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## Abstract

A key issue in creating a new currency union is setting the rates to convert national currencies into the new union currency. We propose a forward-looking econometric methodology to determine conversion rates in the planned GCC currency union by calculating the degree of misalignment in the real exchange rate. For each GCC currency, we first identify the year at which the economy is the closest to its internal and external equilibrium, and then estimate the degree of misalignment in the bilateral real exchange rate vis-à-vis the U.S. dollar, based on WEO forecasts until 2013.Our calculations suggest that there is no need to adjust the actual rates to establish the conversion, as the forecasted misalignments are minor (less than 5%).



## ملخص

المسألة الرئيسية في إنشاء الاتحاد النقدي الجديد هو تحديد معدلات تحويل العملات المحلية إلى عملة الاتحاد الجديد. نقترح في هذه الورقة منهجية استشرافية في الاقتصاد القياسي لتحديد معدلات التحويل في اتحاد دول مجلس التعاون الخليجي عن طريق حساب درجة اختلال سعر الصرف الحقيقي. لكل عملة خليجية ، نحدد أولا السنة التي كان فيها في الاقتصاد هو أقرب الى التوازن الداخلي والخارجي، ومن ثم نقدر درجة الاختلال الثنائية في سعر الصرف الحقيقي مقابل الدولار الأميركي، على أساس توقعات WEO حتى 2013 توحي الحسابات بأن هناك حاجة لضبط المعدلات الفعلية لإنشاء التحويل ، كما هي توقعات الاختلالات البسيطة (أقل من 5 ٪).

## 1. Introduction

In creating a new currency union, a key issue is setting the rates to convert national currencies into the new union currency. The review of the related literature reveals a wide gap on this issue, and we were unable to find any clear methodology for determining the conversion rates.

The European Monetary Union (EMU) model was based on decades' long experimentation with the European Currency Unit (ECU) that allowed market forces (operating with certain bounds and with occasional resetting of individual rates) to affect the evolution of exchange rates, leading up to the euro. This experience presents one model but a priori it is unclear how much guidance it can provide to other regions.

More recently, the European Central Bank (ECB) introduced the notion of a country's equilibrium exchange rate as a guide for setting the conversion rate into the euro within the Exchange Rate Mechanism II. New entrants to the euro area are required to hold their currencies for at least two years within specified bands around a central parity vis-à-vis the euro. The mechanism also requires that the central rate chosen should reflect the best possible assessment of the equilibrium exchange rate at the time of entry into the mechanism, based on a broad range of economic indicators and developments (ECB, 2003).

Identifying the equilibrium exchange rate at the conversion date is therefore essential. If an exchange rate is misaligned (overvalued or undervalued) at the time of the conversion into the union currency, it will be frozen at that misalignment leading to economic distortions across the union members. An undervalued entry would give rise to a higher competitiveness for the country in comparison with its partners in the currency union, and will require a higher than average inflation rate throughout the union to reduce the misalignment. An overvalued entry could involve significant costs in terms of unemployment and bankruptcies (Wren-Lewis, 2003). Therefore, the fair assessment of the misalignment for all members of the union is crucial.

Based on this notion of equilibrium, our paper describes one method that could be used for the conversion of GCC currencies in the planned GCC currency union. We innovate in interconnecting the use of both a REER and RER model, and using forecasted values of the explanatory variables to calculate conversion rates at any hypothetical date of starting the currency union (for which data is available or can be forecasted).

The methodology has an advantage of providing policy makers seeking currency union with a framework to help identify the required exchange rate adjustments in the future. This forward-looking aspect of the approach is an important value added to the literature on currency unions. However, we do not discuss in the present paper whether a single currency implementation is fully-justified or not.

The methodology consists in three steps:

The first step aims at identifying the year in which the economy was closest to its internal and external equilibrium. For that, we use the real exchange rate equilibrium approach linking the exchange rate to its long term fundamentals. The lowest deviation from equilibrium (the lowest misalignment) in recent years is an indication of the equilibrium year.

The second step addresses the issue of estimating the real exchange rate equilibrium and misalignment of each currency vis-à-vis the prospective anchor currency for the union, or vis-à-vis the real effective exchange rate if the anchor is a basket of currencies or if the objective is for the new currency to float freely. We use forecasted values of the real exchange rate and its fundamentals to allow for forward looking perspectives.

The final step consists in normalizing the equilibrium exchange rate we obtained in step two to have a value of zero in the year of equilibrium identified in step one. The forecasted real exchange rate misalignment calculated in step two will serve as a measure of the necessary nominal exchange rate (NER) adjustment for the conversion rate.

The results of applying this methodology to the case of the GCC reflect a low rate of misalignment (less than 5%) in all countries in the different forecasted years. Given these low estimates of the degree of misalignment, the GCC authorities might choose to not modify their current parity vis-à-vis the U.S. dollar, nor the relative configuration of the GCC currencies[1].

The rest of the paper is organized as follows: the following section explains the problem and gives a brief background of the GCC monetary union initiative. Section "C" explains the details of the methodology and section "D" presents the results of the application to the GCC countries. Section "E" concludes.

## 2. Background

### *2.1 The Problem*

A critical step in a new currency union process is converting the individual national currencies into the new union currency. As explained in the introduction, there is a wide gap in the literature on a clear methodology to establish conversion values for new currency unions. The only available methods are those used in ERM I and II.

Conceptually, the conversion rate should be set so that the conversion itself does not create gains or losses in value for any party involved, and does not create shocks between the member economies of the union. For example, the relative value of domestic versus cross-border investments prior to the conversion should not change post conversion. The conversion rate also affects the relative wealth of the economies and estimates of the size of the economies.

Applied to financial accounting, the conversion rates similarly affect the value of consolidated cross border investments. Another important area affected is the value of government debt converted into the new union currency. The list can be extended to numerous other important issues, such as the sustainability of external debt positions. The conversion also establishes relative prices of goods and services between member countries of the union, which affects competitiveness[2].

Thus, it can be seen that it may matter a great deal what conversion rates are used. A method needs to be found that is methodologically robust and can deliver estimates of conversion values that all parties involved find equitable. Serious imbalances can result if the rate is not set in line with economic fundamentals.

### *2.2 The Gulf Cooperation Council*

The Gulf Cooperation Council consists of six Arab countries – Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. These countries share many historical and cultural ties and hope to develop more diversified intra-union trade over time.

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[1]Horváth and Komárek (2006) estimated the real exchange rate equilibrium for the new EU members and concluded that the misalignment for their currencies compared to the central parity vis-à-vis the euro is low and does not require any adjustment, at the time of their research. They also recommend adjusting the central parity only if the real exchange rate misalignment exceeds 10%.

[2] Prior to the start-up of the European Monetary Union, there was widespread concern that a country might suddenly devalue its currency just prior to the launch of the union in order to gain competitive advantages (see De Grauwe, 1997 pp.156-7.). In fact, one of the first acts of the European Central Bank when set up in May 1998 was to set the members' bilateral rates at that point to prevent such competitive changes prior to the Union's formal launch on January 1, 1999.

There has been an urge for greater union since the 1980's. During this period, the dollar became widely used for commerce and for asset-holding in the region, and the peg to the dollar created a fixed relationship between the GCC currencies. The choice of the dollar peg reflects heavy earnings of dollars from the exports of oil and natural gas.

In 2000 plans were made to set up a monetary union, and work towards it has gradually proceeded. As an explicit step to prepare for the union, the states agreed to maintain the peg of their currencies to the U.S. dollar. The external peg and the heavy reliance on the dollar have meant that the region has imported U.S. monetary policy. For example, interest rates in national currencies closely parallel movements in U.S. interest rates.

This has led to some concerns that U.S. monetary policy is not appropriate for the region, especially around 2006 and 2007 when some local economies were overheating, but dollar-based interest rates remained low. Inflation differentials were also a concern. Rapid price increases in Qatar and the UAE, with fixed nominal exchange rates, caused rapid appreciation of their real exchange rates against the other GCC currencies.

By late 2007, there was widespread concern that the dollar peg was also contributing to large capital losses in the region because of the dollar's weakness in exchange markets. Numerous proposals for change were made, such as switching to a basket or announcing a large appreciation (20-30 percent) of the GCC currencies against the dollar. In June 2007, Kuwait formally depegged from the dollar and announced that it would peg its exchange rate to a basket of currencies. Oman in December 2006 and UAE in May 2009 announced that they had decided to not enter the GCC currency union for the time being. Therefore, we focus our analysis on the four remaining candidates for the currency union: Bahrain, Kuwait, Qatar, and Saudi Arabia.[3]

In this context, deciding on the magnitude of the revaluation/appreciation is a critical question. Shall all members revalue by the same rate? How much should this rate be? Should inflation differentials be taken into consideration? When should this revaluation be performed - immediately, or at the date of establishing the new currency? The methodology we propose in this paper can bring answers to these questions.

### *2.3 Oil exporting country specificities and choice of the exchange rate model*

We brought up the euro zone methodology to set the conversion rates. However, the situation is somewhat different in GCC case because exchange rates were market rates in euro zone and exchange rate in GCC countries are US market rates since GCC currencies are pegged to the US dollar except the Kuwaiti Dinar to some extent. So, we have to take into account this feature and the fact that GCC currencies are already pegged together. Two main kinds of models exist to estimate equilibrium exchange rate: normative and positive.

Normative models, for instance Macroeconomic Balance and External Sustainability approaches (IMF 2006) are theoretically robust and seem more relevant to achieve a global equilibrium notably in term of trade and current account. However, oil exporting economies are somewhat different because commodities and manufactured goods are different kinds of tradable goods. Indeed, commodities have an international price and price elasticities of oil exports and imports are close to zero. Current account norms for oil exporters are nevertheless planned in the macroeconomic balance methodology (IMF 2006) but they are based partly on oil prices forecasting which is difficult to implement. Current account sustainability is therefore difficult to take into account in case of oil-exporting economies. Moreover, such models assume "norms" (internal and external balance) that can be endlessly discussed.

[3] We also applied the methodology to Oman and UAE. Results are available upon requests from the authors.

Conversely, a positive approach - Equilibrium Real Exchange Rate Approach - focuses directly on prices (exchange rates) while the other two normative approaches - macroeconomic balance and external sustainability - focus on quantities (current accounts and net foreign assets) and then derive the implications for the exchange rate. Focusing on long term relationship between effective exchange rate and "observed" fundamentals can be considered in some extent as an "ad hoc" model in the sense that we are looking for an exchange rate which is in line with fundamentals, that's why misalignment is usually lower in such models compared to normative models. But these kinds of models are the closest to the euro zone methodology. They indicate a kind of "market rate". So, findings from such models are more "acceptable" by policymakers and then more realistic to implement a single currency. Another issue consists in adopting a panel or a specific country analysis. Panel method has been already used by Kamar and Ben Naceur (2007). However, difficulties exist when panel is composed of heterogeneous countries. In this paper, we adopt a single country analysis, which fits to each country's features, and this explains why we used specific explanatory variables. Findings are more acceptable by policymakers also for this reason. Limits exist nonetheless: a methodology's estimate for a specific country may be disregarded in light of factors such as data limitations, a short sample, and large sensitivity of that country's results to minor modifications in the methodology.

## 3. Methodology to Set Conversion Values

The convergence rate should reflect the best possible assessment of the equilibrium exchange rate at the time of entry into the mechanism. If the exchange rate is misaligned at the time of the conversion (overvalued or undervalued) it would be frozen at that misalignment leading to economic distortions across the members. As the date of the conversion is an event that will occur in the future, the assessment of the misalignment should have a forward-looking perspective based on forecasted data.

Our proposed methodology to set the conversion values for currency unions consists of three main steps: (1) Identifying the year the economy is at equilibrium to serve as a guide for the initial appropriate exchange rate level, (2) measuring the real exchange rate (RER) yearly deviation from equilibrium (RER misalignments) using forecasted values, (3) adjusting the initial exchange rate in step one by the rate of misalignment in step two to estimate the conversion value in any prospective year.

### *3.1 Step One: Identifying periods of equilibrium*

In order to set a conversion value for a currency, either in the context of a multilateral monetary union or bilateral peg to a single currency, the authorities need first to determine the most recent year(s) in which the economy has been the closest to an equilibrium level. By equilibrium, we mean both external equilibrium or balance of payments equilibrium and low exchange rate volatility, and internal equilibrium where the economy is growing at sustainable rate, inflation is under control, and the budget deficit and debt levels are at acceptable standards. Several methodologies exist to assess exchange rate equilibrium and misalignment, each having its pros and cons.

One common approach is to analyze the macroeconomic indicators of each country and judge the year(s) in which the economy seems closest to both internal and external equilibrium, taking into consideration any potential lagged effect of any internal or external shocks[4].The advantage of this judgmental method is that it is easy to implement and does not require any econometric expertise. The disadvantage is that it is not precise as the indicators might diverge from each other without pointing to a certain year.

[4]The application of this judgmental approach to the GCC countries is available upon request from the authors

Another approach is the CGER methodology for exchange rate assessment developed by the IMF (2006) as part of its core mandate to promote the stability of the international monetary system. The CGER methodology supports Article IV analysis of countries while fostering cross-country consistency. Based on the use of multi-country panel data, the CGER approach is designed to be easy for IMF staff economists to apply to countries under investigation, but it might not be ideal to tackle the issue under investigation in our paper. As recognized by its authors[5], assessments of exchange rate misalignment will always need to be informed by country specific factors that are difficult to incorporate into studies based on large cross-country datasets. Moreover, for the particular case of oil exporting countries, the application of the CGER methodology is a difficult exercise[6]and often can yield a wide range of results. This is in part due to the importance of intertemporal aspects (as the real exchange rate may affect the optimal/equitable rate of transformation of finite resource wealth into financial assets), as well as risk considerations given the relatively high volatility of commodity prices. (Enders, 2009)

In order to be able to identify with precision the years of equilibrium and the years in which the exchange rate is misaligned, we need a robust and reliable econometric technique that reflects best the specificity of each economy. Therefore, we use the equilibrium real effective exchange rate (REER) approach, applied to each country separately. Since our aim is to determine the conversion rate within prospective currency unions, we use the long-term fundamental values of the determinants of the REER behavior to identify its level of equilibrium and its yearly misalignment (deviation from equilibrium). This methodology due to Clark and MacDonald (1998) is widely used in the REER literature.[7]

The year at which the REER is the closest to its fundamental equilibrium (the lowest misalignment level) will be considered as an equilibrium year. This approach should be applied to each country individually using the most reliable data, preferably coming from the same database to avoid discrepancies. In our analysis of the GCC, we will have a separate equilibrium equation for each country based on the specific determinants of the behavior of its REER. This requires applying time series cointegration techniques, such as Engle and Granger (1987), two step error correction models (which is what we apply in this paper), or also Johansen cointegration and VAR analysis approaches[8], depending on data availability.[9] Using panel data techniques is unadvisable as the resultant coefficients usually point to the similarity of the impact of the REER determinants across the panel, which masks the specificity of each individual country that we are seeking to capture in order to identify the appropriate equilibrium year for each country.

The determinants of the REER behavior commonly used in the literature are the terms of trade (TOT), productivity (PROD), government consumption to GDP (GCON), capital flows to GDP (CAPF), the degree of openness of the economy (OPEN), the budget balance to GDP (BUDG), and the money supply to GDP (LIQ). Other variables could be included in the equation to test for the significance of their impact on the REER behavior on a case-by-case basis. Also, different proxies for each of the determinants could be tested alternatively to

[5]Lee, Milesi-Ferretti, Ostry, Prati, and Ricci, 2008 "Exchange Rate Assessments: CGER Methodologies", IMF Occasional Paper N. 261, International Monetary Fund, Washington DC.

[6]IMF Middle East and Central Asia Department, 2008, "The GCC Monetary Union—Choice of Exchange Rate Regime", IMF, Washington D.C.

[7] See for example, Elbadawi (1994, 1997); Clark and MacDonald (1998);Baffes, Elbadawi, and O'Connell (1999); Dufrenot and Yehoue (2005); Kamar and Bakardzhieva (2005); Kamar (2006).

[8] For more details on the cointegration techniques see Johansen and Juselius (1990) and Juselius (2007).

[9] Data availability is often a handicap for using Johansen's methodology as it requires a large number of observations, which are hardly available for many Middle Eastern and African countries.

identify the most appropriate for each country. In cases where proxies have nearly identical impact, it is advisable to keep in the model the proxies that witness significance in the majority of the countries under investigation. For a detailed explanation of the calculations and the expected impacts of each variable, refer to Appendix 1.

*The econometric approach*

The application of the cointegration technique requires some preliminary statistical analysis of the data to test if the dependent and independent variables are non-stationary (the presence of unit roots). We use the standard Augmented Dickey Fuller or ADF (1979) and Phillips-Perron (1988) tests in order to determine the order of integration of the individual data series.[10]All variables should be nonstationary at the level, and stationary at the first difference; i.e. integrated of order one, I(1).[11]Next, we estimate the long-run relationship, which requires a test for the cointegration of the variables, either by the Engle and Granger (1987), or by the Johansen methodology. The Johansen procedure assumes the definition and the estimation of a well-specified full system of equations, which makes estimations more difficult. Moreover, in applying that technique, we are limited by the size of our sample. As pointed out by Baffes, Elbadawi, and O'Connell (1997), evidence suggests that the Johansen procedure deteriorates dramatically in small samples, generating estimates with "fat tails".

Therefore, we proceed to the first step in the Engle-Granger cointegration method, which is applying Ordinary Least Squares (OLS) to a static regression relating the levels of the real exchange rate and the variables that determine its behavior.

We assume that the long-run static relationship provided by theory is a linear composition of the logarithmic transformations of the variables (V) chosen:

$$lnE_t = c + \beta^1 * lnV^1{}_t + \beta^2 * lnV^2{}_t + \ldots + \beta^N * lnV^N{}_t + \varepsilon_t \quad (1)$$

where $E$ is the real exchange rate, $\beta$ are the coefficients that we are looking to estimate, $V$ are the $N$ independent variables, $c$ is a constant, and $\varepsilon$ is an i.i.d., mean-zero, stationary random variable (the *residual*). Bearing in mind our small sample[12] and the consequent insufficiency of degrees of freedom, we test subsequently several proxies of openness and capital flows.

To finalize this first step of the cointegration test, we shall test the residual ($\varepsilon$) from the regression of equation (1) for stationarity. If the residual term is stationary, then we could conclude that our variables are cointegrated.

The last step estimates a dynamic version of our model in order to verify the short-run effects of our variables on the RER. The traditional ECM form is as follows:

$$\Delta lnEt = b + \alpha * \varepsilon t\text{-}1 + \gamma 1 * \Delta lnV1t + \gamma 2 * \Delta lnV2t + \ldots + \gamma N * \Delta lnVNt + ut \quad (2)$$

[10]However, the ADF and PP tests can be less robust in the presence of breaks in the level or in the slope of the trend function. In some cases, when graphic observations and correlograms indicate that the series are not stationary in their levels but ADF and PP tests indicate the contrary, we also applied the Kwiatkowski-Phillips-Schmidt-Shin (1992), the Ng-Perron (2001) and the Dickey Fuller-GLS (1996) tests and used the most recurrent outcomes as our unit root results.

[11]Identifying the correct order of integration is essential for the correctness of the equilibrium estimation. The case of the GCC requires special handling of the ADF test as the data include several structural breaks and shifts induced by the oil price fluctuation. Therefore, for the purpose of our study, we applied in some cases the ADF test manually and included dummy variables to capture the breaks in the data. We used the Dickey-Pantula (1987) strategy that consists in testing first the null hypothesis of presence of a unit root in the first difference series. If the null hypothesis is rejected - the series is stationary - we test the null hypothesis for the series in its level. If the null hypothesis is accepted, the series is I(1) because it was necessary to differentiate it one time to make it stationary.

[12] However, the power of unit root tests depends on the span of the data more than the mere size of the sample, as noted in Gujarati (2004).

Where $\alpha$ is the error correction term[13], $\varepsilon_{t-1}$ is the residual from regression (1), calculated as the difference between the actual and the fitted values of the real exchange rate, and $u_t$is a mean-zero, stationary random variable.

Using our model, we proceed to construct indexes of REER equilibrium (REERE) and REER misalignment (REERMIS), using the following approach:[14]

Assume that the real exchange rate at any time $t$ is given by $\log e_t = \hat{\alpha} + \hat{\beta}' F_t$, where $F$ stands for the fundamentals and the corresponding parameters are the estimated regression coefficients;

Using time series decomposition (e.g. Hodrick-Prescott procedure[15]) to decompose the fundamentals into permanent ( $\widetilde{F}$ ) and transitory ( $F - \widetilde{F}$ ) components;

Construct the equilibrium REER: $\log \widetilde{e}_t = \overline{\alpha} + \hat{\beta}' \widetilde{F}_t$, where $\hat{\beta}'$ are the coefficients estimated in the long-run regression and $\overline{\alpha}$ is the intercept that reflects the specificity of each country, only when significant;

The REER misalignment is given by $reermis(t) = (\log e_t - \log \widetilde{e}_t).100\%$, where positive (negative) values indicate REER overvaluation (undervaluation).

Finally, the year at which the misalignment is the lowest, meaning that the REER is the closest to equilibrium, will be considered the equilibrium year at which the exchange rate could be used as the initial conversion rate. The evolution of the fundamentals after this year should determine the deviation of the conversion rate, from this initial level, requiring therefore further adjustment at the date of the establishment of the common currency.

### *3.2 Step Two: Measuring real exchange rate misalignments*

The conversion to the new union currency is a prospective event that will occur in the future. Thus, the methodology relies on forecasted data for all the variables and proxies in the models. Depending on the expected exchange rate regime of the currency union, we could either use the bilateral RER if the objective is to peg to a single currency, or to use the REER of the aggregated economic partners of the members of the union if the objective is to peg to a basket of currencies.

In the case of the GCC currency union, odds are high that the new currency will be pegged to the US dollar at least for the first year of its launch. Therefore, we use the bilateral RER vis-à-vis the US dollar expressed as a logarithm. Ratios are constructed using their respective US equivalents. For example, government consumption to GDP in Qatar is divided by government consumption to GDP in the US. The ratios are expressed as logarithms. This is the case for the series GCON, PROD, TOT, and OPEN. When the series contain negative data, the US series is subtracted from the national one and the ratio is not expressed as

[13] Elbadawi (1997) uses this error correction term to calculate the speed of adjustment of the exchange rate towards its long-term equilibrium path.

[14] See, for example, Elbadawi (1994); Elbadawi and Kamar (2005).

[15]The choice of the smoothing parameter (Lambda) can affect the calculation of the misalignment. If the parameter is too high, (higher than 500) the calculated equilibrium exchange rate will be too smoothed and can lead to higher misalignments. If Lambda is too small (lower than 10), the equilibrium exchange rate will not be smoothed and will fit to the observed REER, leading to minor misalignment. We used different values for lambdas in our paper and the results were not significantly affected (the misalignments varied by only + or – 2%). We recommend using the error correction parameter in the dynamic equation as a guide for the appropriate Lambda for each country.

logarithm. This is the case for the series BUDG, TKF, NKF, and CAPF.The variables used are listed in Table 1 and discussions of each variable are in Appendix 1.

We use the forecasts provided in the WEO database as they are available for all the countries for the coming five years in a harmonized fashion.

The steps we follow to determine the equilibrium and misalignment of the RER are the same as those used in step one to determine the equilibrium and the misalignment of the REER as explained above. We start with the unit root tests of the newly constructed variables and proxies and we integrate the I(1) variables in a long-run model. We check for the validity of the model using the adjusted R square and the Durbin-Watson statistics. We test for the stationarity of the residual and we then include it lagged in our dynamic model where all the variables are I(0). We make sure the error correction coefficient is significant, negative, and between 0 and 1. We calculate the equilibrium RER and its misalignment, as explained above.

### *3.3 Step Three: Adjustments to conversion rates*

The last step consists of determining the deviation of the exchange rate from its initial rate that we identified in points one and two, using the macroeconomic indicators or/and the REER equilibrium. We normalize the equilibrium bilateral RER to equal zero at the predetermined equilibrium year, and we add to it the misalignment to get the required percentage of adjustment for each year following the initial established rate. For example, if the REER was at equilibrium in year 1996, and the misalignment in year 2010 is +27% (i.e., overvalued by 27%), 23% in 2011, and 17% in 2012, the exchange rate needs to be devalued by 27% if the currency union takes place in 2010, by 23% if the currency union takes place in 2011, and by 17% if the common currency in established in 2012.

## 4. Application to the GCC Countries

As explained above, it is crucial to determine with precision the most recent year in which the economy has been closest to internal and external equilibrium. We are seeking to identify a recent period of noninflationary economic growth – internal equilibrium – and sustainable capital flows. Because of the structural changes in the GCC during the last decade, the equilibrium year to use as a benchmark should be fairly recent.

The concept of "sustainability" has to be put into perspective due to the unique features of the GCC economies. They are oil exporting countries with a fixed exchange rate regime against the US dollar. Such a situation generally means on the internal side that maintaining an independent monetary policy is challenging and on the external side that a current account surplus is reflected mostly in increases in foreign reserves that reduce the potential impact on the real exchange rate.

In a previous study, Kamar and Ben Naceur (2007) reviewed the success of convergence of the GCC countries by taking independent actions in preparation for the union. They used a panel analysis of variables possibly related to behavior of real exchange rates to identify common determinants of inflation differentials, which provided information on real exchange rate convergence given the common currency peg to the U.S. dollar. They identified a set of five significant variables and found increased convergence in their real exchange rate indices. The period of high convergence coincided with apparent domestic and external equilibrium around the 2003 or 2004 period. They concluded that this provided an important prerequisite for the planned union. Their study however did not focus on the level of the equilibrium real exchange rate, but only used it as a benchmark for calculating the apparent misalignment of the individual currencies and checking whether the degree of misalignment narrowed over time. They showed that overall misalignments declined by 50 percent over the 1991 – 2005

period, with the most extreme initial misalignment (between Saudi Arabia and the UAE) decreasing by about three-quarters by 2005.

This study extends the earlier results to update the analysis to more recent periods, when inflationary bursts (most strongly in Qatar) might have affected the results, and to move from the panel analysis to more rigorously examine conditions in individual countries. Increased misalignment of a currency could provide a basis for adjusting its bilateral relationship against the exchange rates of the other GCC currencies. The following pages present the analysis of the conditions in the individual countries.

### *4.1 Step One: The REER equilibrium approach to determine the equilibrium year*

The methodology to determine the equilibrium year that will serve as a base for calculating the required adjustment in the nominal exchange rate relies on the identification of the lowest misalignment in the REER in comparison to its equilibrium values. The equilibrium is calculated using the permanent components of the fundamental determinants of the REER behavior as explained in the methodology section.

We use the Engle and Granger (1987) cointegration to identify the fundamental determinants of the REER behavior that we will use to calculate the equilibrium. We applied all the necessary unit root tests to confirm that all the variables we incorporate in our models are I(1). The results are available upon request[16].

Next, we incorporated the theoretical determinants of the REER behavior one by one first, and we kept in the model the most statistically significant variables, and for which the $R^2$and the DW statistics were the most appropriate. We then included one by one the other theoretical determinants of the REER behavior, and again kept those most statistically significant, and for which the $R^2$ and the DW statistics were the most appropriate. This approach provided us with the best specification for our models. We tried several combinations of variables that all provided coherent economic explanations of the REER behavior and also presented acceptable statistics values. The final model for each country is a representation of the long run relation between the REER and its determinants[17].

We then tested the stationarity of the residual[18] we obtained from our long run model and incorporated it with a lag in the error correction model where all the other variables are also stationary (I(0)). For the cointegration to hold, the lagged residual in this dynamic model should be significant and of negative sign, and its absolute value should be between 0 and 1. Appendix 2presents the results that verify this prerequisite.

The model we retained for each country (Table 1) shows that the REER behavior in all countries is affected by almost the same determinants, with the same expected signs in almost all cases, yet with different magnitudes.

The main determinants are the terms of trade, the foreign reserves, the broad money, the trade openness, the net capital flows, the government consumption, and in the case of Qatar - the US nominal effective exchange rate.

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[16] We removed them from the appendix to reduce the number of pages.

[17] Another approach could be that all the relevant variables be used initially then specific variables can be dropped based on statistical significance. We followed this approach at the end of the exercise to harmonize the determinants across countries and limit the disparity of the variables used in our specifications. Both approaches account for possible interaction between the variables to identify the optimal specification.

[18] The residual should be stationary. The critical values for ADF test should be those of Mckinnon (1995), which are not provided in the usual econometric software programs like Eviews. The use of the critical values provided in the ADF results using Eviews is misleading.

TOT has a positive significant effect on REER in all countries except Bahrain. The positive sign is in line with the theoretical explanation provided in Appendix 1. The non-significance of TOT in the case of Bahrain could be explained by the fact that oil exports represent a minor component of its total exports, so oil prices do not play such an important role as in the other five GCC countries.

The RES variable is also positive and significant in all cases except for Qatar. An increase of the reserves in the context of a fixed exchange rate regime can lead to the increase of money supply in the absence of sterilization, leading to higher inflation and translating into REER appreciation. We controlled for money supply by including LIQ in our models and it seems that it captured this effect in the case of Qatar, but not in the cases of the other GCC countries. For example, LIQ still has a positive significant effect in the case of Bahrain, with the presence of RES in the equation. On another hand, LIQ has a significant and negative effect in the case of Saudi Arabia, which contradicts our theoretical intuition. Broad Money/GDP has been relatively stable in Saudi Arabia during the period under investigation, while the REER was depreciating due to a very low inflation. We might consider that in this particular case the Saudi Arabian authorities relied on sterilization to offset the impact of the increase in reserve on money supply and inflation, while achieving their nominal exchange rate peg objective.

Trade Openness proxied by imports to GDP has a significant positive impact on the REER in Kuwait and Qatar, and no impact in the cases of Bahrain and Saudi Arabia. As explained in Appendix 1, trade openness can lead to an improvement in trade balance and an appreciation of the REER (Egert, 2003) as we see in Kuwait and Qatar.

We also included in our tests the USNEER variable to capture the implication of the peg to the US dollar on inflation. An appreciation of the US dollar vis-à-vis the rest of the world's currencies would lead to a similar appreciation of the GCC currencies and of their REER. We couldn't include the USNEER variable in all our models as it is highly correlated with the REER[19], except in the case of Qatar where the correlation was sufficiently low (0.60). As expected, USNEER has a positive impact on REER in both countries and is very important for the stability of the long-run cointegration. We also included NKF to control for capital flows and we obtained significant and expected positive results in Bahrain, and Saudi Arabia, and nonsignificant coefficients in Kuwait and Qatar.

Government Consumption shows negative impact on REER, which is an indication of the dominance of tradable goods in both public and private spending.

In addition to these variables, we used tailor-made dummies that fit the specificity of each country, especially when dealing with the first Gulf war. The dummy for Bahrain takes the value of zero in all years except 1991 and 1992 where it takes a value of 1, and it has a negative sign. The dummy for Saudi Arabia also has a negative sign but it has a value of 1 in 1990, 1991 and 1992. For Kuwait, the country that was the most exposed to the shock, the dummy takes a value of 1 in 1990 and -1 in 1992, reflecting the capital flight in 1990 right before and during the Iraqi attack, and a return of the capital after the end of the crisis. These dummies are important for fine-tuning the coefficients in the equation in order to get the most robust estimation of the REER equilibrium.

Once we finalized the estimations of the long-run relations, we applied the HP filter to separate the transitory components of these determinants and used the permanent components to recalculate the REER using the coefficients in our equation to obtain the so-called equilibrium REER. The difference between the REER and the equilibrium REER is the REER misalignment shown in Figure 1.

[19] The correlation for Bahrain is 0.88, for Kuwait 0.88, and for Saudi Arabia 0.80.

Figure1 shows that the years 1997 to 2006 are those where the misalignment is relatively low. Since we are looking for the most recent year, we will consider 2003 as being the equilibrium year for Saudi Arabia and Kuwait, 2005 for Qatar, and 2006 for Bahrain. These results are consistent with what we found in our macroeconomic analysis; yet more precise. When calculating the adjustment required for each currency in the final stage of our paper, we will use these years as the equilibrium ones.

The observation of Figure 1 also highlights the fact that the misalignments declined significantly over the period. This is an indication of overall convergence and more harmonization and policy coordination between the GCC countries, as observed by Kamar and Ben Naceur (2007).

### *4.2 Step Two: The bilateral RER misalignment between each GCC currency and the US dollar forecasted until 2013*

In this step, we apply the same methodology we already used to calculate the REER misalignments, but with some adjustments. The bilateral RERs use the CPI from the WEO from 1970 to 2013, with the assumption that the nominal exchange rates vis-à-vis the US dollar will remain fixed at their 2008 values. When using bilateral RER, all variables we incorporate in our model should be calculated in relation to their equivalent in the USA.

Figure 2 suggests that the GCC countries' RERs witnessed a sharp appreciation after the first oil shock in the second half of the 1970s, followed by a gradual depreciation during the 1980s and 1990s. After a period of relative stability, RERs started appreciating again since 2005/2006, especially for Qatar. The forecasted RERs from 2008 onward point towards a clear divergence, with Bahrain and Saudi Arabia showing minor RER appreciation, while the expected appreciation in Kuwait, and Qatar is27.5%, and 60.1% respectively in comparison with their 2005 values.

In this case, using the simple inflation differential adjustment to correct the nominal exchange rate parities could be misleading since inflation could result from the behavior of the economic fundamentals, which might not necessarily require any nominal exchange rate adjustment. Therefore, the assessment of the misalignment based on a derived RER equilibrium using the economic forecasted values of the economic fundamentals could be more accurate. To calculate the misalignment, we apply the same econometric approach used to assess the REER equilibrium in the previous section.

The results of the unit root tests show that all the variables we use in our models are I(1). The long run relations between the RERs and their respective determinants are available in Table 2, and the error-correction model is available in Appendix 3.

The main determinants are the trade openness, the foreign reserves, the terms of trade, the government consumption, the net capital flows, and the euro/dollar exchange rate.

OPEN has a positive significant effect on REER in all countries. Calvo and Drazen (1998) showed that trade liberalization of uncertain duration could lead to an upward jump in consumption and, hence, real appreciation. The positive sign we obtain for all countries would thus reflect an upward jump in consumption including nontradables through within-period optimization (Edwards, 1989).

TOT has the expected positive sign in Kuwait and Qatar. The non-significance of TOT in the case of Bahrain could be explained by the fact that oil exports represent a minor component of its total exports, so oil prices do not play such an important role as in the other five GCC countries. Saudi Arabia could be a different case. Since Saudi Arabia does not invest its oil surplus abroad through sovereign wealth funds like Kuwait, an increase in oil revenue will translate into an increase in reserves and net foreign assets, because of the peg to the US

dollar. The authorities therefore might decide to sterilize the impact of the increase in reserves on money supply and inflation, by reducing their net domestic assets.

The RES variable is also positive and significant in all cases except in Saudi Arabia, possibly for the same reasons as above. An increase of reserves in the context of a fixed exchange rate regime can lead to increase of money supply in the absence of sterilization, causing higher inflation and translating into RER appreciation.

We also included NKF to control for capital flows and we obtained the expected positive results in Saudi Arabia and non significant coefficients in the other three countries. Still, the magnitude of the coefficients is relatively small (0.05) in comparison with the other determinants.

Government consumption shows negative impact on RER in the cases of Qatar and Saudi Arabia, which is an indication of the dominance of tradable goods in both public and private spending. On another hand, GCON has a positive sign in Bahrain, which is an indication of a dominance of nontradables in government consumption.

We also included in our tests the EURUSD variable to capture the implication of the peg to the US dollar on imported inflation. EURUSD has a positive impact on RERin Kuwait and Qatar. An appreciation of the US dollar vis-à-vis the Euro(the currency of a major trading partner) would lead to a similar appreciation of the GCC currencies and of their RER.

In addition to these variables, we used tailor-made dummies that fit the specificity of each country, especially when dealing with the first Gulf war. The dummies take zero values in all years with the exception of a specific year(s) where they take value 1. The dummies for Bahrain and Saudi Arabia have a negative sign and take the value of one in 1991 and 1992. For Kuwait, the dummies take values of 1 in 1990 (positive), in 1991 and in 1992 (both negative). Qatar was a special case where a dummy for years 2002 to 2005 is unavoidable for the stability of the equation.

We followed the same procedure as explained above to calculate the RER equilibrium for each country, using the permanent values of the fundamentals. We then calculated the misalignment presented in Figure 3 as the difference between the calculated RER and the equilibrium RER.

### *4.3 Step Three: Identifying the new conversion rates*

The last step consists in normalizing the misalignment obtained in step 2 to have a value of zero in the equilibrium year we identified in step 1, for each country. Given the forward-looking nature of our approach, our methodology can inform the policy makers on how much the adjustment of their respective nominal exchange rate should be in order to eliminate the misalignment.

The results for the GCC countries are presented in Table 3. As can be seen, if hypothetically the GCC decides to establish the new currency in its original planned date, 2010, Saudi Arabia would need to revalue its currency by 2.49% vis-à-vis the US dollar, Kuwait by 5.41%, Qatar by 4.54%, and Bahrain by 3.30%. The methodology provides an estimate of the required adjustment for each currency if the conversion is to take place in 2011, 2012, or 2013.

The results presented in Table 3 reflect a low rate of misalignment (the highest is 5.41% for Kuwait in 2010) in all countries in the different forecasted years. Given these low estimates of the degree of misalignment, the GCC authorities might choose to not modify their current parity vis-à-vis the U.S. dollar, nor the relative configuration of the GCC currencies.

Bolstering the case for not adjusting the configuration of currencies in cases of small misalignments, agents in the economy are highly sensitive to exchange rate variation, especially after a long period of strong peg. In addition, if information of possible adjustments filters to the market, the agents might undertake speculative attacks that might undermine the exchange rate adjustment and could harm the creation of the new currency.

We have not discussed whether a single currency implementation is fully-justified or not, and as a result, we have not taken into account the fact that an exchange rate corresponding to an economy equilibrium in time T should still be appropriate in time T+n or not, given that conditions of the economy will change over time. Such an issue needs to take into account the sustainability of a monetary union and the implementation of some mechanisms such as fiscal harmonization or a transfer system within a federal budget to offset the loss of the exchange rate adjustment tool.

## 5. Conclusions

The paper addresses a crucial issue for currency unions by providing a practical forward-looking methodology to determine the conversion rates for each of the members' currencies, over a medium term horizon. We applied it to the GCC countries, but we believe that it can be extended to other planned unions.

The first step of the methodology identifies the year at which the economy is the closest to its internal and external equilibrium. It considers the period with the least deviation from equilibrium (the lowest misalignment) in the recent years as an indication of the equilibrium year. This requires measuring the real exchange rate equilibrium based on the long-term component of the macroeconomic fundamentals. We calculated the REER misalignment for each of the GCC currencies and identified the year 2003 as the equilibrium year for Kuwait and Saudi Arabia; 2005 for Qatar, and 2006 for Bahrain. The theoretical determinants of the REER equilibrium vary across countries and are summarized as the terms of trade, openness, foreign reserves, government consumption, net capital flows, broad money, and the U.S. nominal effective exchange rate.

The second step addresses the issue of calculating the real exchange rate equilibrium and misalignment of each currency vis-à-vis the prospective anchor currency for the union, or vis-à-vis the real effective exchange rate if the anchor is a basket of currencies or if the new currency will be freely floating. We used forecasted values of the real exchange rate vis-à-vis the U.S. dollar and its fundamentals to allow for forward-looking estimations. The determinants of each bilateral RER are government consumption, openness, terms of trade, foreign reserves, net capital flows, and the euro-dollar exchange rate.

The final step consists in normalizing the misalignment from the bilateral RER equilibrium equations we obtained in step two to have a value of zero in the year of equilibrium identified in step one. The forecasted real exchange rate misalignment calculated in step two serves as a measure of the necessary nominal exchange rate adjustment for the conversion rate in the coming years.

Our calculations suggest that only a small nominal exchange rate adjustment (less than 5%) is needed for the GCC currencies to establish the conversion at the closest level to equilibrium; moreover, the adjustment tends to decline from 2010 to 2013. We recommend that the GCC authorities rigorously apply our proposed method (alongside other methodologies and with full use of information available within the region) to test these results to help set the conversion rates for the future union.

In a broader perspective, we recommend a regular update of the forecasted misalignment using the bi-annual WEO publications, in order to monitor the conversion rate and make sure it is still the closest to the equilibrium value. It could also be useful to calculate the RER

equilibrium and misalignment using forecasts from other databases, like the Economist Intelligence Unit database, or using the national agencies' forecasts.

The methodology also allows for using different scenarios by creating forecasted variables that reflect different shocks. For the example of the GCC, one option would be to construct several terms of trade variables that would reflect different oil prices and use these variables to calculate the RER misalignment to see how the different currencies would deviate from the equilibrium, and calculate the required exchange rate adjustment if any of the scenarios is to occur.

Since the entire methodology and the macroeconomic analysis rely on the assumption that the data are accurate, the creation of a reliable and harmonized database for all variables is an essential step towards the creation of a currency union.

The methodology we propose can be used as a single tool to estimate conversion rates. However, whenever possible, policy makers should use it in conjunction with other methods such as the CGER, the macro-indicators judgmental analysis, surveys of purchasing power parity in prospective union members, or divergences in movements of consumer prices. In addition, we feel that it is advantageous (if schedules for setting up new unions permit) for planned unions to use an ECU-like virtual currency arrangement in which member countries establish a conversion grid so that the rates can be tested against market forces and the configuration of bilateral rates can be embedded into the national macroeconomic frameworks.

Finally, the methodology is applicable elsewhere. The multiple union-building efforts in Africa are potential users of the method, and the tests can apply to other regions too. Conditions will be different and perhaps more challenging and some interesting innovations to the method may result. We have great interest in seeing the directions and results of such work.

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**Box 1: Measuring the Misalignment: Why the Choice of the Real Exchange Rate Matters**

Misalignment is defined as a deviation from a certain level of RER equilibrium. The multilateral REER misalignment identifies the period (year) in which the overall economy is closest to internal and external equilibrium, in comparison with its trading partners, and will inform about any deviation from that level of equilibrium in any other year. When the misalignment is equal or close to zero, the economy is at equilibrium, and if the misalignment points to an overvaluation (undervaluation), a devaluation (revaluation) is necessary to correct the rate for conversion to the union currency at the conversion date.

If the new currency were to float or to be pegged to a basket of currencies, the measured REER misalignment would be a good indicator for the required adjustment in the conversion rate. The use of forecasted data for the REER could inform about the misalignment in the future at the date when the union is to take place. However, if the new currency is to be pegged to a single currency, the REER misalignment might not give a precise measure of the required adjustment. Equilibrium vis-à-vis the anchor currency might take place in a different year and the misalignment might be of different magnitude.* Instead, the use of the bilateral RER equilibrium gives an indication of the misalignment vis-à-vis a single trading partner. Thus, the RER equilibrium alone is not sufficient to identify the period (year) in which the economy is closest to its overall internal and external equilibrium.

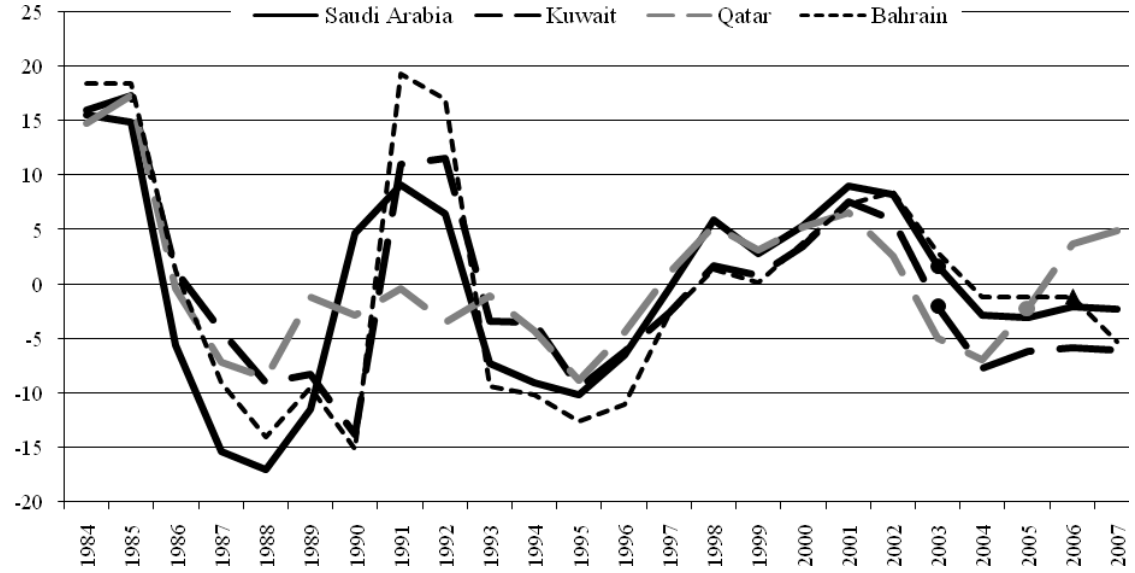
In our methodology, we consider that the conversion rate is optimal when the economy is at its internal and external equilibrium. Therefore, using the REER approach is essential as a first step to determine the equilibrium year. In the second step, if the conversion is to be set vis-à-vis an anchor currency, the US dollar for example, the misalignment should be seen as the deviation from a bilateral RER at the date of the entry. A separate forward looking estimation of the RER misalignment is then required to calculate the conversion rate.

The third step consists of using the identified equilibrium year in step one to normalize the misalignment calculated in step two. The deviation of the bilateral RER after this equilibrium year will be an indication of the required adjustment in the conversion rate.

Therefore, the choice between the RER and REER misalignment has to be made case by case depending on the prospective exchange rate regime decided for the new currency.

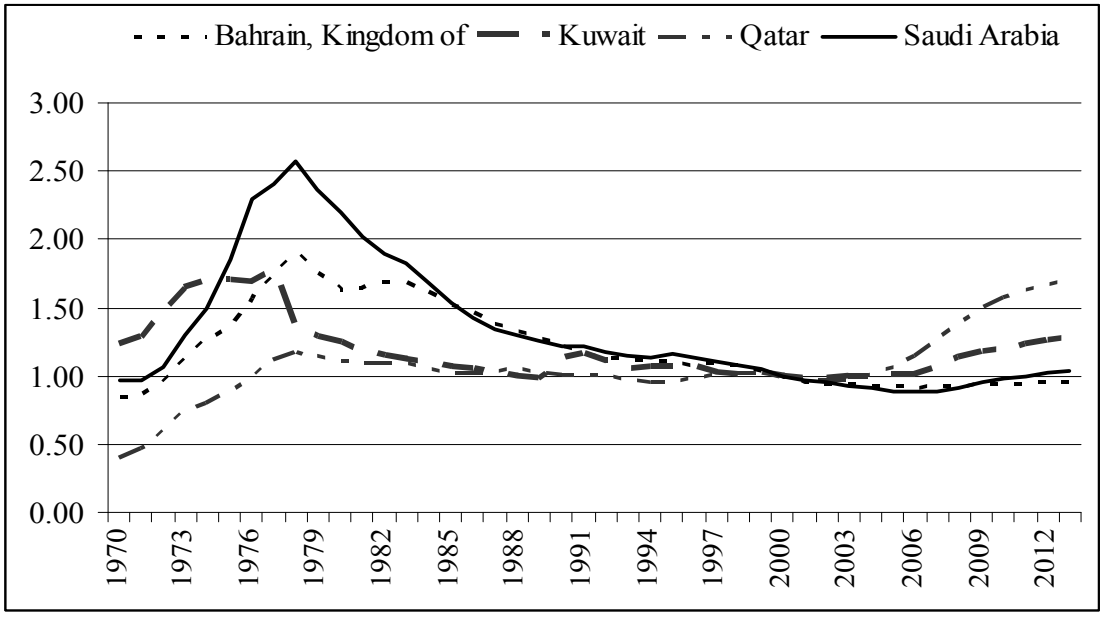
* For example, consider the case of a country pegging to the US$ with two equal trading partners, USA and the EMU at 50% each. If the REER is misaligned by 30% in 2008, does it follow that the peg to the US$ should be devalued by 30%? But what would be the case if the national currency is not misaligned vis-à-vis the US$? For example, the US$ could be overvalued vis-à-vis the euro. We don't think there is a need to devalue vis-à-vis the US dollar in this case as this might create even more economic distortions.

**Figure 1: REER Misalignment**



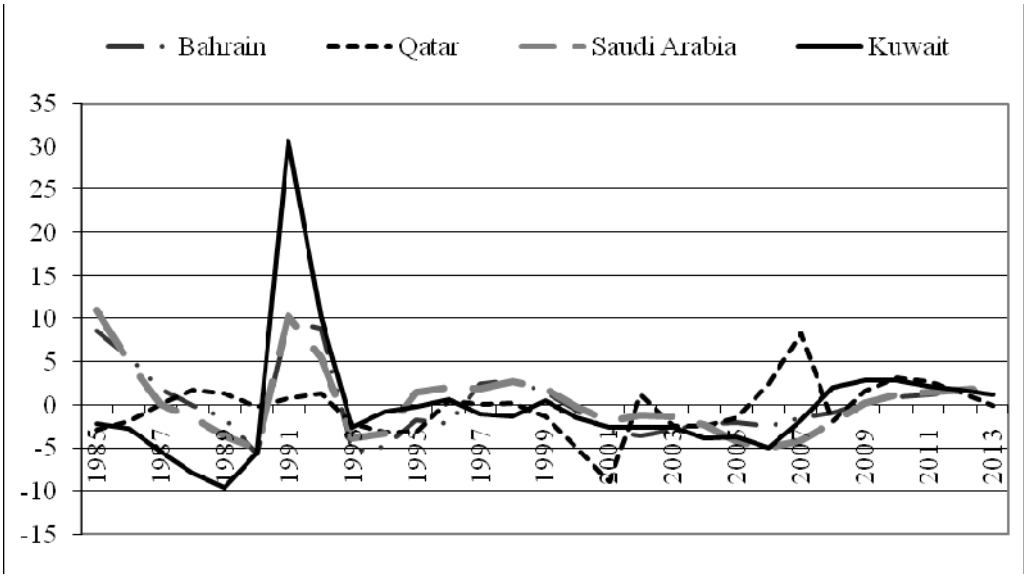

Authors' calculation

**Figure 2: The Bilateral Real Exchange Rates**




Authors' calculation based on WEO data, September 2008.

**Figure 3: RER Misalignment**



## Table 1: OLS Estimations of the Long-run Determinants of the REER

| | Bahrain | Kuwait | Qatar | Saudi-Arabia |
|---|---|---|---|---|
| Sample | 1982-2007 | 1980-2007 | 1980-2007 | 1980-2007 |
| Observations | 26 | 28 | 28 | 28 |
| TOTS | | 0.067570* | 0.197090*** | 0.320610*** |
| | | (1.794583) | (10.72244) | (6.891403) |
| RES | 0.956453*** | 0.249772*** | | 0.104313*** |
| | (12.00120) | (5.955200) | | (3.976523) |
| OPENMS | | 0.242880*** | 0.168733*** | |
| | | (3.133298) | (4.885028) | |
| NKF | 0.193444*** | | | 0.053594*** |
| | (7.658254) | | | (13.26792) |
| GCON | -1.727869*** | -0.226340*** | -0.161979*** | |
| | (-6.564755) | (-5.514604) | (-10.95386) | |
| LIQ | 0.455554** | | 0.193990*** | -0.477913*** |
| | (2.741018) | | (6.568090) | (-11.92426) |
| USNEER | | | 0.553627*** | |
| | | | (9.253821) | |
| C | 5.089198*** | 4.523622*** | 1.040280*** | 4.800039*** |
| | (8.516104) | (16.10013) | (3.657749) | (16.15558) |
| D9192 | -0.342153*** | | | |
| | (-6.319965) | | | |
| D9092 | | | | -0.197183*** |
| | | | | (-5.973684) |
| D90_92 | | 0.150392*** | | |
| | | (3.141780) | | |
| $R^2$ | 0.933012 | 0.786430 | 0.941246 | 0.975126 |
| Adj. $R^2$ | 0.916265 | 0.737891 | 0.927893 | 0.969473 |
| DW | 2.238343 | 1.755969 | 1.688216 | 1.934486 |
| ADF | -5.604480*** | -4.466805** | -4.294952* | -4.945126** |

Note: Data in brackets indicate the *t-Student*. ***, ** and * denote a significance of the coefficient at the 1%, 5% and 10% levels. The ADF test in the last row refers to the *t-statistic* of the residual series from each regression. *t-statistics* are compared to the McKinnon critical values table (1991).

## Table 2: OLS Estimations of the Long-run Determinants of the RER

| Sample | Bahrain 1985-2013 | Kuwait 1984-2013 | Qatar 1976-2013 | Saudi-Arabia 1986-2013 |
|---|---|---|---|---|
| Observations | 29 | 30 | 38 | 28 |
| GCON | 0.254500*** (3.445104) | | -0.089024*** (-3.777828) | -0.085310* (-1.892516) |
| OPENMS | 0.409847*** (8.604324) | 0.180006*** (9.638112) | 0.121229*** (3.077298) | 0.171534*** (7.653251) |
| TOTS | | 0.148089*** (7.648818) | 0.150141*** (10.88924) | |
| RES | 0.135563*** (7.072934) | 0.090369*** (10.40477) | 0.172941*** (6.809258) | |
| NKF | | | | 0.058184*** (18.75023) |
| EURUSD | | 0.203578*** (7.761728) | 0.190148*** (3.728487) | |
| C | -1.137261*** (-12.2426) | -0.472176*** (-11.76104) | -0.454448*** (-5.097038) | |
| D9192 | -0.163669*** (-4.74469) | | | |
| D90 | | 0.077480*** (3.335428) | | |
| D91 | | -0.242567*** (-6.309526) | | -0.131968*** (-4.102496) |
| D92 | | -0.084510*** (-3.620091) | | -0.096769*** (-3.071681) |
| D0205 | | | -0.146203*** (-6.778735) | |
| $R^2$ | 0.939389 | 0.950544 | 0.950021 | 0.960484 |
| Adj. $R^2$ | 0.929287 | 0.934808 | 0.940348 | 0.953612 |
| DW | 1.727984 | 1.970905 | 1.997064 | 1.610879 |
| ADF | -4.426931 | -5.289818 | -5.992595 | -6.019447 |

Note: the ADF test refers to the t-statistic of the residual series from each regression. t-Student are in brackets. ***, ** and * denote a significance of the coefficient at the 1%, 5% and 10% levels

## Table 3: The Required Percentage Change in Nominal Exchange Rates vis-à-vis the US Dollar

| | Saudi Arabia | Kuwait | Qatar | Bahrain |
|---|---|---|---|---|
| 2010 | 2.49 | 5.41 | 4.54 | 3.30 |
| 2011 | 2.73 | 4.75 | 4.11 | 3.60 |
| 2012 | 3.04 | 4.25 | 2.93 | 3.95 |
| 2013 | 3.35 | 3.75 | 1.30 | 4.29 |

# Appendices

## Appendix 1: RER Behavior Determinants

REER is the multilateral CPI-based real effective exchange rate calculated by the IMF World Economic Outlook (WEO) database, where an increase reflects an appreciation for the home country's currency. BUDG is the central government balance as a percent of GDP. We used the WEO database to calculate the ratio. The effect of a change in the fiscal balance on real exchange rate is mixed. Ricardian equivalence is not borne out empirically. Thus, a deterioration of the fiscal balance is not necessarily offset by an increase in private savings and therefore can lead to demand pressures and a real exchange rate appreciation. On the contrary, the GCC countries generally witness fiscal surpluses thanks to oil exports which can lead to demand pressures and so also to a real exchange rate appreciation. But such fiscal surplus can also alleviate the central bank's claims on the government, leading to a decrease in the monetary base. Therefore, a depreciation of the real exchange rate can also occur.

GCON is the log of the public consumption expenditure as a percent of GDP. There is an ambiguity about the relationship between GCON and BUDG in GCC due to oil price changes. Theoretically, an increase in government spending would deteriorate the fiscal balance and is therefore liable to put downward pressure on the exchange rate. But GCC countries have a fixed exchange rate regime and the real exchange rate can be affected in an endogenous way only by prices. However, the impact of public expenditure on real exchange rate is ambiguous. It would be necessary to determine if the public spending is oriented more towards tradable or nontradable goods. Empirical studies tend to confirm that government expenditure is biased toward nontradable goods and so a public spending increase leads to a real exchange rate appreciation. But in non-industrialized countries, increases in public wages may come from public spending and GCON can indirectly depreciate the real exchange rate if the rise in private spending due to the higher wages falls stronger on tradable goods.

LIQis a proxy equal to the ratio of the log of broad money to GDP. GCC countries are major commodity exporting countries with a fixed exchange rate regime. This context implies that money supply can increase (decrease) sharply, notably in times of oil price rising (declining). Such a move can have an important effect on inflation and therefore the real exchange rate. Monetary authorities and governments intervene with an aim to limit the monetary base increase (thus sterilization operations and use of sovereign wealth funds are key elements of monetary policy within the region). The expected sign for LIQ is positive because an increase in money supply leads to inflation and real exchange rate appreciation.

OPEN describes the degree of openness. Usually, the main proxy for OPEN is the ratio of the sum of exports and imports to GDP. OPEN's impact on real exchange rate is mixed in the literature. Egert (2003) drew up an overview of the real exchange rate determinants from empirical studies and their coefficient's expected sign. If we consider openness as an indicator of trade liberalization, an improvement in openness must lead to a depreciation of the real exchange rate. Besides, supply capacity can be improved by openness and this leads to an improvement in the trade balance and an appreciation of the exchange rate. The case of the GCC countries is somewhat specific, as their exports are largely a function of oil exports. A sharp increase in oil prices can be misinterpreted as an improvement of openness. Even if exports, imports, and GDP are expressed in volume, oil exports can result from exogenous factors (world oil demand) that are not linked to openness. Consequently, to avoid misinterpretation, we use imports to GDP ratio to proxy openness.

PROD - Many proxies exist in the purpose to assess productivity. For example, the ratio of the Consumer Price Index (CPI) to the Producer Price Index (PPI) is often used in the literature (Edwards, 1989; and Clark and McDonald, 1999) but two drawbacks make this

proxy unusable in the case of the GCC countries. Concerning CPI, some components are partly subsidized by some governments and concerning PPI, an important share of the GDP consists of hydrocarbon products. Another productivity proxy for the case of the GCC is the real GDP to employment ratio, but we could not use it because of the absence of official employment data. We thus use the real GDP per capita divided by the same series in the OECD countries (REER model) or in the USA (RER model). It is largely admitted in the literature (Egert 2004, Lee, Milesi-Ferretti, and Ricci 2008) that a rise in productivity leads to an appreciation of the real exchange rate. The expected sign is thus positive.

USNEER is the nominal effective exchange rate of the US dollar. This index is a weighted average of the foreign exchange values of the U.S. dollar against a subset of currencies in the broad index that circulate widely outside the country of issue. We use it in the REER model when there is no correlation between it and the real effective exchange rate of the considered country. With the GCC currencies being pegged to the U.S. dollar, an appreciation of the USNEER will lead to an appreciation of the GCC countries' RER. The series is calculated by the U.S. Federal Reserve. In the RER model we use EURUSD which is the euro/dollar exchange rate. To proxy the euro before its launch in 1999, the European Central Bank has aggregated pre-1999 currency data. Data for EURUSD are from the ECB.

TOT expresses the log of terms of trade which is the ratio of export to import prices. It is thus the relative price of exports to imports. In the GCC's case, an oil price rise can create a positive wealth effect which would lead to an appreciation of the real exchange rate. The expected sign of the coefficient is thus positive.

NKF (net capital flows) is a proxy to express capital flows measured by the inverse sign of the balance of goods and services not related to the factors of production (Kamar, 2006). An increase of capital flows usually leads to the appreciation of the RER, unless the country is highly indebted where the impact could be negative.

RES is the ratio of reserves at year-end to GDP. An increase in reserves could lead to excess money supply and appreciation of the RER, in the absence of sterilization.

NFA is the log of net foreign assets as a percent of GDP and could be used alternatively with RES. The data are available notably in *IFS* (*International Financial Statistics*). The expected sign of its coefficient is usually positive (Lee, Milesi-Ferretti and Ricci, 2008).Others get mixed results (McDonald and Wojcik, 2002; Alberola, 2003) or even negative signs (Alonso-Gamo et al., 2002; Lommatzsch and Tober, 2002; Burgess et al. 2003).

## Appendix 2: OLS Estimations of the Short-run Determinants of the REER (ECM)

## Dependant variable: D (REER)

| ECM | Bahrain | Kuwait | Qatar | Saudi-Arabia |
|---|---|---|---|---|
| RESID(-1) | -0.138928**<br>(-2.096549) | -0.408587*<br>(-1.972134) | -0.525991***<br>(-4.761355) | -0.870907***<br>(-5.620615) |
| D(LIQ) | | | | |
| D(OPENMS) | | | 0.091975***<br>(4.802149) | |
| D(TOTS) | | | | 0.266275***<br>(6.902143) |
| D(RES) | | 0.118595***<br>(3.691067) | | |
| D(NKF) | | | 0.146154***<br>(10.46297) | -0.002621***<br>(-5.603233) |
| D(CAPF) | | | | |
| D(TKF) | | | | |
| D(USNEER) | 0.841023***<br>(13.87815) | | 0.867633***<br>(20.36326) | |
| C | -0.018102***<br>(-4.350745) | | | -0.023742***<br>(-3.401323) |
| D90_92 | | 0.128991***<br>(3.703169) | | |
| D90 | | | | -0.105861***<br>(-2.841881) |
| $R^2$ | 0.897632 | 0.508272 | 0.952459 | 0.757695 |
| Adj. $R^2$ | 0.888326 | 0.467295 | 0.946258 | 0.713640 |
| DW | 1.985855 | 1.553620 | 2.517321 | 1.683612 |

Note: Data in brackets indicate the *t-Student*. ***, ** and * denote a significance of the coefficient at the 1%, 5% and 10% levels

## Appendix 3: OLS Estimations of the Short-run Determinants of the RER (ECMl)

**OLS Estimations of the short-run determinants of the RER. (IMF Forecasts). Dependant variable: D(RER)**

| ECM | Bahrain | Kuwait | Qatar | Saudi-Arabia |
|---|---|---|---|---|
| Sample | 1988-2013 | 1985-2013 | 1977-2013 | 1987-2013 |
| Observations | 26 | 29 | 37 | 27 |
| RESID(-1) | -0.3180*** (-3.186047) | -0.8134*** (-3.314431) | -0.4335*** (-3.272853) | -0.5838*** (-4.205921) |
| D(GCON) | 0.159837** (2.260275) | | | |
| D(OPENMS) | | | 0.060971** (2.027242) | |
| D(TOTS) | | 0.072503*** (3.305571) | 0.070333*** (2.996900) | |
| D(RES) | 0.037353** (2.316921) | 0.041487*** (3.109967) | 0.087184*** (3.527177) | 0.027955* (1.884566) |
| D(NKF) | | 0.016256*** (3.374987) | | 0.040699*** (5.926729) |
| D(EURUSD) | | | 0.131027** (2.660826) | |
| C | -0.00959** (-2.274376) | | | -0.006528* (-1.802861) |
| D9192 | -0.032388** (-2.405695) | | | |
| D90 | | 0.101947*** (3.835453) | | |
| D91 | | -0.17551*** (-3.402017) | | -0.054698** (-2.566003) |
| D92 | | 0.104590** (2.465656) | | |
| D07 | | | 0.091296*** (9.109018) | |
| $R^2$ | 0.451813 | 0.795816 | 0.517523 | 0.644775 |
| Adj. $R^2$ | 0.347397 | 0.740129 | 0.439704 | 0.580188 |
| DW | 1.876660 | 1.208452 | 0.884880 | 1.536916 |

Notes: ***, ** and * denote a significance of the coefficient at the 1%, 5% and 10% levels