



# IMF Working Paper

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## Desynchronized: The Comovement of Non-Hydrocarbon Business Cycles in the GCC

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**IMF Working Paper**

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**Abstract**

This paper investigates the empirical characteristics of business cycles and the extent of cyclical comovement in the Gulf Cooperation Council (GCC) countries, using various measures of synchronization for non-hydrocarbon GDP and constituents of aggregate demand during the period 1990-2010. By applying the Christiano-Fitzgerald asymmetric band-pass filter and a mean corrected concordance index, the paper identifies the degree of non-hydrocarbon business cycle synchronization—one of the main prerequisites for countries considering to establish a monetary union. The empirical results show low and heterogeneous synchronization in non-hydrocarbon business cycles across the GCC economies, and a decline in the degree of synchronicity in the 2000s, if Kuwait is excluded from the sample, partly because of divergent fiscal policies.

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## I. INTRODUCTION

**Globalization has stimulated academic and policy interest in analyzing the synchronization of business cycles.** While some significant differences exist, the Gulf Cooperation Council (GCC) countries share similar economic endowments and institutional structures.<sup>1</sup> Along with hydrocarbon dependence exposing them to the volatility of oil prices, the GCC countries have long maintained exchange rate regimes pegged to the U.S. dollar that limit the scope of discretionary monetary policy to manage domestic aggregate demand. Although hydrocarbons still account for an overwhelming share of export earnings and fiscal revenues in the GCC countries, leading to a higher degree of business cycle synchronicity at an aggregate level, economic diversification efforts have led to the emergence of vibrant sectors outside the hydrocarbon complex in recent years. Therefore, with the share of non-hydrocarbon sectors increasing from about 55 percent of GDP in 2000 to above 62 percent by end-2009, a better understanding of the evolution and synchronization of business cycles is warranted, especially at a disaggregated level, across the GCC economies.<sup>2</sup>

**The degree of business cycle synchronicity is important for countries that are considering to establish a monetary union.** Since its establishment in 1981 as a regional cooperation platform, the GCC has moved towards closer economic and financial integration, aiming to establish a monetary union.<sup>3</sup> From a theoretical point of view, an important criterion for participation in a currency union—and the effectiveness of a common monetary policy—is the synchronization of business cycles. According to the theory of optimum currency area developed by Mundell (1961), McKinnon (1963) and Kenen (1969), the more synchronized the business cycles of the members of the currency union, the lower the probability of asymmetric shocks, and the less dramatic the loss of monetary and exchange rate policy for the member country. If business cycles in countries forming a currency union diverge considerably, the common monetary policy will not be optimal for all member countries. For example, whereas countries in the downward phase of the business cycle favor an expansionary monetary policy, countries in the upward phase of the cycle need a more restrictive monetary policy stance. Even if cycle phases coincide perfectly, cross-country differences with respect to the amplitude of the business cycle can still impede the implementation of a common monetary policy. For that reason, business cycle symmetry

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<sup>1</sup> The GCC consists of six countries along the Arabian Gulf—Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (U.A.E.).

<sup>2</sup> Oil price fluctuations tend to influence the share of hydrocarbon-based and non-hydrocarbon sectors in GDP (i.e. lower oil prices may lead to a higher share of non-hydrocarbon GDP, holding everything else constant). As reported in national accounts, non-hydrocarbon GDP excludes the production of crude oil and natural gas, but includes hydrocarbon-based, energy-intensive manufacturing sectors.

<sup>3</sup> The GCC countries remain committed to monetary integration, but Oman and the U.A.E. have opted out at this stage and the launch of the single currency has been postponed for an unspecified period.

among member countries is a necessary condition for the effectiveness of a common monetary framework and the long-term sustainability of the currency union, as recently highlighted by emerging tensions within the Euro area.

**The GCC countries exhibit low and heterogeneous synchronization in real non-hydrocarbon business cycles.** The results show that the degree of non-hydrocarbon business cycle synchronization across the GCC countries—measured by the contemporaneous bilateral correlation coefficients of the cyclical components of each national non-hydrocarbon business cycle vis-à-vis others—was low and heterogeneous during the period 1990-2010 and that cross-country correlations declined in the 2000s compared to the preceding decade, if Kuwait is excluded from the sample. At a disaggregated level, components of aggregate demand also show a low, if not negative, degree of cyclical comovement between the GCC countries. Likewise, the concordance index—an alternative measure of synchronicity—indicates diverging non-hydrocarbon business cycles over time. Another key result is that foreign impulses play a more prominent role than regional factors, as the extent of business cycle synchronization between the GCC countries and their main trading partner countries and blocks indicates a greater degree of contemporaneous correlation, on average, compared to intra-regional synchronicity. In addition to low degree of intra-regional trade and financial integration, divergent fiscal policies contribute to the desynchronization of non-hydrocarbon business cycles. These empirical results, highlighting the incidence of country-specific asymmetric shocks, have a number of relevant policy implications, especially in view of the proposed GCC monetary union.

**The remainder of this paper is structured as follows.** Section II gives a brief overview of recent macroeconomic developments in the GCC countries. Section III discussed conceptual issues regarding business cycle analysis and describes the empirical methodology employed in this paper. Section IV summarizes the estimation results, while Section V offers concluding remarks focusing on areas of reform that would facilitate a greater degree of trade and financial integration and business cycle synchronization.

## II. AN OVERVIEW OF ECONOMIC DEVELOPMENTS IN THE GCC COUNTRIES

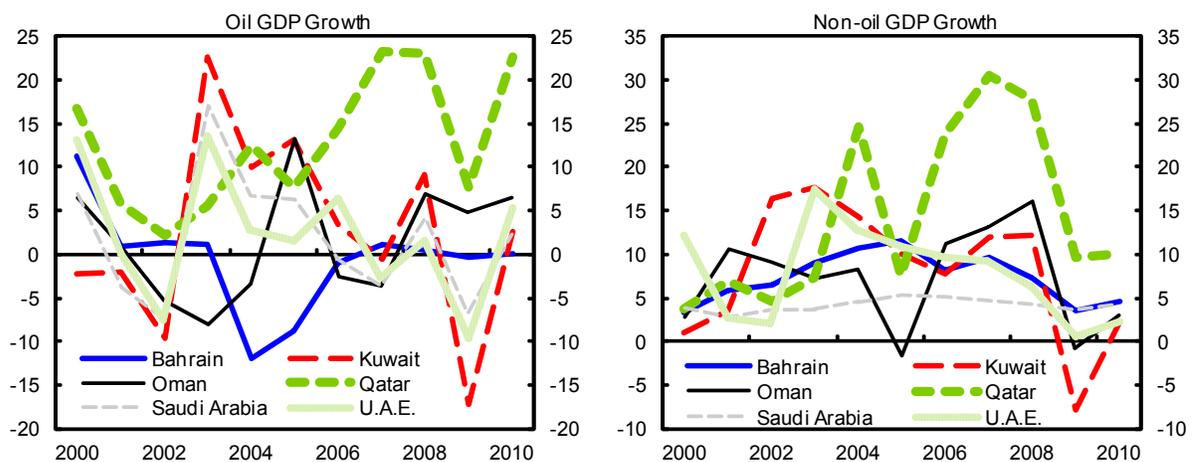
**The GCC economies performed well during the 2003–08 oil boom, but the growth surge also led to macro-financial imbalances.** The GCC countries experienced a surge in real GDP growth to an average of 6.6 percent a year during the 2003–08 oil boom—three percentage points above the pre-boom period (1997–2002). Furthermore, real non-hydrocarbon GDP growth—a more appropriate measure of employment-creating economic activity in hydrocarbon-based countries—averaged 7.3 percent a year during the same period, compared to 4.8 percent during 1997–2002 (Figure 1). The large increase in hydrocarbon revenues resulted in fiscal surpluses averaging 26 percent of GDP in 2008, compared with minimal surpluses, or even deficits, in the pre-boom years. Part of these surpluses was used to retire domestic and external debt, resulting in a decline in total

government debt from 66 percent of GDP in 2002 to 12 percent by end-2008. Nevertheless, the region-wide fiscal contribution to aggregate demand—measured by the non-hydrocarbon primary budget deficit—jumped by 10 percentage points from its average in the pre-boom years, to 51 percent of non-hydrocarbon GDP in 2008.

**Significant increases in bank credit to the private sector contributed to the rise of non-hydrocarbon sectors in the GCC economies.** Average real credit growth was close to 23 percent a year during 2003–08, which led to increasing bank leverage and almost doubling the ratio of private sector credit to non-hydrocarbon GDP to a simple average of 122 percent by end-2008. The cumulative deviation from trend credit/non-hydrocarbon GDP during 2005–08, a measure of excess credit growth, was significant in all countries, ranging between 35 percent of non-hydrocarbon GDP in Bahrain and 70 percent in the U.A.E. This, together with low interest rates and buoyant economic activity, supported higher demand for real estate and financial assets, pushing prices up across the region. Consequently, average GCC consumer price inflation increased from 1.7 percent in 2004 to 10.7 percent in 2008. Higher inflation was fuelled by above-trend increase in domestic demand, nominal U.S. dollar depreciation, and rising international commodity prices. As the economic cycles in the GCC and the United States diverged significantly in 2007 and the first half of 2008, policy action was limited by the exchange rate regime pegged to the U.S. dollar. Inflationary pressures, combined with appreciations of the equilibrium real effective exchange rates given large terms of trade gains, triggered speculative capital inflows into the region, further exacerbating these pressures.

**As the global economic crisis took hold, the GCC economies were affected through trade and financial channels.** The decline in global oil demand had a significant impact on hydrocarbon GDP output and, combined with lower oil prices, led to weaker fiscal and

Figure 1. GCC: Real GDP Growth, 2000-10  
(In annual percentage change)



Source: Country authorities; and author's calculations.

external balances. At the same time, the GCC countries underwent reversals of speculative capital inflows experienced in 2007 and early 2008. These developments tightened liquidity conditions and affected investor confidence, and were further exacerbated by the collapse of Lehman Brothers in September 2008 and the ensuing global liquidity shortages and balance sheet deleveraging. Tighter liquidity conditions and the subsequent economic slowdown led to the bursting of real estate prices in most GCC countries. Coupled with the fall in import prices, slowing domestic demand—with its particular impact on rents—caused average annual inflation in the GCC to decline from double digits in 2008 to 3.3 percent in 2009.

**Economic activity has rebounded in the GCC countries, albeit at varying rates and led mainly by higher oil prices and production.** Average real GDP growth recovered to about 5 percent in 2010, driven largely by the hydrocarbon sector as countries expanded production, and to varying degrees, by fiscal stimulus. Real non-hydrocarbon GDP growth, on the other hand, stabilized below trend at 4.2 percent, despite unprecedented levels of public spending. While the rise in hydrocarbon revenues brought a marked improvement in fiscal and external balances, average inflation increased to 3.2 percent in 2010, driven by higher import prices. On the whole, the economic performance during and after the crisis exhibited considerable differences among the GCC countries, reflecting country-specific economic, financial and structural idiosyncrasies. For example, the share of non-hydrocarbon sectors is 75 percent of GDP in Bahrain and 66 percent in the U.A.E., whereas others remain more dependent on the hydrocarbon complex. Nevertheless, the main channels of economic diversification—financialization and real estate investments—and varying degrees of openness have made the GCC countries prone to domestic and international shocks.

### III. EMPIRICAL METHODOLOGY

**Business cycles are usually characterized as a regular fluctuation in economic output over a specified period.** In a pioneering work, Burns and Mitchell (1946) analyzed business cycles in terms of expansions and contractions in the level of economic activity. However, a decline in the level of economic activity is an atypical occurrence, making it difficult, if not impossible, to make inferences on the evolution of business cycles over time. Accordingly, this paper follows Lucas (1977) and Kydland and Prescott (1990) in defining business cycles as deviations from trend (or potential output). Based on the empirical methodology outlined by Frankel and Rose (1998), Kose, Prasad and Terrones (2003), and Baxter and Kouparitsas (2005), the cyclical component of the fluctuations in real non-hydrocarbon GDP is extracted to estimate the degree of business cycle synchronization between pairs of GCC economies using various approaches. Additionally, the cyclical component of the oscillations in aggregate demand variables—government consumption and investment spending, private consumption and investment spending, non-hydrocarbon exports and imports—and the pairwise correlation coefficients are estimated to determine which aggregate demand component is mostly responsible for the comovement of non-hydrocarbon business cycles across the GCC countries.

**Real non-hydrocarbon GDP and its components are decomposed into trend and cyclical components using a non-parametric filter.**

The theory of the spectral analysis forms a foundation for analyzing different frequency components of the data, with a number of different ways to define the business cycle and various methods—all with shortcomings—and to decompose the behavior of a time series into its trend and cycle components.<sup>4</sup> Different filtering techniques may result in qualitatively and quantitatively different business cycle patterns, especially with a short time series, as it is the case for the GCC countries.<sup>5</sup> To extract the cyclical components of macroeconomic variables, this paper utilizes the band-pass filter proposed by Christiano and Fitzgerald (2003). Unlike several other low-pass filtering techniques (such as the best known and widely applied Hodrick-Prescott filter), the advantage of the Christiano-Fitzgerald full sample asymmetric filter is that it can be used to isolate the component of a time series that lies within a particular band of frequencies, hence allowing the extraction of any preferred cycle range.

**The band-pass filter eliminates both high and low frequency oscillations, isolating the cyclical component.** According to Stock and Watson (1999), the band-pass filter is preferable from a theoretical point of view, since it eliminates both high frequency oscillations, which might arise from measurement errors and noise, and low frequency oscillations, which tend to reflect the long-term growth component. Given observed values of series  $x$ , the required cyclical component of  $x$  with a period of oscillation between  $p_l$  and  $p_u$ , where  $2 < p_l < p_u < \infty$ , is filtered as a new series  $y$ . In practice, however, the values of this true (or “ideal”) unobserved series, denoted as  $\hat{y}$ , are only an estimate. The optimal band-pass filter therefore approximates  $y$  by  $\hat{y}$  in optimal projection context, in the sense that the mean squared error criterion,  $E[(y-\hat{y})^2|x]$ , is minimized by changing the set of optimal band-pass filter weights. In frequency domain representation, the optimal solution for the generalized band-pass filter problem requires minimizing the sum of squared deviations between the “ideal” and approximate filter and weighting those deviations by the spectral density of  $x$ . For the random walk (unit root) case, the estimated values of  $\hat{y}$  for the periodic oscillation between  $p_l$  and  $p_u$  are given as:

$$\hat{y}_t = B_0 x_t + B_1 x_{t+1} + \dots + B_{T-1-t} x_{T-1} + \tilde{B}_{T-t} x_T + B_1 x_{t-1} + \dots + B_{t-2} x_2 + \tilde{B}_{t-1} x_1$$

for  $t = 3, 4, \dots, T-2$

$$\text{where } a = \frac{2\pi}{p_u}, b = \frac{2\pi}{p_l}, B_0 = \frac{b-a}{\pi} \text{ and } B_j = \frac{\sin(jb) - \sin(ja)}{\pi j}, j \geq 1$$

<sup>4</sup> Estrella (2007) provides a comprehensive review and comparative analysis of several commonly applied time-series filters in macroeconomic research.

<sup>5</sup> Canova and Dellas (1993) and Canova (1998) discuss various detrending methods and issues that may affect the empirical results.

$\tilde{B}_{T-1}$  and  $\tilde{B}_{t-1}$  are obtained as simple linear functions of  $B_j$  as:

$$\tilde{B}_{T-t} = -\frac{1}{2}B_0 - \sum_{j=1}^{T-t-1} B_j$$

for  $t = 3, \dots, T-2$  and

$$\tilde{B}_{t-1} = -[B_0 + B_1 + \dots + B_{T-1-t} + \tilde{B}_{T-1} + B_1 + \dots + B_{t-2}]$$

In this application,  $x$  corresponds to natural logarithm of real non-hydrocarbon GDP (or components of aggregate demand) in each country, and  $\hat{y}$  stands for the filtered cyclical component of series  $x$ .

**Non-hydrocarbon business cycle frequency varies across the GCC countries, but appears to be shorter than those in advanced economies.** A typical business cycle frequency range is 6 to 32 quarters with quarterly data or 2 to 8 years with annual data, but these boundaries should not be viewed as carved in stone. Developing countries tend to experience more frequent regime shifts and shocks to trend growth than advanced economies (Aguiar and Gopinath, 2007). As a result, the volatility of trend growth influences the cyclical pattern, making it incompatible to use a rule-of-thumb approach developed for business cycle analysis in the U.S. and other advanced countries. It is therefore necessary to compute the average duration of non-hydrocarbon cycles in the GCC countries and ascertain a typical range of business cycle frequencies. Analyzing business cycles in terms of expansions and contractions in the level of economic activity a la the Burns-Mitchell methodology shows that contractions in real non-hydrocarbon GDP are rare and short-lived, whereas expansions run for a long period. During 1990-2010, Bahrain, Saudi Arabia and the U.A.E. did not experience a decline in real non-hydrocarbon GDP, while the average length of expansions was 12.7 years in the case of Kuwait, Oman and Qatar. On the other hand, defining business cycles as deviations from trend shows that the periods of below-trend growth is no longer a rare event and the episodes of above-trend growth range from 2.3 to 4.5 years—significantly shorter than the range derived from the classical business cycle analysis. This appears to be consistent with the empirical evidence on the nature and characteristics of business cycles in other developing countries (Rand and Tarp, 2002). Accordingly, the filtering calculations in this study are based on a 2-5 year cycle with annual data.<sup>6</sup>

**The degree of non-hydrocarbon business cycle synchronization is estimated with three different approaches.** First, the comovement of business cycles is estimated by the cross-country correlation of the cyclical components of non-hydrocarbon GDP. The higher the

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<sup>6</sup> Data Appendix provides an overview of the data set used in this study.

correlation coefficient, the stronger the synchronization of business cycles across the GCC countries.<sup>7</sup> Second, the extracted cyclical component of real non-hydrocarbon GDP in one country is regressed on the cyclical component for another country to confirm the findings based on correlation coefficients. Third, following the methodology developed by Harding and Pagan (2002), the degree of non-hydrocarbon business cycle synchronization is gauged by the concordance index, which measures the average percentage of time in which two series coincide in the same phase of the cycle.<sup>8</sup> The concordance statistic is based on binary series (0, 1) for each country, in which zero represents a period of below trend growth and one represents above trend growth. Considering that  $C_{x,t}$  is one when the business cycle in country  $x$  is positive and zero when the cycle is negative, and defining  $C_{y,t}$  in the same way, the concordance index for the business cycles of country  $x$  and country  $y$  is defined as:

$$CI_{xy} = \frac{1}{T} \left\{ \sum_{t=1}^T (C_{x,t} \cdot C_{y,t}) + \sum_{t=1}^T (1 - C_{x,t}) \cdot (1 - C_{y,t}) \right\}$$

in which  $T$  represents the sample size. Even though analyzing a binary variable wastes potentially useful information, the concordance index allows detecting linear and non-linear relationships between business cycles. The concordance index ranges between zero and one, with zero indicating complete discordance, a value of 0.5 denoting the lack of systematic relationship between the two variables, and one representing complete concordance of the cyclical behavior. While the concordance statistic is useful in studying linear and non-linear relationships between two cycles, it could be misleading when the series go through an extended period of above-trend or below-trend phase. Therefore, to deal with this potential measurement bias, it is necessary to calculate a mean corrected index of concordance:

$$MCCI_{xy} = \frac{2}{T} \left\{ \sum_{t=1}^T (C_{x,t} - \bar{C}_x) \cdot (C_{y,t} - \bar{C}_y) \right\}$$

in which  $C_{x,t}$  and  $C_{y,t}$  are defined as above and  $\bar{C}_x$  and  $\bar{C}_y$  represent the mean for country  $x$  and country  $y$ , respectively, over the sample period. The mean corrected concordance index ranges from -1 (complete discordance) to +1 (complete concordance). Although this adjustment improves the concordance index's informational content, it still requires a test

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<sup>7</sup> Since the strength of any relationship does not automatically imply its statistical significance, the significance of the correlation coefficient is tested against the null hypothesis of being zero. In the tables presented in the following section, the pairwise correlation coefficients that are statically significant at the five percent level are highlighted in bold.

<sup>8</sup> For the empirical application of the concordance index, see Artis, Kontolemis, and Osborn (1997), Cashin, McDermott, and Scott (1999), McDermott and Scott (2000), Nadal-De Simone (2002), Avouyi-Dovi and Matheron (2003), and Claessens, Kose, and Terrones (2011).

statistic for the significance. Various approaches are used in literature to assess the statistical significance of the concordance index. As per Harding and Pagan (2006), the coefficients ( $\rho$ ) in the below regression is proportional to the mean corrected concordance index:

$$\left(\frac{c_{y,t}}{\sigma_{c_y}}\right) = \eta + \rho \left(\frac{c_{x,t}}{\sigma_{c_x}}\right) + u_t$$

which implies that a null hypothesis of no concordance between  $C_{x,t}$  and  $C_{y,t}$  corresponds to a null hypothesis of  $\rho$  being zero. In order to test significance of the mean corrected concordance index with the correct  $t$ -statistic, it is necessary to compute standard errors corrected for heteroskedasticity and autocorrelation. Hence, the generalized method of moments (GMM) approach is employed to get a heteroskedasticity and autocorrelation consistent covariance matrix, using the mean corrected concordance index for the U.S. economy as the instrumental variable in GMM estimations.

#### IV. ESTIMATION RESULTS

**Contemporaneous correlation coefficients indicate a low degree of non-hydrocarbon business cycle synchronization.** After extracting the cyclical component of real non-hydrocarbon GDP for each GCC economy over the period 1990-2010, the degree of synchronization is estimated by the contemporaneous bilateral correlation coefficients of the cyclical components of each national non-hydrocarbon business cycle vis-à-vis others. The results, presented in Table 1, show that the pairwise correlation coefficients of the cyclical component of real non-hydrocarbon GDP was 0.13, on average, among the GCC countries, while excluding Kuwait—because of the first Gulf War in the early 1990s—from the sample raises the average correlation coefficient to 0.17 over the entire sample period. Although the test results indicate that these aggregated estimates are not statistically significant at the five percent level, a few of the pairwise correlation coefficients come out to be statistically significant—and highlighted in bold in the following tables. Over the period 1990-2010, the highest degree of non-hydrocarbon business cycle comovement was observed between Oman and Qatar (0.64), Bahrain and the U.A.E. (0.42), and Qatar vis-à-vis Saudi Arabia (0.38) and the U.A.E. (0.49). In contrast, partly because of war-related distortions, Kuwait’s non-hydrocarbon business cycle was negatively correlated with that of Bahrain and Saudi Arabia, and the degree of synchronicity between Saudi Arabia and the U.A.E. was virtually non-existent and statistically insignificant.

**Table 1. Bilateral Correlations of the Cyclical Component of Real Non-Hydrocarbon GDP**

	1990-2010 (average = 0.13 or 0.17 excluding Kuwait)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	-0.37	1.00				
Oman	0.13	0.36	1.00			
Qatar	0.19	-0.01	<b>0.64</b>	1.00		
Saudi Arabia	0.23	<b>-0.60</b>	0.02	0.38	1.00	
U.A.E.	0.42	0.02	0.07	0.39	0.07	1.00
	1990-1999 (average = 0.02 or 0.19 excluding Kuwait)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	-0.61	1.00				
Oman	0.10	0.12	1.00			
Qatar	0.19	-0.53	0.35	1.00		
Saudi Arabia	0.26	<b>-0.82</b>	-0.02	<b>0.66</b>	1.00	
U.A.E.	<b>0.73</b>	-0.59	-0.16	0.46	0.23	1.00
	2000-2010 (average = 0.27 or 0.12 excluding Kuwait)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	0.37	1.00				
Oman	0.27	<b>0.61</b>	1.00			
Qatar	0.30	0.49	<b>0.81</b>	1.00		
Saudi Arabia	-0.03	0.13	0.17	-0.02	1.00	
U.A.E.	0.07	0.58	0.21	0.35	-0.31	1.00

## Notes:

1/ The pairwise correlation coefficients are computed using the cyclical component of frequency-filtered real non-hydrocarbon GDP in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

**The comparison of sub-periods reveals interesting trends in business cycle comovement among the GCC economies.** The average correlation coefficient increased from 0.02 in the 1990s to 0.27 between 2000 and 2010, suggesting closer synchronization of non-hydrocarbon business cycles over the past decade. However, excluding Kuwait, the pairwise correlation coefficient showed a decline from 0.19 in the 1990s to 0.12 in the 2000s. While the contemporaneous bilateral correlation coefficients of non-hydrocarbon GDP declined in some cases like Bahrain and Saudi Arabia from 0.26 in the 1990s to -0.03 in the 2000s, Qatar and Saudi Arabia from 0.66 to -0.02, and Saudi Arabia and the U.A.E. from 0.23 to -0.31, it showed a significant increase for others like Bahrain and Kuwait from -0.61 to 0.37, Kuwait and Oman from 0.12 to 0.61, Kuwait and the U.A.E. from -0.59 to 0.58, and Oman and Qatar from 0.35 to 0.81 over the same period. Taking into account the small sample characteristics of the data, the analysis show that even though some of these sub-period estimates are statistically significant, the majority of pairwise correlation coefficients are insignificant and distorted by Kuwait-specific shocks in the early 1990s. Furthermore, regressing the extracted cyclical component of real non-hydrocarbon GDP in one country on the cyclical component for another country also show similar results, highlighting low and heterogeneous business cycle synchronicity across the GCC countries outside the hydrocarbon economy.

**Components of aggregate demand tend to show a low, if not negative, degree of synchronization.** In addition to analyzing the cyclical behavior of non-hydrocarbon GDP at an aggregate level, this paper also extracts the cyclical component of aggregate demand variables—government consumption and fixed investment spending, private consumption and fixed investment spending, non-hydrocarbon exports and imports—and calculates the bilateral correlation coefficients of each national cycle vis-à-vis others.

- As presented in Table 2, the average pairwise correlation of the cyclical component of real government consumption among the GCC countries was 0.05—both including and excluding Kuwait over the entire sample period. The highest degree of comovement in real government consumption was observed between Qatar and Saudi Arabia (0.64) and Oman and Qatar (0.39), while others have low or negative synchronicity.
- In the case of real government fixed investment, the estimations, exhibited in Table 3, indicate that the degree of synchronization is virtually non-existent—and still very low (0.02) excluding Kuwait. While a few pairs of countries had relatively high correlation coefficients, such as Qatar and the U.A.E. (0.43), Bahrain and Qatar (0.23), and Qatar and Saudi Arabia (0.22), most country pairs had low or negative correlation.
- The average correlation coefficient of the cyclical components of real private consumption, presented in Table 4, indicate that the extent of synchronization was also very low (0.09) across the GCC countries (and 0.14 excluding Kuwait). The highest degree of cyclical synchronicity in private consumption was between Oman and Saudi Arabia (0.59), Saudi Arabia and the U.A.E. (0.52), and Oman and the U.A.E. (0.46), while Kuwait had negative correlation vis-à-vis all GCC countries except Bahrain, which was very low (0.09).
- In terms of real private fixed investment spending, the average bilateral correlation coefficient of the cyclical components was -0.14 (and -0.08 excluding Kuwait), as shown in Table 5. While Bahrain and Kuwait had a relatively higher degree of synchronicity in private fixed investment spending (0.30), other countries had either very low or significantly negative readings.
- In the case of real non-hydrocarbon exports, the average pairwise correlation of the cyclical components across the GCC countries, presented in Table 6, was 0.05 (and 0.08 excluding Kuwait). While only Bahrain and Qatar had relatively high and statistically significant synchronization, the rest exhibited negligible and negative correlations in the cyclical behavior of real non-hydrocarbon exports.
- The results for real imports, displayed in Table 7, show that the average correlation of cyclical components was 0.17 (and 0.12 excluding Kuwait). While Oman had relatively high and statistically significant synchronization vis-à-vis Bahrain and the U.A.E., other pairs of countries had low and negative correlation coefficients. Nevertheless, these

results suggest that imports, along with private fixed investment, were the component of aggregate demand mostly responsible for the comovement of non-hydrocarbon cycles.

**Table 2. Bilateral Correlations of the Cyclical Component of Real Government Consumption**

	1990-2010 (average = 0.05)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	0.37	1.00				
Oman	<b>-0.51</b>	0.07	1.00			
Qatar	-0.31	-0.38	0.39	1.00		
Saudi Arabia	-0.05	-0.24	0.28	<b>0.64</b>	1.00	
U.A.E.	-0.25	0.15	0.17	0.35	0.10	1.00

Notes:

1/ The pairwise correlation coefficients are computed using the cyclical component of frequency-filtered real government consumption in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

**Table 3. Bilateral Correlations of the Cyclical Component of Real Government Investment**

	1990-2010 (average = 0.00)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	0.13	1.00				
Oman	-0.33	0.07	1.00			
Qatar	0.23	-0.09	-0.07	1.00		
Saudi Arabia	-0.07	-0.02	0.07	-0.17	1.00	
U.A.E.	-0.18	-0.27	0.10	<b>0.43</b>	0.22	1.00

Notes:

1/ The pairwise correlation coefficients are computed using the cyclical component of frequency-filtered real government investment spending in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

**Table 4. Bilateral Correlations of the Cyclical Component of Real Private Consumption**

	1990-2010 (average = 0.09)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	0.09	1.00				
Oman	-0.17	-0.06	1.00			
Qatar	0.08	-0.15	0.13	1.00		
Saudi Arabia	-0.15	-0.35	<b>0.59</b>	0.13	1.00	
U.A.E.	0.02	-0.18	<b>0.46</b>	<b>0.45</b>	<b>0.52</b>	1.00

Notes:

1/ The pairwise correlation coefficients are computed using the cyclical component of frequency-filtered real private consumption in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

**Table 5. Bilateral Correlations of the Cyclical Component of Real Private Investment**

	1990-2010 (average = -0.14)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	0.30	1.00				
Oman	-0.26	0.09	1.00			
Qatar	<b>-0.55</b>	<b>-0.71</b>	0.26	1.00		
Saudi Arabia	<b>-0.48</b>	<b>-0.51</b>	0.09	0.26	1.00	
U.A.E.	-0.13	-0.11	-0.38	0.26	-0.22	1.00

Notes:

1/ The pairwise correlation coefficients are computed using the cyclical component of frequency-filtered real private investment in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

**Table 6. Bilateral Correlations of the Cyclical Component of Real Non-Hydrocarbon Exports**

	1990-2010 (average = 0.05)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	0.07	1.00				
Oman	-0.14	-0.05	1.00			
Qatar	<b>0.57</b>	0.30	0.17	1.00		
Saudi Arabia	0.20	<b>-0.87</b>	0.11	-0.10	1.00	
U.A.E.	0.28	0.09	-0.10	0.21	-0.02	1.00

Notes:

1/ The pairwise correlation coefficients are computed using the cyclical component of frequency-filtered real non-hydrocarbon exports in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

**Table 7. Bilateral Correlations of the Cyclical Component of Real Imports**

	1990-2010 (average = 0.17)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	0.29	1.00				
Oman	<b>0.51</b>	0.33	1.00			
Qatar	0.17	-0.38	-0.14	1.00		
Saudi Arabia	0.03	0.13	0.13	0.07	1.00	
U.A.E.	0.33	<b>0.45</b>	<b>0.57</b>	-0.24	0.37	1.00

Notes:

1/ The pairwise correlation coefficients are computed using the cyclical component of frequency-filtered real imports in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

**The mean corrected concordance indices also indicate that non-hydrocarbon business cycles of the GCC countries are not synchronous.** In addition to the cross-correlation coefficients between the deviation cycles, the degree of comovement in non-hydrocarbon business cycles is also estimated by a concordance index that measures the average percentage of time wherein two series coincide in the same phase of the cycle. This non-

parametric index ranges from zero to one, with zero indicating complete discordance between the two cycles, a score of 0.5 indicating no concordance, and one representing complete concordance of the cyclical behavior. Since long periods in any given phase of the cycle can cause an upward bias, it is necessary to calculate a mean corrected version of the concordance index. As presented in Table 8, the adjusted concordance indices for the cyclical component of real non-hydrocarbon GDP show that the GCC economies were in the same phase of the cycle—that is, contracting or expanding in tandem—only 6 percent of the time during the period 1990-2010. Although calculating the concordance statistics for sub-periods is problematic because of data limitations, the average concordance index appears to increase from nil in the 1990s to 11 percent in the 2000s, implying a greater degree of synchronization of non-hydrocarbon business cycles across the GCC countries in recent years.

**Table 8. Mean Corrected Concordance Index**

	1990-2010 (average = 0.06)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	-0.22	1.00				
Oman	0.12	0.07	1.00			
Qatar	0.21	-0.04	0.21	1.00		
Saudi Arabia	0.17	-0.24	0.08	0.10	1.00	
U.A.E.	0.02	0.07	0.02	0.21	0.08	1.00
	1990-1999 (average = 0.00)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	-0.21	1.00				
Oman	0.00	0.10	1.00			
Qatar	0.28	-0.20	0.00	1.00		
Saudi Arabia	0.12	-0.40	0.00	0.12	1.00	
U.A.E.	0.20	-0.30	-0.10	0.20	0.20	1.00
	2000-2010 (average = 0.11)					
	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	U.A.E.
Bahrain	1.00					
Kuwait	-0.22	1.00				
Oman	0.23	0.04	1.00			
Qatar	0.15	0.10	0.40	1.00		
Saudi Arabia	0.22	-0.10	0.15	0.08	1.00	
U.A.E.	-0.14	0.40	0.13	0.22	-0.03	1.00

Notes:

1/ The mean corrected concordance indices are computed using the cyclical component of frequency-filtered real non-hydrocarbon GDP in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

**Pairwise concordance indices show low, but converging non-hydrocarbon business cycles among the GCC countries over time.** On a bilateral basis, the highest degree of concordance in non-hydrocarbon business cycles was observed between Oman and Qatar (moving together 21 percent of the time), Bahrain and Qatar (21 percent of the time), and Bahrain and Saudi Arabia (17 percent of the time). In contrast, the cyclical behavior of Kuwait's non-hydrocarbon GDP was in disconcordance vis-à-vis Bahrain, Qatar and Saudi Arabia, while other pairs of countries had very low concordance readings. While none of these findings is statistically significant, the mean corrected concordance indices also confirm heterogeneous—but converging—pattern of non-hydrocarbon business cycles across the GCC countries over time. For example, while the degree of disconcordance between Bahrain and Kuwait increased from 21 percent in the 1990s to 22 percent in the 2000s, the level of disconcordance between Kuwait and Saudi Arabia declined from 40 percent to 10 percent and the relationship between Kuwait and the U.A.E. moved from disconcordance to a concordance of 40 percent over the same period. However, it should be noted that data limitations make sub-period calculations less informative, if not immaterial, since the concordance statistics cover a very small number of cycles even for the full sample period

**Correlation coefficients suggest that foreign impulses play a more prominent role than intra-regional synchronicity.** The degree of business cycle synchronization between the GCC countries and their main trading partner countries and blocks, presented in Table 9, indicates a greater degree of contemporaneous correlation, on average, compared to intra-regional synchronicity during the period 1990-2010. For example, the highest degree of business cycle comovement was observed between Saudi Arabia and Asia (0.48), while the non-hydrocarbon business cycles of Bahrain and Kuwait were negatively correlated with the cyclical component of real GDP in the Eurozone (-0.24) and in Asia (-0.20), respectively. The comparison of sub-periods shows a greater degree of business cycle synchronization in the 2000s compared to the preceding decade. For example, in the case of Saudi Arabia, the contemporaneous bilateral correlation coefficients vis-à-vis China, Japan, the Eurozone and the U.S. increased from 0.48, 0.16, -0.44, and 0.25, respectively, in the 1990s to 0.57, 0.59, 0.73, and 0.56 during the period 2000-2010. Likewise, the correlation coefficient of Bahrain vis-à-vis the Euro area evolved from -0.84 and 0.18 over the same period. In contrast, the U.A.E.'s non-hydrocarbon business cycle turned less synchronized with Asia and particularly China over the past decade compared with the 1990s, while its correlation coefficient vis-à-vis the Euro area and the U.S. showed a marked increase.

**Table 9. Bilateral Correlations of the Frequency-Filtered Cyclical Components**

	1990-2010				
	<i>Real GDP</i>				
<i>Real non-hydrocarbon GDP</i>	Asia	China	Japan	Euro Area	U.S.
Bahrain	0.15	0.25	-0.05	-0.24	0.10
Kuwait	-0.20	-0.15	0.13	0.39	0.10
Oman	-0.06	0.27	0.10	0.30	0.20
Qatar	0.29	0.31	0.18	0.17	0.31
Saudi Arabia	<b>0.48</b>	0.42	0.20	0.00	0.24
U.A.E.	0.29	0.17	0.12	-0.02	0.22

	1990-1999				
	<i>Real GDP</i>				
<i>Real non-hydrocarbon GDP</i>	Asia	China	Japan	Euro Area	U.S.
Bahrain	0.16	0.34	-0.29	<b>-0.84</b>	0.18
Kuwait	-0.46	-0.38	-0.16	<b>0.72</b>	-0.13
Oman	-0.44	0.24	-0.57	-0.12	0.25
Qatar	0.46	0.55	-0.19	-0.37	0.50
Saudi Arabia	0.54	0.48	0.16	-0.44	0.25
U.A.E.	0.55	0.33	-0.04	-0.58	0.13

	2000-2010				
	<i>Real GDP</i>				
<i>Real non-hydrocarbon GDP</i>	Asia	China	Japan	Euro Area	U.S.
Bahrain	0.19	0.12	0.29	0.18	0.06
Kuwait	0.18	0.14	0.35	0.32	0.27
Oman	0.30	0.32	0.41	0.46	0.18
Qatar	0.16	0.15	0.34	0.35	0.23
Saudi Arabia	0.52	0.57	<b>0.59</b>	<b>0.73</b>	0.56
U.A.E.	0.09	0.04	0.19	0.14	0.26

Notes:

1/ Bilateral correlation coefficients are computed using the cyclical component of filtered real non-hydrocarbon GDP for the GCC and real GDP for trading partners in logarithmic form.

2/ The bold figures indicate statistical significance at the 5 percent level.

Source: Author's calculations

## V. FACTORS CONTRIBUTING TO BUSINESS CYCLE DESYNCHRONIZATION

**The limited extent of business cycle synchronization is related to low level of intra-regional trade and financial integration.** While a high degree of sectoral specialization in hydrocarbons can explain business cycle comovement at the aggregate level, the empirical results demonstrate significant differences in non-hydrocarbon business cycles. This could be explained by low level of intra-regional trade and financial integration, which play an important role in the transmission of idiosyncratic shocks and business cycle comovement. The GCC countries are highly open according to total international trade as a share of GDP, but that is mainly a result of hydrocarbon exports and imports from outside the region. Despite the establishment of a free trade area in 1983 and a custom union in 2003, the share of intra-regional trade remains relatively low at less than 5 percent of total on average. This

compares unfavorably with the EU (above 70 percent) and the NAFTA (about 50 percent), reflecting hydrocarbon dependence and weak sectoral complementariness among the GCC economies, and leads to business cycle desynchronization. Nevertheless, it appears that bilateral correlations of cyclical fluctuations move with changes in bilateral trade intensity. Country pairs that have closer trade linkages tend to have a higher degree of non-hydrocarbon business cycle comovement on average, which is consistent with the empirical evidence from a plethora of studies.<sup>9</sup> On the other hand, the regional financial interlinkages remain limited, in spite of an increase in bilateral asset holdings and the acceleration in cross-border financial integration at the regional level as indicated by an increase in stock market correlations between the GCC countries.<sup>10</sup>

**The subcomponents of non-hydrocarbon GDP show different cyclical behaviors, with negative and positive correlation coefficients over the sample period.** Although a systematic analysis of the cyclical patterns of fiscal policy and the behavior of real non-hydrocarbon GDP is beyond the scope of this paper, a preliminary investigation suggests that fiscal policy heterogeneity have a considerable effect on cyclical variability of non-hydrocarbon output across the GCC countries. Over the full sample period, varying fiscal reaction functions—measured by the cyclically adjusted non-hydrocarbon fiscal balance—resulted in different degrees of procyclicality and thereby contributed to a significant share of non-hydrocarbon output variability. This is not an unexpected finding, since government consumption and fixed investment spending account for almost 32 percent of GDP (and over 47 percent of non-hydrocarbon GDP), on average, in the GCC countries. Furthermore, private consumption and imports also exhibit procyclical behavior, along the lines of the fiscal impulse, whereas exports are countercyclical.

**Diverging fiscal policies appear to have made a significant contribution to the desynchronization of business cycles in the GCC.** While fiscal convergence would lead to a higher degree of business cycle synchronization by purging idiosyncratic fiscal policy shocks, asymmetric fiscal behavior reduces the synchronicity of business cycles.<sup>11</sup> Even

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<sup>9</sup> Although Krugman (1993) notes that trade integration may lead to greater specialization and hence cyclical desynchronization, Frankel and Rose (1998) and Baxter and Kouparitsas (2005) show that countries that have closer trade linkages tend to have more closely synchronized business cycles. Similarly, Clark and van Wincoop (2001) find that states within the U.S. are more closely synchronized than countries within the EU, indicating a greater extent of trade linkages within the U.S. as compared with European countries. Nevertheless, as Kose, Prasad and Terrones (2003) suggest, business cycle oscillations in developing countries tend to be driven by country specific shocks and therefore exhibit a low degree of synchronization with other business cycles.

<sup>10</sup> Using interest rate and equity price data, Espinoza, Prasad and Williams (2010) investigated financial integration in the GCC countries and found evidence of regional convergence and integration.

<sup>11</sup> Bower and Guillemineau (2006) show that the homogenization of fiscal policies has been one of the main determinants of business cycle synchronization in the euro area, while Akin (2006) highlights the significance of common fiscal shocks as a determinant of cyclical convergence in a broader set of countries.

though hydrocarbons account for a large share of fiscal revenues in all GCC countries, the extent of fiscal space and the magnitude of discretionary policy reaction functions vary greatly, which in turn shape the cyclical behavior of non-hydrocarbon output at the national level and the comovement of non-hydrocarbon business cycles at the regional level. The low, if not negative, pairwise correlations of the cyclical components of real government consumption and investment spending among the GCC countries indicate that diverging fiscal impulses are likely to be one of key contributing factors to business cycle desynchronization.

## VI. CONCLUSION

**Empirical results show a low degree of non-hydrocarbon business cycle synchronization between the GCC countries.** The empirical analysis shows that the degree of non-hydrocarbon business cycle synchronization, as measured by the contemporaneous correlation coefficients of the cyclical components of each national non-hydrocarbon business cycle vis-à-vis others, remained low and heterogeneous during the period 1990-2010. Even though cross-country correlations show an increase in the 2000s compared to the preceding decade, the results excluding Kuwait suggest a decline in the degree of business cycle synchronicity. This is also the case for components of aggregate demand, indicating a very low, if not negative, degree of synchronization in cyclical oscillations. Likewise, the mean corrected concordance statistics indicate that real non-hydrocarbon GDP in the GCC countries is barely synchronized—with contracting or expanding in tandem only 6 percent of the time during the full sample period. Another key empirical regularity is that foreign impulses play a more prominent role than regional factors, as the extent of business cycle synchronization between the GCC countries and their main trading partner countries and blocks indicates a greater degree of contemporaneous correlation, on average, compared to intra-regional synchronicity.

**The findings have a number of relevant policy implications, especially in view of divergent fiscal impulses.** The low degree of comovement in real non-hydrocarbon GDP—and also in components of aggregate demand—suggests that the GCC countries may be exposed to asymmetric shocks, and that country-specific factors and spillovers from the rest of the world are far more important than regional interlinkages in explaining the cyclical fluctuations. According to these findings, the extent of (non-hydrocarbon) cyclical comovement among the GCC countries is also lower than the degree of synchronicity between European economies prior to the establishment of the euro area (Artis, Krolzing and Toro, 2004; Camacho, Perez-Quiros and Saiz, 2004).<sup>12</sup> Although limited level of intra-regional trade and financial integration and variance in the degree of economic

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<sup>12</sup> The level of business cycle synchronization—both in terms of GDP and aggregate demand components—among the EU countries has increased steadily in the post-war period and especially after the introduction of the single currency.

diversification certainly contribute to business cycle desynchronization across the region, another important factor is the heterogeneous and diverging fiscal policy impulses.

**Structural features present a series of challenges, particularly in view of the planned monetary integration.** Without a higher degree of synchronization in (non-hydrocarbon) business cycles, the cost of monetary union may outweigh its benefits. The GCC countries need to expand and deepen economic diversification and become more complementary in intra-regional trade and financial flows. In this context, it is also important to acknowledge that monetary union requires a set of common fiscal rules to align decentralized fiscal policies among the GCC countries with a centralized monetary policy, which would also help bringing business cycles more in synch. Therefore, establishing a rule-based framework for national fiscal policies and regional coordination would help avoiding the risk of national fiscal impulses leading to divergent non-hydrocarbon growth cycles, especially in view of that fiscal policy is a key determinant of non-hydrocarbon GDP growth in the GCC economies and that government revenues remain exposed to the volatility of oil prices.

**DATA APPENDIX**

The data set consists of annual time series for the GCC countries, China, Japan, the United States and regional aggregates for Asia and the Euro area. All the series come from the IMF's *World Economic Outlook* database and cover the period of 1990-2010, as dictated by the availability of the data. Although business cycle analysis based on higher-frequency data tends to be more robust, providing a wider spectrum of insights, the GCC countries do not publish quarterly national accounts, with the exception of Bahrain since 2008 and Qatar since 2005. There are also no high frequency proxies such as the industrial production index that can be utilized in business cycle analysis.

For the GCC countries, real GDP, real non-hydrocarbon GDP and components of aggregate demand—government consumption and investment spending, private consumption and investment spending, non-hydrocarbon exports, and imports—are used in estimating cyclical patterns and analyzing the extent of comovement. Using the augmented Dickey-Fuller (ADF) unit root test, all the series are found to be non-stationary and integrated of order one.

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