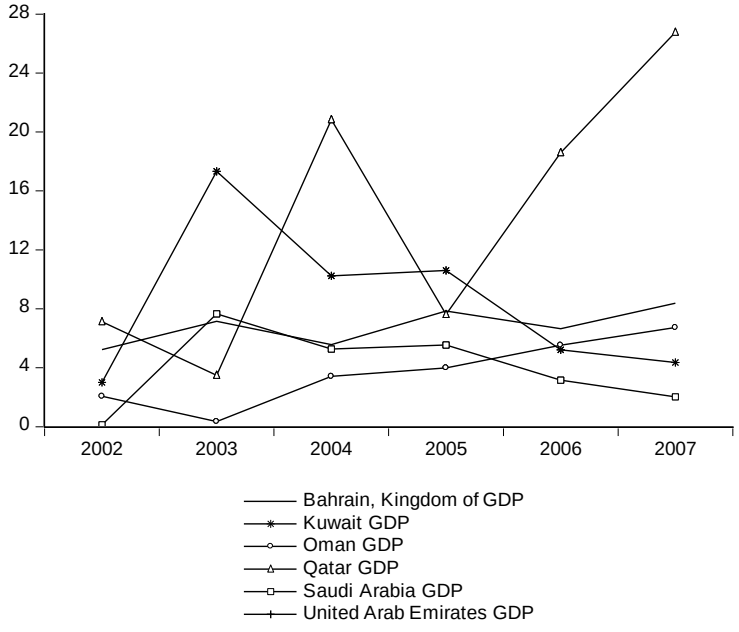


Qatar has the highest GDP per capita as shown in the figure below. Also, the GDP growth rate of Qatar is higher than the remaining GCC. The growth rate of GDP is similar in the other GCC.

GDP PER CAPITA

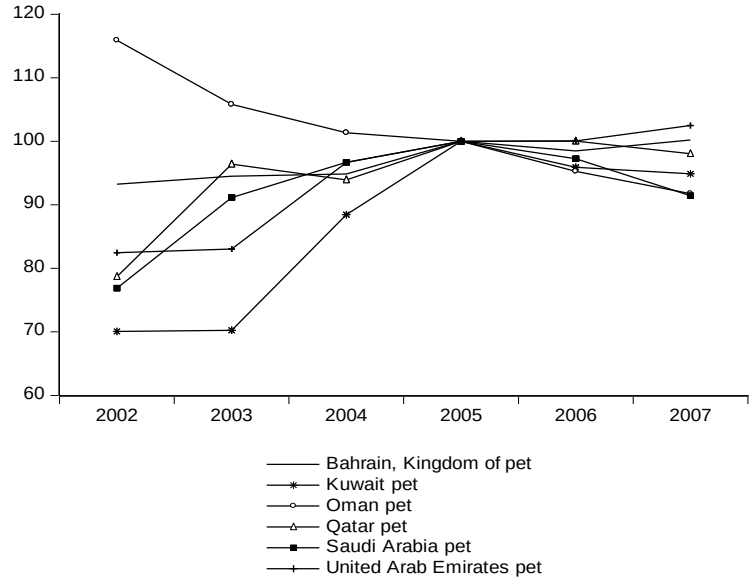


GDP VOLUME & CHANGE

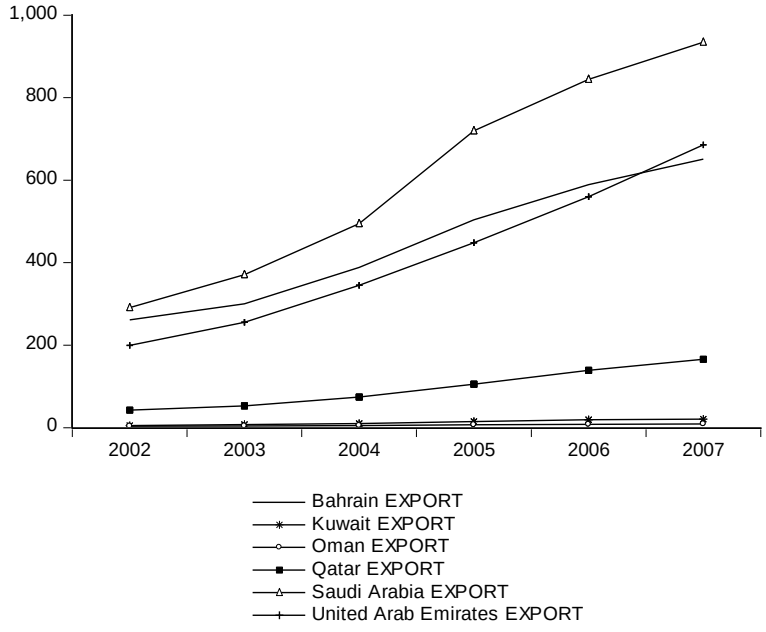


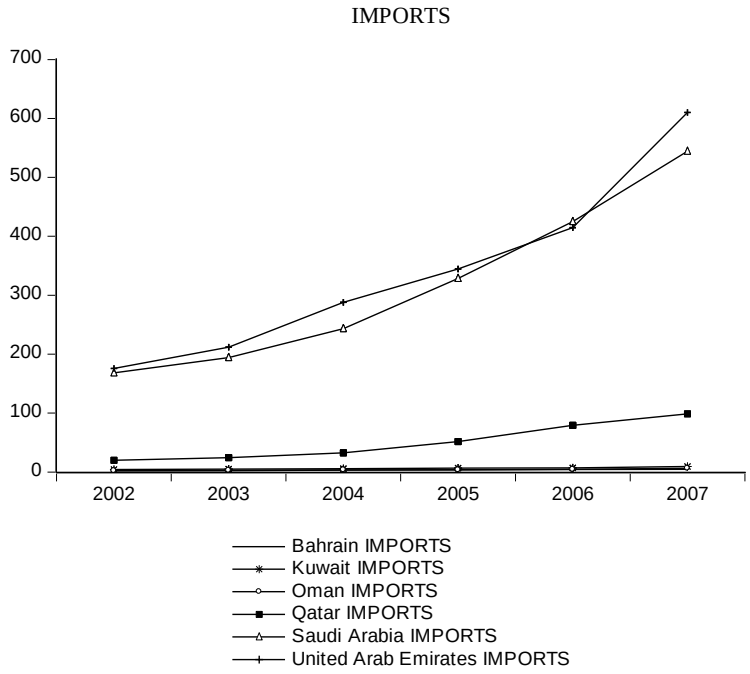
Petroleum production, exports and imports are differ significantly among GCC as presented in the figures below.

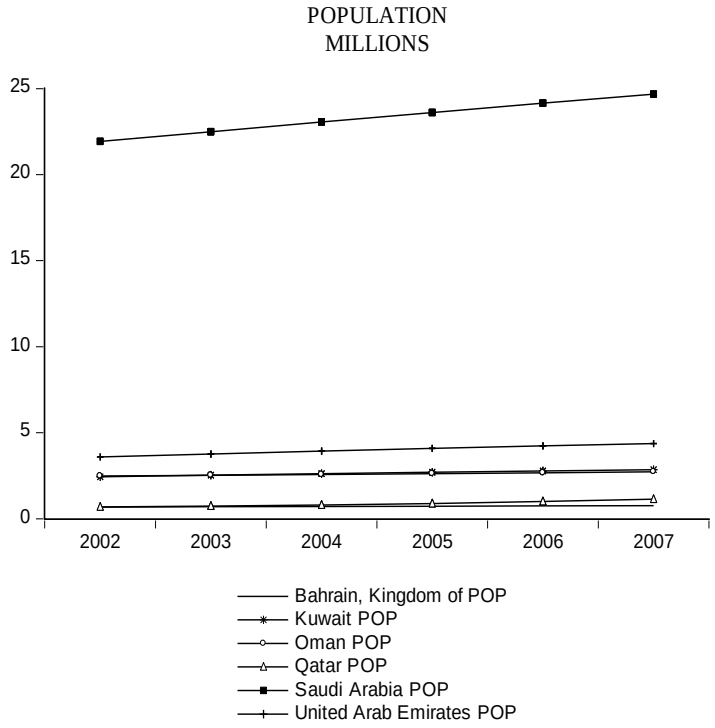
CRUDE PETROLEUM PRODUCTION



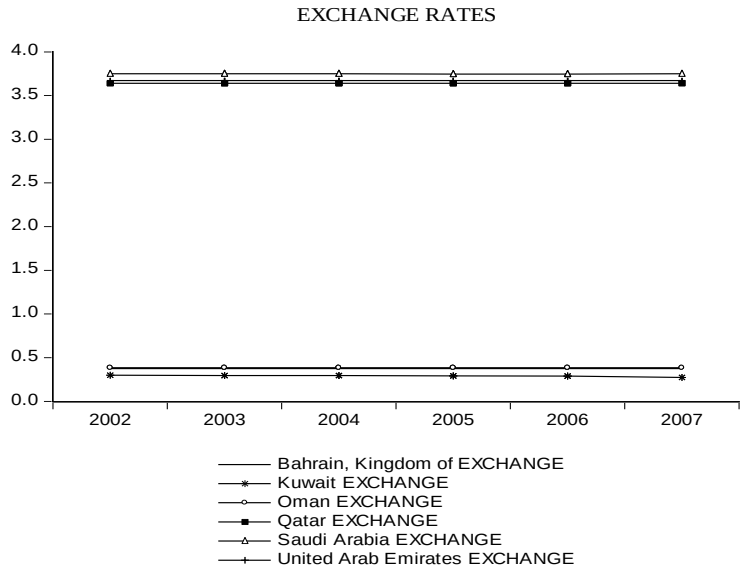
EXPORTS



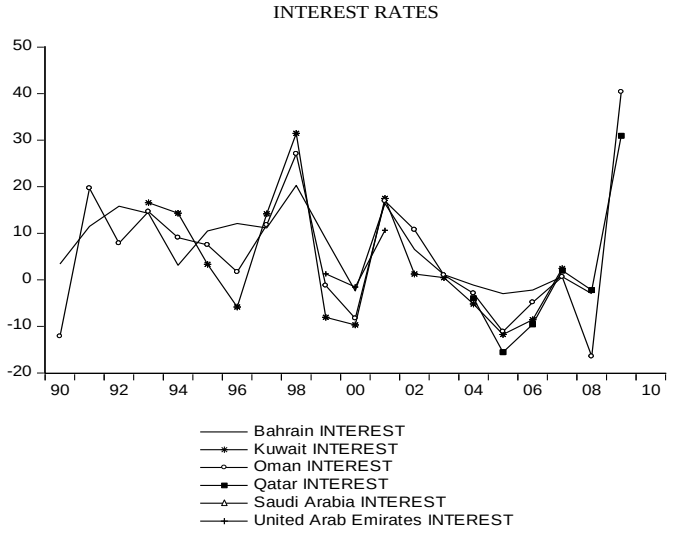

IMPORTS
700
600
500
400
300
200
100
0
2002
2003
2004
2005
2006
2007
Bahrain IMPORTS
Kuwait IMPORTS
Oman IMPORTS
Qatar IMPORTS
Saudi Arabia IMPORTS
United Arab Emirates IMPORTS


POPULATION
MILLIONS
25
20
15
10
5
0
2002
2003
2004
2005
2006
2007
Bahrain, Kingdom of POP
Kuwait POP
Oman POP
Qatar POP
Saudi Arabia POP
United Arab Emirates POP

The remaining figures present the monetary side of the GCC by displaying the exchange rate and interest rate dynamics.



All GCC exchange rates are pegged. The Bahrani dinar and Qatar riyal have been pegged to the US dollar at the rate of 0.37 and 3.64 respectively. The Omani riyal is officially pegged to the US dollar and the Kuwaiti dinar is determined according to a weighted basket. The Saudi Riyal and UAE dirham are fixed at the rate of 3.75 and 3.65 per US dollar.



The central banks of GCC countries have very low transparency. As stated in Dincer and Eichengreen (2009), the transparency indicies of the Central Bank of GCC countries out of 10 is as the following:

Table A.1 Transparency Indices

Country	Transparency Index
Bahrain	4
Kuwait	2
Oman	1.5
Qatar	3
Saudi Arabia	1
United Arab Emirates	2

Also, the GCC central banks have lower independence indices. For example Central Bank of Qatar has an index of 0.21. Keefer and Stasavage (2003) state that all GCC central banks have an independence score of 0 out of 2 which indicates that they are not independent.

Espinoza and Prasad (2012) investigate the monetary policy transmission in the GCC countries. They conclude that the policy interest rate is not very effective in the GCC countries. This caused by the fact that the financial markets are not developed. In addition to policy rates, the GCC monetary authorities use reserve requirement ratios and loan-to deposit ratios to affect the real economy. Also, the interbank interest rates of the GCC central banks are closely related with the Federal funds rate.

Table A.1 Period of Study for each Country

Country	Period of study[3]
Bahrain	1974:M12 - 2005:M12
Kuwait	1973:M1 - 2008:M10
Oman	2001:M1 - 2008:M11
Qatar[4]	1972:Q1 - 2008:Q4
Saudi Arabia	1980:M1 - 2008:M10
United Arab Emirates[5]	

[3] Available time-period at the IFS database.

[4] Monthly monetary aggregates are not available for Qatar. Thus, we use quarterly data for the analysis of Qatar.

[5] The Price index of UAE is only annual from 2000-2008. Thus there are not enough observations to conduct endogeneity tests.