Is the US Dollar a Suitable Anchor for the Newly Proposed GCC Currency?

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1. INTRODUCTION

THE objective in this paper is to determine how the Gulf Cooperation Council (hereafter GCC) economies respond to monetary policy shocks from the United States (US) as they are heading towards the adoption of a single currency.[1] Among the four alternatives available: (a) free float; (b) peg to a basket; (c) peg to the euro; or (d) peg to the US dollar, the GCC has opted for the last with the possibility of reconsideration later.[2] The issue of currency arrangement is not without controversies. There are both a voluminous literature and a continuing debate on the choice of exchange rate regime and on the dollarisation of economies. Most notable is the seminal contribution of Mundell (1961) on optimum currency area (OCA) along with subsequent works by McKinnon (1963), Kenen (1969) and Tower and Willett (1976) that stress the importance of relative economic sizes, labour mobility, degree of openness, trade concentration and similarity of shocks for assessing the suitability of fixed and flexible exchange rate regimes, and prospective monetary unions.

Determination of the degree of shocks symmetry across countries has been thus far the most popular criterion used in empirical works to evaluate OCAs. According to this approach, one needs to test whether or not aggregate demand and aggregate supply shocks are correlated across member countries, *not with a*

[1] The GCC is a regional economic bloc formed in 1980 by six countries, namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE).
[2] For the most recent analysis on this issue, see Khan (2009a, 2009b).

third party, to conclude if a monetary union is feasible, *ceteris paribus* (Abu-Qarn and Abu-Bader, 2008).[3] In this paper, we take a slightly different, innovative approach by investigating how each GCC member country reacts to monetary policy shocks from the US to further justify their choice of the US dollar as the anchor for the new currency. It must be emphasised that in this paper we did *not* examine the suitability of monetary union for the GCC countries but rather the appropriateness of the US dollar as the proposed anchor for the new currency. In this respect, we formulated the following hypothesis: given that the US dollar is already used as the official currency for settling transactions on oil and gas at the world level, if the response of the non-oil sector output and overall prices to monetary policy shocks from the US is similar to that of the US prices and output, then the dollar can be seen as fulfilling an important role for both sectors (oil and non-oil) of the GCC economies.

There are actually three pieces of information that are crucial in assessing the macroeconomic situation of a country or a group of countries: inflation, unemployment and real output growth (Mankiw, 2001). The conundrum that we face with the GCC countries is how to disentangle prosperity that comes from gifts of nature, and prosperity that comes from human contributions. First, it is a truism that oil represents a large proportion of the overall output of these countries, which has been further amplified by the exponential increase in the price and demand for oil (though not lately). Using overall output growth to assess the impact of US monetary policy shocks might be biased and misleading since by setting monetary policy, the US alters the relative price of the US dollar in which oil is already quoted. Hence, the response of output growth to monetary policy shocks from the US might be overshadowed by the oil components of the GCC's total output. Second, labour is mostly imported from foreign countries and data on unemployment are not readily available, which makes it difficult to grasp the full effect of monetary policy imported from the US, or even to talk about prosperity.

For this paper, in addition to the Fed funds rate two key macroeconomic variables were also considered: the non-oil output growth and inflation, while structural vector autoregression (SVAR) methodology was used to extract the shocks for each country. In search of this, the non-cumulative impulse responses of output and inflation for each country were calculated to ascertain any similarity or lack thereof. Likewise, the standard deviation of non-oil output growth and inflation responses for each pair of GCC countries was computed to assess the dispersion of the estimates of the effects of US monetary policy shocks. We also measured the correlation between the responses of each variable to a one-standard-deviation *structural* US monetary policy shock and

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[3] The contribution of these authors is the most thorough empirical piece on the feasibility of monetary union between GCC countries to date.

also the correlation of actual demand and supply shocks of each country with the US monetary policy shock to gauge the synchronisation of the responses. We further assessed the suitability of the US dollar as the anchor currency against a basket peg with both the dollar and the euro as the major currencies by estimating a quadvariate SVAR with a proxy for the European short-term interest rate. Variance decomposition analysis was performed to shed light on the relative importance of the two alternatives for both output growth and inflation.

To foreshadow our results, it is worth noting that some findings stand out. First, the results lend partial support to the US dollar as the anchor currency but also suggest that a basket peg might be a reasonable alternative anchor for the GCC countries' new currency. Second, we find the inflation responses to be more dispersed than the non-oil output responses, insinuating that the underlying determinants of inflation do differ across the GCC economies notwithstanding the similarities in responses to US monetary policy shocks.

The rest of the paper is organised as follows: in Section 2 a brief review of the literature is presented, Section 3 consists of a discussion of the underlying theory and SVAR methodology. Section 4 contains a description and analysis of the data in detail, while Section 5 consists of the empirical results. The paper is concluded in Section 6.

2. LITERATURE REVIEW

There are a number of studies on OCAs that are focused on GCC countries which follow the footprints of previous studies for the European Union. These studies in general can be grouped into two strands, the first of which typically consists of explorations of the benefits and costs of monetary union. Such exercises have been carried out, for instance, by Fasano-Filho and Iqbal (2002), Jadresic (2002), Laabas and Limam (2002), *Oman Economic Review* (2002), Fasano-Filho and Iqbal (2003), Fasano-Filho and Schaechter (2003), Iqbal and Fasano-Filho (2003), Badr-El-Dim (2004) and Sturm and Siegfried (2005), among others. These studies are generally focused on convergence criteria and are attempts to determine whether or not a currency union is justifiable. The most comprehensive study thus far on monetary integration in the GCC countries is that by Sturm and Siegfried (2005). Besides observing commonality in the current choice of exchange rate regime by the GCC countries individually, Sturm and Siegfried do not offer any further convincing reasons to peg the new currency to the US dollar.

The second strand of the literature is concentrated on the choice of a suitable anchor for the GCC countries. Such studies include those by Jadresic (2002), Laabas and Limam (2002) and Abed et al. (2003). For instance, Jadresic

(2002) uses descriptive statistics to show that a common currency between the GCC countries is a worthwhile endeavour in terms of economic efficiency, regional integration and expansion of the non-oil sector, if implemented properly. His cost–benefit analysis shows that a peg to the dollar is the natural choice since all of the countries involved, with the exception of Kuwait, have their national currencies pegged to the US dollar. He also finds that a peg to the euro is the second-best alternative. In line with Jadresic (2002), Laabas and Limam (2002) acknowledge that there are potential benefits for GCC countries to grasp in a monetary union, but their analysis is mute over the choice of exchange rate regime beyond the currency union. Abed et al. (2003), by contrast, use regression analysis to compare a dollar peg to a dollar–euro basket peg of the new GCC currency in terms of their ability to warrant exchange rate and trade stability. Their results show that the alternative dollar–euro basket peg does not dominate the existing dollar peg in most GCC countries. A noticeable implication of their study is that there is no potential loss for the GCC countries in adopting either of these arrangements for the new currency. Abed et al. (2003), however, do not explore how the GCC countries react to shocks from either the US or the European Union to justify the use of the dollar and/or the euro as the anchor for the new currency.

A discernible gap in the above-mentioned literature, however, is how the GCC countries react to monetary policy shocks from the US, and whether or not the responses are similar across member countries. There are a number of reasons for its significance: (a) the large–small country hypothesis postulates that the US as a large country does not take into consideration non-oil shocks that occur in small countries when setting monetary policy to alter the path of output, employment and inflation at home; (b) most of the countries have made commitments to further diversify their economies and reduce the share of oil output to GDP, thereby making aggregate demand and supply shocks more recurrent; (c) imports and exports to the US represent 9 and 12 per cent, respectively, of GCC's total output, while those of the European Union (EU) represent 32 and 11 per cent, respectively (Sturm and Siegfried, 2005, p. 14); and (d) the US dollar has been depreciating against major alternative currencies, which reduces its importance as a store of value. All these espouse the choice of the US dollar as the anchor for the new currency for the GCC countries. Therefore, one may legitimately ask whether GCC countries react in the same fashion to exogenous monetary policy shocks from the US. By disaggregating the real GDPs of these countries and focusing exclusively on the non-oil sector output, it becomes exceedingly easy to capture effectively each country's non-oil sector responses to the US monetary policy shocks in order to determine whether or not there is any synchronisation which could further corroborate the use of the US dollar as the anchor currency. This unequivocal analysis underscores the main contributions of this paper.

3. THEORY AND METHODOLOGY

The underlying theoretical framework of this paper is the basic Mundell–Fleming or IS–LM–BP model with a fixed exchange rate regime and perfect capital mobility for small open economies (Fleming, 1962; Mundell, 1963). Macroeconomic equilibrium occurs when the IS and LM curves and the perfectly elastic BP curve intersect at once, the domestic interest rate equals foreign interest rates and actual output which may – or may not – be equal to potential output, is determined. Since this is a fixed-price model, nominal interest rate equals real interest rate. This model depicts an economy that is so small that, although it is being affected by what happens in the rest of the world, it does not really affect the outside world.[4]

For this exercise the structural vector autoregression (SVAR) methodology was used to uncover the dynamics of the GCC economies as related to the influence of monetary policy in the US. This methodology has been used extensively in the literature since Bernanke (1986) and Sims (1986) used short-run restrictions and Blanchard and Quah (1989) used long-run restrictions as a way to model the innovations using economic analysis in response to Cooley and Leroy's (1985) critique of Sims's (1980) unidentified VAR. Further improvements to the SVAR technique were brought about with the work of Galí (1992) in which short- and long-run restrictions were used to identify their model. Our SVAR exposition closely follows that of Enders (2004).

Assuming Z_t is a vector containing the so-ordered variables (Fed funds rate $= i_t$, non-oil GDP growth $= y_t$, inflation $= \pi_t$) that are driven by the so-ordered structural innovations $\varepsilon_t =$ (US monetary policy shock $= \varepsilon_t^f$, non-oil supply shock $= \varepsilon_t^s$, inflation shock $= \varepsilon_t^i$), which are assumed to follow a normal distribution with a covariance matrix equal to the identity matrix, I. More precisely,

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[4] Under *imperfect* capital mobility, the BP curve is upward sloping and differences in money growth give rise to an interest rate differential between the US and the GCC countries. There is no massive capital outflow or inflow that restores the balance of payment equilibrium automatically as under perfect capital mobility. Instead, what can be observed in the case of expansionary monetary policy in the GCC is a decline in the short-term interest rate below the US short-term rate accompanied by a rise in GCC income, thereby provoking a balance of payment deficit. The balance of payment deficit would lead to a decrease in money supply over time reversing the effect of the initial monetary policy expansion, unless the GCC governments were engaged in sterilisation. The point here is that irrespective of the degree of capital mobility assumed, monetary policy is ineffective under a fixed exchange rate. To model imperfect capital mobility, we would need to incorporate a differential interest rate into the VAR so that we could observe the short-run effect of monetary policy. We would instead be interested in the responses of domestic non-oil output growth and inflation to differential monetary policy shocks. However, this is not possible at present because we have not come across any reliable sources of time series data on interest rate for the GCC countries for the period covered by our analysis. In summary, our assumption of perfect capital mobility simply relates to the absence of capital control in the GCC countries, the long history of fixed exchange rate regime, and the inability of the GCC countries as small countries to influence the world interest rate.

$E(\varepsilon_t \varepsilon_t') = I$. Let $B(L)$ be the polynomial lag matrix. Hence, by ignoring the mean values, the system can be written as:

$$B(L)Z_t = \varepsilon_t. \tag{1}$$

If $B(L)$ is invertible, a condition that holds if – and only if – the polynomial lag matrix of the reduced-form model is invertible, then one can write the infinite Wold moving average (MA(∞)) of the structural system as:

$$Z_t = R(L)\varepsilon_t, \tag{2}$$

where $R(L) = B(L)^{-1}$. However, since the structural model cannot be estimated because ε_t is not observable, one has to first estimate the reduced-form model and transform its residuals in order to obtain an estimate of ε_t. The reduced-form VAR representation is as follows:

$$\psi(L)Z_t = e_t, \tag{3}$$

where $\psi(L) = \psi_0 + \psi_1 L + \psi_2 L^2 + \cdots + \psi_p L^p$; L is the lag operator with $L^i Z_t = Z_{t-i}$, and ψ_0 is the identity matrix. e_t is the reduced-form residuals set with covariance matrix, Ω, being symmetric. In sum, $E(e_t e_t') = \Omega$. Assuming $\psi(L)$ is invertible, one can write the reduced-form MA(∞) representation as:

$$Z_t = C(L)e_t, \tag{4}$$

where $C(L) = \psi(L)^{-1}$. Following Blanchard and Quah (1989), the relationship between the structural shocks and the reduced-form shocks can be established by equating (2) and (4), the MA(∞) of both systems. It follows that:

$$R(L)\varepsilon_t = C(L)e_t. \tag{5}$$

Since $C(0)$ is equal to I and this equation holds for all t, it is straightforward that:

$$R(0)\varepsilon_t = e_t. \tag{6}$$

By squaring both sides and taking expectations, one finds that:

$$R(0)R(0)' = \Omega, \tag{7}$$

and by substituting (6) in (5):

$$R(L)\varepsilon_t = C(L)R(0)\varepsilon_t, \tag{8}$$

and by dividing both sides of (8) by ε_t:

$$R(L) = C(L)R(0). \tag{9}$$

Since Ω is symmetric, equation (7) places $n(n + 1)/2[= 3(3 + 1)/2 = 6]$ restrictions on the elements of $R(0)$, the additional $n(n - 1)/2[= 3(3 - 1)/2 = 3]$ restrictions needed are taken from economic theory in order to fully identify

$R(0)$. Knowledge of this matrix enables us to recover (i) $R(L)$ given that $C(L)$ is already known from (4); and (ii) estimates of ε_t from (6). Finally, the variance decomposition and the impulse response analyses follow from (2), which can be detailed as:

$$\begin{bmatrix} i_t^{US} \\ y_t \\ \pi_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} r_{11,i} & r_{12,i} & r_{13,i} \\ r_{21,i} & r_{22,i} & r_{23,i} \\ r_{31,i} & r_{32,i} & r_{33,i} \end{bmatrix} \begin{bmatrix} \varepsilon_{t-i}^p \\ \varepsilon_{t-i}^s \\ \varepsilon_{t-i}^d \end{bmatrix}. \tag{10}$$

Following Sims (1986), short-run restrictions were used to just-identify the SVAR model. We assume that (1) the Fed funds rate, as the monetary policy instrument of the US as a large country, does not react in the short-run (if it reacts at all) to non-oil supply and inflation shocks originating in the GCC countries, seen as small countries, which is equivalent to setting $r_{12,0} = r_{13,0} = 0$; and (2) non-oil output growth responds to inflation shock with a one-year lag, $r_{23} = 0$. The first set of restrictions is in line with the small–large country hypothesis of the basic Mundell–Fleming model and is a standard theory in international economics. The second restriction might lend itself to criticisms but our objective was to account for the lag in production process that may arise when the economy suffers from either cost–push or demand–pull inflation. For example, an increase in aggregate demand that originates due to an increase in either consumer confidence or income may not give rise instantaneously to higher prices, the menu cost argument. Since we are dealing with annual data, a one-period lag might appear to be long, but there is no alternative.

4. DATA AND DATA ANALYSIS

The annual dataset used for the empirical analysis covers the period 1970–2006.[5] The series includes non-oil GDP at constant 1990 prices in US dollars calculated as the sum of the total value added of all sectors excluding mining and quarrying; the GDP deflator with 1990 as the base year due to unavailability of the consumer price index (CPI); and the Fed funds rate. All but the Fed funds rate were taken from the United Nations Statistical Databases – National Accounts Main Aggregates. The Fed funds rate was taken from the website of the Federal Reserve Bank of St. Louis. At the outset, the series were tested for unit roots by using the augmented Dickey–Fuller (ADF), the Phillips–Perron (PP) and the more robust Dickey–Fuller generalised least squares (DF-GLS)

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[5] Quarterly data for output and prices are not available for the GCC countries for the period under consideration. Several databases, including the International Financial Statistics of the International Monetary Fund, were perused to that effect but none had such low-frequency data available.

tests assuming both a trend and an intercept and a maximum lag truncation of 9 in accordance with the Schwarz information criterion. Although some counter-intuitive results have emerged from the unit root tests in Table 1, due to the trend in non-oil GDP of all countries, we considered output and price variables in our model to be integrated of order 1 or non-stationary.[6] With regard to the Fed funds rate, there are no persuasive arguments to substantiate the non-stationarity of the PP test, which implies that the series exhibit a clear tendency to increase or decrease over time or to revert to a given mean value. Since the unit root tests give conflicting results, we focused on the DF-GLS test, which is known to be more reliable, and concluded that the Fed funds rate was stationary. This is also in concert with the reasoning found in Enders (2004, pp. 158–59).

As a prelude to the empirical estimation, it is customary to look at the raw data for possible relationships among the variables. In this regard, we carried out two types of analysis of the data: one on the aggregate-level basis and the other on a per capita level basis, which is available upon request. On the analysis of the aggregate-level data, Figure 1 displays the paths of non-oil GDP growth and inflation over time for all GCC countries along with the US. Non-oil output growth and inflation are synchronised among GCC countries and the US. There is a clear convergence of both output growth and inflation over time. Figure 2 shows that non-oil GDP as a share of total output ranges from 40 per

TABLE 1
Unit Root Test Results

Variable	ADF	PP	DF-GLS
Funds_Rate	−3.95	−1.92	−3.34
Output US	−3.56	−2.12	−2.24
GDP Deflator US	−3.11	−1.21	−1.99
GDP Deflator Bahrain	−2.96	−2.37	−1.35
GDP Deflator Kuwait	−3.01	−2.96	−1.73
GDP Deflator Oman	−3.75	−4.05	−1.91
GDP Deflator Qatar	−2.74	−2.58	−1.82
GDP Deflator Saudi Arabia	−3.18	−2.75	−1.81
GDP Deflator UAE	−2.18	−2.49	−2.01
Non-oil GDP Bahrain	−2.51	−2.04	−1.72
Non-oil GDP Kuwait	−3.12	−3.14	−3.24
Non-oil GDP Oman	−1.47	−1.79	−1.21
Non-oil GDP Qatar	−2.12	−2.60	−1.60
Non-oil GDP Saudi Arabia	−4.34	−3.07	−2.39
Non-oil GDP UAE	−4.33	−2.79	−1.88

Note:
The critical values at 1, 5 and 10 per cent are respectively −4.26, −3.55 and −3.20 for the ADF test, −4.23, −3.54 and −3.20 for the PP test, and −3.77, −3.19 and −2.89 for the DF-GLS test.

[6] The critical values for both the ADF and the PP tests are from MacKinnon (1996).

FIGURE 1
Non-oil Output Growth and Inflation over Time
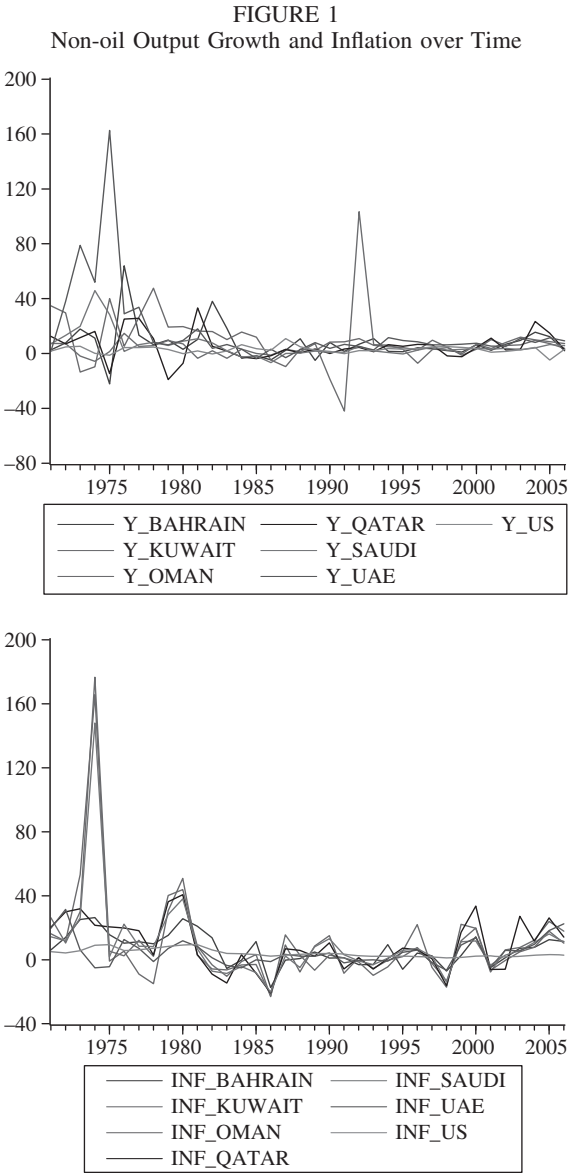
Source: Authors' calculations based on data from United Nations Statistical Databases.

cent in Qatar to almost 70 per cent in Bahrain. We have calculated that for the GCC as a whole, non-oil GDP is around 54 per cent of total GDP, which is considerable by all standards. Figure 2 further conveys information about a deliberate initiative of the GCC countries to reduce their dependence on oil revenue. Bahrain and Qatar have no choices other than to go along with Nature's move.

FIGURE 2
Relevance of the Non-oil Sector for AGCC Countries
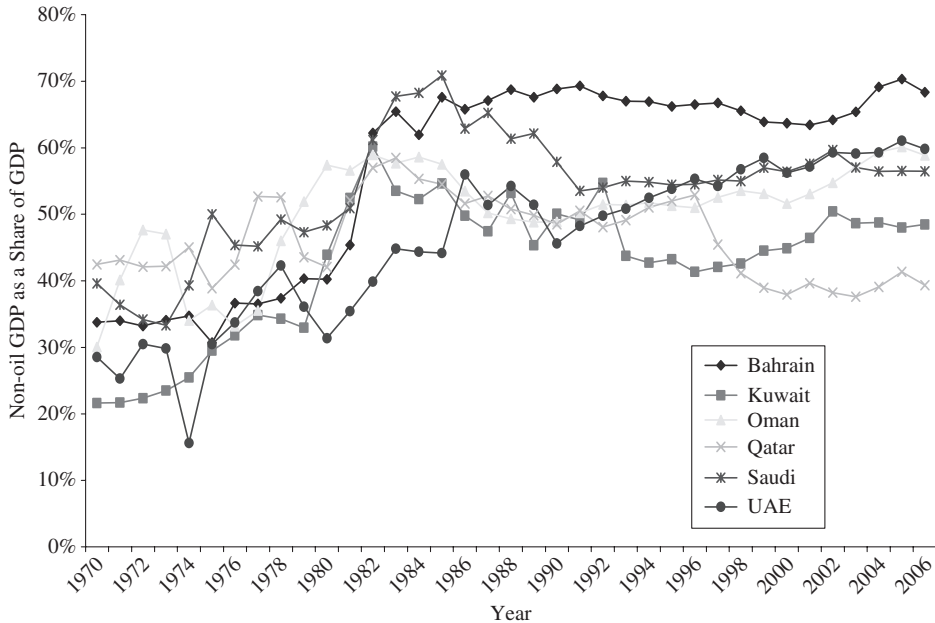
Source: United Nations Statistical Databases and authors' own calculations.

Bahrain's oil and gas reserves are expected to deplete by 2011/12 while Qatar has seen its efforts offset by new discoveries of natural gas. Figure 2 provides further evidence that the share of non-oil output to GDP has become more and more stable over time, as judged by the standard deviations.

In Table 2 a decade-by-decade comparison of the output growth of the non-oil sector in the GCC countries with US GDP growth shows that, on average, the economies of the GCC countries have grown about three times faster than has the overall US economy. However, when volatilities are considered, the GCC's non-oil sector is four times less stable than that of the US. In Table 2 the breakdown is provided on a country-by-country basis. The first Gulf War is definitely a contributing factor to volatility, with the standard deviation for Kuwait's output growth being 10 or more times higher than that of other GCC countries. The 1980s was the only decade with negative growth rates coinciding with the debt crisis of 1982.

The inflation performance of the GCC countries along with its link with US inflation and monetary policy is shown in Table 3. Starting in the 1970s, average inflation in the GCC was 23 per cent and 6.8 per cent in the US, with a maximum average of 84.8 and 9.4 per cent, respectively. The Federal Reserve in the US responded by increasing the Fed funds rate to a maximum of 12 per

TABLE 2
Output Growth, Decade by Decade

Decades	Non-oil GDP Growth	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC	USA GDP Growth
1970s	Mean	**12.29**	**4.83**	**20.00**	**8.35**	**15.17**	**45.54**	**17.70**	**3.00**
	Standard deviation	22.48	6.13	21.60	15.63	14.18	50.30	21.72	2.28
1980s	Mean	**6.84**	**1.59**	**8.09**	**3.21**	**2.07**	**4.84**	**4.44**	**3.39**
	Standard deviation	13.43	3.75	9.85	11.23	5.50	6.23	8.33	3.31
1990s	Mean	**4.09**	**5.80**	**5.85**	**2.97**	**2.18**	**6.73**	**4.60**	**3.04**
	Standard deviation	3.39	37.48	3.65	3.42	**1.77**	2.66	8.73	1.61
2000–06	Mean	**7.82**	**8.06**	**6.56**	**8.88**	**4.29**	**8.27**	**7.31**	**1.68**
	Standard deviation	4.95	2.59	2.67	8.02	1.39	2.43	3.68	3.06
	Maximum	**15.44**	**11.94**	**10.21**	**23.46**	**6.60**	**11.43**	**13.18**	**4.39**

TABLE 3
Inflation Performance and US Monetary Policy, by Decade

Decades	Inflation	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	GCC	USA	Fed Funds Rate
1970s	Mean	**14.9**	**33.9**	**28.6**	**22.3**	**29.9**	**8.2**	**23.0**	**6.8**	**8.0**
	Standard deviation	6.8	55.1	55.4	9.7	45.1	11.9	26.5	1.8	2.4
	Maximum	**26.2**	**176.5**	**165.7**	**36.2**	**147.9**	**31.5**	**84.8**	**9.4**	**12.0**
	Year of worst inflation	1974	1974	1974	1979	1974	1972		1975	1979
1980s	Mean	**5.4**	**2.9**	**2.3**	**0.9**	**0.2**	**1.9**	**2.3**	**4.8**	**10.4**
	Standard deviation	12.8	17.8	19.3	16.8	15.6	5.1	14.6	2.6	3.3
	Maximum	**25.7**	**43.9**	**50.9**	**40.6**	**38.0**	**11.8**	**35.1**	**9.4**	**16.8**
	Year of worst inflation	1980	1980	1980	1980	1980	1980		1981	1981
1990s	Mean	**0.2**	**1.6**	**0.7**	**1.6**	**2.5**	**1.2**	**1.3**	**2.2**	**5.4**
	Standard deviation	5.0	12.5	8.9	9.4	7.7	4.6	8.0	0.9	1.4
	Maximum	**9.4**	**22.1**	**15.0**	**17.1**	**13.1**	**9.0**	**14.3**	**3.8**	**8.2**
	Year of worst inflation	1994	1999	1990	1999	1990	1999		1990	1990
2000–06	Mean	**7.1**	**11.4**	**7.7**	**14.4**	**7.8**	**10.1**	**9.7**	**2.5**	**3.3**
	Standard deviation	6.8	10.6	9.5	15.8	6.6	9.0	9.7	0.5	2.0
	Maximum	**14.3**	**23.9**	**19.9**	**33.5**	**16.1**	**22.4**	**21.7**	**3.1**	**6.5**
	Year of worst inflation	2000	2005	2000	2000	2005	2006		2005	2000

Notes:
Inflation is the percentage change in GDP, implicit price deflators–US dollars. The values for GCC are the average performances of the six countries.

Sources: United Nations Statistical Databases – National Accounts Main Aggregates, Federal Reserve Bank of St. Louis and authors' calculations.

cent in the 1970s and 17 per cent in the 1980s to bring inflation down to an average of 4.8 per cent in the 1980s with a peak of 9.4 per cent occurring in 1981. The GCC countries, with their currencies pegged to the US dollar and oil output traded in US dollars in the international market, had seen a drop in average inflation to 2.3 per cent with a peak of 35.1. The worst inflation year for all the GCC countries was 1980. Further tightening of monetary policy in the US brought inflation down further in both the US and the GCC countries. We observe a resurgence of inflation during the 2000s in the GCC countries, which corresponds with a period of expansionary policy in the US to accommodate inverse supply and demand shocks, the war in Iraq, and post-11 September downturns. Though the rise in inflation might be due to the economic boom stemming from reinvestment of oil revenue in infrastructure and repatriation of Middle Eastern capital from the US and elsewhere, there seems to be a coincidence between monetary policy that has worked for the US and the resulting effects on the GCC countries that have pegged their currencies to the dollar. The data show that the GCC economies are converging towards the North American living standard. Whether or not the same social landscape is there is a totally different question, but income-wise each GCC country has seen improvement in its standard of living over time due to the multiplier effect of oil revenue investment. In sum, the data provide some insights about the relevance of monetary policy in the US to the GCC countries.

5. EMPIRICAL RESULTS

In this section the empirical results from the estimation of a just-identified trivariate SVAR for each GCC country with two lags, as suggested by the sequential modified LR test statistic at the 5 per cent significance level, are presented.[7] We consider a lower-triangular structure $Z_t = [i_t, y_t, \pi_t]'$, implying that the instrument of monetary policy of the United States, i_t, is the most exogenous variable and does not respond contemporaneously to either non-oil supply or demand shocks from GCC countries. The measure of real economic activity in terms of growth, y_t, can respond contemporaneously to both the Fed funds rate and the real economic activity, whereas the measure of inflation, π_t, responds to all variables contemporaneously. It bears reiterating that the Fed funds rate is the variable common to all the VARs estimated and the results are not sensitive to the use of the real Fed funds rate instead.

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[7] We use that same lag length throughout this paper because it is the lag length most often suggested by other information criteria across models, and also since we are endowed with annual data and want to avoid serious degrees of freedom problems, a lag length of two is the most sensible choice available.

For comparison purposes, we also estimated a trivariate SVAR with two lags as per the LR test for the US using a lower-triangular ordering of the variables common to the literature, say, $W_t = [y_t, \pi_t, i_t]'$, which implies that neither policy shock nor inflation shock from the US affects real economic activity contemporaneously, and policy shock does not produce contemporaneous effects on inflation. The last equation is referred to as a contemporaneous policy rule, which is standard in the literature. As indicated at the outset, our overriding purpose in this paper was to determine whether or not the GCC countries react similarly to monetary policy shocks from the US and whether the effects of US monetary policy at home can be compared to its effects abroad on the GCC countries to justify the use of the dollar as the anchor currency.

Since the impulse responses and standard errors are not valid if the reduced-form VAR is not stable, we tested the stability of the parameters using the autoregressive roots. All roots are contained in the unit circle, indicating that the VARs satisfy the stability condition.[8] We summarised the non-cumulative impulse responses of output growth and inflation to a one standard deviation US structural monetary policy shock in Figure 3 where the dotted lines are 95 per cent confidence bands (analytical) and the solid lines are point estimates as follows:[9]

(1) With respect to inflation, the responses to US monetary policy shock (except for Qatar) are characterised by a price puzzle: an increase in US interest rate by one percentage point produces first an increase in inflation – rather than a decrease – that lasts about one period and thereafter decreases below the baseline for each country. This result is consistent with the effects of US contractionary monetary policy on inflation at home (see the bottom right panel of Figure 3) and the price puzzle is a frequent anomaly in VAR estimation for the US as documented in the literature (Sims, 1992; Christiano et al., 1999; Leeper and Roush, 2003; Giordani, 2004; Hanson, 2004).

Accordingly, Sims (1992) argues that the central bank may have more information about future inflation than a simple VAR could adequately capture, and, as a result, the price puzzle occurs. A viable solution to this problem is to include borrowed and non-borrowed reserves along with a commodity price index in the VAR to capture enough additional information. Hanson (2004), however, shows that this strategy does not work for the pre-1979 period; the price puzzle still persists for 18 months despite the use of various consumer price indices. Barth and Ramey (2001) and Chowdhury et al. (2006), by

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[8] Due to space constraints, the estimation outputs such as the reduced-form VARs, the structural factorisation, variance decomposition, responses of both output and inflation to own and each other's shocks are not supplied but are available upon request. They are not incorporated as an appendix either because they would render the paper bulky.

[9] The values on the vertical axes of Figure 3 are all percentages. For example 0.10 should be read as 0.10 per cent.

FIGURE 3
Impulse Responses to a US Structural Monetary Policy Shock
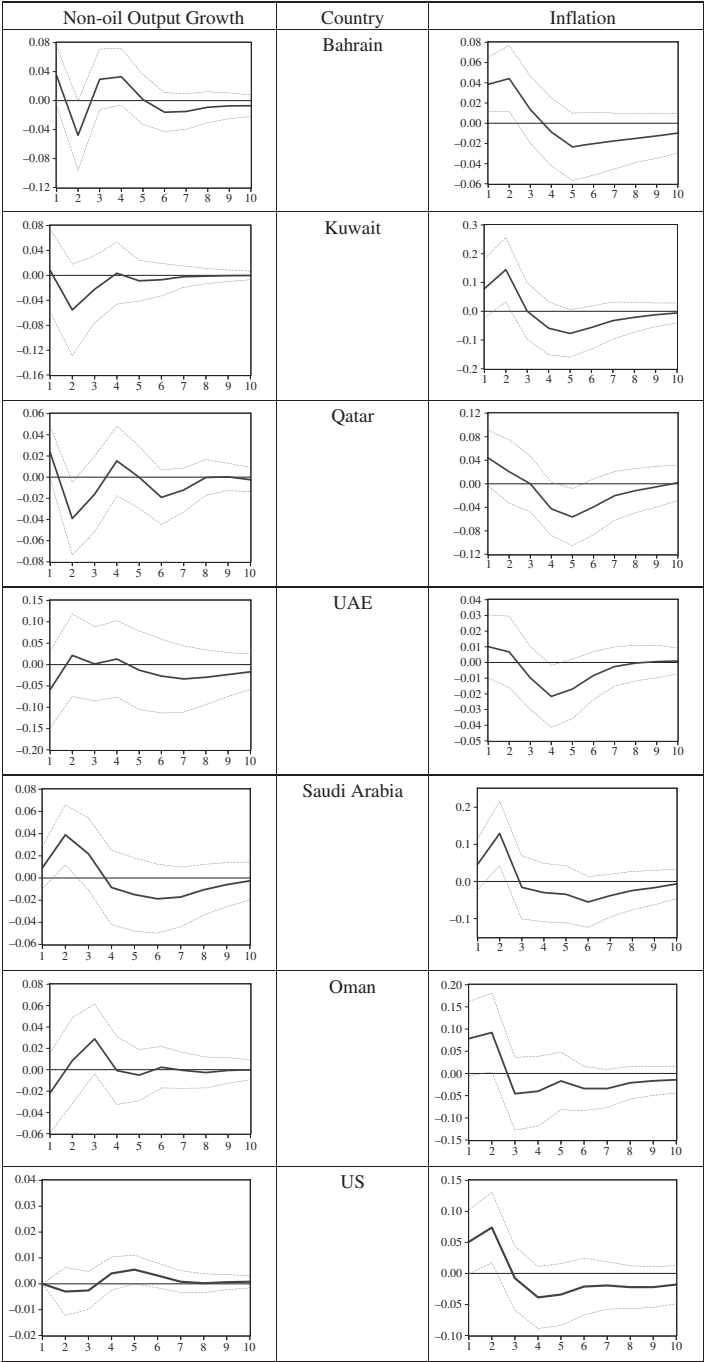
contrast, argue that the price puzzle is not a puzzle at all, but a reflection of the increase in the borrowing costs tributary to contractionary monetary policy. According to Giordani (2004), the price puzzle is the manifestation of model misspecification. He suggests the inclusion of a measure of potential output or output gap in the VAR to rectify the problem. A new attempt at explaining the prize puzzle is suggested by Bache and Leitemo (2008). In their view, an exogenous change in the short-term interest rate may occur either because of temporary monetary policy shocks or because the inflation target has changed as a result of changes in inflation expectations (the permanent component). Consequently, the monetary policy shocks extracted from a VAR are by-products of these two forces; a price puzzle will emerge if the shock to the inflation target dominates the transitory shock, which – in their view – is not a puzzle at all.

In this paper we are constrained in many ways since data on consumer price indices, borrowed and non-borrowed reserves are not readily available for the period covered by our study. We have experimented with the strategy proposed by Hanson (2004) to address the price puzzle, but this empirical exercise was unsuccessful. It is only when we combined Hanson's proposition with that of Bache and Leitemo (2008) that a credible explanation of the puzzle is achieved. Essentially, we decomposed the Fed funds rate into its permanent and transitory components and ran a VAR with each component along with output gap and a measure of inflation for each GCC country. We arrived at some quite interesting findings, and present the results in Figure 4. For each country, inflation in essence decreases due to transitory monetary policy shocks, but increases after a permanent monetary policy shock. Therefore, the price puzzle observed in Figure 3 is a reflection of the dominance of the shocks to inflation targets in the US transmitted to the GCC countries via the fixed exchange rate regime.[10] When we factored in region- and country-specific premium risks, contractionary monetary policy shocks in the US did give rise to higher borrowing costs in the GCC countries, and these costs were passed onto the consumers giving rise to higher inflation. Viewed through these lenses, the explanation by Barth and Ramey (2001) and Chowdhury et al. (2006) that the puzzle may not be a puzzle at all may be reasonable for the GCC countries.

Largely, the price puzzle that emerged from our estimation can be attributed to increases in borrowing costs as a result of contractionary monetary policy, or austerely the use of the GDP deflator instead of CPI, which is not available for the period considered. In this paper we provide evidence that monetary policy that works for the US might also work for the GCC countries as a group in terms of inflation, which is to be expected since these countries have had their individual currencies pegged to the US dollar for a long period of time.

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[10] Since we have provided an explanation of the puzzle, the rest of the analysis is based on Figure 3 wherever possible.

FIGURE 4

Responses of Output and Inflation to Permanent and Transitory Monetary Policy Shock
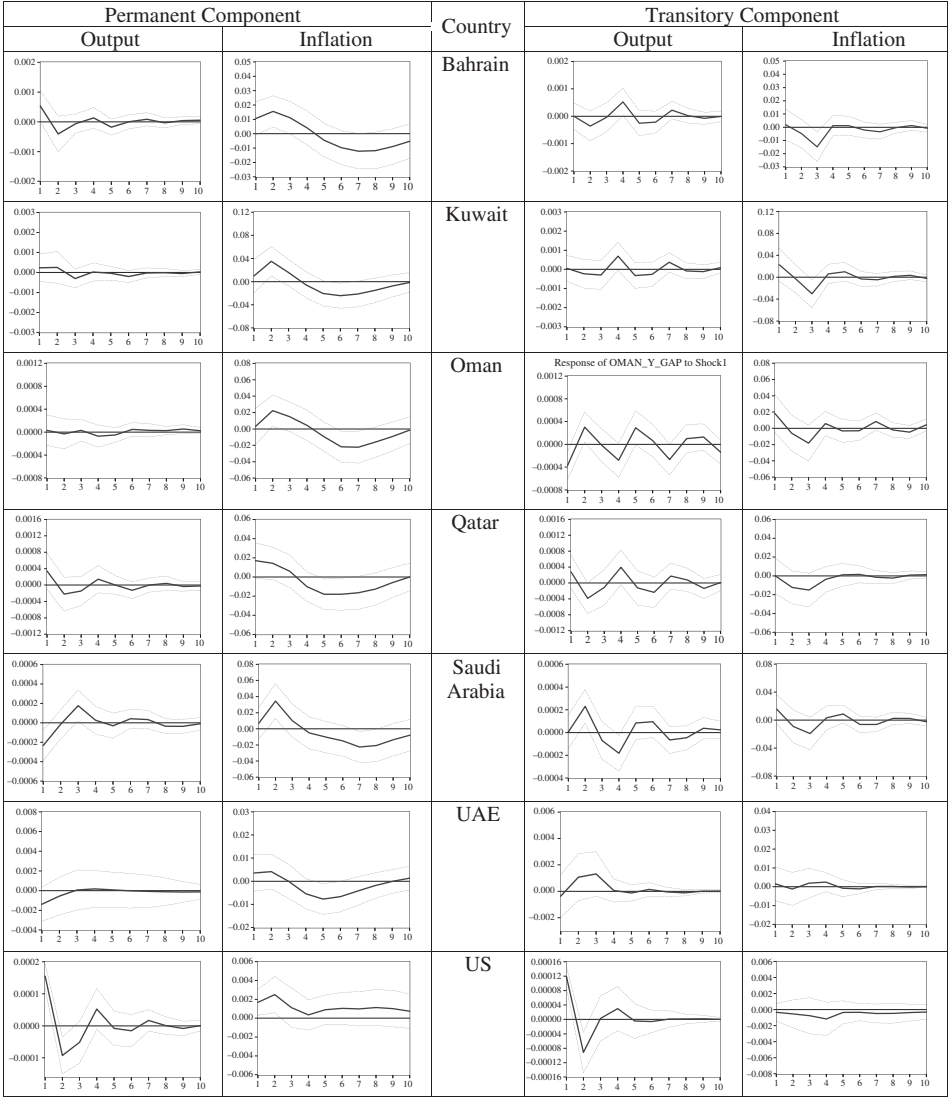
Correspondingly, Table 4 shows the cross-correlation of inflation and non-oil output growth of these countries and resolutely lends incontrovertible support to our earlier findings.

(2) With respect to non-oil output growth, we observed a dichotomy in terms of responses to US monetary policy shock: Bahrain, Kuwait and Qatar's non-oil output growth shows relatively similar patterns of responses to what

TABLE 4
Correlation of Output and Inflation Across GCC Countries

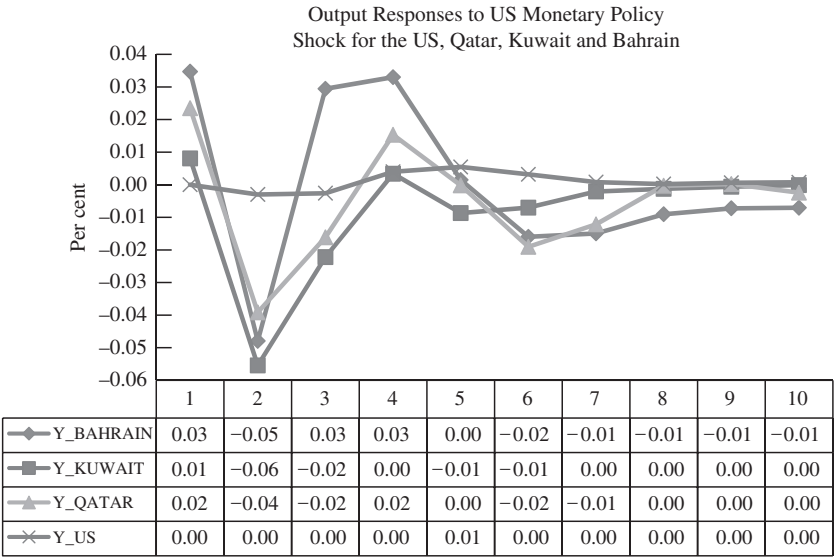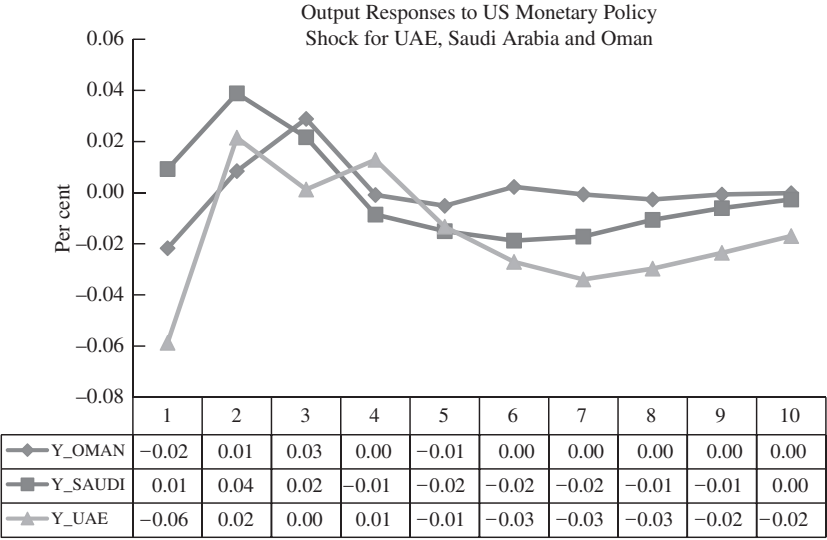|	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
Bahrain	**1**	0.61	0.61	0.71	0.60	0.37
Kuwait	0.10	**1**	0.96	0.51	0.97	0.10
Oman	−0.14	0.08	**1**	0.52	0.96	0.80
Qatar	0.50	0.02	−0.04	**1**	0.50	0.61
Saudi Arabia	−0.02	−0.02	0.10	0.14	**1**	0.08
UAE	−0.16	−0.06	0.23	−0.06	0.70	**1**
US	0.02	0.05	−0.20	0.03	−0.30	−0.21

Note:
The upper triangle above the diagonal captures the correlation of the response of inflation while the lower triangle captures the correlation of output.

would be anticipated for the US (a decline, as per the bottom left panel of Figure 5, which is derived from Figure 3) while the UAE, Oman and Saudi Arabia display an output puzzle: an increase instead of a decrease in non-oil output growth as a result of contractionary monetary policy. Whether monetary policy from the US is able to smooth non-oil output in the GCC countries in the same fashion at home depends on the combined responses of Bahrain, Kuwait and Qatar relative to the combined responses of the UAE, Oman and Saudi Arabia. We believe that this is a long stretch because Saudi Arabia is the largest economy of all GCC countries. Since the responses of the GCC members do not vary greatly, we made a last attempt to shed light on this issue by estimating a SVAR with the Fed funds rate, average non-oil output growth, and average inflation rate for the GCC countries. The impulse responses in Figure 6 show that it is the combined responses of Saudi Arabia, Oman and the UAE with the output puzzle that dominate the responses of other countries to a US monetary policy shock.

A possible explanation of the output puzzle is that positive supply shocks due to the reinvestment of oil revenue may in fact dominate the effects of the foreign monetary policy shocks on GCC's outputs at shorter horizons. This is evident from the changing structure away from oil and the major build-ups of infrastructure in the region. Sterne and Bayoumi (1993) obtained similar results for countries such as Ireland, Portugal, Greece and Spain over the period 1960–88 that have moved away from agriculture as the engine of their economies. Our paper therefore shows that monetary policy shocks from the US do not influence GCC non-oil output growth in a way similar to that in which they influence US output growth. The weak link that characterises the output data is also present in the cross-correlation shown in Table 4.

We present further evidence that consolidates the findings of Figures 3, 4 and 5 above, that the responses of inflation across the GCC countries to US

FIGURE 5
The Dichotomy of Output Responses

Output Responses to US Monetary Policy
Shock for UAE, Saudi Arabia and Oman

	1	2	3	4	5	6	7	8	9	10
Y_OMAN	−0.02	0.01	0.03	0.00	−0.01	0.00	0.00	0.00	0.00	0.00
Y_SAUDI	0.01	0.04	0.02	−0.01	−0.02	−0.02	−0.02	−0.01	−0.01	0.00
Y_UAE	−0.06	0.02	0.00	0.01	−0.01	−0.03	−0.03	−0.03	−0.02	−0.02

Output Responses to US Monetary Policy
Shock for the US, Qatar, Kuwait and Bahrain

	1	2	3	4	5	6	7	8	9	10
Y_BAHRAIN	0.03	−0.05	0.03	0.03	0.00	−0.02	−0.01	−0.01	−0.01	−0.01
Y_KUWAIT	0.01	−0.06	−0.02	0.00	−0.01	−0.01	0.00	0.00	0.00	0.00
Y_QATAR	0.02	−0.04	−0.02	0.02	0.00	−0.02	−0.01	0.00	0.00	0.00
Y_US	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00

monetary policy shocks are similar but that this is not the case for non-oil output. Figure 7 makes the comparison more explicable and reveals a note-worthy issue: although the inflation responses are more synchronised than the output responses to US monetary policy shocks, the magnitudes of the initial responses do differ and vary across countries. This led to further analysis of this issue and efforts were made to calculate the dispersion of the estimates of

FIGURE 6

Impulse Responses of Average GCC Countries to US Monetary Policy Shocks
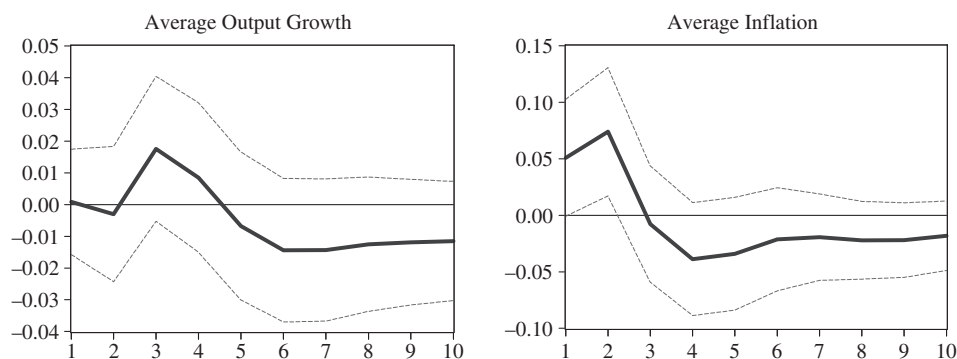
the responses depicted in Figure 3. The standard deviations of both inflation and non-oil output responses to US monetary policy shocks for each period and pair of GCC countries were computed and the results are presented in Panel 1 of Table 5. These results indicate that the inflation responses are relatively more dispersed than the output responses, though the responses of non-oil output growth vary considerably and are dissimilar to US own output. This finding suggests that inflation is more sensitive to US monetary policy than non-oil output is, and also that the underlying determinants of inflation are likely to be dissimilar across the GCC member countries thereby causing the dispersion observed.

We also computed the correlation of the impulse responses of inflation and non-oil output growth to a one standard deviation US monetary policy innovation for each pair of GCC countries and inserted the results in the lower panel of Table 5. Table 5 confirms that the synchronisation, or lack thereof, of the responses to US monetary policy shocks observed is not pure coincidence. All pairs of countries display positive and statistically significant correlation of inflation responses (the upper triangle) whilst the correlation of non-oil output responses is mostly negative and weak (the lower triangle). The dissimilarity in output responses can be explained partly by the relative degree of development of the member countries and the speed at which oil revenues are reinvested in the other sectors of their economies. Infrastructure in the UAE (the Emirates of Dubai and Abu Dhabi, especially) is quite advanced with respect to Oman, for example.

Lastly, we recovered the structural shocks from the estimated reduced-form disturbances and then examined how the actual supply and demand shocks of each country were correlated with the US monetary policy shock (see Table 5). We found that the correlation of US monetary policy shock with demand shocks was positive for all countries except the UAE, whereas the correlation

FIGURE 7
Comparison of Inflation and Output Responses

Inflation Responses to US Monetary Policy Shock

	1	2	3	4	5	6	7	8	9	10
INF_BAHRAIN	0.04	0.04	0.01	–0.01	–0.02	–0.02	–0.02	–0.01	–0.01	–0.01
INF_KUWAIT	0.08	0.14	0.00	–0.06	–0.08	–0.06	–0.03	–0.02	–0.01	–0.01
INF_OMAN	0.08	0.09	–0.05	–0.04	–0.02	–0.03	–0.03	–0.02	–0.02	–0.01
INF_QATAR	0.04	0.02	0.00	–0.04	–0.06	–0.04	–0.02	–0.01	–0.01	–0.01
INF_SAUDI	0.05	0.13	–0.02	–0.03	–0.03	–0.06	–0.04	–0.02	–0.02	–0.01
INF_UAE	0.01	0.01	–0.01	–0.02	–0.02	–0.01	0.00	0.00	0.00	0.00
INF_US	0.00	0.00	0.00	–0.01	–0.01	–0.01	0.00	0.00	0.00	0.00

Output Responses to US Monetary Policy Shock

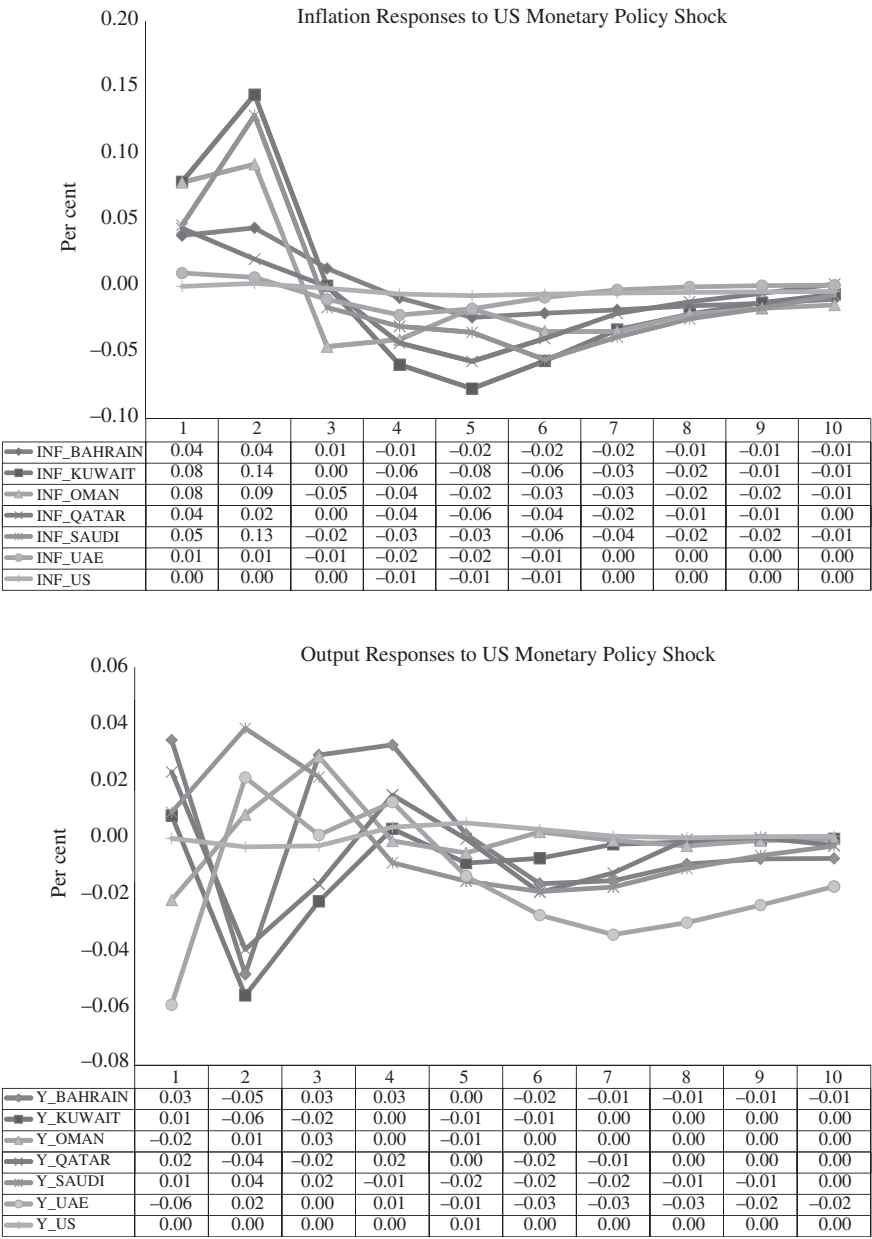|	1	2	3	4	5	6	7	8	9	10
Y_BAHRAIN	0.03	–0.05	0.03	0.03	0.00	–0.02	–0.01	–0.01	–0.01	–0.01
Y_KUWAIT	0.01	–0.06	–0.02	0.00	–0.01	–0.01	0.00	0.00	0.00	0.00
Y_OMAN	–0.02	0.01	0.03	0.00	–0.01	0.00	0.00	0.00	0.00	0.00
Y_QATAR	0.02	–0.04	–0.02	0.02	0.00	–0.02	–0.01	0.00	0.00	0.00
Y_SAUDI	0.01	0.04	0.02	–0.01	–0.02	–0.02	–0.02	–0.01	–0.01	0.00
Y_UAE	–0.06	0.02	0.00	0.01	–0.01	–0.03	–0.03	–0.03	–0.02	–0.02
Y_US	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00

TABLE 5
Dispersion and Correlation of GCC Output and Inflation Responses with US Policy Shock and Correlation of US Policy Shock with Actual Demand and Supply Shocks

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
Panel 1: Median Dispersion of Output and Inflation Responses to US Monetary Policy Shock						
Bahrain	*	0.02	0.08	0.03	0.02	0.02
Kuwait	0.01	*	0.04	0.01	0.00	0.01
Oman	0.01	0.00	*	0.04	0.04	0.05
Qatar	0.02	0.00	0.00	*	0.01	0.01
Saudi Arabia	0.01	0.00	0.00	0.00	*	0.01
UAE	0.02	0.01	0.01	0.00	0.01	*
Panel 2: Correlation of the Responses of Output and Inflation with US Policy Shock						
Bahrain	**1.00**	0.93	0.84	0.77	0.90	0.82
Kuwait	0.53	**1.00**	0.90	0.83	0.96	0.90
Oman	−0.11	−0.55	**1.00**	0.70	0.91	0.80
Qatar	0.74	0.86	−0.65	**1.00**	0.71	0.95
Saudi Arabia	−0.11	−0.68	0.40	−0.39	**1.00**	0.82
UAE	0.34	0.00	−0.20	0.29	0.68	**1.00**
Panel 3: Correlation with Actual US Policy Shock						
Demand shocks	0.40	0.16	0.31	0.16	0.26	−0.06
Supply shocks	0.08	0.06	−0.008	0.29	−0.28	0.17

Notes:
The upper triangle above the diagonal captures the dispersion/correlation of the response of inflation while the lower triangle captures the dispersion/correlation of output response to US monetary policy shock. The mean dispersion is subject to outliers and the maximum dispersion is an outlier and are therefore not presented here. Nonetheless, whether we compare the mean, the median, or the maximum dispersion of inflation responses with those of the output responses on a pairwise basis, the finding is the same: the latter is less dispersed than the former.

with supply shocks was very weak and even negative in some cases (Oman and Saudi Arabia). This result is to be expected since monetary policy shocks are demand shocks by nature. By and large, it confirms that the GCC countries have been importing monetary policy from the US as a result of their long history of having their currency pegged to the US dollar.

Overall, our findings lend support to a synchronisation of GCC countries' inflation – but not non-oil output growth – to US monetary policy shocks, which partially validates the use of the US dollar as the anchor currency for the new GCC currency. Put differently, these results suggest that adjustment costs may be an issue. It is also noted that a continued depreciation of the US dollar might complicate the situation in the long term by putting the non-oil export sector of the group in a competitive position while the oil sector might suffer. Ultimately, it is the relative magnitude of these two effects that will matter for the union, and this depends entirely on how quickly the non-oil sector grows as a share of total output. If the situation calls for major concerns

TABLE 6

Relative Importances of US and European Monetary Policy Shocks for Output Growth and Inflation in GCC Countries

Period	SE	US Policy Shock	European Policy Shock	Supply Shock	Demand Shock
Variance Decomposition of Output Growth					
1	0.02	1.05	14.62	84.33	0.00
2	0.02	2.22	34.92	56.63	6.23
3	0.02	1.96	38.28	44.29	15.48
4	0.02	1.97	37.88	43.79	16.36
5	0.02	2.94	37.17	43.60	16.30
6	0.02	7.42	35.43	41.61	15.54
7	0.03	13.16	33.24	39.03	14.57
8	0.03	17.68	31.47	37.06	13.79
9	0.03	20.54	30.55	35.66	13.25
10	0.03	22.39	30.30	34.43	12.88
Variance Decomposition of Inflation					
1	0.05	20.93	31.36	0.00	47.71
2	0.05	29.72	28.60	0.28	41.39
3	0.06	27.77	27.04	6.21	38.99
4	0.06	30.48	26.34	6.16	37.02
5	0.06	34.66	25.65	5.65	34.03
6	0.06	37.38	24.79	5.67	32.16
7	0.06	38.73	24.19	5.68	31.40
8	0.06	39.39	24.29	5.61	30.72
9	0.06	39.93	24.62	5.46	30.00
10	0.07	40.70	24.67	5.31	29.32

in the future, and perhaps even now, linking the new currency to a basket of currencies might be the best alternative. This is what the variance decomposition analysis of our augmented quadvariate SVAR suggests when we use the average of the short-term interest rates of France and Italy as a proxy for the European short-term interest rate. The results are presented in Table 6.[11]

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[11] We estimated an augmented lower triangular SVAR with two lags of the form $Z_t = [i_t^{US}, i_t^{Euro}, y_t, \pi_t]'$ allowing both non-oil output and inflation to be influenced by both the Fed funds rate and the European short-term interest rate. We followed the same identification scheme of small and large countries in identifying the model and also accounted for the fact that the US economy is the largest, followed by the European Union (EU) in ordering the variables. It is customary in the literature to use all three major European Union economies in computing proxies for the EU over a long period of time (see Horvath and Rátfai, 2004). However, we could not use the short-term interest rate for Germany in the computation of the proxy for the European interest rate because it contains a number of missing data points. We attempted to remedy this problem by switching to the money market rates for France, Germany and Italy provided by the International Financial Statistics but our efforts were in vain since the model fails to improve after one iteration. Therefore, our findings presented in Table 8 are based on the proxy computed as the average of the short-term interest rates for France and Italy taken from OECD Outlook No. 81. The dataset is available upon request.

Table 6 shows that the portion of the variability in the GCC non-oil output that could be explained by the European short-term rate proxy is far greater than that of the US at all horizons. However, when we turn to the dynamics of inflation, the European effect is stronger for the first period only. Although US monetary policy shocks show a clear dominance, the proportion of variance in GCC inflation that can be explained by European monetary policy shocks averages around 25 per cent which, in our view, is non-negligible. This result undeniably confirms our findings and further substantiates our recommendation that a basket peg with both the US dollar and the euro might be a sensible alternative anchor for the GCC currency.

6. CONCLUSION

On the issue of pegging the new currency of the GCC economic bloc to the US dollar, in this paper we have studied the effects of monetary policy shocks on the GCC member countries' non-oil output and inflation to determine whether or not there is synchronisation and also whether or not what is observed in terms of responses is similar to the US's own output and inflation to validate the choice of the US dollar as the anchor currency. The paper is built upon the basic Mundell–Fleming model of open economy with a fixed exchange rate regime and the SVAR methodology was used to obtain the impulse responses.

The SVAR models are identified with short-run restrictions only, in line with Sims (1986): (1) the instrument of monetary policy of the US is not contemporaneously affected by the non-oil supply and inflation shocks of the GCC countries – the large–small country hypothesis; and (2) non-oil output growth reacts with lag to inflation shock. The overall results show that the responses of inflation to monetary policy shocks from the United States are similar both across GCC countries and to the responses of the US's own inflation. The same does not necessarily hold true for non-oil output growth. Therefore, we argue that choosing the dollar as the anchor currency may involve some adjustment costs or losses – though oil output, which represents approximately 46 per cent of GCC total output, is already traded in the international market in US dollars. Our finding that the non-oil sector does not respond in the same way to monetary policy shocks coming from the US and their overall responses are not similar to the effects of US monetary policy on own output is in itself a puzzle for decision makers and an issue that requires further research. Our result here lends partial support to the US dollar as the anchor currency if GCC countries believe that the primary purpose of a dollar peg is to guarantee stable inflation. However, we caution that if the US currency continues to depreciate against major currencies and loses its importance as a store of value, pegging the new currency to a basket of euro and the US dollar might be the optimal choice,

when considering the responses of non-oil output growth – although it is the relative importance of the non-oil sector that matters for the GCC countries in case of continuous depreciation of the dollar.

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