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On the choice of an anchor for the GCC currency: does the symmetry of shocks extend to both the oil and the non-oil sectors?

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Abstract This paper assesses the costs of forming a monetary union among the Gulf Cooperation Council (GCC) countries by looking at economic linkages within the GCC, and between the GCC and the potential anchors (the US, and major European countries such as France, Germany and Italy) for their proposed new currency. We investigate the importance of the US dollar compared to the Euro by focusing on aggregate demand (AD) and aggregate supply (AS) shock symmetry across these countries. We differentiated between oil and non-oil sector by estimating structural vector autoregression (SVAR) models with a combination of variables: oil output, non-oil output, total output, nominal/real price of oil and overall price level. One set of models was identified with the long-run restrictions of Blanchard and Quah (Am Econ Rev 79(4):655–673, 1989), whereas the set that assesses the robustness of the findings was estimated with the short-run restrictions of Sims (Eur Econ Rev 36(5):975–1000, 1992). We find overwhelming support for AD shock symmetry across the GCC countries and between the GCC and the US, but none for the major European countries with the GCC. Non-oil AS shocks are mostly asymmetric, but oil AS shocks are mostly

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symmetric when the real price of oil is included. This agrees with the view that GCC countries are subjected to common oil shocks. It also suggests that previous VAR models estimated to pass judgment on the feasibility of monetary union across GCC countries may have suffered from problems of mis-specification if the real price of oil was not considered. We surmise that the US dollar is a better anchor candidate for anchoring the new GCC currency than the Euro, since US monetary policy can at least help smooth demand shocks in these countries.

Keywords Currency anchor · GCC · Monetary union · Shock symmetry

JEL Classification E32 · F33 · F36

1 Introduction

The materialization of the European monetary union (EU) has given impetus to many countries or regional blocs to pursue further economic integration to emulate the successes of the European countries. A seamless example is that of the GCC countries,[1] which, starting in the early 1980s embarked on a path towards monetary union, despite the tumultuous surrounding political environment of the Middle East and North Africa region. This decision was justified on a number of grounds. With the exception of Bahrain, these countries are mainly endowed with oil and gas, which constitutes a large portion of their exports, and they are all tied by cultural affinities—the same religion, the same language and a common history (see Balli et al. (2009) and Khan (2009) for a discussion). These attributes place the GCC in an even better position to pursue further economic integration than the initiators of the EU. Progress in terms of trade openness, factor mobility and labor market adjustments has been made towards a common currency at a faster pace than most unions. According to Khan (2009) and Berengaut and Elborgh-Woytek (2006), the GCC has already met the criteria for a single currency among its members when factors such as proximity, size, output fluctuation, trade structure, inflation performance, and ongoing harmonization and regulation of the banking system are taken into consideration. However, although these generally accepted prerequisite conditions have been met, issues surrounding the choice of an appropriate anchor for the proposed new currency still remain unresolved. This is despite (a) the long history of their national currencies being pegged to the US dollar, though Kuwait and Oman have been officially, but not in reality, in and out of the dollar shelter; and (b) the US dollar being the accepted currency for settling oil transactions in the international market, and oil represents a large share of each country's total exports, save for Bahrain.

The process of diversification that has taken place in the GCC to make them less reliant on oil has given rise to a growing non-oil sector, financed mostly with export revenues from the oil sector. An interdependent linkage has emerged between the two sectors, since the oil sector revenues fuel the non-oil sector, and increasing demand for energy from the non-oil sector added to foreign demand also puts pressure on the price

[1] The GCC bloc is composed of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE).

of oil to rise, thereby inducing a surge in oil supplies. This holds even though the Organization of Petroleum Exporting Countries (OPEC), to which the GCC pertains, has the power to and often does inhibit overall supplies to maximize revenues. This dichotomization of the GCC economy that has taken place over time posits quite an interesting dynamic when it comes to analyzing the commonality (or lack thereof) of the GCC's responses to macroeconomic shocks in their quest for monetary union. In assessing the potential cost of forming a GCC monetary union purely on the basis of macroeconomic shocks, *ceteris paribus*, should one solely focus on overall demand and supply shocks? Or on overall demand, oil-supply shock, and non-oil supply shock? Or just on overall demand and non-oil supply shocks, since it is a common belief that oil shocks have similar effects on the member countries due to the nature of their economies? In this paper, we tackle these questions at length by first considering the common belief, then by performing robustness tests based on the other alternatives while factoring in the effect of the nominal and the real oil prices.

In a few words, we provide answers to two key empirical questions. To what extent does the non-oil sector of the GCC countries satisfy the prerequisite of common shocks for monetary union?[2] More precisely, does the degree of shock symmetry or asymmetry between these countries and the United States (US) and the three major countries of the EU (namely France, Germany and Italy) warrant the choice of the US dollar, the Euro or a combination of the two as the anchor for the newly proposed single currency? Essentially, we are keen to explore whether the growing importance of the non-oil sector for these economies is likely to impose substantial adjustment costs if their responses to these shocks are not synchronized, and if the benefits of joining the union such as lower transaction costs, reduction in exchange rate risk, equalization of interest rates, decline in relative price variability and increase in production efficiency do not outweigh those costs (Frankel and Rose 1998; Bayoumi and Eichengreen 1994, 1997)

Of course, the motivation of this paper primarily stems from the imminent signing of a monetary union by the GCC countries and the issuing of a single currency, which was initially slated to be pegged to the US dollar. Unfortunately, rising government debts in the US, along with the recent decline in the value of the dollar relative to the Euro and other major currencies such as the Chinese Renminbi, have sparked a debate on the choice and suitability of the Dollar as a solid anchor for the GCC's proposed new currency. In summary, we are very interested in determining how suitable an alternative the Euro or a basket of currencies could be for these countries.

A vast amount of literature on the choice of exchange rate regimes and on the dollarization of economies has developed following the seminal paper of Mundell (1961) on optimum currency areas (OCAs) along with subsequent works by McKinnon (1963), Kenen (1969), and Tower and Willett (1976), to cite just a few. Much of this literature focuses on the importance of relative economic sizes, labor mobility, the degree of openness, trade concentration, similarity of shocks and cycles, and, finally, the system of risk-sharing for assessing the suitability of fixed, flexible exchange rate regimes and prospective monetary unions (see surveys by

[2] It is worth noting that the government of Oman has officially pulled out of the monetary union initiative in 2007 due to their inability to meet inflation targets, and the UAE has recently followed suit because of disagreements on the location of the new Central Bank of the Union.

Tavlas (1992) and Bayoumi and Eichengreen (1997)). Out of all these criteria, the degree of symmetry between shocks across countries is considered to be the basic prerequisite and therefore has received much attention empirically. According to this line of research, one needs only to determine whether the aggregate demand (AD) and aggregate supply (AS) shocks are correlated across interested member countries to draw conclusions on the aptness of monetary union. However, Frankel and Rose (1998) have shown that a similarity of response to shocks or similar business cycles provides a misleading picture of a country's suitability for entry into a currency union, because the OCA criteria, namely international trade patterns and international business cycle correlations, are endogenous. In their view, the endogeneity arises as a result of specialization. As tariff and nontariff barriers are removed, international trade is fomented and countries reallocate their resources towards industries in which they have comparative advantage, thereby exposing themselves to more asymmetric shocks. According to Frankel and Rose, it is quite possible that countries that enter a monetary union because of the similarity in business cycles, *ceteris paribus*, may likely to find that they experience different business cycles once in the union than before. In their view, closer international trade may also result in tighter correlations of national business cycles if demand shocks prevail or if intra-industry trade, as a share of total trade, is substantially greater than other trade shares. It is worth noting that Frankel and Rose believe that the latter case is the more realistic one.

Without denying the importance of the contribution of Frankel and Rose and the multitude of papers that tests their hypothesis (Frankel 1999; Eichengreen 2000; Kenen 2000; Hughes-Hallett and Piscitelli, 2001; Kose and Yi 2001, to cite just a few), our main focus in this paper is not to investigate the endogeneity of the OCA criteria for the GCC countries but to rater explore the traditional view of Mundell (1961) that the more highly correlated the business cycles of countries, the more suitable they are for monetary union endeavor, *ceteris paribus*. Without further debating the aptness of a fixed or floating exchange rate, this strand of the literature clearly establishes that it is the symmetry of shocks that dictates the appropriate anchor of choice for these countries In this vein, the approach taken in this paper is comprehensive in that not only do we test for symmetry between the GCC member countries, but we also investigate whether shocks are synchronized between the GCC countries and their strategic and/or trading partners in assessing the suitability of either the US dollar or the Euro as the principal anchor for the newly proposed GCC currency.

We alter Bayoumi and Eichengreen (1994) approach by concentrating on the growth rates of oil and non-oil output/total output and prices while modeling both the nominal and the real oil prices. We have three reasons for taking this route: (1) the oil sector contributes about 46% on average of total output; (2) the price of oil is quoted and traded in US dollars in the international market; and (3) the uneven pace and magnitude of economic diversification across GCC countries along with labor market conditions.[3] All these support the common belief that the GCC countries are already subjected to shocks symmetry in the oil sector.

[3] It is important to note that labor mobility may not fulfill the role of a shock absorber for the GCC countries as it does for other countries because only nationals of the economic bloc are granted such freedom. Except for Saudi Arabia, the numbers of nationals in the GCC countries are, on average, smaller than the number of foreign workers who potentially suffer from unemployment.

Given that the GCC countries have initially expressed their will to peg the new currency to the US dollar, and recognizing that US monetary policy already influences the price of oil in the international market through the linkages between monetary and foreign exchange markets, it makes sense to investigate whether shocks affecting the GCC non-oil sector are similar in nature to shocks affecting the US. After all, it is monetary policy from the US that will have the major impact on non-oil output and prices in the GCC countries as an economic bloc, since the US has the largest economy in the world. We also recognize that our analysis would be incomplete if we did not incorporate the growing importance of the EU into the picture. To that end, we also investigated whether the GCC countries and the core European countries are subjected to similar macroeconomic shocks in order to justify the suitability of the Euro as an alternative anchor.

Holding constant factors such as political and cultural affinities and benefits from joining the monetary union, we formulate the following hypothesis: if both demand and supply shocks are symmetric between the GCC countries and the US (core European countries), then the US Dollar (Euro) is qualified to be the suitable anchor. However, if, supply (demand) shocks are symmetric between the GCC countries and the US but demand (supply) shocks are symmetric between the GCC countries and the core European countries, then it may make sense for a basket with these two major currencies to be the appropriate anchor. The choice of an anchor here is only guided by the underlying principle that the costs of forming a currency union tend to be relatively small when shocks are synchronized across countries. In this vein, it is preferable for a country to adopt the currency of another country with which they share at least one common shock as opposed to none.

The methodology followed in this study draws from the works of Bayoumi and Eichengreen (1994), and Horvath and Rátfai (2004), who used bivariate structural vector autoregression (SVAR) of output growth and inflation identified with the long-run restrictions of Blanchard and Quah (1989). Analogously, these variables were computed using data on non-oil output, real gross domestic product (GDP) and GDP deflators for the period 1970–2008 from the United Nations Statistical Databases—National Accounts Main Aggregates. The SVARs used in the first part of this study include only non-oil GDP growth and inflation for the GCC countries, but for that of the prospective anchor countries, only data on real GDP were used. This estimated model can be regarded as the base model. Although non-oil GDP can be seen as a proxy for industrial production, there is no great loss of information from computing the correlation between shocks originating from SVARs with non-oil output growth and those emerging from real GDP growth. In this regard, the SVAR uses the long-run restriction that only non-oil supply (supply) shocks can have permanent effects on non-oil output (output) to identify our model.

We performed estimations on a battery of SVAR specifications to test the robustness of the findings emerged from the base model: (a) we used short-run identification schemes, (b) we incorporated both oil output and non-oil output, and (c) we endogeneized the nominal/real oil prices along with non-oil output/total value added. Our results show, at the 5% significance level, that: (a) although demand as well as supply shocks are symmetric for core European countries, these shocks are mostly asymmetric with shocks affecting GCC countries; (b) GCC non-oil supply shocks are asymmetric with US supply shocks; (c) with the exception of the UAE,

demand shocks are mostly symmetric between GCC countries and the US; and (d) on average, non-oil supply shocks as well as demand shocks are symmetric across GCC countries, with the latter showing a tighter link. Moreover, when the real price of oil enters the SVARs, we find AD shocks to be symmetric, non-oil AS shocks to be mostly asymmetric, and oil AS shocks to be symmetric for all pairs of countries, but not for those involving Saudi Arabia. These results clearly suggest that there are major adjustment costs involved for the GCC countries if they choose to anchor their new currency with the Euro. We concur with Khan (2009) that, despite the continuous decline vis-à-vis other currencies, the US dollar remains a better option for the GCC, since monetary policy from the US can at least smooth demand shocks for the GCC.

The rest of the paper is structured as follows: Section 2 reviews the literature and Section 3 discusses the theoretical foundations and the SVAR methodology followed by analyzing the data in details in Section 4. Section 5 discusses the empirical results, while Section 6 deals with the conclusion of the paper.

2 Background

Although the literature on the feasibility of monetary unions is in general quite developed, only a few studies have specifically paid attention to monetary union issues among GCC countries. These studies typically emulate those of the EU and emphasis is often put on the convergence criteria[4] as researchers weigh the costs against the benefits of these countries joining in a monetary union (Khan 2009; Sturm and Siegfried 2005; Pattanaik 2007; Dar and Presley 2001; Jadresic 2002; Iqbal and Fasano 2003; Fasano and Schaechter 2003; Fasano and Iqbal 2002, 2003; Hebous 2006; Laabas and Limam 2002; Oman Economic Review 2002; Ibrahim 2004; Abed et al. 2003). Sturm and Siegfried's (2005) study is one of the most comprehensive works on the GCC countries. Their objective was to examine the similarity of economic structures across GCC countries. Their results show that these economies are indeed endowed with similar structures, and oil and gas represent a large share of their output. However, a considerable limitation of their study is that they fail to examine how the GCC reacts to macroeconomic shocks in their assessment of the viability of a monetary union between member countries. Similarly, Abu-Bader and Abu-Qarn (2006) have done a thorough empirical analysis on the GCC economies to investigate the feasibility of a monetary union among these countries. They used bivariate SVARs of total output and prices (in natural log differences) identified with long-run restrictions to extract AD and AS shocks for the GCC countries. In their analysis, they used correlation, co-integration and common business cycle tests to determine the long-run movements in real output and the existence (or lack thereof) of common short-run cycles. Altogether, their analysis indicates that the transitory demand shocks are symmetric but the permanent supply shocks are asymmetric. Consequently, it is worth accentuating that their study

[4] Namely, these studies compare inflation, real GDP growth, fiscal imbalances, tariff structures, current account balances, debt to GDP ratio, non-oil fiscal deficits, volume of intra-regional trade and movement in real effective exchange rate across countries.

did not find synchronous long-run and short-run movements in real output for these countries.

Analogous to the other studies that focus on monetary integration issues among GCC countries, Abu-Bader and Abu-Qarn's paper has two fundamental limitations in addition to Buiter's (2007) reservations on their use of long-run restrictions to identify the SVARs. The first is the use of aggregate instead of disaggregate data. The use of the aggregate data makes it problematic to disentangle symmetry from asymmetry of supply shocks when there is irrefutable evidence that the structure of the GCC economies is dichotomous in nature in that oil and non-oil output each account for approximately 50% of total output. An inverse (positive) supply shock from the oil sector may accompany a positive (inverse) supply shock from the non-oil sector. In such cases, it is the relative size of these shocks that can ascertain the general disturbance to the economy of each member country. Even though common beliefs point to these countries being subject to similar oil-related supply shocks, yet there is no empirical evidence in the literature indicating that is the case for the non-oil sectors. For instance, Bayoumi and Eichengreen (1994, p.10) noted that for countries where output is dominated by the oil sector (or other raw materials), a rise in the price of oil tends to increase total output (due to the boost in oil production) and finally AD (through the impact of oil revenues on real incomes). They therefore argued that it may be quite problematic for oil-producing countries to distinguish between AD and AS shocks caused by a change in oil prices.

The second limitation to Abu-Bader and Abu-Qarn's paper is that their empirical analysis does not explore the issue of currency anchor for the GCC countries, which is essential in the formation of the regional monetary integration. In the specific case of the GCC countries, it begs the question: is it indubitably an issue whether supply shocks are asymmetric if there are no other underlying objectives beyond the formation of a monetary union? Certainly, all the countries in the region except one have their currencies pegged to the US dollar already and whether external factors give rise to more serious supply shocks or not, the tools these countries currently possess to neutralize the effects of those shocks would be the same after forming the monetary union since they have decided from the outset to peg their unified currency to the US dollar. A more sensible approach, in our view, is to determine empirically whether the choice of the US dollar as the continued anchor is more apposite than the option of adopting the Euro, a market basket or a free float. Along this line, Khan (2009) only provides a situational analysis to back up his recommendation for the US dollar, whereas Jean Louis et al. (2010) focused mainly on the correlation of impulse responses to monetary policy shocks between the GCC and the US to assert that the US dollar was a suitable anchor for the GCC currency.

This paper complements existing research in the literature and extends the study of Abu-Bader and Abu-Qarn's in two ways. First, instead of using solely aggregate data, we disaggregate output into oil and non-oil. However, only the non-oil output is used in the base SVAR model for all the countries, which allows us to capture the demand shocks that are likely to determine the impact of oil shocks on real incomes. We believe this approach is relatively new to the literature. We also estimate bivariate and trivariate models with both oil and non-oil output, total value added, and nominal and real oil prices. These models are identified with short-run restrictions to address the issue raised by Buiter (2007). Furthermore, along the

lines of Horvath and Rátfai (2004), we used France, Germany and Italy as core European countries to assess whether supply and demand shocks from these countries are synchronized with those of the GCC countries, which could ultimately justify the feasibility of the Euro as an alternative anchor currency.

3 Theory and methodology

The underlying theoretical framework of this paper is the aggregate demand (AD) and aggregate supply (AS) model.[5] The short-run AS (SRAS) curve slopes upward, allowing for changes in AD to influence output. The long-run AS (LRAS) curve is vertical, denoting potential output and preventing AD shocks from having long-term real effects on the economy.[6] The AD curve slopes downward. In a price-output space, full employment equilibrium is achieved when all three curves intersect at once. A positive supply shock shifts both AS and LRAS to the right, permanently giving rise to an increase in output and a decrease in price. A positive demand shock, though permanent, can only affect output temporarily due to its impacts first on prices, then on real wages and other price-sensitive determinants of AS. More precisely, this implies that output and prices move in the same direction when demand shocks hit the economy, and in opposite directions when subjected to supply shocks. However, actual data for GCC countries may not display these impulse response patterns, since these economies' output is largely dominated by oil production, the point made by Bayoumi and Eichengreen (1994). In other words, for countries with oil as a large share of their output, an increase in oil prices also has real potential to insulate aggregate demand as oil revenues find their ways in other sectors and thereby increase real incomes.

For the base model, we use a bivariate SVAR model with the right-hand side variables being log differences of non-oil output ×100 (Δy_t) and log differences of prices ×100 (Δp_t). Each of these variables is driven by both a non-oil supply shock (e_{st}) and a demand shock (e_{dt}). Using the lag operator L, the infinite moving average representation of the structural model can be represented as:

$$\begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} \alpha_{11,i} & \alpha_{12,i} \\ \alpha_{21,i} & \alpha_{22,i} \end{bmatrix} \begin{bmatrix} e_{st} \\ e_{dt} \end{bmatrix} \tag{1}$$

The model is identified with the long-run restriction *of* Blanchard and Quah (1989). We therefore assume that only non-oil supply shocks can have long-run effects on non-oil output. This implies that the cumulative effects of demand shocks on the growth rate of non-oil output (Δy_t) are zero, i.e.:

$$\sum_{i=0}^{\infty} \alpha_{12,i} = 0 \tag{2}$$

[5] The diagram is not reproduced, here as in Bayoumi and Eichengreen (1994), and Abu-Bader and Abu-Qarn (2006), because of space restrictions.

[6] However, once we allow AD shocks to have a permanent effect on the economy, the LRAS curve is no longer vertical but upward sloping with slope steeper than the SRAS curve.

Since the SVAR methodology is standard in the literature, we do not provide further details regarding the procedures of extracting the unobserved structural shocks.[7] Controversy also surrounds the interpretation of shocks with a permanent impact on output as supply disturbances, and shocks with temporary effects on output as demand innovations, as found in Buiter (2007). We address this issue by identifying alternative SVARs with short-run restrictions to test the robustness of our findings. More explicitly, we estimate the following models $[\Delta x_t, \Delta y_t, \Delta p_t]'$, where x_t is the natural log of either oil output, nominal oil price or real oil price, and y_t is the natural log of either non-oil output or total value added when x_t is either the nominal or real oil price. We also estimated a bivariate model with the natural log difference of total output and prices. In total, we estimated 60 SVAR models above and beyond the original 10 of the reference model. We assumed that oil output and oil prices (nominal or real) are the most exogenous of all the variables incorporated in the SVARs, which implies that only shocks to the oil sector can have contemporaneous effects on these two variables. Also, due to the inability of the non-oil sector or the overall economy to respond instantaneously to either positive or negative disturbances from the demand side, we did not allow AD shocks to influence non-oil output or total value added at impact. This assumption may lend itself to criticism since we have access to annual data, but there is always a price to pay when one simply wants to identify the models. The key to remember here is that we have allowed AD to have permanent effects on the GCC economy.

4 Data and estimation

The annual dataset used for the empirical analysis covers the period 1970–2008. The series includes: non-oil GDP in US dollars, calculated as the total value added of all sectors except mining and quarrying; total value added or real GDP; and the GDP deflator with 1990 as the base year because of the unavailability of consumer price index (CPI).[8] All output data, valued in US dollars at constant 1990 prices along with the price level, were taken from United Nations Statistical Databases—National Accounts Main Aggregates. The monthly spot oil price data (West Texas Intermediate) were downloaded from the Dow Jones Industrial Average website and were then expressed in yearly averages prior to their conversion in real terms.

[7] Interested readers may wish to consult Hamilton (1994), Bayoumi and Eichengreen (1994), Enders (2004), and Amisano and Giannini (1997), among others.

[8] We thank an anonymous referee for making the point that "using GDP deflator is not a good idea because (1) it does not cover the prices of imports and therefore does not represent a measure of purchasing power, and (2) it contains the impact of the oil price, whereas the oil production itself has been removed from the specification. This is bound to yield problematic estimates." Our main issue, however, is that the CPI is not available for the GCC countries for the sample period considered in our paper. Although World Economic Outlook is a good source of data and contains the CPI, we cannot use it because it would reduce our sample size to less than 30 data points per country since it does not go back to the 1970s. This would put us in a real problem of unreliable estimates. We address the problem that the referee mentions in respect to the impact of the oil price and the exclusion of the oil production by estimating SVARs with (a) oil output, non-oil output, and the price level; (b) nominal/real oil price, non-oil output, and the price level; (c) nominal/real oil price, total output, and the price level; and (d) total output and the price level.

We also extract data on the flows of imports and exports for the GCC member countries, the US, and the EU from the Direction of Trade Statistics database of the International Monetary Fund (IMF). These data were used to ascertain the pace of economic integration among the GCC countries, and the relative importance of the US and the EU as trading partners for the GCC countries. The series were then tested for unit roots using the Augmented Dickey–Fuller (ADF), the Dickey–Fuller Generalized Least Square (DF-GLS) and the Phillips-Perron (PP) tests, and were found to be integrated of order 1 or non-stationary.[9] Hence, the SVARs were estimated with the variables expressed in first natural log differences.

Prior to the empirical estimation, we conducted a thorough analysis of the data to uncover any possible relationships among the variables. In Table 1, we present a breakdown of the total output into the two components of oil and non-oil for each country and economic bloc, and the magnitude of each country/bloc relative to the US and the core European countries for the last five years of the data. For example, on average, we find that non-oil output was $8.48 billion of a total of $8.74 billion for Bahrain (the smallest of the GCC countries) and $131.02 billion of a total of $190.88 billion for Saudi Arabia (the largest economy of the GCC). For the same period, the mean outputs of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE were, respectively, 0.11%, 0.50%, 0.24%, 0.28%, 2.10% and 0.96% relative to the US mean output, and 0.21%, 0.94%, 0.45%, 0.54%, 3.98% and 1.81% relative to the core European countries. Table 1 is quite useful, as it enables us to rank the GCC members in importance for the union's overall output and immediately establishes that the US economy is the largest of all. It also shows that non-oil output as a share of total output is in the 96–97% range for the US and within the 97–98% bracket for the core EU countries. This is in line with common understanding of the composition of the four major economies. It is also reassuring for us, since it ascertains that our approach to differentiate production into oil and non-oil makes intuitive sense.

Table 1 can also be used to infer the size of the oil and non-oil industry output as a share of US or core EU total output. We present non-oil output as a share of total value added for the GCC members. The data shows that on average Bahrain (with 83.4%) and the UAE (with 75.45%) have the largest non-oil sector of all for the last 5 years of the sample. The yearly data is plotted in Fig. 1, which also contains the importance of the non-oil sector for the US, France, Germany and Italy. It shows that the oil sector represents a negligible portion of their total output. Therefore, for these four countries, there is indeed no great loss of information from using total output as opposed to non-oil output, though we did harmonize the choice of the variables for the robustness section. For the GCC countries, the non-oil sector in the 1970s averaged 41%, by the 2000s this figure has grown to 65%. The trend towards expansion of the non-oil sector in the data is evident: save for Qatar, which shows declining trends due to the discovery of new gas deposits, most countries have shown significant progress towards economic diversification over the years.

We also looked into the linkages between the oil sector and the non-oil sector by conducting Granger non-causality tests across countries. We asked whether disturbances to nominal/real oil prices, oil/non-oil output and overall price levels are interconnected. At the 5% significance level, we could only find two-way

[9] The unit root results are available upon request.

Table 1 The magnitudes of the GCC economies and the economic blocs—analysis for 2004–2008

The GCC Economies																		
Real GDP (in billions of 1990 US dollars)																		
	Bahrain			Kuwait			Oman			Qatar			Saudi Arabia			UAE		
	Non-oil	Oil	Total	Non-oil	Oil	Total	Non-oil	Oil	Total	Non-oil	Oil	Total	Non-oil	Oil	Total	Non-oil	Oil	Total
Mean	8.48	1.65	10.13	26.81	18.23	45.04	14.30	7.27	21.57	13.30	12.63	25.93	131.02	59.86	190.88	65.80	21.39	87.19
Share	83.70	16.30	100.00	59.53	40.47	100.00	66.29	33.71	100.00	51.30	48.70	100.00	68.64	31.36	100.00	75.47	24.53	100.00
Country size relative to the USA based on total output																		
Mean	0.09	0.02	0.11	0.30	0.20	0.50	0.16	0.08	0.24	0.15	0.14	0.28	1.44	0.66	2.10	0.72	0.24	0.96
Country size relative to the core European countries																		
Mean	0.18	0.03	0.21	0.56	0.38	0.94	0.30	0.15	0.45	0.28	0.26	0.54	2.73	1.25	3.98	1.37	0.45	1.81
The Economic Blocs																		
Real GDP (in billions of 1990 US dollars)																		
	GCC			France			Germany			Italy			Core European countries			USA		
	Non-oil	Oil	Total	Non-oil	Oil	Total	Non-oil	Oil	Total	Non-oil	Oil	Total	Non-oil	Oil	Total	Non-oil	Oil	Total
Mean	259.71	121.03	380.74	1413.98	32.41	1446.40	2020.03	57.91	2077.93	1240.61	31.84	1272.45	4674.62	122.16	4796.78	8747.47	316.74	9064.21
Share	68.21	31.79	100.00	97.76	2.24	100.00	97.21	2.79	100.00	97.50	2.50	100.00	97.45	2.55	100.00	96.51	3.49	100.00
Country size relative to the USA based on total output																		
Mean	2.86	1.33	4.19	15.60	0.36	15.96	22.29	0.64	22.93	13.70	0.35	14.05	51.59	1.35	52.94	96.50	3.50	100.00
Country size relative to the core European countries																		
Mean	5.41	2.52	7.93	29.48	0.68	30.15	42.10	1.21	43.31	25.87	0.66	26.53	97.45	2.55	100.00	182.32	6.61	188.93

United Nations Statistical Database—National Accounts Main Aggregates. Real GDP in billions of 1990 US dollars is the sum of all value added of all sectors and is broken down into non-oil and oil. Non-oil output is the total value added of all sectors minus mining and quarrying. We computed the country size relative to the USA, for example, by taking the ratio of the total output of each country to the total output of the US. Similar calculations were performed for the sectors. The upper panel clearly shows that Saudi Arabia's economy is the largest of the GCC followed by the UAE, Kuwait, Qatar, Oman, and Bahrain. Also, we computed the economic bloc/country size relative to the USA, for example, by taking the ratio of the total output of each bloc/country to the total output of the US. The lower panel shows that the US economy is about twice the size of the core European countries, 25 times the GCC, and the core EU countries is about 12 times the size of the GCC. The non-oil sector averages around 97% for the US and the European countries

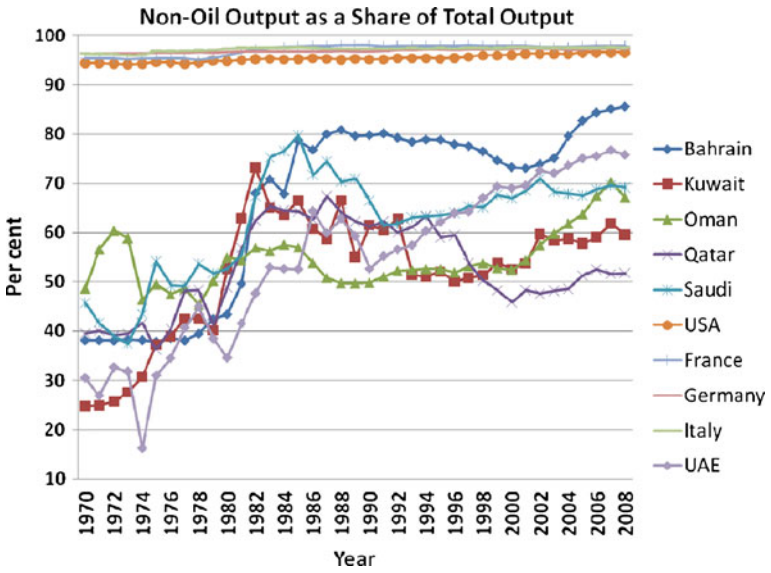

Fig. 1 Non-oil output as a share of total output

Granger causality between the oil output and the non-oil output for Kuwait and the UAE when nominal oil price volatility enters the VARs, but only for Kuwait when real oil price volatility is included in the VARs. The joint disturbances in all the variables explain innovations in non-oil output and overall prices for Bahrain; oil output and overall prices for Kuwait; oil output, non-oil output and overall prices for Oman and Saudi Arabia; non-oil output for Qatar; and nominal oil prices, oil output and non-oil output for the UAE. For Oman, Qatar and the UAE, the results do not change when real oil prices are taken into consideration. However, we observe that real oil prices for Bahrain (at the 5% level), real oil prices and non-oil output for Kuwait (at the 10% level) have become significant, while the joint effects on oil output are no longer significant for Saudi Arabia. The insight gathered from the Granger non-causality tests also indicates that GCC member countries, with the exception of Kuwait, do not individually influence the international market price of oil as demonstrated by the effects of innovations on oil and non-oil output. It further establishes that these five variables (nominal/real oil price, oil output, non-oil output and overall prices) are important in assessing the costs of forming a monetary union, and therefore justifies our undertaking to estimate various SVAR specifications.[10]

Further analysis of the data led us to carry out Granger non-causality tests using similar variables for the US, France, Germany and Italy. No two-way Granger non-causality was detected for any pairs. The joint effects of the variables are significant and explain, at the 10% level, variations in oil prices, oil output, and overall prices

[10] We thank two anonymous referees for making the point that oil output and/or oil prices must be incorporated into the SVARs. We have followed this recommendation faithfully but have found no major deviations from the original results. Detailed results from the Granger non-causality tests are available upon request to keep the paper within the allowable length.

for the US; non-oil output for France; all variables for Italy, and none for Germany. These results hold irrespective of the measure of oil price considered. When we consider how volatility in oil output of the GCC member countries is linked to volatility in non-oil output of the four major countries, we find some quite interesting results. Table 2 reveals that volatility in output of the GCC countries as a group causes (according to Granger non-causality) non-oil output volatility in the US, France and Italy at the 5% level, and Germany at the 10% level. When the test was reversed, we found that combined fluctuations in economic activity of the non-oil sector of the US and the core EU countries give rise to volatility in oil output for Bahrain, Kuwait, Oman and the UAE at the 5% level, but not for Saudi Arabia and Qatar, which are major producers of oil and gas. When we count the number of significant correlations in Table 2 for the US (4) and take an average of the same for the three major EU countries (8/3=2.67), we find that the dollar is more dependent

Table 2 Linkages between GCC's oil sector and the non-oil sectors in the US and the three European countries

		Volatility in non-oil output				
	←	US	France	Germany	Italy	All
	Causality	→	→	→	→	→
	Directions	←	←	←	←	←
↑		Probabilities				
Volatility in oil output	Bahrain	0.02	0.22	0.72	0.09	0.01
		0.00	0.98	0.45	0.07	
	Kuwait	0.10	0.03	0.51	0.65	0.03
		0.96	0.28	0.08	0.23	
	Oman	0.09	0.06	0.13	0.00	0.00
		0.25	0.02	0.08	0.40	
	Qatar	0.56	0.83	0.27	0.84	0.28
		0.93	0.01	0.90	0.10	
	Saudi Arabia	0.00	0.23	0.57	0.00	0.29
		0.75	0.43	0.31	0.48	
	UAE	0.50	0.01	0.02	0.06	0.00
		0.20	0.01	0.94	0.77	
	ALL	0.00	0.00	0.08	0.00	–

United Nations Statistical Database—National Accounts Main Aggregates. Real GDP in billions of 1990 US dollars is the sum of all value added of all sectors and is broken down into non-oil and oil. Non-oil output is the total value added of all sectors minus mining and quarrying. Estimations were carried out over the full sample of the data 1970–2008. "All" stands for the joint effects of volatility in oil output in the GCC countries, and non-oil output from the major economies. Arrow moving from West to East (→) is for causality that runs from the variables in column to the variables in rows, whereas arrow moving from East to West (←) is for the opposite. For each cell, the upper value corresponds to causality that runs from West to East whereas the lower value corresponds to causality that runs from East to West. For example, the probability that oil output volatility from Bahrain Granger causes volatility in non-oil output for the US is 0.02 and the probability that the opposite occurs is 0.00

on the oil supplies of the GCC countries than the three EU countries. This is in line with the common understanding that the US economy is the largest in the world and therefore needs more energy to produce output.

In investigating the costs of monetary union, assessment of trade linkages and the extent of economic integration must also be taken into account. To that effect, we document export and import flows within the GCC region, between the GCC and the US, the EU and the remainder of the Middle East, namely Middle East/North Africa (MENA) non-GCC countries.[11] Save for Kuwait, we observe that total trade with the US and with the GCC as a share of total trade with the world for each GCC country has declined when we compare the average of the first five years of the sample with the last five years, though the share of trade with the EU is far superior to that with the US. Therefore, the argument for the adoption of the Euro instead of the dollar cannot solely rest on trade integration between the EU and the GCC. A number of events may be at the origin of the declining importance of the EU for the GCC: (1) the rise of Russia as a major oil exporter and its close proximity to other European nations, (2) the shift towards energy efficiency and the movement to protect the environment, and (3) the process of diversification of the GCC economies, which may have given rise to import substitution at home of certain products. Also, we have found that total exports to the US as a share of world exports for Bahrain, Oman and the UAE have fallen, whereas those of Kuwait, Qatar and Saudi Arabia have increased over the years. This tighter integration observed for the three countries may be attributed to the heavier military presence of the US. Exports to the EU as a share of total exports have increased for Bahrain only. In some cases, the fall is quite sharp, from 43.19% during 1980–1984 to 5.86% during 2005–2009 for Qatar.

Without a doubt, total trade with the world for the GCC countries has increased substantially over the years. The growth for the two sample periods considered in some cases is in the vicinity of 400%. However, trade integration with the MENA non-GCC countries and within the GCC is at a standstill. Bahrain, Kuwait and Qatar have seen their share of total exports decline, whereas Oman, Saudi Arabia and the UAE have recorded an increase in their exports to the MENA—non-GCC region. Within the GCC, we recorded an increase in the share of exports to the other five member countries for Oman, Saudi Arabia and the UAE, but a decrease for Bahrain, Kuwait and Qatar. Of course, trade integration is only one aspect of economic integration, but the data do not support the claim that the GCC economies have become more integrated than ever.[12] However, if it is true that countries with closer trade links tend to have more tightly correlated business cycles, then the GCC patterns uncovered tend to suggest that Oman and Saudi Arabia are more likely to have their business cycles synchronized and therefore are suitable candidates for monetary union, as per Frankel and Rose's (1998) endogeneity of OCA criteria.

An analysis of the data used in the base model estimation is shown in Table 3, which reports the mean and standard deviations for real non-oil output growth and

[11] The table containing the GCC trade patterns and economic integration is available upon request.

[12] One may still claim that we should have used total trade, as we did for the US and the EU, to make this point, but there is no need because the import of one country is the export of another country within the same group.

Table 3 The comparison of real non-oil output growth and inflation across countries

	Real non-oil output Growth		Inflation	
	Mean	S. D.	Mean	S. D.
Bahrain	2.91	4.96	2.61	4.05
Kuwait	1.46	7.07	3.79	9.11
Oman	3.92	4.96	2.81	9.12
Qatar	2.13	4.29	3.33	6.28
Saudi Arabia	2.31	3.45	3.23	7.82
United Arab Emirates	5.61	8.22	1.93	3.41
USA	0.77	1.09	1.74	1.02
France	1.06	0.53	2.21	4.77
Germany	0.94	0.71	2.23	4.90
Italy	1.00	0.85	2.42	4.68

Data on GDP Deflator and total value added come from the United Nations Statistical Database—National Accounts Main Aggregates. Real GDP in billions of 1990 US dollars is the sum of all value added of all sectors and was broken into non-oil and oil. Non-oil output is the total value added of all sectors minus mining and quarrying. The growth rates of non-oil output and GDP Deflator were computed as the first log differences times 100. S.D. stands for standard deviation

inflation for all GCC countries, the US and the three core European countries. It shows that all the GCC countries have experienced higher growth and higher inflation rates than the US and the European countries. However, when volatilities are considered, their non-oil output growth is at least three times less stable than that of the US and the European countries. Inflation appears to follow a similar pattern but with a smaller gap in relative variability compared to the selected European countries. The same holds for the average of the GCC bloc, while the US is by far the most stable economy on all accounts. This table indicates that a move of the GCC countries away from the US dollar as their principal anchor currency towards the Euro is a move from a low to a high inflation shelter, which is suboptimal, since there is no accompanying gain in employment.[13]

Table 4 presents both the cross-country correlations of GCC real non-oil output growth and inflation with the USA and core European countries. We could only find two significant positive co-movements in non-oil output growth: Bahrain with France and Bahrain with Italy. These might be due to Bahrain's status as an offshore country. Overall, the GCC countries' non-oil output is not correlated with either the US or the three European countries. Table 4 also shows that inflation in all GCC countries, save the UAE, is significantly correlated with US inflation, which is not surprising because of the long history of these countries' national currencies being pegged to the US dollar. But the same cannot be said in relation to the European

[13] All GCC countries import foreign labor from the rest of the world. The short-run Phillips curve prediction of a tradeoff between unemployment and inflation may not hold for these countries.

Table 4 Correlations of real non-oil output growth (1) and inflation (2) with the USA's and the core European countries' output growth and inflation

	USA		France		Germany		Italy	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Bahrain	0.04	0.69*	0.34*	−0.04	0.17	−0.11	0.37*	−0.05
Kuwait	0.11	0.49*	0.04	0.06	−0.20	0.10	−0.04	0.13
Oman	−0.20	0.44*	−0.09	0.06	−0.03	0.10	−0.30	0.08
Qatar	0.04	0.42*	0.20	0.22	0.04	0.14	0.09	0.15
Saudi Arabia	−0.30	0.53*	0.08	0.05	−0.20	0.11	0.11	0.08
United Arab Emirates	−0.19	0.04	0.00	0.07	−0.08	0.05	0.04	0.03

Data on Real GDP, non-oil output, and GDP deflator come from the United Nations Statistical Database—National Accounts Main Aggregates. Real GDP in billions of 1990 US dollars is the sum of all value added of all sectors and was broken into non-oil and oil. Non-oil output is the total value added of all sectors minus mining and quarrying. Overall output was considered for the major economies because the non-oil sector accounts for about 97% of their total output. The growth rates of non-oil output and overall GDP were computed as the first log differences times 100 and the correlations were computed over the full sample 1970–2008. Inflation was computed as the first natural log difference times 100 of the GDP Deflator. The correlations were computed over the full sample 1970–2008. * denotes significance at the 5% level

countries. Not a single correlation is significant. Again, there is no gain for GCC countries to switch to the Euro, despite the tighter trade linkages with Europe.

Table 5 summarizes the cross-country correlations of real non-oil output and inflation among GCC countries. With the exception of the UAE, where a significant co-movement is detected with only Bahrain and Qatar, inflation is significantly correlated among member countries. We are able to uncover only two positively significant correlations when we look into output linkages: Qatar with Bahrain and

Table 5 Correlations of real non-oil output growth and inflation for GCC countries

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates
Bahrain	–	0.68*	0.66*	0.72*	0.67*	0.39*
Kuwait	0.11	–	0.93*	0.65*	0.94*	0.25
Oman	−0.16	0.10	–	0.63*	0.94*	0.21
Qatar	0.52*	0.03	−0.07	–	0.64*	0.62*
Saudi Arabia	−0.03	0.00	0.09	0.13	–	0.21
United Arab Emirates	−0.15	−0.04	0.15	0.00	0.75*	–

Data on GDP Deflator and total value added come from the United Nations Statistical Database—National Accounts Main Aggregates. Real GDP in billions of 1990 US dollars is the sum of all value added of all sectors and was broken into non-oil and oil. Non-oil output is the total value added of all sectors minus mining and quarrying. The growth rates of non-oil output and GDP Deflator were computed as the first log differences times 100. S.D. stands for standard deviation. The correlations were calculated over the full sample period of 1970–2008. The upper triangle of the matrix contains the correlation coefficients for inflation whereas the lower one presents the correlation coefficients for non-oil output growth. * denotes significance at the 5% level

the UAE with Saudi Arabia. Therefore, non-oil output growth is mostly not correlated among GCC countries.

5 Empirical results

5.1 The base model

In this section, we present results pertaining to the estimation of a bivariate SVAR with non-oil output growth and inflation for each of the 10 countries, in line with the common belief or assumption that oil shocks affect the GCC countries in a similar fashion. We estimated the SVARs with two lags even though the optimal lag length recommended for some countries was higher in some cases. According to Enders (2004), OLS estimates are asymptotically efficient and consistent, provided that the independent variables are the same in each equation. We extracted the AD and AS shocks for each country, and computed their bilateral correlations. A positive correlation indicates symmetry while a negative correlation indicates asymmetry of shocks. Emphasis is put mostly on correlations that are statistically significant.

Table 6 presents the correlation of the GCC non-oil supply shocks with overall supply shocks from the US and the core European countries. We also explore the correlation of supply shocks between the core European countries to test whether our SVAR models are capable of producing results similar to those of Bayoumi and Eichengreen (1994). We report a stronger statistically significant correlation of supply shocks at the 5% level: 0.90 for France with Germany; 0.85 for France with Italy and 0.81 for Germany with Italy.[14] Surprisingly, we could only detect two significant correlations of supply shocks between GCC countries and the core European countries at the 10% level: Qatar displaying symmetry with France and the UAE exhibiting asymmetry with France. Supply shocks are categorically asymmetric between US and GCC countries. This can be explained by the fact that oil shock is a large component of supply shocks in the US and in Europe, while it is mostly a demand shock for GCC countries (Bayoumi and Eichengreen 1994).

Table 6 presents the correlation coefficients of demand shocks as well. It shows that the three European countries respond similarly to demand disturbances but they are not synchronized with GCC countries. A different picture, however, emerges in relation with the US. With the exception of the UAE, demand shocks are mostly symmetric between GCC countries and the US. These relationships are statistically significant, suggesting that monetary policy from the US can at least serve the purpose of the GCC countries. Unfortunately, the same cannot be said for European monetary policy on the basis of what we could infer from the three major EU members.

In Table 7, we report the correlations of both supply and demand shocks among GCC countries. We place the correlation coefficients for supply shocks on the upper triangle while those of demand shocks are on the lower one. Demand shocks are mostly symmetrical among GCC countries. Twelve (80%) of the 15 coefficients are

[14] It appears that 13 years of data since the publication of Bayoumi and Eichengreen's work have made a great difference but this is also a sign that economic integration has contributed to the synchronization of the countries in response to disturbances.

Table 6 Correlation of aggregate Demand Shocks (DS) and aggregate Supply Shocks (SS) between the GCC and the USA and core European Countries

	USA		France		Germany		Italy	
	DS	SS	DS	SS	DS	SS	DS	SS
Bahrain	0.69*	0.13	−0.04	0.18	−0.11	−0.01	−0.05	0.16
Kuwait	0.44*	−0.11	0.06	−0.10	0.10	0.05	0.08	−0.12
Oman	0.44*	−0.08	0.06	−0.09	0.10	0.06	0.08	−0.11
Qatar	0.42*	0.02	0.21	0.30†	0.14	0.16	0.15	0.23
Saudi Arabia	0.53*	0.10	0.05	−0.03	0.11	0.07	0.08	−0.04
United Arab Emirates	0.04	−012	0.07	−0.32†	0.05	−0.23	0.03	−0.14
France			–		0.95*	0.90*	0.88*	0.85*
Germany					–		0.85*	0.81*
Italy							–	

* and † = Significant at the 5% and 10% levels, respectively

positive and statistically significant at the 5% level. The UAE's links with Kuwait, Oman and Saudi Arabia are non-significant. These results are, by and large, consistent with those of Abu-Bader and Abu-Qarn (2006). However, there is no overwhelming support of their conclusion that supply shocks are mostly asymmetric; hence, their stance on the readiness of the Gulf countries to form a monetary union. Six (40%) of the possible 15 pairwise correlations are positive and statistically significant, while only one of the coefficients (UAE–Bahrain, -0.47) is significantly negative. Interestingly enough, Saudi Arabia, which has the largest economy, shares common non-oil supply shocks with all GCC countries except the UAE.[15] Percentage-wise, we cannot conclude that non-oil supply shocks—and to that effect, supply shocks—are asymmetric under the assumption that oil shocks affect these countries in a similar way. Nevertheless, we shall acknowledge a tighter relationship between the GCC countries in response to demand shocks.

To summarize, our results thus far indicate that:

(1) The Euro may not be the appropriate anchor for GCC countries because of shock asymmetry.
(2) Despite the US's misfortune lately, the dollar remains the best option for pegging the individual GCC currencies and the expected single currency to. The US currency can at least help five of the six countries, including the largest economy of the region, in smoothing demand shocks.
(3) The member country that is to be most concerned about the monetary union with the rest should be the UAE, not Oman. The UAE appears to be on a path of its own.

[15] The discrepancy between the correlation of non-oil output growth results and responses to shocks is an anomaly of the data also found in Bayoumi and Eichengreen (1994) for the case of correlating Canada with the United States. In their case, they had used quarterly data as an alternative to confirm their findings, but in our case, we cannot because such data are not available.

Table 7 Correlation of non-oil supply and demand shocks among GCC countries

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates
Bahrain	–	−0.14	−0.03	0.56*	0.35*	−0.47*
Kuwait	0.66*	–	0.99*	−0.01	0.39*	0.04
Oman	0.66*	1.00*	–	0.08	0.53*	−0.02
Qatar	0.72*	0.63*	0.63*	–	0.37*	−0.24
Saudi Arabia	0.67*	0.94*	0.94*	0.64*	–	−0.22
United Arab Emirates	0.39*	0.21	0.21	0.62*	0.21	–

The upper triangle contains correlation coefficients for supply shocks; the lower one presents correlation coefficients for demand shocks. * denotes significance at the 5% level

(4) GCC countries are, on average, subject to similar shocks and are therefore good candidates for monetary union. They are all reliant on oil and have channeled substantial portions of their oil revenues, at differing degrees, towards development in infrastructure, manufacturing, and services. Although this is reassuring, when we consider these countries have a common language, religion and culture in general, labor mobility remains one of the major hurdles in combating asymmetric shocks.

6 Further discussion

In this section, we present results pertaining to a variety of SVAR specifications to test the robustness of the base model findings. The assumption that GCC countries react similarly to oil shocks was relaxed to incorporate either the oil output or the nominal or the real oil price as a third variable. Also, we addressed the issue related to the use of the real GDP for the possible anchor countries and non-oil output for the GCC. In SVAR models where we differentiated between oil and non-oil output, the same variables were used for all countries. The same applies for cases where total value added had to be used.

The rationale for estimating some SVARs with nominal oil price and others with real oil price is because of the unsettled debate in the literature. For example, Hamilton (1996, 2003), and Hamilton and Herrera (2004) used a nominal net oil price increase measure, whereas Rotemberg and Woodford (1996), Kilian (2008a, b, 2009), and Herrera and Pesavento (2009) used the real price of oil in their SVARs to gauge the effects of oil shocks on key macroeconomic variables. We used these two approaches to broaden the scope of our work and thereby cover all grounds.

Prior to considering models with oil output or nominal/real oil prices, we estimated a bivariate SVAR with the growth of total value added and inflation for each country. The results presented in Table 8 support our earlier findings that AD shocks are symmetric across GCC countries and between the GCC and the US, but not between the GCC and core EU countries. There is no evidence of AS shock symmetry, with four statistically significant pairs of both positive and negative

Table 8 The correlations of demand and supply shocks based on models estimated with the growth of [total value added, price level]

Correlation of AD shocks

	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1	0.64*	−0.13	0.19	0.09	0.28*	0.32*	0.48*	0.33*	0.46*
Kuwait	0.61*	1	−0.43*	0.27	0.46*	−0.31*	0.34*	0.2	0.21	−0.01
Oman	0.56*	0.59*	1	−0.06	−0.66*	0.41*	0.15	−0.05	0.09	0.25
Qatar	0.58*	0.51*	0.67*	1	0.19	−0.1	0.43*	0.21	0.11	0.06
Saudi	0.42*	0.76*	0.48*	0.46*	1	−0.31*	0.23	0.23	0.14	−0.07
UAE	0.51*	0.41*	0.31*	0.56*	0.37*	1	0.06	0.28	0.14	0.54*
USA	0.28	0.40*	0.20	0.41*	0.36*	0.16	1	0.39*	0.48*	0.39*
France	−0.25	−0.21	0.02	0.13	−0.32*	−0.06	−0.10	1	0.37*	0.76*
Germany	−0.24	−0.13	0.06	0.10	−0.28	−0.11	−0.14	0.94*	1	0.58*
Italy	−0.22	−0.06	0.03	0.15	−0.14	−0.02	−0.13	0.85*	0.84*	1

The upper triangle contains correlation coefficients for supply shocks; the lower one presents correlation coefficients for demand shocks. * denotes significance at the 5% level

correlations for the GCC. However, we find positive correlations of AS shocks with the US for all GCC members, three of which are significant: US–Bahrain, US–Kuwait and US–Qatar. The average significant correlation pairs between the GCC and the core EU countries is two, suggesting that the GCC would be better off in adopting the US dollar over the Euro. Table 8 also shows that both AD shocks and AS shocks are symmetric across the European countries, but their AD shocks are asymmetric but the AS shocks are symmetric with the US.

Table 9 supplies the results related to SVARs estimated with the growth of oil output, non-oil output and prices. It confirms our earlier finding with respect to AD shock symmetry, but also hints that non-oil as well as oil AS supply shocks are not symmetric. For the former, nine of the 15 correlation pairs are positive but only two are significant, whereas for the latter, only four pairs are significant for the GCC countries. Although we have more positive than negative correlations, this is not strong enough evidence of symmetry. In this case, we find evidence that neither the US nor the core EU countries are subjected to similar non-oil or oil AS shocks.

Table 10 investigates the impact on the linkages between the set of countries when nominal/real oil price replaces oil output in the SVAR model. We use a lower and upper triangular structure to summarize the results for SVARs with nominal and real oil prices, respectively. The symmetry of AD shocks documented earlier is now even stronger. There is no support for non-oil AS shock symmetry within the GCC, or between the GCC and the potential anchor countries. However, when we analyze the correlations of oil AS supply shocks, we find that 40% of them are positive and statistically significant for the SVARs with nominal oil price when compared to 67% for the SVARs with the real oil price. Moreover, we find statistically significant positive oil AS shock correlations between the GCC and the four major countries. With the exception of Saudi Arabia where oil AS shocks are asymmetric with most

Table 9 The correlations of demand and supply shocks based on models estimated with the growth of [oil output, non-oil output, price level]

Correlation of AD shocks										
	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1									
Kuwait	0.52*	1								
Oman	0.54*	0.60*	1							
Qatar	0.61*	0.50*	0.55*	1						
Saudi	0.37*	0.74*	0.52*	0.30*	1					
UAE	0.63*	0.40*	0.30*	0.60*	0.36*	1				
USA	0.22	0.51*	0.27	0.54*	0.31*	0.15	1			
France	−0.10	−0.25	−0.01	0.05	−0.28	−0.09	0.00	1		
Germany	−0.06	−0.18	0.02	0.07	−0.26	−0.10	−0.03	0.92*	1	
Italy	−0.05	−0.17	−0.01	0.07	−0.15	0.02	−0.09	0.84*	0.83*	1
Correlation of non-oil AS shocks										
	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1									
Kuwait	−0.01	1								
Oman	0.08	0.22	1							
Qatar	0.50*	0.09	0.15	1						
Saudi	0.14	−0.61*	0.10	0.24	1					
UAE	−0.26	0.11	−0.44*	−0.13	−0.32*	1				
USA	0.26	0.35*	−0.13	0.26	−0.20	0.14	1			
France	0.41*	−0.27	0.06	0.21	0.30*	−0.19	0.18	1		
Germany	0.09	−0.32*	0.15	0.04	0.25	−0.23	0.10	0.85*	1	
Italy	0.16	−0.26	0.01	−0.04	0.25	0.01	0.02	0.80*	0.77*	1

Correlation of oil AS shocks

	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1									
Kuwait	0.34*	1								
Oman	−0.09	0.16	1							
Qatar	0.31*	0.36*	−0.02	1						
Saudi	0.28*	0.11	−0.40*	0.22	1					
UAE	0.21	0.24	−0.07	−0.08	−0.08	1				
USA	0.30*	−0.15	−0.15	0.06	0.30*	0.08	1			
France	0.30*	0.02	−0.15	0.01	0.17	−0.16	0.30*	1		
Germany	0.00	−0.12	0.28	0.20	0.07	0.11	0.25	0.14	1	
Italy	0.15	0.05	0.09	−0.06	−0.12	0.15	0.20	0.43*	0.40*	1

*denotes significance at the 5% level

Table 10 The correlations of demand and supply shocks based on models estimated with the growth of [nominal/real oil price, non-oil output, price level]

Correlation of AD shocks										
	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1	**0.60***	**0.53***	**0.60***	**0.40***	**0.48***	**0.40***	**-0.23**	**-0.25**	**-0.24**
Kuwait	0.58*	1	**0.60***	**0.50***	**0.74***	**0.40***	**0.51***	**-0.21**	**-0.18**	**-0.14**
Oman	0.58*	0.70*	1	**0.55***	**0.52***	**0.30***	**0.27**	**0.02**	**0.01**	**0.00**
Qatar	0.60*	0.43*	0.46*	1	**0.30***	**0.60***	**0.54***	**0.10**	**0.06**	**0.10**
Saudi	0.55*	0.89*	0.75*	0.31*	1	**0.36***	**0.31***	**-0.28**	**-0.25**	**-0.10**
UAE	0.48*	0.42*	0.42*	0.69*	0.37*	1	**0.15**	**-0.04**	**-0.09**	**0.05**
USA	0.43*	0.56*	0.27	0.34*	0.60*	0.15	1	**0.01**	**-0.02**	**-0.05**
France	-0.23	-0.23	-0.15	0.03	-0.22	-0.03	-0.02	1	**0.94***	**0.84***
Germany	-0.25	-0.21	-0.09	-0.04	-0.18	-0.07	-0.07	0.94*	1	**0.84***
Italy	-0.24	-0.14	-0.06	0.05	-0.10	0.05	-0.06	0.84*	0.84*	1
Correlation of non-oil AS shocks										
	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1	**0.03**	**0.00**	**0.38***	**0.08**	**-0.12**	**0.21**	**0.37***	**0.01**	**0.23**
Kuwait	0.16	1	**0.25**	**0.25**	**-0.28**	**0.15**	**0.26**	**-0.05**	**-0.04**	**-0.17**
Oman	-0.25	0.21	1	**0.19**	**-0.29***	**-0.40***	**-0.16**	**-0.16**	**-0.24**	**-0.25**
Qatar	0.25	0.30*	-0.01	1	**0.20**	**-0.16**	**0.26**	**0.29***	**-0.16**	**-0.03**
Saudi	0.15	-0.29*	-0.71*	0.12	1	**-0.28**	**-0.11**	**0.23**	**-0.18**	**0.28**
UAE	-0.35*	-0.01	0.04	-0.10	-0.28	1	**0.27**	**-0.09**	**0.00**	**-0.01**
USA	0.23	0.30*	-0.12	0.23	-0.11	0.01	1	**0.38***	**0.29***	**0.20**
France	0.37*	-0.03	-0.38*	0.19	0.19	-0.27	0.44*	1	**0.19**	**0.54***
Germany	0.01	0.04	-0.18	-0.11	-0.14	-0.03	0.28	0.19	1	**-0.23**
Italy	0.23	-0.20	-0.31*	-0.24	0.27	-0.19	0.24	0.54*	-0.23	1
Correlation of oil AS shocks										
	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1	**0.36***	**0.12**	**0.68***	**-0.23**	**0.77***	**0.80***	**0.74***	**0.71***	**0.72***
Kuwait	-0.21	1	**0.55***	**0.32***	**0.56***	**0.48***	**0.38***	**0.44***	**0.39***	**0.35***
Oman	-0.32*	0.51*	1	**0.35***	**0.36***	**0.19**	**0.27**	**0.28**	**0.19**	**0.15**
Qatar	0.73*	-0.10	0.03	1	**-0.17**	**0.65***	**0.57***	**0.71***	**0.70***	**0.65***
Saudi	-0.55*	0.78*	0.64*	-0.28	1	**-0.13**	**-0.20**	**-0.22**	**-0.23**	**-0.24**
UAE	0.86*	-0.06	-0.18	0.72*	-0.34*	1	**0.77***	**0.80***	**0.79***	**0.77***
USA	0.85*	-0.22	-0.22	0.66*	-0.46*	0.80*	1	**0.83***	**0.81***	**0.84***
France	0.80*	-0.07	-0.18	0.71*	-0.32*	0.81*	0.81*	1	**0.96***	**0.94***
Germany	0.77*	-0.14	-0.27	0.69*	-0.39*	0.77*	0.79*	0.94*	1	**0.97***
Italy	0.82*	-0.19	-0.30*	0.69*	-0.45*	0.79*	0.85*	0.94*	0.97*	1

The upper triangle contains correlation coefficients for models estimated with real oil price growth whereas the lower one presents correlation coefficients for models estimated with nominal oil price growth. * denotes significance at the 5% level

countries, this finding overall does not defy common knowledge, and therefore tends to suggest that previous research on the costs of monetary union for the GCC countries may have suffered from problems of model mis-specification if the real oil price does not enter the SVAR. This might be the reason why Abu-Bader and Abu-Qarn (2006) found that AS shocks are asymmetric between the GCC countries, as demonstrated by the outcomes of the various SVARs estimated in this paper. When

Table 11 The correlations of demand and supply shocks based on models estimated with the growth of [nominal/real oil price, total value added, price level]

Correlation of AD shocks for estimation of [nominal/real oil price, *total value added*, price level]'										
	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1	**0.58***	**0.57***	**0.55***	**0.39***	**0.54***	**0.27**	**-0.26**	**-0.24**	**-0.23**
Kuwait	0.58*	1	**0.55***	**0.41***	**0.78***	**0.48***	**0.46***	**-0.25**	**-0.19**	**-0.07**
Oman	0.58*	0.70*	1	**0.64***	**0.50***	**0.36***	**0.24**	**-0.01**	**0.03**	**0.03**
Qatar	0.60*	0.43*	0.46*	1	**0.44***	**0.58***	**0.31***	**0.09**	**0.05**	**0.13**
Saudi	0.55*	0.89*	0.75*	0.31*	1	**0.38***	**0.41***	**-0.29***	**-0.26**	**-0.11**
UAE	0.48*	0.42*	0.42*	0.69*	0.37*	1	**0.22**	**-0.04**	**-0.08**	**0.01**
USA	0.43*	0.56*	0.27	0.34*	0.60*	0.15	1	**-0.12**	**-0.12**	**-0.12**
France	-0.25	-0.27	-0.17	0.01	-0.26	-0.05	-0.06	1	**0.95***	**0.86***
Germany	-0.24	-0.20	-0.08	-0.04	-0.17	-0.07	-0.06	0.96*	1	**0.85***
Italy	-0.25	-0.16	-0.07	0.03	-0.13	0.03	-0.09	0.86*	0.85*	1
Correlation of non-oil AS shocks for estimation of [nominal/real oil price, *total value added*, price level]'										
	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1	**0.74***	**-0.09**	**0.23**	**0.11**	**0.07**	**0.35***	**0.40***	**0.28***	**0.19**
Kuwait	0.16	1	**-0.20**	**0.32***	**0.27**	**0.04**	**0.09**	**0.25**	**0.06**	**0.12**
Oman	-0.25	0.21	1	**-0.19**	**-0.40***	**-0.38***	**-0.13**	**-0.33***	**-0.26**	**-0.23**
Qatar	0.25	0.30*	-0.01	1	**0.15**	**0.11**	**0.46***	**0.23**	**0.16**	**-0.03**
Saudi	0.15	-0.29*	-0.71*	0.12	1	**0.67***	**0.04**	**0.13**	**0.03**	**0.24**
UAE	-0.35*	-0.01	0.04	-0.10	-0.28	1	**0.05**	**0.09**	**-0.03**	**0.47***
USA	0.23	0.30*	-0.12	0.23	-0.11	0.01	1	**0.41***	**0.30***	**0.29***
France	0.31*	0.07	-0.38*	0.04	0.13	-0.20	0.48*	1	**0.61***	**0.33***
Germany	-0.01	0.08	-0.14	-0.11	-0.19	0.03	0.24	0.61*	1	**-0.22**
Italy	0.22	-0.21	-0.40*	-0.24	0.32*	-0.18	0.29*	0.33*	-0.22	1
Correlation of oil AS shocks for estimation of [nominal/real oil price, *total value added*, price level]'										
	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	France	Germany	Italy
Bahrain	1	**0.38***	**0.25**	**0.68***	**-0.01**	**0.79***	**0.82***	**0.66***	**0.71***	**0.72***
Kuwait	-0.21	1	**0.65***	**0.37***	**0.63***	**0.53***	**0.34***	**0.45***	**0.41***	**0.40***
Oman	-0.32*	0.51*	1	**0.47***	**0.47***	**0.41***	**0.31***	**0.37***	**0.30***	**0.30***
Qatar	0.73*	-0.10	0.03	1	**-0.05**	**0.69***	**0.57***	**0.66***	**0.69***	**0.66***
Saudi	-0.55*	0.78*	0.64*	-0.28	1	**0.07**	**0.05**	**0.13**	**0.10**	**0.12**
UAE	0.86*	-0.06	-0.18	0.72*	-0.34*	1	**0.79***	**0.81***	**0.82***	**0.81***
USA	0.85*	-0.22	-0.22	0.66*	-0.47*	0.80*	1	**0.78***	**0.80***	**0.81***
France	0.69*	-0.02	-0.15	0.66*	-0.24	0.75*	0.78*	1	**0.92***	**0.93***
Germany	0.76*	-0.14	-0.27	0.68*	-0.38*	0.77*	0.78*	0.90*	1	**0.96***
Italy	0.80*	-0.13	-0.30*	0.67*	-0.40*	0.78*	0.83*	0.92*	0.95*	1

The upper triangle contains correlation coefficients for models estimated with real oil price growth whereas the lower one presents correlation coefficients for models estimated with nominal oil price growth. * denotes significance at the 5% level

we repeated the estimation of the model by replacing the non-oil output with the total value added, as presented in Table 11, the results remained the same except that Saudi Arabia now displays positive correlations that are not statistically significant with most countries. In neither of these two models is there evidence of a tighter linkage between the core EU countries and the GCC, compared to between the GCC and the US, to support any claim that the Euro is more suitable than the US dollar as

anchor for the GCC currency.[16] Overall, this new finding tends to suggest that SVARs with the real price of oil are more suitable for capturing the dynamics of shocks underlying the business cycles of the GCC countries.

7 Conclusion

Our objective in this paper was to assess the feasibility of monetary union between the GCC countries and the choice of either the US dollar or the Euro or a basket with the two as an anchor for the proposed unified currency of the GCC. Our focus was primarily on the costs of forming a monetary union using the contribution of Mundell (1961) as a springboard in determining whether macroeconomic shocks across member countries are symmetrical and whether there is any synchronization of those shocks with the US and the three core European countries, namely France, Germany and Italy.

Overall, we find overwhelming support for AD shock symmetry across the GCC countries and between the GCC countries and the US, but none for the three major EU countries with the GCC. Non-oil AS shocks are mostly asymmetric for all, but oil AS shocks are mostly symmetric when the real price of oil enters the SVARs. We therefore surmise that the US dollar is a more appropriate candidate for the new currency than the Euro, since US monetary policy can at least help smooth demand shocks in GCC countries.

The findings of this paper are in line with the common view that GCC countries must be subjected to common oil shocks. It also suggests that previous SVAR models estimated to pass judgment on the feasibility of monetary union across GCC countries may have suffered from mis-specification if the real price of oil was not taken into consideration. This might be the reason underlying Abu-Bader and Abu-Qarn's (2006) finding that AS shocks were asymmetric between the GCC countries, though other flaws, such as the failure to decompose total output into oil and non-oil outputs and the unreliability of their dataset, which came from various sources with differing sample sizes, were noted in their paper.

It is also worth emphasizing that of the 70 SVAR models estimated, we could not find any instance where business cycle linkages between the three EU countries and the GCC dominate those of the US with the GCC. Trade linkages between the EU and the GCC cannot be used as an argument for the Euro over the US dollar as an anchor, though the GCC's trade with the EU is greater than trade with the US as a share of their total trade. The main reason is that the GCC's share of total trade with the EU has been declining quite drastically over recent years. Therefore, our findings from the base model that AD shocks are symmetric but AS shocks are weakly symmetric, and that the US dollar is a more appropriate anchor for the new GCC currency, sit on firm grounds.

[16] We thank an anonymous referee for noting that there are a number of events going on the 1970 that are unlikely going to be matched in the future, which might have certain influence on the results of this paper. These events are the abolishment of the Bretton-Woods in 1973, the oil crises of 1973 and 1979, the European Monetary Union of 1999, and the many financial and currency crises that followed the debt crisis of 1982. Since we are endowed with yearly data, accounting for structural break is just not possible in this context. Also, had we left the 1970s out, we would have faced problems of unreliable estimates due to the small sample size.

In summary, this paper has contributed to the debate on the anchor currency by providing statistical evidence to GCC decision makers who have been wrestling with the dilemma of whether to revalue or to de-peg their actual currencies. We are also aware that our finding that US monetary policy can at least help contain demand shocks affecting GCC economies is debatable. Many believe that imported inflation resulting from the depreciation of the US dollar lately has worsened the inflation problem in these countries. We have, however, two arguments in response: (1) imported inflation is temporary and is a negligible share of total inflation; and (2) as the GCC economies are gearing towards more diversification, the depreciation of the dollar has the potential to boost exports and improve current account balances, as long as they do not rely too heavily on imported raw materials and intermediate goods. The problem of inflation in GCC countries is mostly due to rent and food prices. A better solution is for governments to release the pressure on the prices of land they control and the fees they charge to developers so that rentals can become more affordable, though the recent financial and housing crisis originating in the US has already done part of the job. Our paper therefore hints that de-pegging or revaluing the respective currencies to curb inflation will not accomplish much and the choice of the Euro instead does not guarantee a better outcome, despite these countries' closer trade links with Europe. Moreover, although we rely solely on the dynamics of macroeconomic shocks to suggest that a monetary union is feasible among the GCC countries, labor mobility and the level of intraregional trade remain some of the issues that they must address if they want to reap the full benefit of the union.

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