Real Interest Rate Linkages in the GCC Countries

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Abstract

Linkages among real interest rates in the Gulf Cooperation Council coun-tries and the US are investigated using a variety of time series tests. These tests provide an evidence of strong linkages among real interest rates within the GCC countries and between the GCC rates and the US real interest rate in the long run, but they provide weaker evidence for linkages in the short-run. More-over, the US does not seem to have a dominant financial role in the GCC mar-kets and that the GCC countries seem to have more integrated markets within the region than with the USA. (**JEL Classifications**: F36, F21) <**Key Words** : GCC, financial integration, real interest parity>

I. Introduction

The Gulf Cooperation Council (GCC) was established in May 1981 and it includes six Arab oil-states countries, namely, Saudi Arabia, the United Arab Emirates, Kuwait, Bahrain, Qatar, and Oman. Among many of its objectives is to work toward an economic integration of the GCC states and to form a

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single-market. To work toward this objective, the states forming the GCC have agreed to remove barriers to investment and trade between the member states. Therefore, they agreed to allow investment and ownership in any member country to all nationals of the GCC countries, and to remove tariffs and quotas on goods that are produced in these states and move within the GCC region. Moreover, these states have agreed to coordinate in their development and economic policies to help achieve these objectives.

In this paper the links among real interest rates are investigated in three of these states: Kuwait, Bahrain, and Qatar using the real interest parity to indicate goods and capital markets integration.[1] If there is any success to the above-mentioned liberalization of capital and goods markets among the GCC states, then we should expect some strong links among real interest rates after more than 17 years since the establishment of the GCC. Moreover, these countries have relatively new financial markets and they are very similar in population size, country size, economic structure, and political and legal structures.

The rest of the paper is organized as follows: section II presents the theory of the real interest parity and some literature review, section III describes the econometric techniques used in the paper, section IV describes the data and presents the empirical evidence, and section V concludes.

II. Theory and Literature Review

The real interest parity (RIP) stems from two conditions: the uncovered interest parity (UIP) and the *ex-ante* purchasing power parity (EPPP):

$$i_{t,j} - i^*_{t,j} = \Delta s^e_{t+j} \tag{1}$$
$$\pi^e_{t,j} - \pi^{e*}_{t,j} = \Delta s^e_{t+j} \tag{2}$$

where $i_{t,j}$ and $i^*_{t,j}$ represent the nominal interest rates for j maturity security in the domestic and foreign countries, respectively, Δs^e_{t+j} represents the expected exchange rate defined as the domestic price per unit of foreign currency, and $\pi^e_{t,j}$ and $\pi^{e*}_{t,j}$ are the expected inflation rates in the domestic

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1. The choice of these countries for the GCC members was largely dependent on the availability of data.

and the foreign countries, respectively. The condition in (1) is the UIP and says that nominal interest rates on similar securities in two countries differ only by the expected rate of appreciation of the foreign currency. If the condition is not satisfied then investors shift to the security with higher expected yield restoring the equality. The condition in (2) is the EPPP and it states that inflation rates in two countries differ by the expected rate of appreciation of the foreign currency. If the condition is not satisfied then consumers shift to goods in the country with lower inflation rate and, so, restoring the equality. These two conditions when they are put together imply the real interest rate parity (RIP) condition, which states that the ex-ante real interest rates in the two countries are equal:

$$r_{t,j}^{e} = r_{t,j}^{e*} \tag{3}$$

Or by imposing rational expectations hypothesis the RIP can be written as:

$$r_{t,j} - r_{t,j}^{*} = e_{t,j} \tag{4}$$

Where r is the *ex-post* real interest rate and e is white noise. The RIP is taken in most of the literature to indicate financial markets integration. But, following Frankel and MacArthur [1988] and Branson [1988], real interest differential can arise because of the lack of integration of bond, currency, or goods markets. Therefore, we take linkages in real interest rates in this paper to indicate financial and goods markets integration.

A large body of literature has attempted to investigate financial markets integration (and financial and goods markets integration) by investigating relationships among real or nominal interest rates, mostly in the industrialized nations. Some of the authors (*e.g.*, Mishkin [1984], Cumby and Mishkin [1986]) use regression techniques to test the hypothesis of equality among real interest rates in different countries, which is strongly rejected. These tests may be miss-specified since they ignore the possible nonstationarity of the regressors. Another line of work, (*e.g.*, Karfakis and Moschos [1990], Katsimbris and Miller [1993], Throop [1995], Goodwin and Grennes [1994], Chinn and Frankel [1995], Al-Awad and Goodwin [1998]), uses cointegration methodology to test for linkages among real interest rates in the long-run and uses causality methods and/or impulse responses to test for linkages among these rates in the short-run. In gener-

al, there is no common conclusion regarding linkages among real interest rates. Karfakis and Moschos [1990] find no evidence of bivariate cointegration between nominal interest rates in Germany and other European Monetary System members, but Karfakis and Miller [1993] support a long-run relationship among European real interest rates and the US but not among the German nominal interest rate and other European rates, and that the German nominal interest rates does not Granger cause other European rates. Throop [1995] finds little evidence of cointegration between the US and other industrialized countries' *ex-post* real interest rates and that the impulse response functions show no causal linkages among these rates in the short-run, while Goodwin and Grennes [1994] find evidence of cointegration among real interest rates in 10 industrialized countries using both bivariate and multivariate cointegration tests. Moreover, Chinn and Frankel [1995] also find an evidence of bivariate and trivariate cointegration between real interest rates in the Pacific Rim region and the US and Japan. However, they reject equality among real interest rates in those countries. Finally, Al-Awad and Goodwin [1998] find a strong evidence of cointegration among *ex-ante* real interest rates in the G-10 countries and they provide a weaker evidence of linkages among these rates in the short-run using out-of-sample causality tests and the impulse response functions.

III. Econometric Techniques

Bivariate and Multivariate cointegration tests are calculated using the standard Johansen [1988, 1991] and Johansen and Juselius [1990] maximum likelihood technique. This procedure allows us to test for equality among real interest rates by testing for a particular cointegration vector that has zeros everywhere and (1, −1) for the two interest rates that are tested to be equal. The existence of at least one cointegrating vector is taken to imply the existence of a long-run link between real interest rates in the sample. The Johansen procedure is used also to test for unit roots in the individual series given the cointegration rank along with the usual augmented Dickey-Fuller [1979, 1981] (ADF) and the Phillips and Perron [1988] tests. The Johansen test differs from the usual ADF tests in that it is a chi-square test and that the hypothesis of stationarity is stated in the null rather than in the

alternative hypothesis.

Short-run linkages among real interest rates are investigated using a modified version of the out-of-sample Granger causality test developed by Ashley, Granger, and Schmalensee (AGS) [1980] and by the impulse response functions. The AGS test is modified to take into account cointegration relationships in the system. The modified version is superior to the usual Granger causality type tests in three directions. First, it defines causality as the ability of one variable to forecast future values of another variable rather than evaluating the goodness-of-fit as carried out by the traditional Granger causality tests, where the same data is used to estimate and evaluate the model (see Ashley [1981]). Second, it includes the US as a proxy for other important variables. As noted by Granger [1980], if a missing variable drives two variables in the system at different lags then we may find an evidence of causality even if causality does not exist in reality. Third, The procedure takes into account cointegration relationships by including an error correction form in the forecasting model. If cointegration exists, then models that do not explicitly incorporate cointegration relationships in the system will be miss-specified (Granger [1988]).

Let r_i and r_j be two real interest rates for countries i and j respectively. To test if r_j causes r_i (*i.e.*, r_j helps in forecasting future values of r_i) we split the data sample into two sub-periods and fit the following two models over the first sub-period:

$$r_i = \alpha + \sum_{l}^{m}\sum_{k}^{p}\beta_{l,t-k}r_{l,t-k} + v_t \qquad (l \neq j) \tag{5}$$

$$r_i = \alpha + \sum_{l}^{m}\sum_{k}^{p}\beta_{l,t-k}r_{l,t-k} + \sum_{k}^{p}\beta_{j,t-k} + EC_{ij,t} + \eta_t \tag{6}$$

Where r_l denotes all real interest rates in the sample except r_j, v_t, and η_t are white noise series, and $EC_{ij,t}$ is an error correction form that relates r_i and r_j. Then moving-horizon, one-step-ahead forecasts of r_j are estimated in both models. For every observation added to the system, the models are re-estimated and the one-step-ahead forecasts are performed until the entire second sub-sample is used. Then we define u_t^1 and u_t^2 to be the forecast errors from models (5) and (6) respectively, and the following variables are generated:

$$\Delta_t = u_t^1 - u_t^2$$
$$\Sigma_t = u_t^1 + u_t^2$$

(7)

Then one can estimate the following regression:

$$\Delta_t = \delta_1 + \delta_2 (\Sigma_t - \overline{\Sigma}) + \varepsilon_t$$

(8)

Where $\overline{\Sigma}$ is the mean of (Σ_t) and the error ε_t has a zero mean, and independent of Σ_t. In (8) δ_1 represents the difference in the mean forecast errors and δ_2 is proportional to the difference in forecast variances between models (5) and (6). Then the forecast performances of the two models are compared using both the means and the variances of the forecast errors. Therefore, we say that r_j causes r_l if we reject the following null hypothesis in favor of the alternative:

$$H_0 : \delta_1 = 0 \text{ and } \delta_2 = 0$$
$$H_1 : \delta_1 > 0 \text{ and/or } \delta_2 > 0$$

(9)

If we fail to reject H_0, then adding r_j to the system does not help in forecasting r_l and, therefore, we conclude that r_j does not cause r_l. Brandt and Bessler [1983] show that since the above test does not take into account the signs of the coefficients in (8), then the F-test is a four-tailed test. Moreover, if either δ_1 or δ_2 is significantly negative, then the null hypothesis is not rejected. On the other hand, if either δ_1 or δ_2 is negative but not significantly different from zero we should perform a t-test on the other variable to test for causality.

The orthogonalized impulse response functions are also used to assist for detecting short-run linkages among real interest rates. They are calculated for every shock to each variable in a VAR system and 95% standard error bands of the impulse response functions are generated through Monte Carlo integration methods.

IV. Data and Empirical Evidence

The monthly nominal interest rates for the period 1985 to 1994 are commercial bank lending rates and are taken from the IMF's International Financial Statistics. Consumer price indices (CPI) cover the period 1984 to

1994 and are also taken from the IMF's International Financial Statistics except for Qatar's CPI series, which is taken from the GCC Data Book CD, and it is available only on an annual basis. CPI series for Qatar is converted from annual to monthly frequencies by fitting cubic spline curves to the CPI values to form continuous time approximations and then the monthly CPI rates are interpolated from these approximations. As noted by de Boor [1981] this method works well for non-noisy data, such as the CPI. The same method is also used to interpolate missing data for Kuwait for the period 1990:8 to 1991:2 for the nominal interest rates, and for the period 1990:7 to 1991:6 for the CPI data. *Ex-post* real interest rates are calculated using the Fisher's equation as the difference between inflation rates and nominal interest rates.

Table 1
Multivariate and Bivariate Cointegration Tests

Variables	r=0		r=1		r=2		r=3	
	L=max	Trace	L=max	Trace	L=max	Trace	L=max	Trace
US, Ku, Ba, & Qa	43.03*	54.07*	11.73	20.04	5.63	8.31	2.68	2.68
Ku, Ba, & Qa	15.02*	25.24	7.92	10.22	2.30	2.30	-	-
US-Kuwait	4.64	7.61	2.97	2.97	-	-	-	-
US-Bahrain	11.56*	15.86	4.30	4.30	-	-	-	-
US-Qatar	8.39	10.10	1.70	1.70	-	-	-	-
Kuwait-Bahrain	12.10*	17.05	4.95	4.95	-	-	-	-
Kuwait-Qatar	7.47	9.74	2.26	2.26	-	-	-	-
Bahrain-Qatar	10.46*	12.62	2.16	2.16	-	-	-	-

(*) indicates rejection of the null hypothesis of r=a *vs.* the alternative of r=a+1 at the 10% level.

Table 2
Johansen Tests for Stationarity

r=	$x^2(5)$	USA	Kuwait	Bahrain	Qatar
1	9.49	32.81	29.89	32.03	32.35
2	7.81	10.55	8.07	10.04	10.08
3	5.99	5.25	2.74	5.06	4.30

Table 1 presents the multivariate and the bivariate cointegration tests. Specification testing, as suggested by Johansen [1992], indicates the inclusion of only an intercept term in the cointegration relationships when testing for cointegration in the multivariate and the bivariate settings. The first row shows the results of the multivariate cointegration test for the GCC countries with the inclusion of the USA real interest rate. Both the L-max and the Trace tests suggest that there is one cointegrating vector among real interest rates in the GCC countries and the USA. In table 2 the Johansen unit root tests of the individual series are presented. The x^2 test suggests that all individual interest rates are non-stationary at rank 1 as the null hypothesis of stationarity is rejected in every case[2]. Therefore, there is an evidence of long-run linkages among real interest rates in the GCC countries and the USA.

In the second row of table 1 the multivariate cointegration tests are repeated among the GCC countries without the inclusion of the US. Using the L-max test, there is an evidence of one cointegrating rank among real interest rates in the GCC. The Trace test indicates that there is no cointegration among real interest rates in the GCC countries. However, as Johansen and Juselius [1990] suggest, the trace test may lack power relative to the L-max test. Therefore, we may take this as evidence of the existence of long-run linkages among real interest rates among the GCC countries.

Bivariate cointegration tests are presented in the last six rows of table 1. Using the L-max tests, there is an evidence of cointegration in three out of six cases: the USA-Bahrain, Kuwait-Bahrain, and Qatar-Bahrain.

In table 3 the hypothesis of equality among real interest rates is tested within cointegration allowing for non-zero intercept. As noted by Chinn and Frankel [1995], by allowing for a constant in the RIP we account for the differences in default risk attributes of the debt instruments and for a time invariant risk premium. In the case of the multivariate cointegration with the inclusion of the USA, the hypothesis of equality is rejected in all cases except for two pairs of countries: the USA-Bahrain and Kuwait-Qatar. In the case of cointegration among the GCC real interest rates without the inclu-

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2. The Dickey-Fuller and the Phillips and Perron tests also support non-stationarity of the interest rates and, therefore, are not reported here.

Table 3
Tests for Equality among Real Interest Pairs within Cointegration

Pair	Multivariate Cointegration		Bivariate Cointegration
	with USA	without USA	
USA and Kuwait	15.57	-	-
USA and Bahrain	3.98*	-	0.51*
USA and Qatar	14.71	-	-
Kuwait and Bahrain	6.02	2.64*	5.18
Kuwait and Qatar	2.58*	2.90*	-
Bahrain and Qatar	21.95	6.93	7.83

(*) indicates the equality hypothesis is not rejected at the 5% level.

Table 4
AGS Out-of-Sample Granger Causality Tests

Caused/Causal	USA	Kuwait	Bahrain	Qatar
USA	F(104.45) (0.00)	No Test	F(0.55) (0.58)	No Test
Kuwait	F(1.52) (0.23)	F(44.68) (0.00)	T(14.79) (0.00)	No Test
Bahrain	F(47.49) (0.00)	No Test	F(38.44) (0.00)	F(3.32) (0.048)
Qatar	F(0.90) (0.37)	No Test	No Test	F(126.8) (0.00)

F(.) and T(.) indicate F-tests and t-tests, respectively and (.) indicate the corresponding p-values. "No Test" indicates that one or both of the coefficients in equation (9) are significantly negative, and, therefore, the null of no causality is not rejected.

sion of the USA real rate, we fail to reject the hypothesis of equality of the real interest rates allowing for a constant in two out of three cases, namely Kuwait-Bahrain and Kuwait-Qatar real interest rates. Finally, we fail to reject the hypothesis of equality between real interest rates in only the case of USA-Bahrain when testing in the bivariate cointegration setting.

In all, cointegration tests indicate that there is an evidence of strong long-
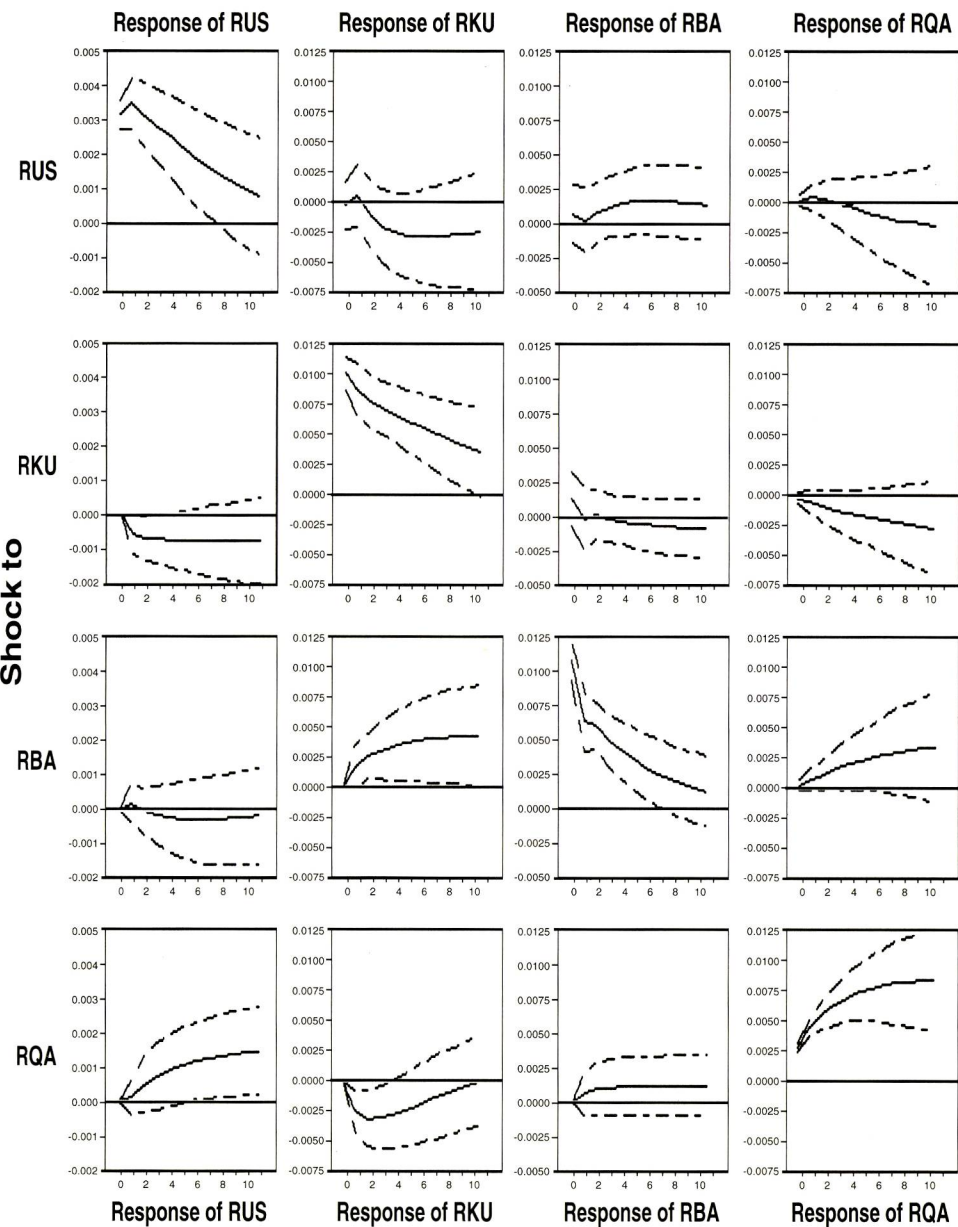
run linkages among real interest rates in the GCC region in one hand, and between real rates in the GCC and the USA on the other hand. Moreover, the real interest parity, taken as the equality of real interest rates allowing for a constant, is rejected in most cases, which indicates that there is no strong evidence of full integration of financial (and goods) markets among these countries.

Table 4 presents the AGS tests. An error correction component of the interest differential is included in equation (6) whenever there is an evidence of cointegration in the bivariate cointegration tests. "No Test" indicates that one or both of the parameters in equation (8) are significantly negative and, therefore, the null hypothesis of no causality is not rejected. There is an evidence of one way causality in three out of six cases: the USA real interest rate causes Bahrain real rate, Bahrain real rate causes Kuwait real rate, and Qatar real rate causes Bahrain real rate. These results are consistent with the results of bivariate cointegration tests in table 1 since, as noted by Granger [1988], if two variables are cointegrated then there must exist a Granger causality in at least one direction so that to provide the necessary dynamics for the two variables to have an attainable long-run equilibrium. However, strong short-run linkages among real interest rates are indicated by the existence of two-way causalities. There is no evidence of two-way causalities in any case.[3]

In figure 1 the impulse response functions along with 95% upper and lower standard error bands are presented. The impulse functions are calculated in a four-variable vector autoregression system and the upper and the lower error bands are generated, as outlined by Kloek and Van Dijk [1978], through 1000 draws for the coefficients to see how the responses change. A response to a shock is considered to be significant whenever the 95% standard error band does not include zero. Apart from the own-countries shocks, only the Kuwait real interest rate responds significantly to shocks to the Bahrain and Qatar real interest rates. The response to a shock to

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3. In Sample Granger causality tests give results that are not consistent with the cointegration results and, moreover, they indicate that Qatar real interest rate causes the US real rate, which is not consistent with common sense expectations given the relative size of Qatar's economy to the US economy.

Figure 1
The Impulse Response Function

Note: Dashed lines represent upper and lower 95% error bands.

Bahrain real interest rate begins after around two months and dies out within eight months. The response to a shock to Qatar real interest rate is immediate but dies out within two months. Moreover, there is no evidence of any significant response to the USA real interest rate which, taken with the results of the out-of-sample Granger causality tests, implies that the US may not have a great effect on financial markets in the GCC countries. For all countries except Qatar, own-country shocks evoke significant responses that last less than ten months. Qatar real interest rate own response lasts for more than a year. In all, the short-run linkages between real interest rates among the GCC countries, on one hand, and between the GCC countries and the USA on the other hand as indicated by the impulse response functions look weaker than those indicated by the out-of-sample Granger causality test. Moreover, both the out-of-sample Granger causality tests and the impulse response functions indicate that there still exist some barriers to capital (and goods) movements within the GCC countries and between the GCC countries and the outside world, which is proxied by the USA.

V. Conclusion

Multivariate cointegration tests indicate the existence of long-run links among real interest rates within the GCC countries and between the GCC rates and the USA real interest rate. Moreover, there is an evidence of equality between some pairs of these rates, which, in turn, implies that there is an evidence of moving toward an integration of financial markets (and probably goods markets) among these countries. However, the out-of-sample Granger causality tests taken with the impulse response functions provide a weaker evidence of linkages among these rates in the short-run. Finally, as indicated by the out-of-sample Granger causality tests and the impulse response functions, the USA real interest rate does not seem to have a strong effect upon the GCC real interest rates, which in turn indicates that the USA may not have a dominant financial role in the GCC region. This might be explained by the fact that the GCC countries still have capital controls toward investors from outside the GCC region while they are working toward relaxing all capital controls within the GCC region.

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