Essays in the Gulf Cooperation Council Economies and Market Dynamics

A thesis presented
by

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Declaration

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This thesis dedicated to the memory of my great father

To my beloved mother and my supportive brothers

To all my family and friends

Thesis Abstract

Countries rich in natural resources may be deemed to have an economic advantage with regards to their economic growth. However, this has been questioned as such countries have been found to underperform those that are significantly disadvantaged in terms of such resources, leading to what has been termed as the resource curse. The current thesis aims to investigate the existence of resource curse for the oil abundant GCC countries as well as the remaining OPEC members that share similar characteristics; most notably the dependence on oil exports. Oil has a prominent status among all commodities as it acts as a barometer to a country's, and perhaps the world's, economic outlook. High oil prices may fuel inflation pressure, thereby increasing the cost of production of many goods. As such we also investigate the impact of oil on the GCC stock markets. Specifically, we investigate whether the oil dynamics have acted as a contagion transmission channel, which would have imported the uncertainty pertaining to the Global Financial Crisis from the western economies to the, admittedly secluded, GCC stock markets.

The first chapter of the thesis lays out key background information related to the economic and financial environment of the GCC economies, necessary to fully comprehend the complexities that over-reliance on a particular resource can generate. The second chapter focuses on the economic impact of oil by offering an investigation as to whether the resource curse is observed for the GCC and other OPEC members. A system-GMM method is adopted to account for any omitted variable bias and endogeneity issues. Furthermore, classification trees are used to divide the countries based on their oil level and re-consider the association between oil and per capita GDP by accounting for the

country differences in terms of the per capita oil reserve and oil rent, the two oil proxies used.

The third chapter examines the role of oil in the financial sector of the GCC and OPEC markets. In particular, we rely on the well-established and relevant given the Global Financial Crisis, framework of financial contagion to investigate: i) how affected were the GCC stock markets; ii) what has been the role of oil in the transmission of the financial shocks. We use an asymmetric multivariate GARCH framework which allows for dynamic properties of correlations across the financial markets. Our results suggest that GCC markets were affected by financial contagion, while the oil has been an important transmission channel of varying intensity during the phases of the crisis. The UAE, which have the largest and most progressive financial sector in the region, have been the most affected, while Kuwait has been the least.

A fourth chapter provides critical reflections and discussion around the results. In particular, it highlights the steps that, particularly the GCC governments have taken to ensure that their resource abundance is not a curse over the past couple of years. Most importantly, the GCC governments have been diversifying their income streams into tourism, manufacturing, real estate and financial services. The impact of oil on the GCC financial sector is of particular importance as financial services are one of the main business lines that the local governments have been investing and promoting in their attempt to diversify their income generating process away from oil and gas. A fifth chapter concludes.

Keywords: Resource Curse, GMM, GCC, Financial Contagion, Oil, GARCH

JEL Classification: C53; C32; C14; C15; G12; C5; G1; Q

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Contents

Chapter 1

Introduction

Energy resources such as oil and its refined components have been essential to the growth and integration of the global economy in both the 20^{th} and 21^{st} century. The overall situation and importance of the international oil market was shaped significantly by the sustained demand for oil after the Second World War, as oil was the main energy resource required to rebuild the European and Japanese war-torn economies and that of the US, which with only 6% of the world population consumed a third of the total global oil production. This increased demand moved the oil production's centre of gravity of from the Western hemisphere to the Middle-East, such that the overall increased economic activity across the globe caused the demand for oil from the Middle East to grow at a sustained pace.

Although there proved to be abundant supplies available in the Middle East to replace declining US production, the transition from a world petroleum market centred in the Gulf of Mexico to the one centred in the Persian Gulf did not go smoothly. This led to the creation of the Organization of Petroleum Exporting Countries (OPEC), which was formed in 1960 by oil-producing countries, namely: Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. The organization's purpose was to unify and coordinate its members' petroleum policies so that fair and stable prices would be secured for petroleum producers and supply to consumers would be efficient and economical. However, the real transition of power from the US to OPEC was first seen in March 1971, when Texas oil producers had no limit to the amount of oil they could produce. Subsequent to this, Qatar, Indonesia, Libya, the United Arab Emirates, Algeria and Nigeria had become members of OPEC by the end of 1971. At July 2016, OPEC has 14 member countries: six in the Middle East (Western Asia), one in Southeast Asia, five in Africa, and two in South America. In its first ten years of existence, the only major achievement of OPEC was to prevent further cuts in oil prices. According to 2015 estimates, almost 73% of the world's proven oil reserves are located in OPEC Member Countries, with the bulk of OPEC oil reserves being in the Middle East, amounting to 66% of the OPEC total (OPEC, 2016).

The annual consumption per country, per year has been on the steady increase. Over the past 15 years alone the annual global consumption of oil has increased by 10,000 barrels per year (See Figure 1).

[Figure 1 here]

This increased consumption, along with a decade long of stable high oil prices, has led to a substantial increase in petro-dollar income, thereby allowing OPEC member states to develop investment programs in their national economies. Some of the OPEC countries have been able to implement this investment program to their benefit by using the revenue generated from oil to create foundations for sustained economic growth and investing in non-oil sectors in order to reduce dependence on oil and so to avoid the retrenchment in economic activity due to oil price shocks.

However, a growing body of the literature has been pointing at the phenomenon that *oil*, which is one of the vital resource commodities for the sustainable growth of modern developed economies, can sometimes become a *curse* for those countries that produce it.

This *resource-curse* syndrome or phenomenon is gaining traction because various studies have been able to document that countries that are rich in energy resources such as hydrocarbons and other natural resources, witness a slower economic growth over the long haul as opposed to countries that are less endowed. The relationship between resource abundance and economic and social development is becoming a subject of intense debate in recent years. Despite the historically positive association of natural resource abundance and industrial growth in many now-advanced countries, the literature covering less developed countries since the 1950s has largely drawn the opposite conclusion (Gelb, 1988; Auty, 1993; Ross, 1999; Luong and Weinthal, 2001; Bayülgen, 2005; Luong and Weinthal, 2006a; Di John, 2011).

Petroleum wealth and the extent to which the abundance of this resource affects the overall economic performance via different development indicators is the main subject of this study, which has been supplemented by an analysis on the trickle-down effects of oil price movements in the financial markets of oil exporting countries. Examining the nature of the relationship between the energy markets and financial markets, specifically the stock market, is again a challenging issue as it is difficult to gauge the extent to which asset prices are sensitive to differing economic events. Studies show(e.g., Kellogg, 2010; Stein and Stone, 2010) that when equity markets are scaled down to sector-level elements, the response of the equity index to commodity price movements differs, which makes the relationship between oil price movements and equity index response all the more important for retail and institutional investors. There is a large body of literature which has empirically tested the effects of oil price changes on the economies of both oil importing and oil exporting countries. Many studies state that oil-related volatility and investment decisions are linked (Bernanke, 1983; Hooker, 1996; Hamilton, 1996; Bjornland, 2000; Hamilton, 2003; Barsky and Kilian, 2004; Kellogg, 2010; Stein and Stone, 2010). The large consensus of these studies is that the linkage between oil price volatility or a surge in oil prices results in a negative outcome for the economies of the oil importing countries (Wanga, Wua and Yang, 2013), whereas the same surge in oil prices leads to positive economic outcomes for the oil exporting countries (Arouri and Rault, 2012; Degiannakis, Filis and Kizys, 2014). This notion negates resource endowment as a curse. This thesis thus attempts to investigate how oil affects the economic development of oil exporting countries from two differing viewpoints, giving a meaningful discourse to the oil curse theory.

1.1 Motivation

The choice of analysing the presence of oil as a curse or a blessing and its implications for the financial and economic development of OPEC countries stems from the following main reasons:

Firstly, the phenomenon of citing oil as a ‘blessing’ or a ‘curse’ remains a conundrum for OPEC countries. Several studies have been devoted to ascertain the presence of a ‘resource-curse’ in resource abundant countries. The last two to three decades have witnessed the emergence of a significant body of literature analysing the relationship between resource abundance, economic underperformance and other negative effects in terms of bad governance and corruption. However, there has been a counter narrative argument posed by the critics of the resource curse theory, who point to countries such as Norway and Indonesia, which have been able stay clear of the resource curse trap. This unresolved debate is one of the main motivations behind choosing oil-curse as the subject of this thesis.

Secondly, oil price volatility in recent times is a reminder that oil might act as a resource curse for oil exporting countries – specifically those economies that are overly dependent on petro-dollar revenue. Additionally, increased uncertainty with regard to the outlook for oil prices in the medium term – due to a slowdown in the Chinese demand as well as a major glut in the international oil market – makes it all the more relevant to analyse the effect of oil price movements on economic performance and development in the OPEC countries.

This study aims to add to the existing empirical literature, presenting theoretical and empirical arguments that will show to what extent the oil curse is present or absent in the 14 different OPEC countries. The study will be supplemented by an analysis of the volatility spill over effect of crude oil prices on the stock markets of oil exporting countries. An empirical investigation of the presence or absence of a financial contagion of oil price volatility in the OPEC countries will help us ascertain the extent to which oil can affect the financial markets in oil exporting countries. It is hoped that the outcome of this study will help policy makers determine whether the growth induced by oil revenue is sustainable or not and become aware of the imminent need to take steps to reduce overall reliance on endowed resources so as to avoid the resource curse.

1.2 Structure of the thesis

The thesis is organized into three chapters, of which the first one, this introductory chapter, presents an economic review of the GCC (Gulf Cooperation Council) and OPEC countries and an overview of the financial markets in the GCC and Saudi Arabia that is relevant to the subject of this study.

Chapter 2 examines the presence of the oil curse in the GCC and OPEC countries, in order to evaluate and gauge to what extent their economic and social development is due to the presence of oil. The contribution and objectives of the chapter are three-fold: first, the presence of the oil curse is investigated in all GCC and OPEC economies, utilizing an extended set of economic and social variables by using both parametric (panel methods) and non-parametric (regression trees) approaches. The use of such extended variables and various methodologies enhances the robustness of results and aims at shedding light on the dynamics of the oil curse in each of the countries under scrutiny. Our results provide evidence that refutes the oil curse and this conclusion still holds when different country clubs – whether they are countries with a low or medium or high oil level – are taken into account in our panel data analysis. In fact, in certain cases oil may be seen as a blessing for the 14 countries in the data sample.

Chapter 3 focuses on the oil price volatility in the GCC and OPEC countries, investigating the contagion effects of the oil price movement on the financial markets in the countries being studied. The main objective is to assess the spill over impact of oil price shocks on the financial markets. The stock markets based in the GCC are compared with those of three non-GCC countries who are OPEC members, to identify the spill over effects from oil and to gauge the impact of oil price volatility on the financial markets. The DCC-GARCH (Dynamic Conditional Correlation) model is used to capture the time-varying nature of correlations and volatilities of oil prices on the stock market behaviour in the countries under study. We find that the contagion effect of oil price shock is not prevalent in the financial markets of the entire sample of the countries under study. It is also observed that GCC stock markets show statistical evidence of financial contagion, with Abu Dhabi and Saudi Arabia being severely affected by the oil price shocks. An interesting observation is that some of the countries show evidence of decoupling, a process where following a crisis, the correlation between the financial markets and the change in oil price is minimal.

1.3 Background Information

OPEC member countries produce about 40 percent of the world's crude oil and OPEC's oil exports represent about 60 percent of the total petroleum traded internationally. According to current estimates, more than 80% of the world’s proven crude oil reserves are located in the OPEC member countries, with the bulk of OPEC oil reserves being in the Middle East, and amounting to 65% of the OPEC total (OPEC, 2016) (see Figure 2 here).

[Figure 2 here]

The rise in oil prices since 2002, which lasted until mid-2014, led to significant improvements in the external and fiscal balances of most net oil exporters (see Figure 3 here). Although the oil exporting countries benefitted the most from this 11-year oil price rally, the oil slump in the past two years from mid-June 2014 until now is having far-reaching consequences for business and economics in those same oil exporting countries. The economies of some of the oil exporting countries that rely heavily on oil exports have been hit particularly hard, as seen in the comparison between OPEC and non-OPEC developing countries (see Table 1).

[Figure 3 and Table 1 here]

The differences in the major economic indicators between the OPEC and non-OPEC economies are explained by the fact that oil exports are a high proportion of the total exports of these economies (see Table 1). This is also precisely the reason why a significant fall in the current account balances was observed for the OPEC member countries. It shows that heavy reliance on the oil and gas sector can be an impediment to the growth prospects of the OPEC member countries. However, the oil trade balance as a percentage of GDP differs from region to region, hence the economic growth and indicators of different regions are likely to have been impacted differently (see Figure 4).

[Table 1 and Figure 4 here]

1.4 Macro-Economic Review

A brief overview of the key macroeconomic indicators of OPEC countries shows the extent to which these economies have been able to use oil as a blessing and to their advantage. In the light of the current oil crisis, a quick preview of these key indicators can show the extent to which these economies can sustain themselves if the new normal of oil prices was to remain low given the supply glut by other non-OPEC members.

The oil exporters in the GCC showed a remarkable increase in the real GDP growth in the years 2007 and 2010, which can be attributed to the increasing oil prices leading to the global financial crisis in 2008. The global financial crisis only temporarily halted the upward trend in the oil prices, which regained their ground within one year. However this annual percentage change in real GDP plunged down in 2014 and 2015 due to the oil price volatility (see Figure 5). This signifies that a fall in oil prices has led to a major draw-down in government expenditure which is having far-reaching consequences on all sectors ranging from banks and services to manufacturing; this inevitably affects the real GDP growth, which has gone down significantly. With dwindling oil revenues, the focus should move away from government expenditures to the private sector, which should harness the non-oil growth and job creation and become the driving force moving it forward.

With the exception of Angola and Nigeria, the oil exporting countries of the GCC have been able to sustain low inflation rates (see Figure 6). Low inflation was observed in the GCC region, with the exception of 2007, which was largely attributed to the depreciation of the US dollar against other major currencies and since most of the currencies in the GCC are pegged to the dollar, slight inflationary pressure was seen in these countries. They have been using prudent and fiscal and monetary policies and also encouraged channelling the petro-dollar income into developing the non-oil sectors.

[Figures 7 and 8]

The OPEC countries witnessed huge surpluses on their trade and current accounts from 2005 to 2014 (See Figure 7). A comparison of the current account balance (CAB) between OPEC and non-OPEC developing countries for the period 2014 shows the extent to which the OPEC countries have been ahead of the non-OPEC ones in terms of their current account balance (for OPEC countries the current account balance was noted to be US$ 238.1 billion whereas for non-OPEC developing countries the CAB was US$ -116.8 billion) (See Table 2). However, after the fall in oil prices the CAB for OPEC countries decreased by 141.8% to a negative US$ 99.6 billion figure whereas the non-OPEC developing countries' CAB increased by 43%, rising from US$ -116.8 billion to US$ -66.2 billion in 2015. This is mainly attributed to the fact that oil exports as a percentage of total exports in OPEC countries is very high, compared to non-OPEC developing countries. Focusing just on the OPEC member countries, the CAB figures during 2005, 2010 and 2015 depict an interesting trend (See Figure 8). For example, Saudi Arabia, which had the highest CAB during the peak in oil prices, has seen a severe plunge in its CAB as opposed to Qatar which also had a high CAB during that peak. This shows that although Qatar and Saudi Arabia are based in the same region, their dependence on oil is reflected differently when there is a fall in oil prices. This directs attention to the fact that oil exporting countries which have the highest exports as a percentage of the country's total exports, or as a share of the total OPEC exports, are likely to show differing trends (see Figure 9). This shows Saudi Arabia's high reliance on its oil exports and indicates that it will continue to see the effects of lower oil prices and increasingly a trickle-down effect on the non-oil economy as spending on capital projects are reduced and subsidies are scaled back.

[Figure 9 and 10 here]

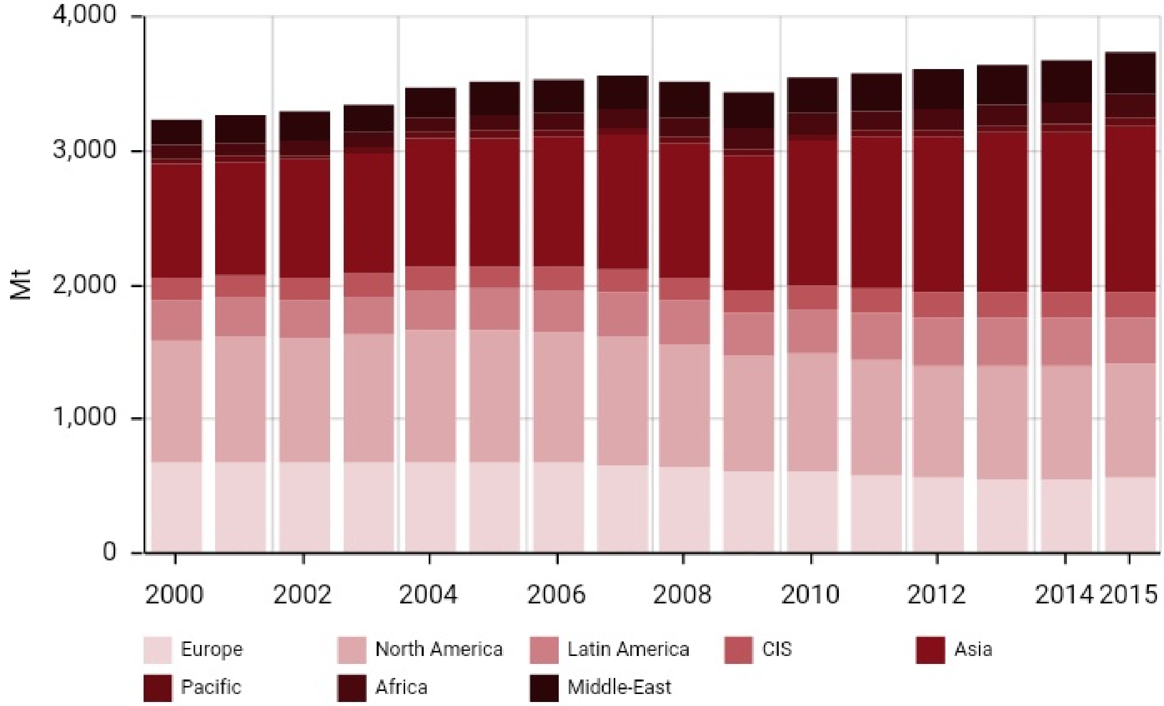
1.5 Financial market overview

1.5.1 GCC, Nigeria, Ecuador and Venezuela

The stock markets of the OPEC member countries which are under study for this research showed moderate economic growth albeit at a decreasing pace. The main impetus behind the stock markets in the GCC was linked to the increased economic activity in the private sector backed by prudent stock market reforms. In the GCC, the stock markets of Qatar, Saudi Arabia, Oman and the UAE have developed, compared to 2010, and the Index compiler MSCI upgraded Qatar and the United Arab Emirates from frontier market to emerging market status, effective from May 2014. The Qatar and Bahrain stock markets showed the highest market capitalization as a share of GDP at the end of 2015 (see Table 2). However, the S&P indices for all the given countries showed a negative percentage change from 2014 to 2015. This can be mainly attributed to the volatility in oil markets during that period and signifies the trickle-down effect on the stock markets in the OPEC member countries. In 2015, Nigeria and Ecuador, the two non-GCC OPEC member countries, showed a dismal performance in terms of turnover and market capitalization as compared to 2010. Moreover, the S&P indices in these markets experienced the greatest fall, with 23% and 27 % for Ecuador and Nigeria respectively.

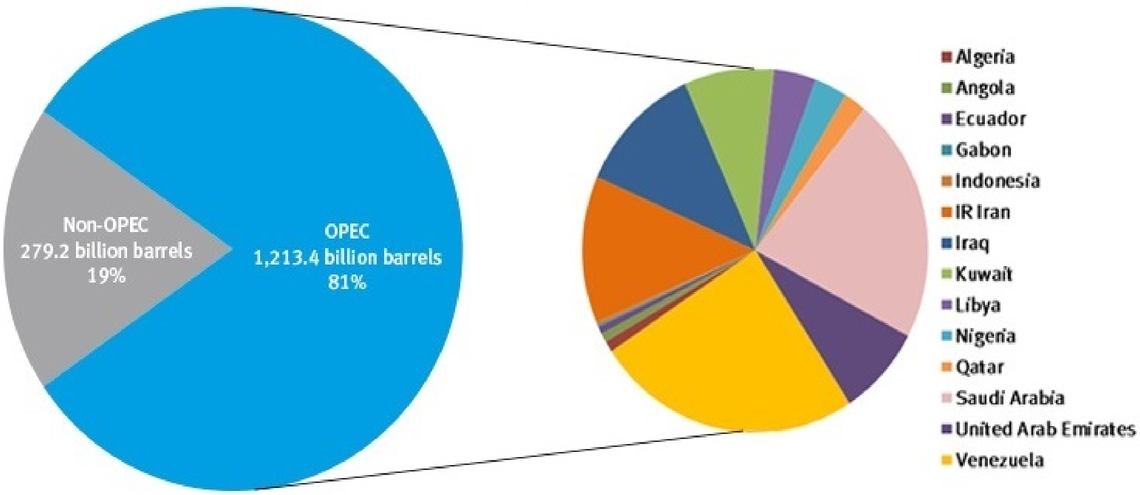
[Table 2 here]

Figure 1: The Annual Global Consumption of Oil



Source: Enerdata (2016)

Figure 2: OPEC Share of World Crude Oil Reserves, 2015

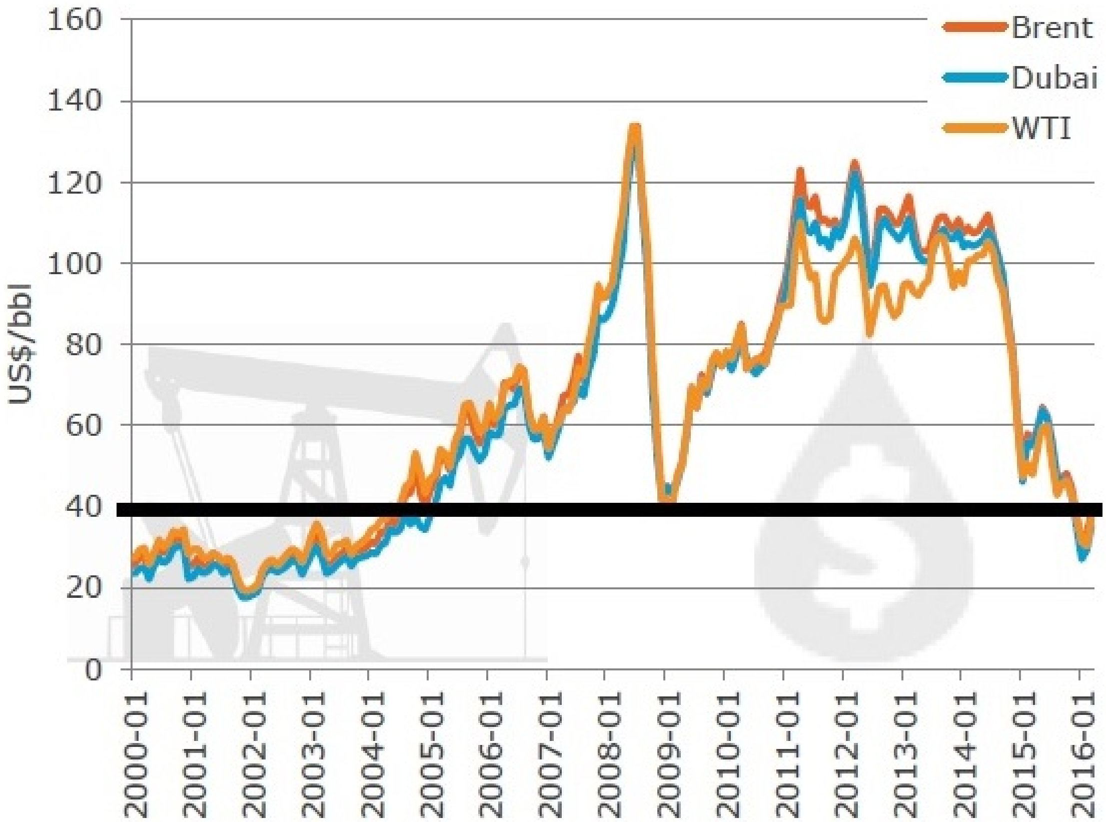


OPEC proven crude oil reserves , at end 2015 *(billion barrels, OPEC share)*

Venezuela	300.88	24.8%	Kuwait	101.50	8.4%	Qatar	25.24	2.1%	Indonesia	3.23	0.3%
Saudi Arabia	266.46	22.0%	United Arab Emirates	97.80	8.1%	Algeria	12.20	1.0%	Gabon	2.00	0.2%
IR Iran	158.40	13.1%	Libya	48.36	4.0%	Angola	9.52	0.8%			
Iraq	142.50	11.7%	Nigeria	37.06	3.1%	Ecuador	8.27	0.7%			

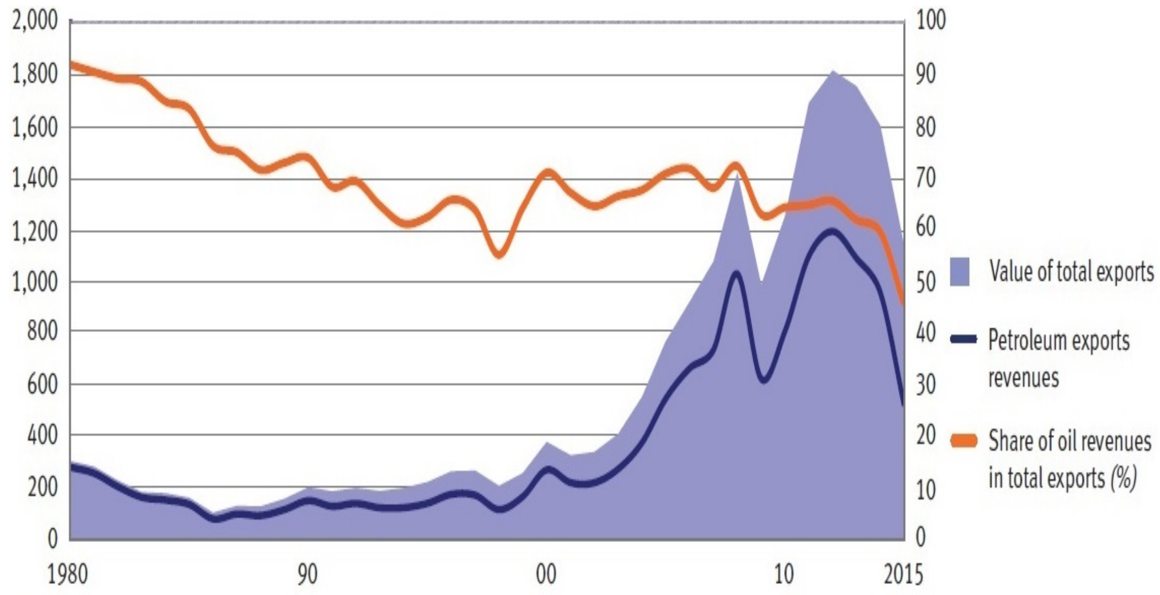
Source: OPEC Annual Statistical Bulletin 2016.

Figure 3: Crude Oil Price Evolution, 2015



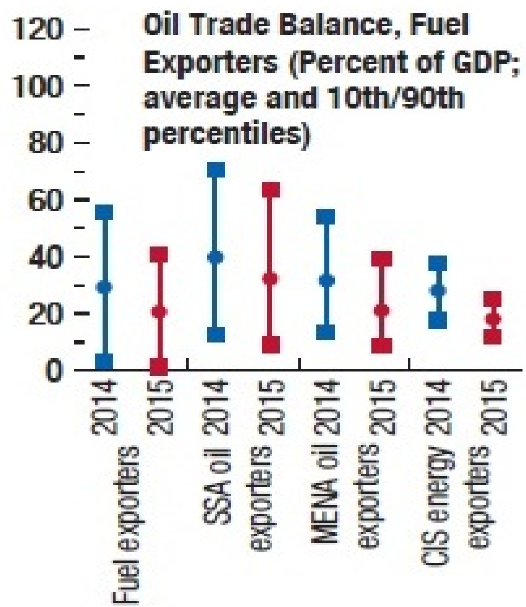
Source: Bloomberg (2016)

Figure 4: OPEC oil export revenues vs value of total exports (bn $)



Source: OPEC Annual Statistical Bulletin (2016)

Figure 5: Oil Trade Balance for Fuel Exporters



Sources: International Energy Agency (IEA); IMF, Primary Commodity Price System; Organisation for Economic Co-operation and Development; and IMF staff estimates.
Note: APSP = average petroleum spot price; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa; SSA = sub-Saharan Africa

Figure 6: Annual Real GDP Growth in OPEC member countries

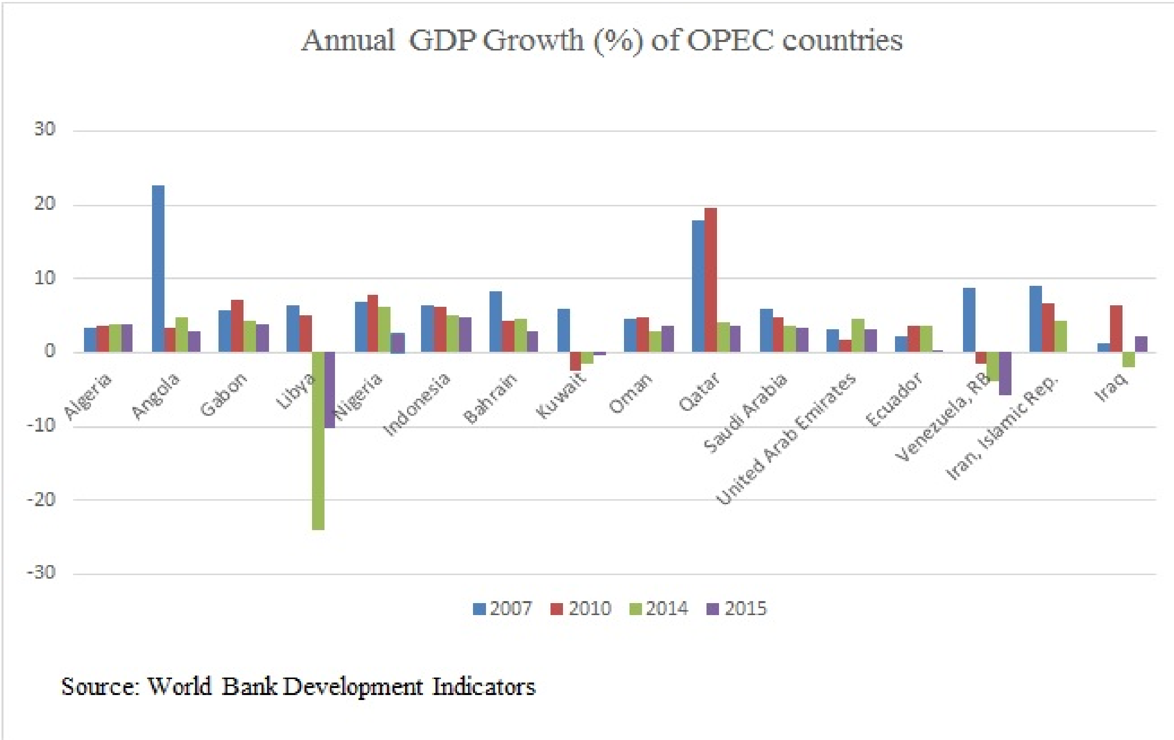
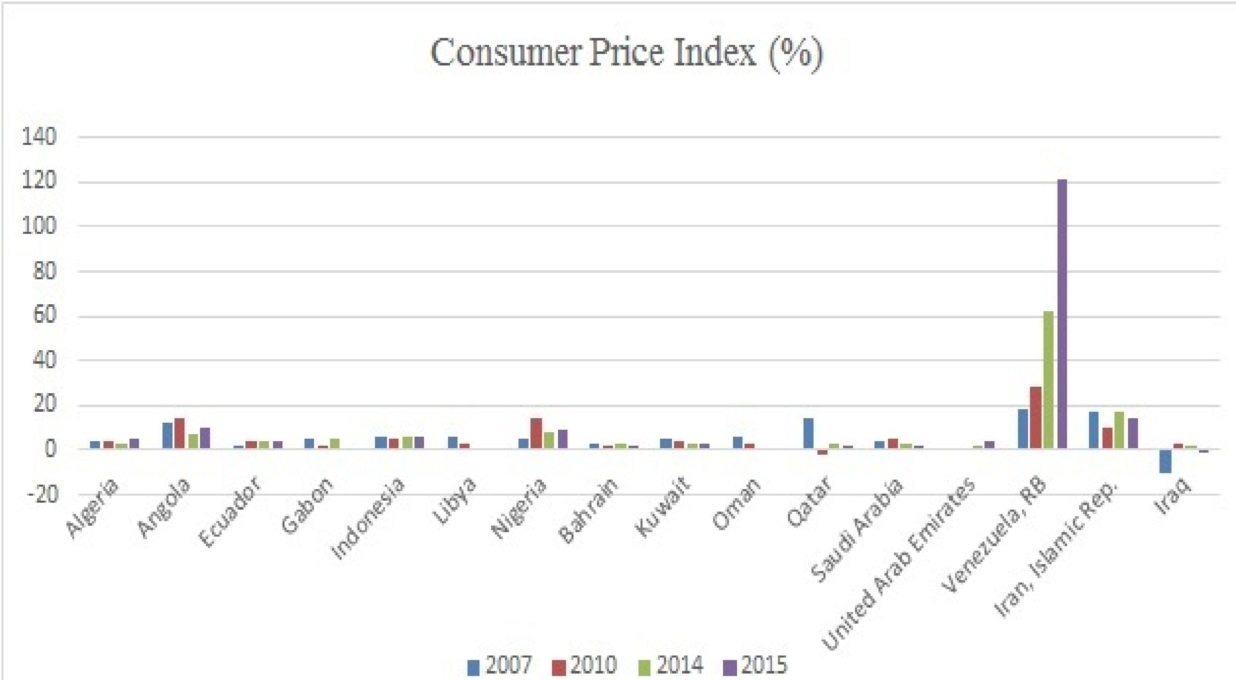
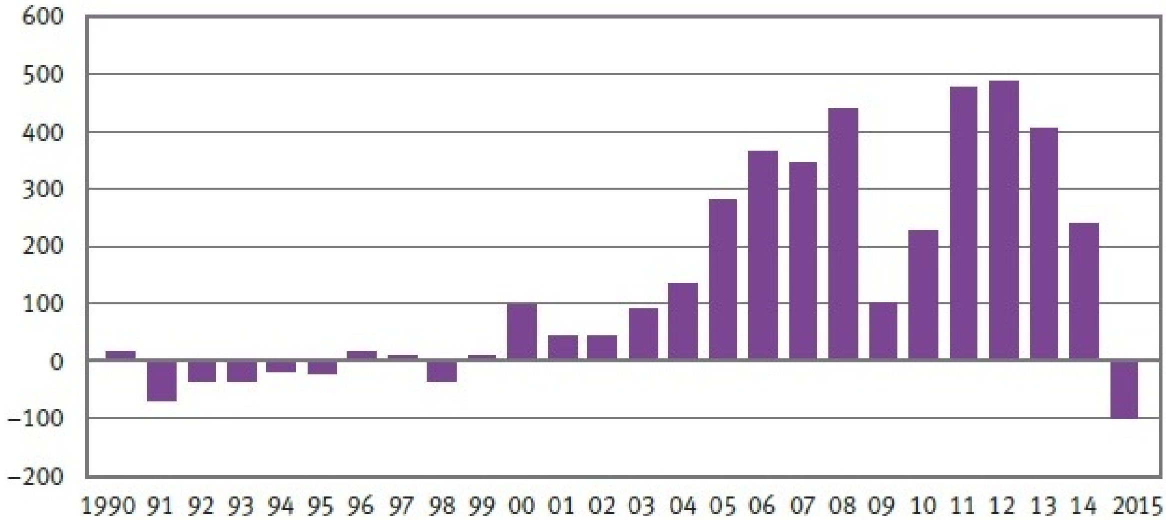


Figure 7: Inflation (CPI (%)) Rate in OPEC member countries



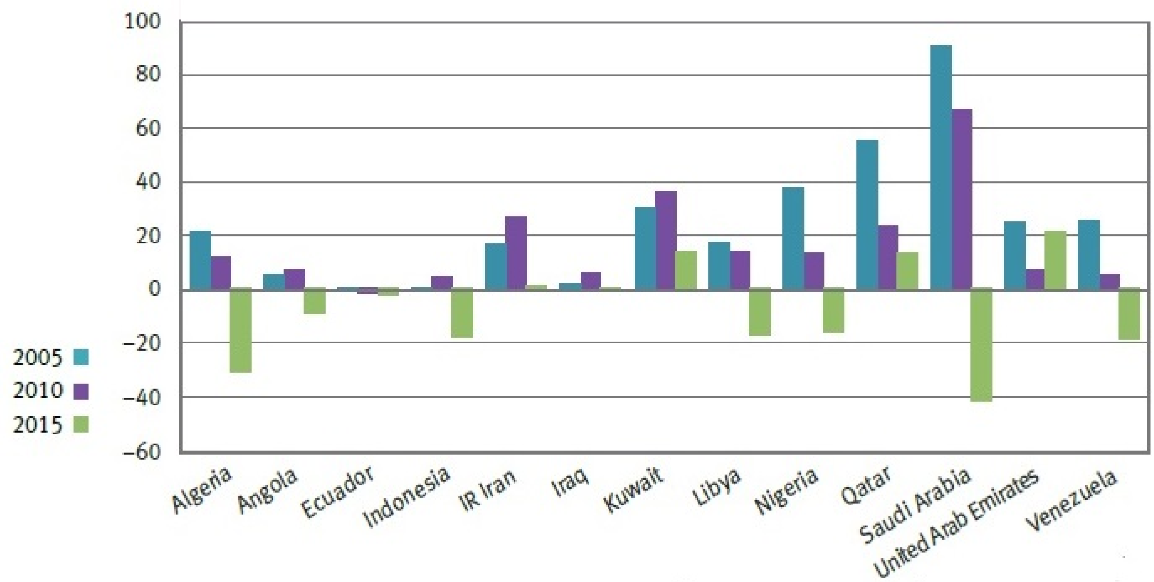
Source: World Bank Development Indicators

Figure 8: Current Account Balances in total OPEC ($ US billion)



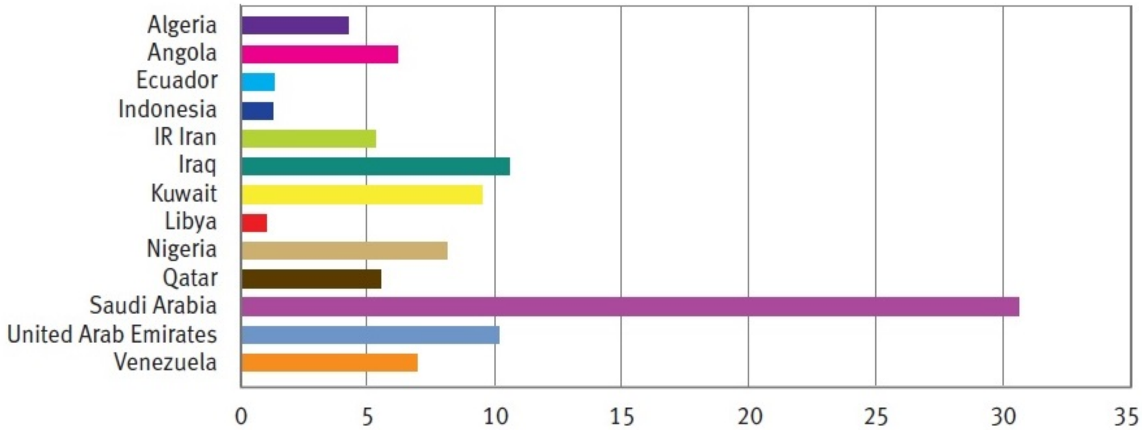
Source: OPEC Annual Statistical Bulletin (2016)

Figure 9: Current Account Balances in total OPEC Members ($ US billion)



Source: OPEC Annual Statistical Bulletin (2016)

Figure 10: Values of Petroleum Exports as a Share of Total OPEC, 2015 (per cent)



Source: OPEC Annual Statistical Bulletin (2016)

Table 1: Comparison of Macroeconomic Performance of OPEC and non-OPEC Developing Countries

	2014		**2015**	
	OPEC	**Non-OPEC**	**OPEC**	**Non-OPEC**
Real GDP growth rate *(%)*	2.9	3.8	2.3	3.1
Petroleum export value *(US $ bn)*	956.2	380.9	518.2	243.7.
Value of non-petroleum exports *(US $ bn)*	648.4	3,011.2	618.8	2,743.5
Oil exports as percentage of total exports *(%)*	59.6	11.2	45.6	8.2
Value of imports *(US $ bn)*	1,062.7	3,829.2	970.0	3,361.1
Current account balance *(US $ bn)*	238.1	-116.8	-99.6	-66.2
Crude oil production *(mb/d)*	30.8	9.4	31.8	9.6
Reserves, excluding gold *(US $ bn)*	1,508.6	2,716.3	1,294.2	2,726.2

Source: OPEC Annual Report (2015)

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Table 2: Key Stock Market Indicators

	Market Capitalization				Market Liquidity Value of shares		Turnover ratio value of shares		Listed domestic number		S&P/Global Equity	
	$ millions		% of GDP		% of GDP		% of market				% change	
	2010	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2014**	**2015**
Bahrain	20,060	19,251	78	59.7	1.1	0.9	1.4	1.5	44	44	4.1	-12.3
Ecuador	..	..	..	..	..	..	..	..	..	..	0.7	-23.4
Kuwait	119,620	..	99.74	..	13.9	23.2	..	..	215	0	-8.7	-18.3
Nigeria	50,546	49,974	13.7	10.4	1.4	0.8	10.1	8.2	215	183	-31.9	-26.8
Oman	28,316	41,123	48.3	58.5	5.6	5.1	11.7	8.7	114	116	-3.6	-12.8
Qatar	76,531	142,556	66.4	85.4	14.7	14.5	63	16.9	43	43	23	-18.6
Saudi Arabia	353,410	421,060	67.1	65.2	38.2	67.6	56.9	103.8	146	171	-6.5	-17.7
UAE	131,491	195,874	46	52.9	9.7	15.6	21.1	29.4	104	125	12.7	-18.1
Venezuela, RB	..	..	..	..	..	..	..	..	55	37	..	..

Chapter 2

Resource Curse in Oil Exporting Countries: Fact or Fiction

Abstract

The negative relationship between natural resource abundance and economic growth of a country has been termed as the *resource curse*. One of the most important natural resources for a country's economy has been oil, and consequently is the one resource that has been studied the most in this context. However, mixed findings in the literature do not offer a solid conclusion as to whether the oil abundance in a country is a "curse" or a "blessing".

Against this background, this chapter contributes to the current empirical literature by examining the presence of an oil curse and exploring the joint impact of oil with other factors on the per capita GDP growth, with the focus on 14 oil exporting countries listed in both the GCC and OPEC over the period 1980 - 2014. The Arellano-Bond difference Panel GMM method is adopted to account for any omitted variable bias and endogeneity issues. Traditional random/fixed effects estimators are also considered in the panel data analysis to highlight the benefits of adopting the difference GMM approach and also maintain a large degree of comparability with the literature. Furthermore, we make use of the method of classification trees to divide the countries based on their oil level and re-consider the association between oil and per capita GDP by accounting for the country differences in terms of the per capita oil reserve as well as oil rent.

Our results suggest that there is no significant evidence of an oil resource curse in our sample. This is robust to alternative specifications, an array of macroeconomic and socioeconomic indicators, which have been considered in the literature.

Keywords: JEL Classification: C53; C32; C14; C15; G12

2.1 Introduction and Motivation

It has been universally accepted that natural resource wealth is not always a blessing. In some empirical cases, it goes hand-in-hand with poverty, corruption, environmental damage and civil conflict and does not function well in accelerating economic development. Among a various range of natural resources, crude oil is undoubtedly the most important one and thus attracts substantial interest of researchers and policy makers. In general, great poverty and impoverishment in spite of abundant oil resource wealth is the so-called *paradox of plenty* or the *oil curse*.

As pointed out by Ross (2012), before 1980, there was almost no evidence for the presence of oil curse. Among the developing countries, the oil members are similar to their non-oil counterparts in the way that they had authoritarian governments and were trapped by civil wars. However, since 1980, non-oil countries in the developing world have generally become more affluent, democratic and peaceful, while the oil countries, mainly located in the Middle East, Africa, Latin America and Asia, do not seem to progress in these aspects and the economic situations in some of the listed areas are even worse. It is also worth noting that not all countries with abundant oil resources are found to exhibit the oil curse. Examples are Norway, Canada and Great Britain, which have extracted amounts of oil but maintain strong economies and high incomes. The most extreme case is the United States, which has been both one of the global leading oil producers and the largest economy in the world. Against this background, the most complicated impact of this curse is observed in the oil countries in the developing world. The regions own more than 50 percent of the world's recorded oil reserves but they also drop behind the other countries not only in terms of economies, but also in terms of democracy, gender equality, education and so on. On the plus side, the substantial oil resource has helped some countries, such as the United Arab Emirates and Oman to make dramatic economic enhancements in a short time period; thus promoting development in other fields.

Given the mixed effects of the oil resource, this paper concentrates on the situations in countries listed in both the Gulf Cooperation Council (GCC) and the Organisation of the Petroleum Exporting Countries (OPEC). In specific, our sample countries include Algeria, Angola, Bahrain, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Oman, Qatar, Saudi Arabia, United Arab Emirates (UAE), and Venezuela. We examine the presence of the oil curse among these countries using different oil proxies, i.e. per capita oil reserve and oil rent, for the robustness of empirical results. Based on a panel data analysis, our paper applies both the popular random effects estimator and the Arellano-Bond generalised method of moments (GMM) technique. The latter dominates the former in dealing with the endogeneity problems induced in the procedure we undertake. In addition, we exploit the method of classification trees to split the sample countries according to their level of oil abundance and account for the differences in countries' oil resources in our panel data investigation, which allows us to further evaluate the effects of the oil reserve on economic development. Notably, we also include a range of economic variables to measure the effects on economies of education, health, democracy, openness, the role of government and so on. Our paper contributes to the existing empirical literature in a number of aspects. First, we look at the most important energy resource, oil, for both GCC and OPEC countries over a relatively long time period. Second, we investigate the oil curse by employing various panel-data techniques to ensure the robustness of the empirical results. As far as we are concerned, this is the first paper which employs the method of classification tree to split countries according to their oil abundance. Third, this paper selects variables for empirical analysis according to the neoclassical growth theory and thus is able to take a closer look at the effect of different factors on economic development.

This chapter consists of 6 sections of which this is the first. Section 2 describes the sample data. Section 3 outlines the methodology and the hypothesis to be tested. Results are presented and interpreted in section 4. Conclusions are discussed in section 5.

2.2 Background Information: The Resource Curse

The *resource curse* is a well-documented phenomenon in the natural resource-exporting economies, whereby economies that are rich in natural resources have been found to exhibit low economic growth despite their advantageous situation. Historically, it has been documented in studies by Gelb (1988), Auty (1990), Sachs and Warner (1995), and Gylfason et al. (1999) that economies endowed with natural resources tend to underperform economically relative to expectations**.** Alongside poor economic growth, these economies are in a worse than expected social and political situation. As Ross

(2014, p.250) puts it, “The perverse effects of a country’s natural resource wealth on its economic, social, or political well-being”.

In this section, we give a brief historic overview to the resource curse and present the most prominent explanations that have been put forward in the literature.

2.2.1 History of the resource curse

The interest in the impact of great wealth goes back to the fourteenth century when the Arab philosopher Ibn Khaldun identifies the fifth stage of the state as one of waste and squandering (Gates, 1967). Two centuries later, French philosopher Jean Bodin praises the citizens of infertile lands by stating that “Men of a fat and fertile soil are most commonly effeminate and cowards; whereas contrariwise a barren country makes men temperate by necessity, and by consequence careful, vigilant and industrious.” (Cited in Sachs and Warner, 1999, p. 14).

In the Golden Age of resource-based development between 1870 and 1914, the conventional thinking was that natural resource abundance is a benefit for development. In fact, many resource-rich countries such as the United States and Germany outperformed resource-poor countries (Auty 1993; 2000; 2001a). Rostow (1960) argued that large natural resource endowments would enable developing countries to make the transition from an underdevelopment stage to that of an industrial ‘take-off’, just as happened with countries like Australia, the United States, and Britain.

Scepticism on the negative impacts of being producers and exporters of natural resources on economies emerged during the 1950s and 1960s (Prebisch, 1950, 1964). Singer (1950) argued that primary product exporting countries would find themselves disadvantaged in trading with the industrialized countries because of deteriorating terms of trade. Furthermore, Hirschman (1958), Seers (1964) and Baldwin (1966) reinforced this negative consequence by arguing that linkages from primary product exports would be limited compared to manufacturing. In contrast, Roemer (1970) and Lewis (1989) argue that primary products could promote growth. In general, natural resources were seen as a blessing, not as a curse in developing countries.

The oil crises in the 1970s shifted the focus to the oil exporting countries. Some of these resource-rich countries stagnated as a result of the changes in the world economy following the oil crises since the large-scale revenues could not be sustained once oil prices plummeted. Naturally this put a halt in the development prospects of these countries, while at the same time the academic literature on oil and hydrocarbons resources emerged (Mabro and Monroe, 1974; Mabro, 1980; Neary and Van Wijnbergen, 1986).

Arguments about the beneficial role of natural resource endowments on a country's industrial development were put forward by Balassa (1980), Drake (1972) and Krueger (1980), disregarding the oil crises experience of the oil producing economies. However, Gelb et al. (1988) offered an alternative explanation, and were the first to use the term 'curse'. The explanation, which was formalized by Auty (1993), was based on a negative relationship between the endowment of natural resources and economic growth.

Since then, a large body of studies employing a variety of methodological approaches has examined the link between natural resources and economic growth. In particular, the influential research by Sachs and Warner (1995, 1997, 1999, 2001), who were the first to investigate the curse empirically using different countries and periods. These studies solidified the existence of a resource curse, while extending its repercussions at other parts of an economy with demographic, social and political impacts.

Despite the evidence surrounding the negative relationship between natural resource endowment and economic growth, there has been a lack of understanding on why this phenomenon occurs. As a result, several theories have emerged in an attempt to explain why the resource curse occurs.

The interest on the resource curse has reached a wider audience, including non-governmental organizations (NGOs), who are mainly concerned with the treatment of natural resources (especially non-renewable ones) as well as achieving the best use of them in promoting economic growth and society welfare (Collier and Hoeffler, 2004; Collier, 2010). A growing attention on behalf of policy makers is also warranted given the oil price volatility between 1998 and 2006 as well as the sustained low oil prices around 2014 onwards that jeopardise economic planning in the resource rich economies.

2.3 Explanations of the resource curse

2.3.1 The Dutch disease

The term ‘Dutch Disease’ was coined in the 1960s to describe the collapse of the Netherlands’ manufacturing sector following the discovery of a Groningen natural gas field. This term is used in a narrower meaning, as defined by Sarraf and Jiwanji (2001) who state that “a failure of resource-abundant economies to promote a competitive manufacturing sector” (In Stevens et al, 2015, p.14), but over time, the term ‘Dutch disease' was given a broader meaning to involve all negative macroeconomic effects related to the resource curse. The classical version of the Dutch Disease was first modelled by Corden and Neary (1982). Corden (1984) developed a model that showed how capital moves away from non-oil sectors, thus reducing their competitiveness, often in conjunction with an exchange rate appreciation.

Furthermore, existence of the Dutch Disease can be harmful to any economy in many different ways. It can slow the competitiveness in industrialization and delay the absorption of excess rural labour as argued by Auty (2007), and can be inhibited from being the main driving force within the economy (Fosu, 1996). Frankel and Romer (1999) argued that the Dutch Disease could slow down economic growth by hindering exports in manufacturing and service sectors. Ismail (2010) reported an average fall of 3.4% in value added in manufacturing recorded with every 10% oil windfall profits. Herbertsson et al. (1999) explained that existence of the Dutch Disease could affect all economic sectors based on the results from the domestic supply shocks in Iceland. In addition, Gylfason et al. (1999) showed that a natural resource boom is associated with raw-material exports that can raise real exchange rate and reduce manufacturing and service-exports; thus reducing investment in the tradable sector as well as goods and services imports and exports.

However, the resource curse is often presented as a symptom of the Dutch disease, thereby failing to fulfil its purpose of explaining the resource curse. For example, decreasing in savings and physical investment (Gylfason, 2001; Papyrakis and Gerlagh, 2007), restricted entrepreneurship (Sachs and Warner, 2001), as well as lowered investment in human capital and education (Gylfason, 2001; Birdsall et al., 2001; Bravo-

Ortega and Gregorio, 2007) cannot be explained solely by the Dutch disease, yet these are fundamental repercussions of the resource curse.

Mikesell (1997), Leite and Weidmann (2002), and Sala-I-Martin and Subramanian (2003) concluded that the Dutch disease was not the major deterrent of economic growth in most of the countries investigated. By contrast, Conway and Gelb (1988) and Gelb et al., (1988) found an improvement in manufacturing and agriculture sectors in the case of Algeria, and an exchange rate depreciation at the same time. In addition, Sarraf and Jiwanji (2001) argue that de-industrialization may be the result of adjustment towards a new equilibrium in the economy and not because of the Dutch disease phenomena. In addition, some countries like Australia, Norway and the United Kingdom managed to diversify their economies to prevent the long-term negative effects. Consequently, a decline in the level of manufacturing (e.g., in the Netherlands) can neither be attributed to the increased level of spending on social services nor any resource curse.

2.3.2 Rent seeking behaviour

Rent seeking behaviour refers to a situation where an individual or a firm works towards increasing their own share of wealth without necessarily increasing the overall level of wealth (Baland and Francois, 2000). Deacon (2011, p.125) defined rent seeking as “the process whereby competing political interests expend economically valuable resources to obtain government favours”. Krueger (1974) develops the rent seeking concept to explain activities that would develop the institutions on the basis of specific rents, and it is a key part of the social activity. This type of behaviour can lead a country’s economic situation to be worse off (Papyrakis and Gerlagh, 2004).

There are a large number of studies on how rent seeking can determine how the economy operates (Svennsson, 2000; Torvick, 2002, Mehlum et al., 2006). Torvik (2002), Sandbu (2006), and Robinson et al. (2006) argued that the negative impact on economic growth caused by activities of rent seeking is linked with abundance of natural resource. Torvik (2002) shows that as the number of entrepreneurs involved in rent seeking behaviour increases, a decrease in economic growth is expected. In addition, Auty (1998) and McMahon (1997) findings indicated that an increase in natural resources would result in lowering the welfare of the economy.

Auty (1998) argued that rent seeking behaviour diverts attention from long-term development goals towards maximizing rent creation activities. Tornell and Lane (1999) conclude that in the resource rich economies, the rent seeking behaviour will cause the growth rate to fall as a result of capital reallocation to less productive sectors that are safe from taxation. Meanwhile, Sachs and Warner (1997) added that rent seeking would lower growth along the steady state, by lowering steady state income. In addition, rent seeking can create a powerful lobby that can hinder the progress of economic reform, and this could raise the social costs of development (Wenders, 1987).

Rent seeking has often been regarded as being inherently linked to perverse fiscal redistribution, inefficient capital projects and corruption. The relation between extensive rent seeking and corruption in business and government was explained by Shleifer and Vishny (1993) who argued that this relationship can distort the allocation of resources and reduce both economic efficiency and social equity.

2.3.3 Institutions Quality

Economic development of a country can be affected by the effectiveness of the government and its institutions' merits, such as the level of corruption and the applicability of a rule of law (Ross, 2014). In resource-rich economies it is often evidenced that the government (often made up by dictators) abuses its power, which adversely affects economic performance. In particular, Gelb et al. (1988) argues that resource revenues are often committed by national governments to supporting existing political and economic institutions. Moreover, a study by Mauro (1995) concludes that resource dependence is strongly associated with a high corruption index and lower economic growth. In fact, as Lei and Michaels (2014) and Arezki et al. (2015) argue large oil discoveries are increasing the incidence of armed conflict by five to eight percentage point. A tendency of naturally rich resource countries to become involved in international conflict, or indeed to be the target of international conflict has also been highlighted (Stijns, 2005).

The prevalence of non-democratic governments in resource-rich economies has been highlighted in Mavrotas et al. (2006) and Ross (1999, 2001a), *inter alia*. Also, these economies will suffer from a wider list of perils including low quality education, rising unemployment, income inequalities as well as poor quality health services, public sector infrastructure and foreign policy (Gylfason, 2001; Birdsall et al., 2001; Bravo-Ortega and Gregorio, 2007; Cao et al., 2015). Many studies have investigated the link between institutional efficiency and economic growth in resource-rich countries either focusing on a regional/global level, see for example Ades and Di Tella (1999), Treisman (2000), Leite and Weidmann (2002), Serra (2006), Ross (2001a), Barro (1999), Aslaksen (2010), Bhattacharyya and Hodler (2010) or on specific countries including Colombia (Angrist and Kugler, 2008), Nigeria (Sala-i-Martin and Subramanian, 2003), Congo (Acemoglu et al., 2003), São Tomé and Cape Verde (Vicente, 2010), Brazil (Caselli and Michaels, 2013) and the US (Papyrakis and Gerlagh, 2007) among others.

By contrast, Atkinson and Hamilton (2003) document a positive relationship between institutional quality, saving/investment rates and per capita GDP. In sum, the resource curse can be turned into a blessing with existence of efficient institutions (Atkinson and Hamilton, 2003; Mehlum et al., 2006; Robinson et al., 2006; Sarr et al., 2011).

2.4 Resource curse: Empirical evidence

It is crucial to understand the nature of the relationship between natural resource abundance and economic growth as this will help to understand the determinants of economic growth and the measurement of sustainability. Therefore, a large body of literature has focused on the causes of the resource curse.

A large number of studies investigate the negative correlation between natural resource abundance and economic growth (for example: Gelb, 1988; Ranis, 1991; Matsuyama, 1992; Auty 1993, 2001a; Bulmer-Thomas, 1994; Sachs and Warner, 1995, 1997, 1998; Karl 1997; Luong and Weinthal, 2006; ODI, 2006; Rosser, 2006; Papyrakis and Gerlagh, 2007; Frankel, 2012; Gylfason, 2001; Bhattacarya and Hodler, 2010; James and Aadland, 2011). Most of these studies confirm that a negative relation between natural resource abundance (i.e., resource curse) on economic growth is observed.

The identification of what constitutes a natural resource with regards to the resource curse and whether different resources affect economic growth differently has been investigated in Sala-I-Martin and Subramanian (2003), Bulte et al. (2005), Isham et al. (2005), and Mavrotas et al. (2006) and Isham et al.’s (2003) for resources including oil, minerals, plantation crops, coffee and cocoa.

Sachs and Warner (1995, 1997) were the first to conduct an empirical study of the curse using a cross-country analysis, to investigate what they called a ‘puzzle’ and ‘oddity’. Their studies’ findings resulted in the confirmation of a significant strong negative relationship between the ratio of primary exports to Gross National Product (GNP), as a proxy for resource endowment, and the growth rate of Gross Domestic Product (GDP) per capita. In particular they investigated the negative link between resource endowment and economic growth in a sample of 95 developing countries over the period 1970-1990. They found that only two countries, namely Malaysia and Mauritius, sustained 2% per annum economic growth during 1970-1980, while for the rest of the countries considered; the results confirm the negative correlation. Since the works of Sachs and Warner (1995, 1997), the resource curse phenomenon has been confirmed by a vast number of studies (Gylfason et al., 1999; Ross, 1999; Auty, 2001a; Papyrakis and Gerlagh, 2004; Mehlum et al., 2006; Van der Ploeg and Poelhekke, 2009, 2016) documenting the significant negative relationship between resource dependency in the economy and the GDP; thereby giving evidence in support of the resource curse.

The negative effect of the natural resource curse was not a definite in all cases; some studies couldn’t identify the direct impact of natural resource on economic growth. Sachs and Warner’s (2001) study pointed out that the resource curse has no direct impact on the nature of wealth; they added that extensive wealth minimizes the growth of the economy particularly through crowding out promoting growth activities. De Ferranti et al. (2002)

added that negative economic growth is a reason for dependence on primary commodities exports and not as a result of resource effects on government investment, education or crowding out effect of manufacturing or entrepreneurship. In addition, Maloney (2002) argues that the economic growth process happens across a very long time and cannot be summarized and concluded by cross-section regression for a short period of time. Furthermore, Larsen (2005) examined the relationship between the richness of Norway and the resource curse using structural break techniques and data from 1960 to 2002. Results confirmed that after discovery of oil, Norway accelerated its GDP per capita growth relatively to GDP per capita of Denmark and Sweden. More studies have questioned the existence of the resource curse, including Davis (1995), Gylfason (2001), Sarraf and Jiwanji's (2001), Stijns (2005), Brunnschweiler (2008) and Neumayer (2004) for a variety of countries, time periods, measures and techniques.

Corden and Neary (1982), Neary and Van Wijnbergen (1986), Gelb (1988) and Auty (1990) are among the first studies to highlight some of the economic and political causes that might be behind the poor economic performance of resource-rich economies. Gelb et al. (1988) and Auty (1993) focused on macroeconomic policies, while Mehlum et al.'s (2006) results illustrated how failed policies and weak institution can facilitate corruption and decrease growth. Relatedly, Yaduma et al. (2013) tested the robustness of the resource curse using genuine income measures[1] of economic output as an indicator of sustainable development, as well as GDP. The existence of an oil curse was investigated for 49 OECD and non-OECD oil-exporting economies from 1980 to 2007, by applying a dynamic panel growth regression model. Their results suggest that oil abundance is a

[1] Genuine Income is defined as Gross National Income (GNI) less physical and natural capital depreciation.

blessing rather than a curse but only for the OECD countries. On the contrary, oil abundance is a curse in the non-OECD economies. More recently, Papyrakis (2016) argues that the impact of the resource curse goes beyond economic growth; hence human development indices and sustainability indicators need to be taken into account.

2.5 The Resource Curse in Oil Exporting Countries

Boschini et al. (2007) argued that possibility of the curse could be defined by the type of resources. Various studies show that mineral-intensive countries (especially the oil-endowed ones) seem to fail to achieve a high level of economic growth compared to less endowed countries. Typically, such are the country-members of the OPEC and GCC political unions as well as countries in the MENA region.

Ross (2014) argued that petroleum has at least three important effects: it makes authoritarian regimes more durable, heightens corruption and triggers violent conflicts in low and middle-income countries. He stressed that one resource in particular has been consistently correlated with corruption, political environment and stability: “petroleum”. Studies by Mahdavy (1970), Beblawi (1987), Crystal (1990), Bellin (1994), Yates (1996), Chaudhry (1997) Vandewalle (1998), Aslaksen (2010), Tsui (2011), Gassebner et al. (2012), Ahmadov, (2013), concluded that oil abundance and prevalence of democracy are inversely related, with negative repercussions on economic growth, as discussed in earlier sections.

Badeeb et al. (2016) examined the oil curse in Malaysia, placing emphasis on the indirect effect of oil dependence on the finance-growth nexus via the investment quantity and efficiency channels. Their findings show a significant direct effect of financial development on economic growth and total factor productivity, and a direct and positive effect of financial development and oil dependence on the level of investment. The significant negative interaction between financial development and oil dependence supported the findings of Doraisami (2004), who argued that Malaysia is affected by the oil curse.

Gelb et al. (1998) study the impact of oil reserves on economic development in six oil-exporting countries (Algeria, Ecuador, Indonesia, Nigeria, Trinidad and Tobago and Venezuela). Their results show evidence in support of the resource curse in these oil exporter countries. Shams' (1989) results show that "some OPEC countries have a negative relationship between oil revenue and GNP in long term and between oil revenue and investment in short term" (In Stevens, 2015, p.9). Mikesell (1997) concluded that Saudi Arabia and Venezuela have lower than average GDP growth rates, while Mexico is presented as an example of a country that suffered from the resource curse.

The Nigeria case is, perhaps, the most dramatic example of a country hit by the resource curse (Collier and Gunning, 1999; Sala-I-Martin and Subramanian, 2003). In particular, Van Der Ploeg (2011) argues that in spite of the huge oil exports and the increase in oil revenues from 33US$/capita in 1965 to 325US$/capita in 2000, Nigeria counted as one of the fifteen poorest countries in the world since becoming independent in 1960. Between 1970 and 2000 part of the Nigerian population has to survive on less than 1 US$ daily. Moreover, the Nigerian economy has suffered from a Total Factor Productivity (TFP) decline of by 1.2% yearly since independence.

Another example is Venezuela with Agnani & Iza (2011) finding evidence of the resource curse over the period 1950 to 2006. When comparing the growth rate of Venezuela with those of Mexico and Norway (major oil exporting countries), the results showed that the underperformance characterizing Venezuela has not occurred in other oil-abundant and oil-exporting economies such as Mexico and Norway. In addition, the findings of this study didn't support the effect of the magnitude of the oil rents on economic growth, and attribute the poor performance of the non-oil sector to bad government policies.

Escobar and Le Chaffotec (2015) failed to find evidence for a resource curse when examining the effects of OPEC membership on economic development. They used per capita GDP as the dependent variable, and oil reserves, membership in OPEC, democracy index and population as an independent variables. Their results showed that OPEC membership exerts a significant and positive impact on the GDP per capita of its members. In addition, the findings indicated that the benefits of oil reserve endowment are higher for OPEC countries, but these benefits decrease at higher levels of economic development.

Al-Youssif (1997) examined the relationship between oil exports and economic growth for four GCC countries[2]: Kuwait, Oman, Saudi Arabia and the United Arab Emirates (UAE) for the period 1973-1993. The findings of this study show that in the short-run there are signs of a positive relationship between oil exports and economic growth, but this relation disappears in the long run. This study also concluded that the diversification of the economies of these four countries was crucial to long-term economic growth. In addition to Al-Youssif's (1997) study, Harb (2009) found that the oil exports of Kuwait,

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[2] The majority of empirical studies focusing on the resource curse did not include the Gulf Cooperation Council (GCC) countries as a result of the lack of the data, which became available more recently. Since then, various studies emerged in an attempt to investigate the relationship between oil and economic growth and the existence of the curse in these countries.

Oman, Qatar, Saudi Arabia and UAE did not have a long-run impact on the overall performance of the economy. Harb (2009) argued that the oil revenue was not responsible for bad economic performance of these countries, but the absence of the relationship between natural resources and economic growth.

Al Awad (2010) examined the role played by manufacturing sector and growth of the non-oil economy in the GCC. Results show that manufacturing has strong association with non-oil economic growth in GCC over the long run. In the short run, outcomes indicated that manufacturing have no significant impact towards stimulating the non-oil GDP growth levels, and government spending might be ineffective to obtain non-oil GDP growth or stimulating efforts in diversification. At the same time, it was noted that failure of industrialization or manufacturing strategies had a strong effect on the growth of non-oil GDP, and effects of diversification in terms of institutions and policies than income availability. Results show that institutions and policies are more significant than population and income in promoting the manufacturing sector and differentiate the economy away from oil resources.

Behbudi et al. (2010) examined the relationship between human capital, natural resource abundance and economic growth in two groups of oil-exporting countries, namely major oil exporters and other oil exporters in the second, using panel data for the period 1970 to 2004. Their results showed an inverse relationship between natural resource abundance and economic growth in both groups. Arezki and Nabli (2012) noted that the resource-rich nations in the MENA region have experienced low growth of their economy and high macroeconomic volatility levels over the past 40 years. They also concluded that major reforms in the field governance and institutions are important to achieving economic transformation. In an earlier study, Makdisi et al. (2010) examined the determinants of growth in the MENA region and confirmed the existence of the resource curse. According to the authors, human capital and institutions' quality are responsible for lower performance of MENA nations. Other studies in the MENA region have found evidence in favour of the resource curse, such as Alsayaary (2013), Dreger and Rahmani (2014), Driouchi (2014), and Ncube et al (2014). The majority of these studies besides the negative link between oil reserves and economic growth, find a negative relation between the resource endowment and key social development indicators, such as poverty, rule of law and income inequality.

Some countries have been blessed by the oil. Norway is the world's third largest oil exporter after Saudi Arabia and Russia, but has witnessed remarkable economic growth in general, and in manufacturing sector in particular. Furthermore, Norway has well-developed institutions, market-friendly policies, and it is one of the least corrupted countries in the world. Van der Ploeg (2011) argued that with 10% on the world's crude oil and 4% of the world natural gas reserves, United Arab Emirates is one of the GCC countries that turned the resource curse into a blessing. Fasano's (2002) study shows that diversity in the economic activities into telecommunications, finance, tourism and light manufacturing in Dubai, and concentration in the petrochemical and fertilizers in Abu Dhabi made these Emirates have low inflation, modernized infrastructure, job creations, free access to education and health care system, and helped them to establish a generous welfare system. Apergis and Payne (2014) findings show that after 2003, oil abundance became a blessing to economic growth in MENA region, and this can be attributed to improvements in institution quality and economic reform strategies implemented.

2.6 Methodology

2.6.1 The resource proxy

The investigation of the existence of resource curse requires a definition of a measure of the resources, i.e., a resource proxy. A large number of studies exist on the topic of resource curse, most of which having employed a variety of proxies to capture resource abundance. Until today there is no consensus on a universally adopted resource proxy. In this section we provide a brief overview of the proxies that have been used, their advantages and disadvantages and conclude with our chosen proxies.

Perhaps the most used proxy for resource abundance has been the share of natural resource exports to GDP, first employed by Sachs and Warner (1995, 1997). Many of the studies that adopted this proxy support the existence of the resource curse, albeit some variation is expected given the variety in independent variables, study period, data and econometric techniques. Studies by Davis (1995), Leite and Weidmann (1999), Stijns (2000), Lederman and Maloney (2003), Sala-I-Martin and Subramanian (2003), Neumayer (2004), Papyrakis and Gerlagh (2004), Isham et al. (2005), Brunnschweiler and Bulte (2008), Alexeev and Conrad (2009), can be a good example of how the variation in variables can yield different results, even though the same resource proxy is used. Among the key criticisms of this proxy has been those of Bulte et al. (2005) and Brunnschweiler and Bulte (2008) who argue that the proxy used by Sachs and Warner (1995, 1997) might imperfect in capturing what it is purported to capture and also suffer from endogeneity issues.

Davis (1995) attempted to challenge the results of Sachs and Warner (1995) by using the share of mineral exports in total merchandise exports as the chosen natural resource proxy. His results showed a positive relationship between resource abundance and economic development; thus contradicting the existence of the resource curse. Other studies (e.g., De Soysa, 2000; Stijns, 2000; Gylfason, 2001; Lederman and Maloney, 2003; Brunnschweiler and Bulte, 2008; Alexeev and Conrad’s, 2009), have used the Davis (1995) proxy, each failing to confirm the existence of the resource curse.

Other proxies have been used, such as the worldwide oil discoveries and extractions by Cotet and Tsui (2010), the geological variation in oil abundance by Michaels (2011) and percentage of rents in government revenue by Herb (2003). The results of these studies dismiss the existence of a resource curse. Hence, Brunnschweiler and Bulte (2008) showed that the resource curse is detected when using the share of natural resource exports to GDP (i.e., the Sachs and Warner (1995, 1997, proxy) as the proxy for resource abundance.

Auty (2001a) argued that it is not the different proxy that biases the results, rather what is implicitly classified as a natural resource. Auty (2001a) proceeds to distinguish between rents derived from “diffuse resources” (e.g., farming) and “point resources” (e.g., mining), while stressing that the negative link between resource abundance and economic growth is evidenced in the economies dominated by “point resources”; a finding later confirmed by Boschini et al. (2007), Isham et al. (2005) and Papyrakis and Gerlagh (2004).

Ross (2014) argues that there is no single best measure that can be used as resource proxy. Some of the proxies are biased in poorer countries, for example: oil export dependence, representing petroleum exports as a fraction of GDP. “Government revenue from the extractive sector" is one of the important resource endowment measures, yet it is one of the most difficult measures to obtain. To overcome this problem, alternative measures such as discovery of large oil fields (Caselli and Michaels, 2013; Cotet and Tsui, 2013), the value of oil production per capita (Ross, 2008, 2012; Haber and Menaldo, 2011), and global price shocks (Besley and Persson, 2011; Ramsay, 2011) were used.

2.6.2 Methodological Approaches

Early studies in the field of the resource curse typically rely on cross-sectional regressions. Such is the case of the Sachs and Warner (1995, 1997) studies. Subsequent studies employ more alternative techniques aided by the increasing availability of data and econometric techniques. Hence, Manzano and Rigobon (2001, 2006) argue that investigating the resource curse in a cross-sectional design does not control for unobserved country fixed effects and could give inconsistent results. Furthermore, when they use Sachs and Warner's (1995) data but a panel data with country fixed effects design they show that the resource curse disappears.

In addition, Van Der Ploeg (2011) presents additional reasons necessary to move away from cross-country designs and adopt panel data approaches. He argues that cross-country regressions do not control properly for initial conditions, such as productivity, thereby inducing a type of omitted variable bias, especially if resource dependence is expressed as a fraction of national income.

Consequently, most of the recent papers used panel-based techniques as a minimum to examine the relationship between GDP and natural resources. Collier and Goderis (2012) use an error correction model to estimate the long-run equilibrium relationship between resource-export prices and economic growth and reported a negative long-run effect of price increases. Cotet and Tsui (2013) employ a panel specification that evaluated the effect of changes in oil rents on different outcomes over 5-year periods; their results indicated positive effects on health measures but no significant effect on income. Smith (2015) investigated the relationship between GDP per capita and natural resource discoveries (oil, diamond, and natural gas) using panel data for a group of countries, which became resource rich post-1950. Smith's paper (2015) was the first paper using the Quasi-experimental treatment-control approach that provide plausible test of causality for the effect of natural resources on the dependent variable than has been performed in former studies. In addition, it is the first paper that examines the resource curse using the synthetic control method, which allows for causal analysis for many individual countries, and the first to empirically evaluate by direct observation both the short- and the long-run effects of resource discoveries on growth. The results of this study showed a positive effect on GDP per capita that persists in the long term for developing countries and no effect for developed countries.

In addition, Guilló et al. (2015) employed an advanced empirical mechanism to explain the natural resource curse puzzle. They employed the standard dynamic Heckscher–Ohlin model that take international output prices as given, they argued that using a novel mechanism could provide different results. The findings of this study, show that the estimated coefficient sign for a variable in a growth regression doesn't imply that this variable will have the same sign effect on long-run income, i.e. finding evidence of a resource curse may not imply that a natural resource do not contribute positively to long-run income.

2.6.3 Sample Data and Methodological approach

2.6.3.1 Variables of Interest

The sample data employed in the present chapter is collected from the WorldBank and includes a panel of annual observations from 14 countries over the period 1980-2014. The countries under investigation are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the UAE, Libya, Algeria, Nigeria, Ecuador, Angola, Iran, Iraq and Venezuela. All of the countries are members of the OPEC, while the first six are also members of the GCC.

In our empirical analysis we consider the popular random effects and fixed effects panel data estimators. Subsequently and to deal with the problems caused by country-specific effects, endogeneity and the dynamic feature, i.e. lagged dependent variables, in the economic growth model, we adopt a GMM dynamic panel approach. Finally, to allow for the fact that not all countries may be part of the same group in the sense that they give evidence in favour or contradicting the resource curse, we employ a classification tree approach. This allows us to split the sample in a way that groups the countries according to the degree of exposure to the resource curse.

Our choice for the dependent variable is the growth in GDP per capita, which represents the measure of economic growth and is one of the most commonly adopted in the literature (See also Appendix Table 1). Alternatively, Boos (2011) argued that using genuine saving as a dependent variable alongside GDP could be more informative. Boos and Holm-Muller (2013) added that using genuine savings and the rates of change of physical, human and natural capital that make up genuine saving as dependent variables can explain the curse more comprehensively than GDP growth.

The second most important variable in the model is the resource proxy. Our choice here is dual-natured as we use: i) oil rent and ii) oil reserve per capita. The former represents the difference between the value of crude oil production at world prices and total costs of production, while the latter denotes the per capita amount of petroleum (oil) discovered in any given oil field or nation.

Other explanatory variables in the model are used in the spirit of the work of Barro (1996) and Barro (2003) to account for the economic and social environment in these countries. In particular, and in order to account for the effects of *human capital*, we include measures of education attainment. Our choice of metrics here is: i) *the tertiary enrolment* and ii) *the literacy rate*. The tertiary enrolment is expressed in percentage of the total population of the five-year age group following on from secondary school leaving. The focus on the higher education is due to the widespread recognition that higher education is a major driver of economic competitiveness in the context of knowledge-driven global economy (see Hemsley-Brown and Oplatka, 2006 for further details). The other variable, adult literacy, is the percentage of people aged 15 and above who can both read and write with understanding a short simple statement about their everyday life.[3] A study by Coulombe and Tremblay (2004) has pointed out that investment in human capital, e.g. education and skills training, is three times as important to economic growth over the long term as investment in physical capital. They also found that the measures of human capital based on literacy dominate the years of schooling in explaining economic growth

[3] Due to data limitations, this variable was only available for a subset of countries. An investigation employing it revealed similar results; hence this is not reported.

per capita. In practice, we introduce the variables one at a time to observe which contributes more significantly to the overall economy and to avoid any multicollinearity issues. As these two measures are decomposed for the two sexes, male and female; in a robustness check we introduce each sex at a time to ascertain the role of the sex in the effects of the human capital on the output.

Another measure of the human capital is the *health capital* which is proxied in our empirical analysis by the *reciprocal of life expectancy at age one*. As indicated by Barro (2003), if the likelihood of dying does not depend on age, then the reciprocal would result in the likelihood per year of dying. As an alternative, we also take the *infant mortality* into consideration, which represents the number of infants dying before reaching one year of age. High life expectancy is usually associated with high income per capita. However, growth in life expectancy may have mixed effects on per capita income. As noted by Cervellati and Sunde (2011), on the one hand, higher life expectancy may help to improve per capita income through the increase in productivity of existing resources. On the other hand, higher life expectancy or lower mortality may give rise to a growth in population size, which tends to decrease per capita income in the existence of fix factors of production.

The *fertility rate*, which generates large effects on population growth; hence it is also related to human capital. Specifically, it has been shown by Barro (2003) that it has a negative influence on economic growth. Barro (2003) also argues that the increasing fertility suggests more resources spent on child-rearing, which also, to some extent, explains why greater fertility is expected to hamper economic growth. More recently, Ashraf et al. (2013) make use of a simulation model to examine quantitatively the impact of exogenous reductions in fertility on output per capita. They find that a decrease in fertility rates improves per capita income by an amount which some may consider economically significant.

We also include variables related to the *government consumption*, which measures expenditures not directly affecting productivity but containing distortions of private decisions. Barro (2003) shows that a higher value of the government consumption ratio results in a lower growth rate. This finding is consistent with the seminal work of Landau (1983) who suggest a negative relationship between the share of government consumption expenditure in GDP and the rate of growth per capita GDP. It is further pointed out that this negative relationship holds for all cases considered: full sample of countries unweight or weighted by the population; all time duration considered; the major oil exporters included or excluded.

Another variable we take into account is *investment*, which is represented by the *foreign direct investment* defined as *the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term* as shown in the balance of payments. The investment shows net inflows in the reporting economy from foreign investors, in percentage of GDP. Many researchers and policy makers take the position that investment has significant positive effects on a host country's development. Apart from the direct capital financing it brings, investment can be taken as a source of precious technology benefiting the local companies, which altogether helps to enhance the whole economy. However, the advantages of investment have begun to be suspected in the real settings recently. We list several representative studies which debate over issue of positive spillovers produced by investment for host countries. Hanson (2001) points out that the evidence that investment delivers positive spillovers for host countries is essentially rather weak. Görg and Greenaway (2002) find that such effects are mostly negative with the main focus on microeconomic data. Lipsey (2002) suggests positive effects in view of the microeconomic studies while conclude that there is no consistent relationship between investment and growth by investigating the macroeconomic empirical work. Later, Alfaro (2003) investigates on this controversial issue by looking at the impact of investment on economic growth in different sectors such as primary, manufacturing and services sectors. Using cross-country data, she argues that investment tends to generate an ambiguous effect on economy. In specific, investment in the primary sector exerts a negative effect on growth while investment in manufacturing sector generates a positive one.

We also take *international openness* into consideration. International openness is measured as *the sum of exports and imports of goods and services as a share of GDP*. It is well known that trade openness changes by country size—larger sized countries tend to be less open, relative to those small sized countries, since the domestic trade already provides a large platform which can substitute effectively and efficiently for international trade. To gain a better understanding about the trade-growth relationship, we need to consider the channels which international openness may impact a country's economic growth through. There are two main drivers of per capita GDP growth: capital accumulation such as physical and human capital and productivity growth. International openness may produce effects on both sources. First, physical capital and human capital may be accumulated more quickly locally due to the effects of openness to international flows of capital. Second, the increasing technological improvement gained by the openness may enhance productivity growth rate. Furthermore, it has been found that (1) capital accumulation is not the main driver of economic growth (Klenow and Rodriguez-Claire, 1997; Hall and Jones, 1999), and (2) international openness affects growth mainly through productivity (Frankel and Romer, 1999). Therefore, most subsequent analysis is conducted on with the main focus on the impact of international openness on productivity. Andersen and Babula (2008) argue that there is likely to be a positive relationship between international trade and economic growth. Ulasan (2012) provides evidence that man openness variables under consideration have significantly positive relationships with long-run economic growth. He also points out the instability of the association between openness and growth in the sense that the openness variables become no long significant once other growth determinants are involved in the analysis, such as institutions, population heterogeneity, geography and macroeconomic stability.

We also account for the effects of *inflation*. It is usually considered that inflation hurts long-run economic growth. There are a number of reasons to explain this phenomenon. First, high inflation is often associated with high volatility, i.e. uncertainty, of inflation or future profitability of investment plans. This can further make market participants uncertain about what future price will be and become more conservative about the investment strategies they may take. As a result, high inflation may lead to a reduction in levels of investment and economic growth. Second, high inflation can make a country's exports relatively more expensive and thus reduce its international competitiveness. Third, inflation creates distortions in economic decisions with regard to saving and investment through the interaction with the tax system. Companies may be forced to put more efforts on coping with the problems caused by the inflation (see further details in the work of Gokal and Hanif, 2004).

To account for the quality of institutions, we include an indicator of the extent of democracy, measured by the *polity2 index*. Among the data set available to researchers who study the issues associated with democracy, the Polity data (Jaggers and Gurr, 1995; Marshall and Jaggers, 2002) is the most widely accepted one. Some reasons for the popularity of this index are such as: it covers a broadest range of all democracy indicators, including 187 countries from either 1800 or the year of independence up to 2008. Moreover, it is based on a rather comprehensive definition about democracy, which accounts for electoral rules and different measures of the openness of political institutions; it also offers details with regard to the aspects of institutionalized democracy and autocracy in a country or at a given point of time period. With the switch from the Polity III (Jaggers and Gurr, 1995) to the Polity IV (Marshall and Jaggers, 2002), a new polity score, termed polity2, was introduced. Although both *polity* and *polity2* are based on the same evaluation procedure and range between -10 and 10, the latter exhibits a uniquely distinct advantage: it offers a democracy score for time periods of so-called “interregnum” and “transition”. As noted by Barro (2003), the impact of democracy on output is fairly ambiguous. On the one hand, in political models, which lay emphasis on the incentive of electoral majorities to exploit the political power to move resources away from affluent minority clubs. On the other hand, in the presence of great degree of democracy, government is forced to commit itself not confiscate the capital achieved by the private sector and therefore democracy may help to enhance the economy from such a point of view.

All the variables listed above are taken in natural logs, with the exception of oil rent and inflation. All data are obtained from The World Bank.

2.6.3.2 Methodology – Panel Data Analysis

A panel data contains a set of cross sectional units, i.e. countries in our specific case, which are observed over some time period. In line with the mainstream of the existing literature, we denote the number of cross sectional units by N and number of time periods where we observe the individuals as T. The use of panel data helps to account for individual differences, or heterogeneity. In a panel data set which is "long and narrow", implying that we have only a few individuals but long time duration, the seemingly unrelated regression model is more frequently employed. However, in a situation where we have a "short and wide" panel data set, i.e. there are many individuals and relatively few time-series observations, the fixed effects model is more useful and can be applied to panel data with different features (any number of individuals).

Consider a flexible linear regression model as follows

$$y_{it} = \beta_{1i} + \beta_2 x_{2it} + \beta_3 x_{3it} + e_{it}, \mathrm{t} = 1, \dots \mathrm{T} \qquad (2.1)$$

By averaging the data across time periods, we obtain the following

$$\bar{y}_i = \beta_{1i} + \beta_2 \bar{x}_{2i} + \beta_3 \bar{x}_{3i} + \bar{e}_i \qquad (2.2)$$

The "bar" notation suggests that we have averaged the values of the variable across time and thus the subscript time t is discarded. Subtract the second equation from the first one, we have

$$y_{it} - \bar{y}_i = \beta_2 (x_{2it} - \bar{x}_{2i}) + \beta_3 (x_{3it} - \bar{x}_{3i}) + (e_{it} - \bar{e}_i) \qquad (2.3)$$

Therefore, the least squares estimates of the parameters β_2 and β_3 are equivalent to those from the more complicated least squares dummy variable model.

The random effects model is constructed on the idea that the individuals contained in a panel data set may be chosen randomly from a large population. By contrast, in the fixed effect model we introduced earlier, all individual differences are assumed to be measured by the differences in the intercept parameter, β_{1i}. By contrast, in the random effect model, we make the same assumption that all cross sectional differences are accommodated by the intercept parameters, but we treat the individual differences random instead of fixed. To achieve this, we let the intercept parameter β_{1i} to include a fixed component which denotes the population average on the whole, $\bar{\beta}_1$, and random individual differences, represented by u_i, given by

$$\beta_{1i} = \bar{\beta}_1 + u_i \qquad (2.4)$$

Where u_i represents the random effect. We assume that u_i has zero mean, is uncorrelated across different individuals and has a constant variance, σ_u^2. Having some rearrangements, we obtain a familiar regression below

$$y_{it} = \bar{\beta}_1 + \beta_2 x_{2it} + \beta_3 x_{3it} + (e_{it} + u_i) \qquad (2.5)$$

the term $e_{it} + u_i$ can be further expressed as v_{it}. We assume that the error term e_{it} has zero mean, constant variance σ_e^2, and is uncorrelated over time period. Furthermore, we assume the individual effects u_i are not correlated with the error e_{it}. Overall, v_{it} has zero mean and a constant variance $\sigma_v^2 = \sigma_u^2 + \sigma_e^2$. However, v_{it} is serially correlated, i.e. the errors for each individuals are inter-correlated with the correlation coefficient $\rho = \sigma_u^2 / (\sigma_u^2 + \sigma_e^2)$. In such a particular situation, the least squares estimator is still unbiased and consistent, however, it is no longer efficient, i.e. the variance is not minimum. Hence, the standard errors obtained from the least squares technique are incorrect. To account for this problem, the generalized least squares estimator (the minimum variance estimator) is proposed to solve the random effects model. We first apply the least squares to a transformed model as follows

$$y_{it}^{*} = \bar{\beta}_1 x_{1it}^{*} + \beta_2 x_{2it}^{*} + \beta_3 x_{3it}^{*} + v_{it}^{*} \qquad (2.6)$$

Where we have

$$y_{it}^{*} = y_{it} - \alpha \bar{y}_i \quad (2.7)$$

$$x_{1it}^{*} = 1 - \alpha \quad (2.8)$$

$$x_{2it}^{*} = x_{2it} - \alpha \bar{x}_{2i} \quad (2.9)$$

$$x_{3it}^{*} = x_{3it} - \alpha \bar{x}_{3i} \quad (2.10)$$

$$v_{it}^{*} = v_{it} - \alpha \bar{v}_i \quad (2.11)$$

The transformation parameter α is given by $\alpha = 1 - \frac{\sigma_e}{\sqrt{T\sigma_u^2 + \sigma_e^2}}$. It can be further shown that the transformed v_{it}^{*} has constant variance σ_e^2 and is uncorrelated.

In the previous section we introduced the fixed effects and random effect models for panel data. In practice, the latter is more preferred due to several advantages over the former. For example, the random effects estimator accounts for the random sampling process where the data set is collected; it allows for the variables that are individually time-invariant; as it is essentially a generalized least squares estimation technique, in large sample sizes, generates a smaller variance compared with the least squares estimator. However, a potential difficulty one may encounter in applying the random effects estimator is that the random error $v_{it} = e_{it} + u_i$ is correlated with any of the explanatory variables on the right hand side of the regression. In such a situation, both least squares and generalised least squares become biased and inconsistent and the fixed effects estimator, which removes the random effect u_i together with any other time-invariance components, can provide a good alternative.

In order to examine the correlation between the error term u_i and the explanatory variables in a random effects regression and thus to decide on the most appropriate estimation procedure to apply, we consider a Hausman test. The test is based on the comparison between the regression coefficient estimates obtained from the random effects model with those obtained from the fixed effects model. If the error u_i is not correlated with the explanatory variables x_{kit}, both random effects and fixed effects estimators show consistency and thus converge to their underlying values in the cases of large sample sizes. However, if there is correlation between u_i and x_{kit}, then the random effects estimator is no long consistent while the fixed effects estimator remains consistent. In practice, the Hausman test can be carried out employing the student t test with the null hypothesis that there is no correlation between u_i and any of the explanatory variables. Consequently, if the null cannot be rejected, one should implement the random effects estimator since it tends to have a smaller variance compared with the competitor. Correspondingly, if the null is rejected, the fixed effects estimator should be preferred as it shows consistency.

2.6.3.3 Methodology – GMM

The dynamic generalised method of moments (GMM) method, developed by Holtz-Eakin et al. (1988), Arellano and Bond (1991) and Arellano and Bover (1995) is the second method we utilize in this chapter. Relative to the conventional cross-country method, the dynamic panel GMM techniques exhibit several benefits in investigating such a financial growth phenomenon. First, it deals with the problem that the regressors may be correlated with the error term. Second, it accounts for the correlation of the time-invariant country characteristics, e.g. geography and demographics, with the explanatory variables. Third, it allows for the autocorrelation in the lagged dependent variable. The potential problems that the panel GMM copes with will be further detailed in the following part.

Consider a structural model below

$$y_{i,t} = \varphi y_{i,t-1} + \beta' x_{it} + u_i + \varepsilon_{i,t} \quad (2.13)$$

Where i and t stand for individual country and time periods, respectively. In addition to a set of exogenous and endogenous regressors $x_{i,t}$, $y_{i,t}$ also depends on its own past realisations, demonstrating the dynamic nature of the framework. u_i measures the country-specific effect independent of time t and $\varepsilon_{i,t}$ represents the random error term.

Although the inclusion of the lagged dependent variable may be important for having consistent estimates of the slope parameters associated with $x_{i,t}$ (Bond, 2002), the dynamic model of (3.3) is subject to the problems of omitted variable bias and endogeneity. Similar to the approach adopted in the recent work of Yaduma et al. (2013), we exploit the difference/Arellano-Bond GMM technique, developed by Arellano and Bond (1991), to account for these potential econometric issues.

In equation (3.3), the presence of the unobservable country-specific term u_i is usually treated as a component of the residual term, inducing the problem of endogeneity such as $E(residual_t | y_{i,t-1}) \neq 0$. The difference GMM procedure solves the problems outlined by eliminating u_i and involving an instrument for the lagged dependent variable $y_{i,t-1}$. First, we take the first difference of equation (3.3) and obtain

$$\Delta y_{i,t} = \varphi \Delta y_{i,t-1} + \beta' \Delta x_{it} + \Delta \varepsilon_{i,t} \quad (2.14)$$

To meet the requirement of strict exogeneity, we follow the method of Arellano and Bond (1991) to introduce $y_{i,t-2}$ as an instrument, which is, by construction, related to $\Delta y_{i,t-1}$ but not correlated to $\Delta \varepsilon_{i,t}$ provided that the error terms are not serially correlated and the covariates are weakly exogenous. Throughout the whole testing and estimation procedure described above, of our main interest in the oil model is the sign of the coefficient associated with the per capita oil reserve. It is concluded that oil curse is present for the negative coefficient while absent for the positive.

Apart from this, Arellano and Bond (1991) point out the biasedness of asymptotic standard errors present in the GMM difference procedure in the case where the number of cross sections is small. Relative to the one-stage estimator of the GMM difference, estimates of coefficients of the two-stage estimator is considered asymptotically more efficient. Furthermore, the standard covariance matrix given by the two-stage procedure is robust to panel-specific autocorrelation problems and thus the two-stage difference GMM is employed in our empirical applications. We use the Stata command *xtabond2*, in line with Roodman (2009) for our GMM estimations. Further calibrations to the command include a limit on the number of instruments, where in all regressions we set this equal to 5, following (Yaduma et al., 2013), although as a robustness check we increase this to 8 with the results presented in the Appendix. In the *xtabond2* package this is achieved by the use of the lag limit command. Furthermore, and in line with (Yaduma et al., 2013) we use the collapse option that generates one instrument for each variable and lag distance instead of the default option of one instrument for all explanatory variables, time periods, and lag distances. We also specify the two step and robust options in the *xtabond2* package that provide a finite sample correction for the two step covariance matrix according to Windmeijer (2005).

2.6.3.4 Methodology – Classification Tree

The present chapter employs the non-parametric Classification and Regression Tree (CART), proposed by Breiman et al. (1984) and further analysed by Gatu et al. (2007), Hofmann et al. (2007) and Shih and Tsai (2004), which has been widely applied for constructing prediction models from data. Both the classification tree and regression tree are implemented by partitioning the data sample and fitting an estimated model within each split. The difference between the two lies in that: classification trees are developed for dependent variables which are categorical, e.g. class, group membership, country, etc. The prediction error is represented by the misclassification cost; regression trees are for dependent variables which are continuous and the prediction error is usually represented by the squared difference between the actual and estimated values. For both types of trees, predictors can be one or more continuous and/or categorical variables. The purpose of our analysis is to see how we can discriminate between different countries based on the values of their per capita oil reserve or oil rent. Hence, we choose to employ the classification trees and detail the procedure in the following part.

The classification trees procedure may be viewed as a union of piecewise linear functions, where observations are grouped according to the control variables. The splits are chosen with respect to minimising misclassification costs (Breiman et al., 1984). The essence of the algorithm is described here; for a full exposition of the classification tree algorithm see among others Breiman et al. (1984) and Durlauf and Johnson (1995). Assume Y to be the endogenous variable of interest and $X_1, \dots, X_j$ the control variables. The aim is to find a model for predicting Y from $X_1, \dots, X_j$ through binary recursive splits.

Starting from a club equivalent to the entire population of countries, say $= \{i_1, i_2, \dots, i_n\}$ (this can be referred to as step 0) the algorithm searches for the best binary splits in the dataset.

Step 1. For the data under investigation select a binary split, which is of the form $x_j < s$ versus $x_j \geq s$. The choice of the binary split consists of two components, the selected control variable (j) and the realisation of the control variable (s). The binary split creates two nodes that are subsequently tested for *impurity*. *Impurity* of a node is measured by the Gini's Diversity Index (GDI)[4]. The GDI of a node is given as $1 - \sum_i p^2(i)$ where the sum is over the clubs i at the node and $p(i)$ is the observed fraction of clubs with club i that populate the node. A pure node has only one club and a GDI equal to zero; otherwise positive values of GDI measure the degree of impurity in the node where more than one clubs are present.

Therefore, at each splitting level the following expression is minimised:

$$\Delta(h) = \min_{js}\left\{\min_{c_2}\left(1 - \sum_i \left(\frac{c_1}{c_1+c_2} | x_i \in R_{1,js}\right)\right) + \min_{c_1}\left(1 - \sum_i \left(\frac{c_2}{c_1+c_2} | x_i \in R_{2,js}\right)\right)\right\} \quad (2.15)$$

[4] For a full exposition of impurity metrics used in this context we direct you to (Berzal, Cubero, Cuenca, & Martín-Bautista, 2003).

where the parameter h denotes the splitting level with $h = 1$ denoting the first level that two nodes exist. The variables of interest to the algorithm (j, s) split the realisations of the Y variable (c_1,c_2)[5] into two nodes R_1, R_2. The lower the value of the quantity $1 - \frac{c_1}{c_1+c_2}$ the higher the purity level of the first node.

Step 2. If one of the resulting nodes has zero impurity score, then this is classified as a *pure node* and the branch is terminated here. Conversely, if one of the resulting nodes has a positive impurity score, then a further split may be possible.

Step 3. For the impure nodes, continue from step 1.

The algorithm finishes when the resulting nodes are either pure or cannot be broken down any further due to observation requirements.

2.7 Results

2.7.1 Descriptive Statistics

Table 1 reports key descriptive statistics of all the variables considered. The large dispersion of the GDP per capita is mainly driven by the existence of Qatar in the sample, which is among the top countries in that respect. However, most of the remaining countries in our sample have an average GDP per capita of around 12,000 USD. It is worth noting that we have large amounts of missing values for the variable of adult literacy. However, we have two different measures for educational attainment, i.e. tertiary enrolment and adult literacy, and thus we can concentrate more on the effects of the former if the presence of missing values in the latter causes any problems.

[5] For ease of exposition we assume that the predictor variables are categorical variables.

[Table 1 around here]

Table 2 shows the correlations matrix for the variables used in our study. We find there is a statistically significant positive correlation between GDP per capita and Oil reserve which gives preliminary evidence that the resource curse will not be supported in this study.

[Table 2 around here]

2.7.2 Empirical Results based on GMM

Our results are presented in Tables 3 to 16 for a wide variety of explanatory variables, dependent variables and estimation methods. The main layout is that we divide each of these tables into 2 sections. The section on the left uses the Per capita oil reserve as a resource proxy, while the section on the right uses the oil rent. Each table reports estimated coefficients and standard errors, while statistical significance is denoted by the use of asterisks next to the coefficient. The lower part of each table shows additional goodness-of-fit statistics that relate to the estimation method at hand as well as number of observations, groups and instruments used in each regression. As such, the GMM estimation present the p-values for the AR(1) and AR(2) lags, where in all the cases we reject the null hypothesis for the first lag but not the second. The Hansen J-test is much higher than the conventional significance levels indicating that the GMM is an appropriate specification.

Table 3 presents the estimated coefficients from the GMM models where the dependent variable is the per capita GDP growth, and the proxy for resources is either the per capita oil reserve or the oil rent. In this model, we allow also for human education in the form of tertiary enrolment. The variables pertaining to the oil resource curse are statistically insignificant, thus indicating no statistical evidence in favour of a resource curse. Our results therefore do not support the resource curse for these economies. Moreover, the role of education fails to reach conventional statistical levels. Furthermore, in different models, there is no serial correlation in the differenced residuals by looking at AR(1) and AR(2) test results and the instruments we include in the difference panel GMM are considered valid by the Hansen J-test.

[Table 3 around here]

A series of robustness checks is conducted to ensure statistical validity of these results. First, we use a higher lag limit for the instruments, which is now set to eight instead of five. The results, presented in table A1 in the appendix show no qualitative differences in the story above. That is, no statistical support for the resource curse is given. Furthermore, we allow for heterogeneity across the years by inserting year fixed effects in our estimations and these results are presented in table A2. Once again, no empirical support for the resource curse is given. In a third robustness check, and to cater for potential volatility in the dependent variable, we use a 5-year backward moving average to smooth the per capita GDP growth. Table A3 reports the results but once again our story is not challenged. Finally, we use an alternative routine to the xtabond2, the xtlsdvc which relies on alternative Anderson-Hsiao, Arellano-Bond and Blundell-Bond estimators. The routine has limited functionality compared to the more complex xtabond2 but from the output, see Table A4, we observe that the statistical insignificance of the variables related to the oil curse is not questioned.

[Tables A1 – A4 around here]

Table 4 presents the estimated coefficients from the GMM models where the dependent variable is the per capita GDP growth, and the proxy for resources is either the per capita oil reserve or the oil rent. In this model, we allow also for human education in the form of tertiary enrolment for both sexes. Furthermore, this model includes macroeconomic variables, such as consumption, trade openness and investment. These results verify that the countries under investigation show, if any, evidence of oil blessing under both the per capita oil reserve and the oil rent indicators. In any case, however we don't observe any statistical significance in these variables, so the resource curse claim does not receive any empirical support from our analysis. With regards to key macroeconomic conditions, consumption is found to decrease the economic growth, while trade openness increases growth in per capita GDP. Investment has an ambiguous and very small in economic terms effect. In any case, however, macroeconomic variables do not individually have statistical significant effects, albeit they are jointly significant in our specifications.

[Table 4 around here]

Tables A5-A7 in the appendix present the robustness checks of the previous section, namely, Table A5 allows for up to eight lags for the instruments, Table A6 incorporates year fixed effects to cater for time heterogeneity and Table A7 utilises a 5-year moving average to smooth any volatility in the dependent variable. The main conclusion from all these robustness checks is that the lack of empirical support for the resource curse claim remains, hence our key findings are not questioned.

[Tables A5 – A7 around here]

Table 5 repeats the analysis of Table 4 but with the inclusion of some social variables, namely fertility, mortality and democracy. The results remain qualitatively similar. In particular, the oil resource curse is not verified under either of the two natural resources measures. If anything, the per capita oil reserve shows a positive, but not significant sign, which may be interpreted as slight evidence in favour of an oil blessing. Consumption retains its negative influence on economic growth, which however is not significant at conventional significance levels under both specifications. Conversely, trade openness does not show any definite relation with respect to the influence on per capita GDP growth. Investment appears with a positive sign that shows a positive impact on per capita GDP growth through increased investment levels. Higher values of fertility are associated with lower economic growth in the case that per capita oil reserve is used as the natural resource proxy; the opposite being observed when the oil rent is used. However, this fails to reach conventional significance levels, suggesting that the effect of fertility is not particularly significant on its own. Mortality carries a negative and positive sign when the resource proxy is the oil rent and per capita oil reserve respectively, even though these do not reach statistical significance levels. Democracy also fails to reach conventional significance levels, implying that the effect on per capita GDP growth is not clear-cut. Overall, however, the macroeconomic variables add to the explanatory power of the model, as suggested by their joint significance from the wald-statistic reported in the goodness-of-fit section.

[Table 5 around here]

The usual robustness checks are reported in appendix tables A8-A10, with the instrument lags increased to 8, allowing for year fixed effects and using a 5-year moving average to smooth the per capita GDP growth. In all cases, our results are qualitatively similar, with the resource curse never gaining statistical evidence to its support.

[Tables A8 – A10 around here]

Table 6 further adds inflation to the list of explanatory variables of Table 4. The results still support the conclusion of no oil resource curse for the sample countries. On the contrary, when controlling for the full set of macroeconomic and social characteristics the per capita oil reserve carries a positive and significant sign, suggesting that an oil blessing may be the case for these countries. However, the oil blessing cannot be verified when the oil rent is used. Consumption carries a positive sign albeit this fails to reach conventional statistical significance levels. Inflation carries a negative sign that is significant at the 10% level but only for the case of the per capita oil reserve. In any case the set of macroeconomic and social variables added are jointly significant as verified by the wald statistic.

[Table 6 around here]

Table 7 repeats the analysis of table 6, however this time mortality is replaced by the reciprocal of life expectancy. The results are broadly in line with Table 6, without any statistical evidence of a resource curse at conventional significance levels.

[Table 7 around here]

2.7.3 Empirical Results based on panel random effects

To ascertain the benefits of the technique of difference panel GMM, we also consider the fixed effects and random effects estimators as introduced in the section of methodology. The Hausman test with the null that there is no correlation between the individual error term and any of the explanatory variables cannot be rejected in our case and therefore we make use of the random effects estimator and report the results in Table 8 and 9. Similar results are obtained such as: there is no resource curse no matter which oil proxy is considered; tertiary education is significantly positively and affects the economy; government consumption has negative but not statistically significant effects on per capita GDP growth; inflation hampers the economy significantly when either oil proxy is used. However, a serious problem is that strong serial correlation in residuals is identified in both cases listed in Table 8 and 9, suggesting that hypothesis tests may not be reliable. Consequently, difference panel GMM clearly dominates the conventional estimation technique here since the former tacked the problem of the serial correlation in error terms. However, an advantage of the panel random effects is that it maintains comparability with the majority of the literature on the resource curse as system GMM has not been used extensively.

[Tables 8 and 9 around here]

2.7.4 Empirical Results based on Classification Trees

We use the classification trees to account for the fact that certain countries in our sample may exhibit the resource curse, while others may exhibit an oil blessing. Similarly, we may have evidence that a subset of countries is affected to a larger extent by the oil curse than others. As a result we implement the classification tree algorithm to split the 14 countries in our sample data into different groups with regards to their level per capita oil reserve or oil rent. Figures 3 and 4 present the results.

[Figures 3 and 4 around here]

In Figure 3, we classify countries according to the log of per capita oil reserve. At the end of the tree, we can split 14 countries into 3 groups based on the criteria (peroil>2.67). We term the 3 groups as “HIGH”, “MEDIUM” and “LOW”, which represent the countries with high, medium and low level of per capita oil reserve. In particular, the “HIGH” group includes UAE (ARE), Kuwait (KWT), Qatar (QAT) and Saudi Arabia (SAU); the “MEDIUM” group includes Iran (IRN), Iraq (IRQ), Libya (LBY), Oman (OMN) and Venezuela (VEN); the “LOW” group includes Angola (AGO), Bahrain (BHR), Algeria (DZA), Ecuador (ECU) and Nigeria (NGA).

Figure 4 classifies the countries baser on oil rents. Similarly, three groups are defined; “HIGH”, “MEDIUM” and “LOW”. The “HIGH” group includes Angola (AGO) and Kuwait (KWT); the “MEDIUM” group includes Iraq (IRQ), Libya (LBY), Nigeria (NGA), Oman (OMN), Qatar (QAT) and Saudi Arabia (SAU); the “LOW” group includes UAE (ARE), Bahrain (BHR), Algeria (DZA), Ecuador (ECU), Iran (IRN) and Venezuela (VEN).

The output of the classification tree analysis is fed back into the panel GMM regressions in the form of slope dummies. In particular, we interact the resource proxies – the per capita oil reserve and the oil rents – with dummy variables that signify the membership of each country. For example, the three groups identified in Figure 3 pertaining to the per capita oil reserve enter the specification as three variables, namely: per capita oil reserve, which accounts for the MEDIUM category; per capita oil reserve × LOW and per capita oil reserve × HIGH that account for the LOW and HIGH country groups respectively. By the same token we construct the oil rents using the information from the classification trees depicted in Figure 4.

Table 10 presents estimated coefficients and p-values for the statistical significance of the explanatory variables. Table 10 augments the model presented in Table 7 with the results of the classification trees. The results pertaining to the resource curse remain the same with no country group verifying the resource curse due to the either the positive and statistically significant sign or the lack of statistical significance in the case of a negative sign. In particular, the MEDIUM group exhibits a positive and statistical significance sign when the per capita oil reserve is used as the resource proxy, which in turn suggests that those countries receive an oil blessing. By contrast, the LOW and HIGH groups also do not exhibit the oil blessing as the MEDIUM group but at the same time they do not verify statistically the presence of resource curse. When the oil rent is used however, no statistical significance results are found, which is to some support against the existence of the resource curse. The results overall suggest that only the countries with the lowest values of oil rents (these are UAE (ARE), Bahrain (BHR), Algeria (DZA), Ecuador (ECU), Iran (IRN) and Venezuela (VEN), repeated from a section above) are actually capable of evidencing a positive link between economic growth and resource endowment (i.e., an oil blessing).

[Table 10 around here]

2.8 Discussion: The resource curse and the GCC

Our results do not support the contention that a resource curse exists over the examined period for the countries under investigation. However, this does not mean that these countries never experienced the resource curse. By contrast, it may be more plausible that the countries have taken necessary actions to reduce the impact of the curse and turn the apparent drawback of large natural resource endowments to their advantage.

With regards to overcoming the resource curse many scholars have focused on economic policy related actions. Usui (1997), Mikesell (1997) and Sarraf and Jiwanji (2001), among others, argue that resource abundant countries should avoid large foreign and domestic debt., pursue competitive exchange rate, and control inflation to avoid the Dutch disease. Auty (1994), Collier (2000), and Sarraf and Jiwanji (2001) added that resource-rich countries should diversify their economies and adopt investment strategies as a way to reduce the dependence on natural resources. Cao et al. (2015) argued that replacing traditional development patterns with more balanced development, increasing technology adoption, focusing on value-added goods and creating processed materials will help to diversify the economy and overcome the resource curse.

A second group of scholars contributed that direct distribution of a substantial proportion of resource revenues to citizens (i.e., income diversification and redistribution) would minimize opportunities for corruption and misappropriation (Sala-I-Martin and Subramanian, 2003). Ross (2001a) argued that even though resource revenue was transferred directly to citizens, the state can still receive a significant share through taxation; this policy is still ‘plausible’. Caspary (2012) argued that wealth arising from oil and mining must be distributed in a transparent manner to avoid using this wealth to fund corruption.

A third group of scholars recommended privatization of the natural resource sectors. Weinthal and Jones Luong (2001) used Russia and Kazakhstan as good examples of oil sector privatization. Rosser (2004) added that this procedure could explain how Indonesia overcomes the curse. In a later study, Rosser (2007) argued that the Indonesian economy grew strongly between the 1970s and 1980s, although the oil sector counts for more than 80% of Indonesian total annual exports and 70% of the government annual revenues for the same time.

A fourth group of authors attempted to identify the political and social changes required to overcome the resource curse. They argue that it is important to have political and social environment transformation in resource abundant countries to overcome the curse. Mitra (1994) argued that it is not possible to overcome the resource curse until changes in the political elite's mindset happen. Karl (1997), Ascher (1999), Auty (2001b, 2004), and Pearce (2005) have emphasized the need for resource-rich countries to promote capability and institutional reform; this action will prevent growth collapse and facilitate policy reform and successful economic policy in general.

The fifth group of scholars added that various actions could be implemented at the international level to help overcome the resource curse. Bannon and Collier (2003) suggested that World Bank and IMF design new mechanisms to reduce the negative effects of price instability in resource abundant countries. Shaxton (2005) argued that a revision of the nature of the contracts between oil-endowed countries and international oil companies could help to deal with price shocks, while Ross (2001b), recommended an international agreement to control commodity prices as a solution to overcome resource curse in global economy. Farhadi et al. (2015) argued that resource-rich countries could turn the resource curse into a blessing via three channels. First, by improving the legal structure to secure property rights and judicial system efficiency; this will make the incentive to invest in resources higher. Second, by simplifying credit and business regulations to increase competition and enable efficient allocation of natural resources. Third, trade liberalization to encourage creating larger markets and increase the gains to all trading partners.

All these aforementioned policies are particularly relevant for the GCC members who were heavily dependent on oil exports during the 1980s and 1990s. During that time the strong positive correlation between oil prices and real GDP growth is a key characteristic of the GCC economy (IMF, 2011b). However, the rising oil prices of the late 70s and early 90s led to significant revenues for the GCC countries, which however could not be manifested into sustainable growth after the oil prices reverted to normal levels. Relying on a non-renewable and highly volatile source of income, such as oil and gas, can be an impediment to the growth prospects of any country. Saudi Arabia and Qatar have the largest endowments of oil and gas respectively in the region. By contrast, Bahrain’s energy resources are depleted. All these necessitate the need for careful investment planning that would diversify the income of these countries away from energy towards sources that are non-exhaustible and less susceptible to price fluctuations. To a degree, the GCC appears to have seized the opportunity better by taking steps towards all directions mentioned above.

Fiscal balances show increasing surpluses. International reserves soared to a record high level of 515 USD billion in 2008, up from 75 USD billion in 2002 (IMF, 2011b). Having cut their external debt obligations from 66% to 12% of GDP, national governments now have the capacity to invest in projects designed to sustain economic growth (IMF, 2011b). Investments in infrastructure and technology at the GCC level increased from 300 USD billion in 2004 to 2.5 USD trillion by the end of 2008 (IMF, 2011a). Some countries have taken significant steps towards income diversification with Bahrain, which has established itself as a financial hub in the region offering exquisite products such as Islamic finance. Tourism and transportation are also promoted. The UAE have diversified into tourism, manufacturing and financial services (IMF, 2012). Although Kuwait recently has engaged with financial services, its dependence on oil remains high. Saudi Arabia, by far the largest economy in the region (469.4 USD billion - 44.3% of GCC total), has the huge revenues from energy related products (89.3% of total revenue in 2008); construction and manufacturing are increasingly important as revenue sources (IMF, 2011a). As a result of this diversification process, non-oil sectors in the GCC have been expanding at 7.3% yearly, while the non-oil GDP represented 65% of total GDP in 2008, up from about 56-58% in the early 90's. The UAE (and Dubai in particular) have been remarkably progressive despite the non-democratic government. As a results, Dubai is well-known hub for conventional and Islamic financial services, tourism and fashion industry. Economic growth is no longer entirely energy related in the GCC, as such the resource curse is no longer empirically supported. By contrast, Cendrero (2014) investigated the changes to Bolivia's gas policy since 2006 and institutional performance to evaluate if these changes helped this country to overcome the resource curse. His findings show that Bolivia's government has not developed or set a sufficient policies to deal with the curse, and Bolivian economy still suffer from the curse as a result of this.

2.9 Conclusion

Economies rich in natural resources would be expected to be in an advantageous position with regards to pursuing economic growth. Indeed, the discovery of oil would have appeared to be the basis of good prosperity. However, early empirical evidence suggested otherwise with many studies documenting an inverse relationship between economic growth and natural resource abundance. Even though the key driving force of this relationship does not appear to be the abundance of natural resources per se, rather the social, political and institutional level of development surrounding such countries, a large part of the literature appears separated into studies favouring the existence of the resource curse and those contradicting it.

In this chapter we revisit the resource curse for countries that are oil exporters. Hence, we seek to ascertain whether these countries exhibit the oil curse or the oil blessing. Our dataset comprises a panel of annual observations from 14 countries over the period 1980-2014. The countries under investigation are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the UAE, Libya, Algeria, Nigeria, Ecuador, Angola, Iran, Iraq and Venezuela. All of the countries are members of the OPEC, while the first six are also members of the GCC. Economic growth is measured via the growth in the GDP per capita, while the resource proxy is in line with the most recent literature and is proxied by per capita oil reserve and oil rents. Furthermore, we include the usual socio-economic explanatory variables, such as Tertiary Enrolment, Fertility, Mortality, Consumption, Investment, Trade Openness and Democracy – a proxy for the quality of institutions. We rely on panel data random effects and system GMM for our main estimations. We augment our approach using a novel technique in the field, namely classification trees so as to categorize the countries into groups in line with the magnitude of their oil curse (or oil blessing).

Our results support the notion that the oil curse is not a cause of concern for the sampled countries. Indeed, a positive link between oil abundance and economic growth (i.e., oil blessing) is evidenced in some specifications. Even when allowing for different country groups using the classification trees, we fail to find any evidence in favour of the resource curse.

In acknowledging parts of the previous literature that finds evidence of the resource curse we argue that the GCC, in particular, have taken all the steps that the literature has identified for an economy to heal itself from the resource curse. Towards that direction the governments of the GCC member states have realized the over-exposure to the oil and gas sectors during the late 1970s and 1980s which rendered their economic growth not only very volatile due to the oil prices but also unsustainable. Hence, they diversified their income to manufacturing, construction, financial services and tourism. As such, the oil exposure has been reduced and the countries have engaged into a well-paved path of sustained growth.

Table 1. Summary Statistics

	Mean	Std.Dev.	Min	Max	Obs
per capita GDP	12854.730	15855.730	494.239	81788.960	389
per capita Oil Reserve	8.279	13.569	0.093	60.947	473
Oil Rent	30.548	14.654	4.222	78.932	446
Tertiary Enrolment	17.563	13.105	0.013	77.457	286
Adult Literacy	82.487	12.492	49.631	97.478	69
Consumption	18.087	9.083	2.332	76.222	415
Openness	79.219	40.007	0.210	251.139	424
Investment	1.838	3.878	-13.605	40.467	441
Fertility	4.278	1.714	1.726	8.352	476
Mortality	39.867	36.267	5.900	138.300	476
Life expectancy	67.305	9.700	40.159	78.418	476
Democracy	2.718	2.524	0	9.330	440
Inflation	28.222	218.735	-16.117	4145.108	371

Note: er capita oil reserve has got scaled down by 1000 (barrel). This table reports the overall statistics for the full 14 countries in our sample.

Table 2. Correlation Matrix

	per capita GDP	per capita Oil reserve	oil rent	enlment (both)	enrolment (m)	enrolment (f)	consumption	openness	investment	fertility	mortality	life expectancy	democracy	inflation
per capita GDP	1.000													
	-----													
per capita Oil reserve	0.501	1.000												
	0.000	-----												
oil rent	0.213	0.403	1.000											
	0.002	0.000	-----											
enlment (both)	-0.092	-0.081	-0.226	1.000										
	0.191	0.249	0.001	-----										
enrolment (m)	-0.339	-0.215	-0.351	0.870	1.000									
	0.000	0.002	0.000	0.000	-----									
enrolment (f)	0.169	-0.013	-0.246	0.910	0.730	1.000								
	0.016	0.850	0.000	0.000	0.000	-----								
consumption	0.173	0.458	0.184	-0.046	-0.140	-0.077	1.000							
	0.013	0.000	0.008	0.513	0.045	0.273	-----							
openness	0.319	0.085	0.202	-0.197	-0.412	-0.046	0.215	1.000						
	0.000	0.225	0.004	0.005	0.000	0.516	0.002	-----						
investment	0.090	-0.177	-0.092	-0.100	-0.160	-0.020	-0.091	0.199	1.000					
	0.200	0.011	0.189	0.155	0.022	0.778	0.196	0.004	-----					
fertility	-0.342	-0.103	0.242	-0.563	-0.410	-0.687	0.136	-0.194	-0.057	1.000				
	0.000	0.145	0.001	0.000	0.000	0.000	0.052	0.005	0.419	-----				
mortality	-0.466	-0.285	0.100	-0.469	-0.288	-0.597	-0.324	-0.401	0.027	0.815	1.000			
	0.000	0.000	0.156	0.000	0.000	0.000	0.000	0.000	0.706	0.000	-----			
life expectancy	0.461	0.225	-0.144	0.469	0.321	0.599	0.283	0.361	-0.017	-0.820	-0.981	1.000		
	0.000	0.001	0.040	0.000	0.000	0.000	0.000	0.000	0.806	0.000	0.000	-----		
democracy	-0.390	-0.249	-0.484	0.086	0.364	0.005	-0.484	-0.397	-0.108	-0.017	0.238	-0.162	1.000	
	0.000	0.000	0.000	0.223	0.000	0.946	0.000	0.000	0.123	0.814	0.001	0.021	-----	
inflation	-0.341	-0.280	-0.229	-0.045	0.211	-0.138	-0.462	-0.412	0.028	0.171	0.423	-0.365	0.507	1.000
	0.000	0.000	0.001	0.519	0.003	0.049	0.000	0.000	0.695	0.015	0.000	0.000	0.000	-----

Note: this table reports the correlation coefficient between different pairs of variables in our empirical study. Values below the correlation coefficients represent the P-value for the significance of the correlation.

Table 3. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.698***	0.768***
	0.197	*0.097*
Per capita Oil Reserve	-0.076	
	0.153	
Oil Rent		0.000
		0.003
Tertiary Enrolment	-0.005	-0.005
	0.028	*0.028*
Constant	2.688	2.050**
	1.786	*0.895*
Observations	313	305
Groups	13	13
Instruments	19	19
AR(1)	-1.650*	-2.540**
AR(2)	-0.990	-1.850
Hansen J	7.030	9.270
Wald chi-sq	17.680***	79.800***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. Robust standard errors are reported in italics.

Table 4. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.528	0.962*
	0.486	*0.503*
Per capita Oil Reserve	0.065	
	0.149	
Oil Rent		-0.001
		0.005
Tertiary Enrolment	0.027	-0.009
	0.051	*0.037*
Consumption	-0.149	-0.002
	0.155	*0.195*
Openness	0.242	0.030
	0.244	*0.363*
Investment	-0.003	0.000
	0.002	*0.001*
Constant	3.413	0.223
	3.636	*3.448*
Observations	300	300
Groups	13	13
Instruments	37	37
AR(1)	-1.630*	-1.340*
AR(2)	-1.000	-1.560
Hansen J	4.270	8.660
Wald chi-sq	67.180***	30.820***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. Robust standard errors are reported in italics.

Table 5. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.469**	1.028***
	0.237	*0.387*
Per capita Oil Reserve	0.029	
	0.107	
Oil Rent		0.004
		0.004
Tertiary Enrolment	-0.009	0.071
	0.011	*0.128*
Consumption	-0.188	0.021
	0.190	*0.221*
Openness	0.074	-0.393
	0.260	*0.862*
Investment	0.002	0.003
	0.002	*0.008*
Fertility	-0.534	0.026
	0.574	*0.930*
Mortality	0.197	-0.087
	0.324	*0.683*
Democracy	-0.007	-0.115
	0.131	*0.116*
Constant	4.889***	1.401
	1.134	*7.062*
Observations	260	260
Groups	13	13
Instruments	55	55
AR(1)	-0.980*	-0.610*
AR(2)	-0.860	0.030
Hansen J	0.940	1.840
Wald chi-sq	206.750***	59.810***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. Robust standard errors are reported in italics.

Table 6. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.476	0.639**
	0.361	*0.269*
Per capita Oil Reserve	-0.185*	
	0.107	
Oil Rent		0.000
		0.002
Tertiary Enrolment	0.115	0.121
	0.083	*0.131*
Consumption	0.012	0.004
	0.079	*0.081*
Openness	-0.253	0.222
	0.256	*0.311*
Investment	0.011**	-0.006
	0.006	*0.006*
Fertility	-1.784**	0.174
	0.689	*0.818*
Mortality	1.010**	-0.103
	0.416	*0.632*
Democracy	0.044	-0.089
	0.160	*0.065*
Inflation	-0.001*	-0.001
	0.001	*0.001*
Constant	4.195	2.348
	3.823	*4.157*
Observations	205	205
Groups	12	12
Instruments	61	61
AR(1)	-0.040*	-1.080
AR(2)	4.560	-0.150
Hansen J	0.950	0.770
Wald chi-sq	27.210***	24.480***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. Robust standard errors are reported in italics.

Table 7. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	2.196***	0.481
	0.218	*0.622*
Per capita Oil Reserve	0.004	
	0.113	
Oil Rent		-0.001
		0.003
Tertiary Enrolment	0.411*	0.152
	0.230	*0.134*
Consumption	-0.087	0.028
	0.108	*0.099*
Openness	-0.084	0.178
	0.146	*0.483*
Investment	0.004	-0.011
	0.011	*0.016*
Fertility	-2.320	0.450
	2.944	*0.948*
1/Life Expectancy	16.178	-2.990
	16.896	*5.587*
Democracy	-0.207	-0.107
	0.194	*0.083*
Inflation	-0.002	0.000
	0.002	*0.001*
Constant	60.347	-9.547
	75.083	*20.438*
Observations	205	205
Groups	12	12
Instruments	60	60
AR(1)	-0.150	-0.890
AR(2)	1.420	-0.320
Hansen J	0.750	0.500
Wald chi-sq	12.010**	220.180***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. Robust standard errors are reported in italics.

Table 8. Panel Data Estimation

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	-0.016	-0.011
	0.017	*0.014*
Per capita Oil Reserve	0.003	
	0.003	
Oil Rent		0.000
		0.000
Tertiary Enrolment	0.019*	0.020*
	0.011	*0.011*
Consumption	-0.004	-0.004
	0.023	*0.023*
Openness	0.024	0.016
	0.018	*0.014*
Investment	0.001	0.001
	0.001	*0.001*
Fertility	-0.025	-0.029
	0.028	*0.026*
Mortality	0.012	0.014
	0.023	*0.023*
Democracy	0.001	0.002
	0.003	*0.004*
Inflation	0.001**	0.000**
	0.000	*0.000*
Constant	-0.006	-0.033
	0.141	*0.140*
Observations	205	205
Groups	12	12
Adjusted R-squared	0.113	0.117
LM test for random effects	25.14***	28.44***
LM test for serial correlation	8.74***	7.97***

Notes: ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. Robust standard errors are reported in italics.

Table 9. Panel Data Estimation

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	-0.023*	-0.018*
	0.013	*0.010*
Per capita Oil Reserve	0.004	
	0.003	
Oil Rent		0.001
		0.000
Tertiary Enrolment	0.017	0.017
	0.012	*0.012*
Consumption	-0.006	-0.006
	0.024	*0.023*
Openness	0.023	0.013
	0.019	*0.014*
Investment	0.001	0.001
	0.001	*0.001*
Fertility	-0.009	-0.009
	0.017	*0.018*
1/Life Expectancy	-0.027	-0.039
	0.032	*0.031*
Democracy	0.001	0.001
	0.003	*0.004*
Inflation	0.000***	0.000***
	0.000	*0.000*
Constant	-0.034	-0.091
	0.125	*0.136*
Observations	205	205
Groups	12	12
Adjusted R-squared	0.112	0.116
LM test for random effects	34.74***	36.47***
LM test for serial correlation	9.78***	9.71***

Notes: ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. Robust standard errors are reported in italics.

Table 10. Dynamic Panel Estimation

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.942***	0.663
	0.127	*0.819*
Per capita Oil Reserve	0.303***	
	0.021	
Oil Rent		-0.005
		0.052
Per capita Oil Reserve X Low	-0.352	
	0.452	
Per capita Oil Reserve X High	-0.332	
	0.638	
Oil Rent X Low		0.004
		0.062
Oil Rent X High		0.011
		0.037
Tertiary Enrolment	0.073	0.199
	0.211	*0.164*
Consumption	-0.047	-0.077
	0.101	*0.160*
Openness	0.159	0.624
	0.182	*1.729*
Investment	0.000	-0.008
	0.005	*0.019*
Fertility	-0.153	0.099
	0.100	*0.369*
Mortality	0.002	0.150
	0.133	*0.475*
Democracy	-0.041	-0.160***
	0.088	*0.061*
Inflation	0.000	0.000
	0.001	*0.001*
Constant	-0.668	-0.216
	1.029	*1.464*
Observations	205	205
Groups	12	12
Instruments	61	61
AR(1)	-1.490	-0.990
AR(2)	0.430	0.330
Hansen J	0.000	0.000
Wald chi-sq	335504***	224716***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. Low (high) is a dummy variable which accounts for countries with higher (lower) level of per capita oil reserve or oil rent, respectively. Robust standard errors are reported in italics.

Table A1. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.802***	0.871***
	0.166	*0.114*
Per capita Oil Reserve	-0.048	
	0.117	
Oil Rent		0.001
		0.001
Tertiary Enrolment	0.019	0.007
	0.029	*0.014*
Constant	1.633	1.065
	1.383	*1.018*
Observations	313	305
Groups	13	13
Instruments	28	28
AR(1)	-2.040**	-2.650***
AR(2)	-1.510	-1.790*
Hansen J	7.140	5.360
Wald chi-sq	42.980***	59.910***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 8. Robust standard errors are reported in italics.

Table A2. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.994***	1.008***
	0.031	
Per capita Oil Reserve	0.032	
	0.136	
Oil Rent		0.002
Tertiary Enrolment	0.017	-0.039
	0.068	
Constant	0.048	0.062
	0.177	
Observations	313	305
Groups	13	13
Instruments	51	51
AR(1)	-1.300	-1.280
AR(2)	-0.600	-0.570
Hansen J	0.000	0.000
Wald chi-sq	59804***	684372***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. The estimation is also using year fixed effects. Robust standard errors are reported in italics.

Table A3. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.956***	0.940***
	0.083	
Per capita Oil Reserve	-0.020	
	0.055	
Oil Rent		0.000
Tertiary Enrolment	0.000	-0.004
	0.005	
Constant	0.388	0.550
	0.767	
Observations	313	305
Groups	13	13
Instruments	19	19
AR(1)	0.220	0.190
AR(2)	-0.210	-0.800
Hansen J	6.020	8.030
Wald chi-sq	1262***	598***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. The dependent variable has been smoothed using a 5-year moving average. Robust standard errors are reported in italics.

Table A4. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.861***	0.844
	0.073	*0.051*
Per capita Oil Reserve	0.020	
	0.013	
Oil Rent		0.001
		0.000
Tertiary Enrolment	0.009	0.012
	0.006	*0.005*
Constant	0.388	0.550
	0.767	*0.428*
Observations	313	305
Groups	13	13
Instruments	19	19

Notes: ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. This is the analysis based on the xtlsdvc routine of stata. Robust standard errors are reported in italics.

Table A5. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.775***	1.079***
	0.235	*0.361*
Per capita Oil Reserve	-0.053	
	0.104	
Oil Rent		0.003
		0.003
Tertiary Enrolment	0.000	0.026
	0.029	*0.032*
Consumption	-0.186	0.072
	0.174	*0.113*
Openness	0.175	-0.004
	0.136	*0.244*
Investment	-0.001	-0.001
	0.002	*0.003*
Constant	1.826	-1.047
	2.072	*2.515*
Observations	300	300
Groups	13	13
Instruments	55	55
AR(1)	-1.740*	-1.710*
AR(2)	-0.440	-1.290
Hansen J	6.200	5.800
Wald chi-sq	90.490***	814.890***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 8. Robust standard errors are reported in italics.

Table A6. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	1.023***	0.976***
	0.050	*0.075*
Per capita Oil Reserve	-0.008	
	0.053	
Oil Rent		0.003
		0.003
Tertiary Enrolment	0.016	-0.007
	0.034	*0.041*
Consumption	-0.077	0.058
	0.141	*0.178*
Openness	0.175	-0.004
	0.136	*0.244*
Investment	-0.001	-0.001
	0.002	*0.003*
Constant	-0.247*	-0.041
	0.147	*0.076*
Observations	300.000	300
Groups	13.000	13
Instruments	69.000	69
AR(1)	-1.440*	-1.650*
AR(2)	-0.230	-0.120
Hansen J	0.000	0.000
Wald chi-sq	108418***	183533***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. The estimation is also using year fixed effects. Robust standard errors are reported in italics.

Table A7. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.935***	0.985***
	0.067	*0.018*
Per capita Oil Reserve	0.019	
	0.038	
Oil Rent		-0.001
		0.001
Tertiary Enrolment	-0.003	-0.003
	0.010	*0.022*
Consumption	-0.048	-0.018
	0.047	*0.124*
Openness	0.053	0.023
	0.071	*0.034*
Investment	0.000	0.001
	0.001	*0.001*
Constant	0.489	0.108
	0.565	*0.448*
Observations	300	300
Groups	13	13
Instruments	37	37
AR(1)	-0.910	-0.140
AR(2)	-0.410	-1.030
Hansen J	4.520	6.290
Wald chi-sq	1521***	4747***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. The dependent variable has been smoothed using a 5-year moving average. Robust standard errors are reported in italics.

Table A8. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.682**	1.272***
	0.283	*0.311*
Per capita Oil Reserve	0.021	
	0.114	
Oil Rent		0.002
		0.003
Tertiary Enrolment	-0.103	0.186
	0.081	*0.187*
Consumption	-0.369*	0.224
	0.216	*0.335*
Openness	-0.250	0.305
	0.204	*0.465*
Investment	0.005*	-0.005
	0.003	*0.007*
Fertility	-0.010	-0.670
	0.915	*0.790*
Mortality	-0.216	0.446
	0.628	*0.582*
Democracy	0.130	0.029
	0.116	*0.171*
Constant	5.689	-5.425
	3.707	*6.663*
Observations	260	260
Groups	13	13
Instruments	82	82
AR(1)	-1.180*	-1.880*
AR(2)	-0.820	-0.430
Hansen J	2.890	3.410
Wald chi-sq	42.760***	93.940***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 8. Robust standard errors are reported in italics.

Table A9. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	1.011***	0.990***
	0.010	*0.008*
Per capita Oil Reserve	0.055	
	0.063	
Oil Rent		0.002
		0.002
Tertiary Enrolment	-0.039	0.025
	0.032	*0.030*
Consumption	-0.369*	0.224
	0.216	*0.335*
Openness	-0.250	0.305
	0.204	*0.465*
Investment	0.001	0.002
	0.002	*0.003*
Fertility	-0.010	-0.670
	0.915	*0.790*
Mortality	-0.216	0.446
	0.628	*0.582*
Democracy	0.130	-0.047
	0.116	*0.038*
Constant	0.042	0.043
	0.030	*0.046*
Observations	260	260
Groups	13	13
Instruments	85	85
AR(1)	-1.480*	-1.750*
AR(2)	-1.000	-0.520
Hansen J	0.000	0.000
Wald chi-sq	4660000***	2250000***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. The estimation is also using year fixed effects. Robust standard errors are reported in italics.

Table A10. Dynamic Panel GMM

Dependent Variable	Per capita GDP growth	Per capita GDP growth
Lagged Dependent Variable	0.963***	0.896***
	0.075	0.150
Per capita Oil Reserve	0.007	
	0.022	
Oil Rent		0.000
		0.001
Tertiary Enrolment	-0.014	-0.016
	0.017	0.039
Consumption	-0.008	-0.040
	0.046	0.080
Openness	0.023	-0.127
	0.110	0.218
Investment	0.001	0.003
	0.001	0.003
Fertility	0.080	0.131
	0.101	0.163
Mortality	-0.110	-0.134
	0.081	0.166
Democracy	0.022	-0.023
	0.019	0.023
Constant	0.520	1.869
	0.539	2.614
Observations	260	260
Groups	13	13
Instruments	55	55
AR(1)	0.430*	-0.160
AR(2)	-0.220	-1.110
Hansen J	2.330	3.900
Wald chi-sq	26.990***	5881.19***

Notes: AR(1) and AR(2) test are for the first and second order tests of serial correlation in the differenced residuals. Hansen J-test are for the null hypothesis that the overidentifying restrictions are valid. ***, **, * denote statistical significance at the 1, 5 and 10% statistical level respectively. All variables are in natural logs with the exception of Oil rent and Inflation. The null of panel data unit root test has been rejected for each variable under analysis. Instrument lag limit is set to 5. The dependent variable has been smoothed using a 5-year moving average. Robust standard errors are reported in italics.

Figure 1. Time Series Plots: per capita GDP vs. per capita Oil Reserve

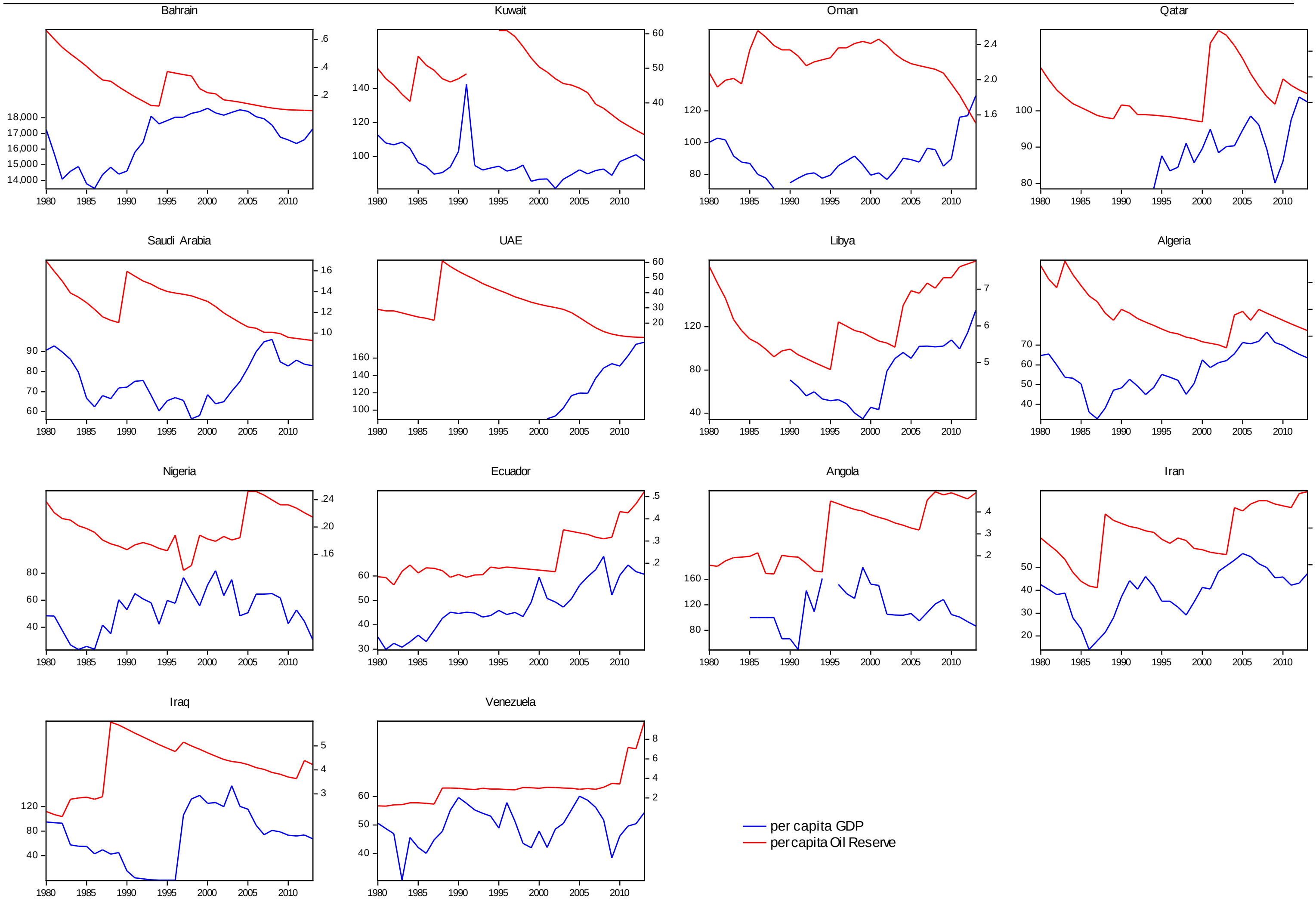


Figure 2. Time Series Plots: per capita GDP vs. Oil Rent

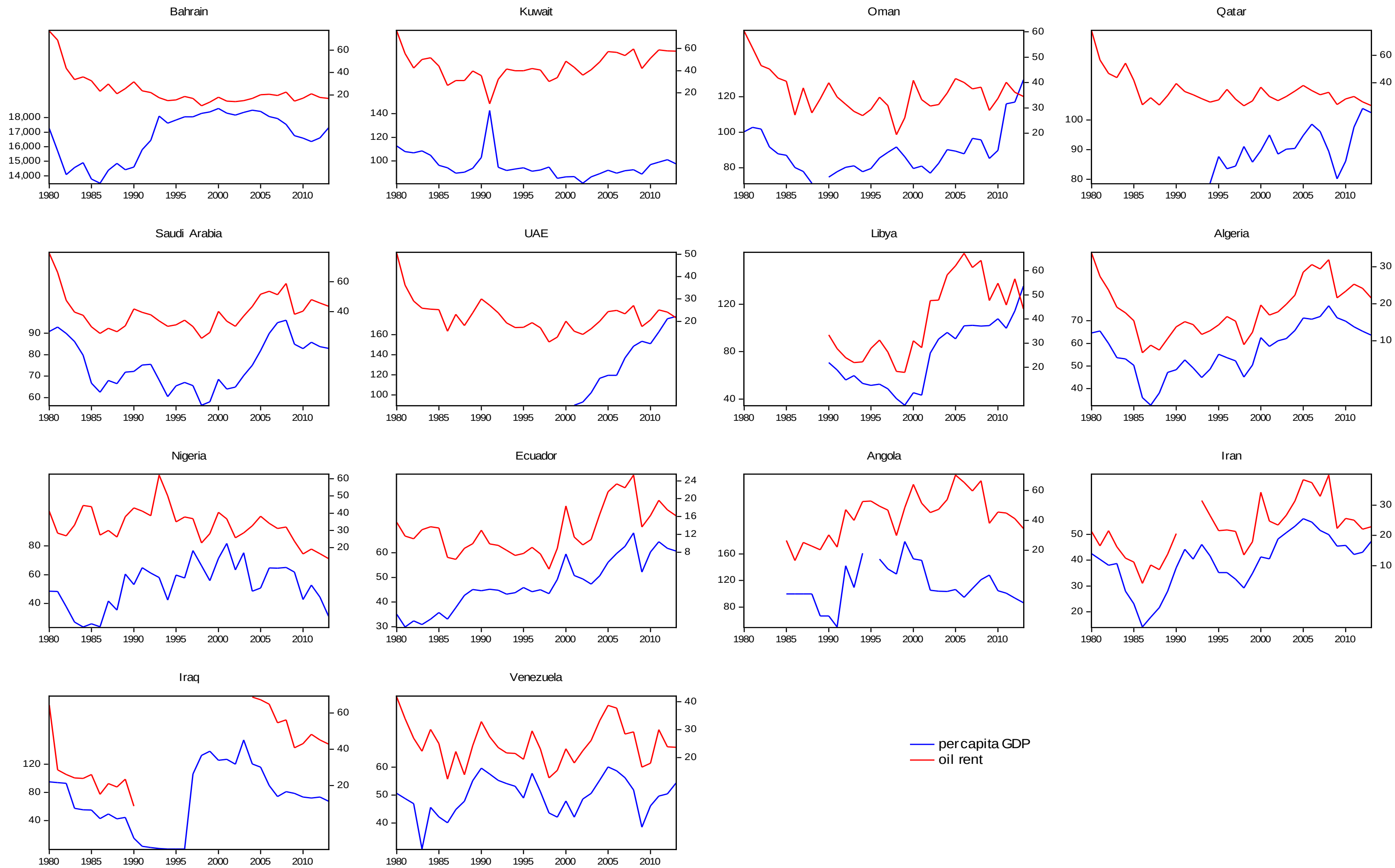
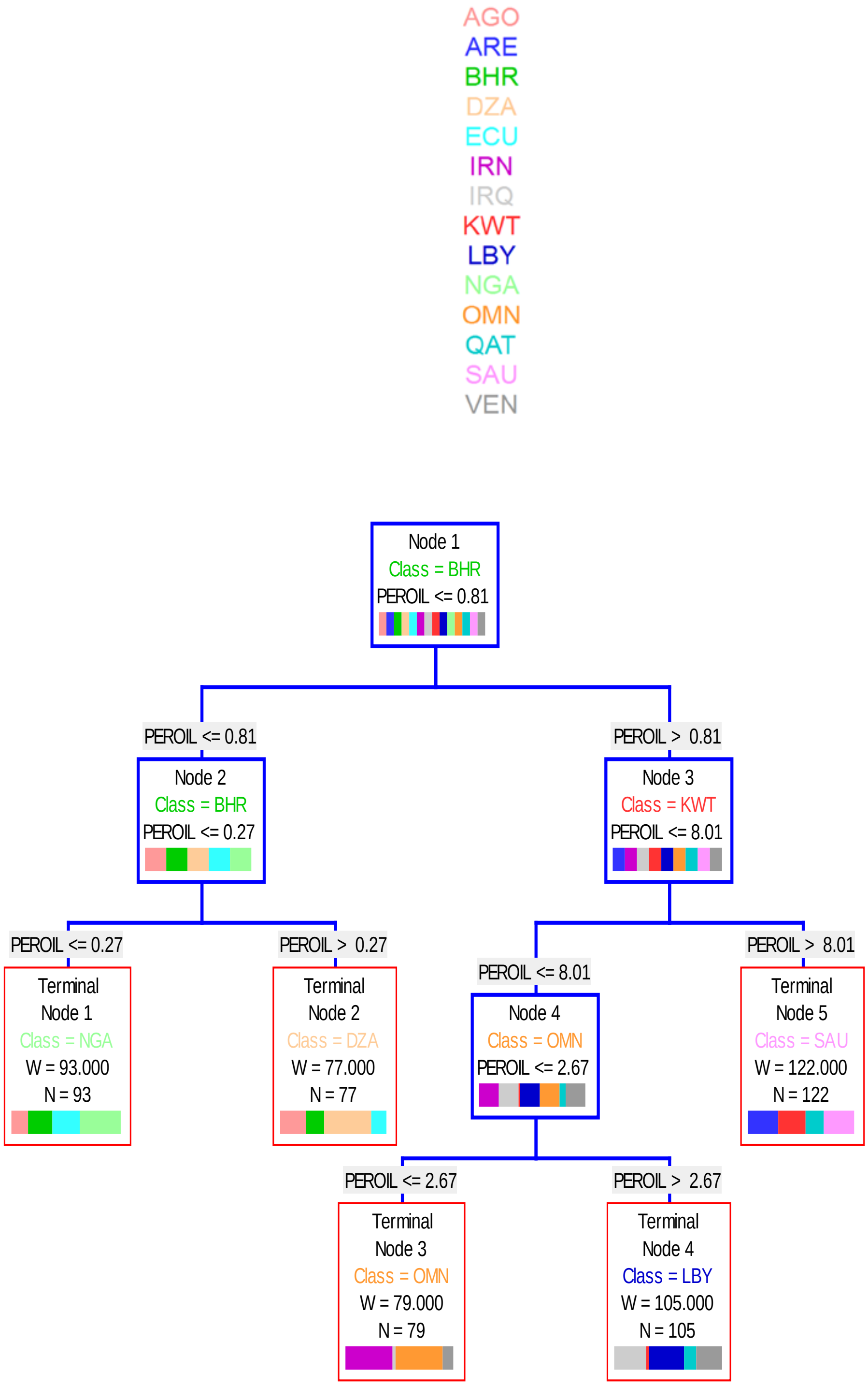
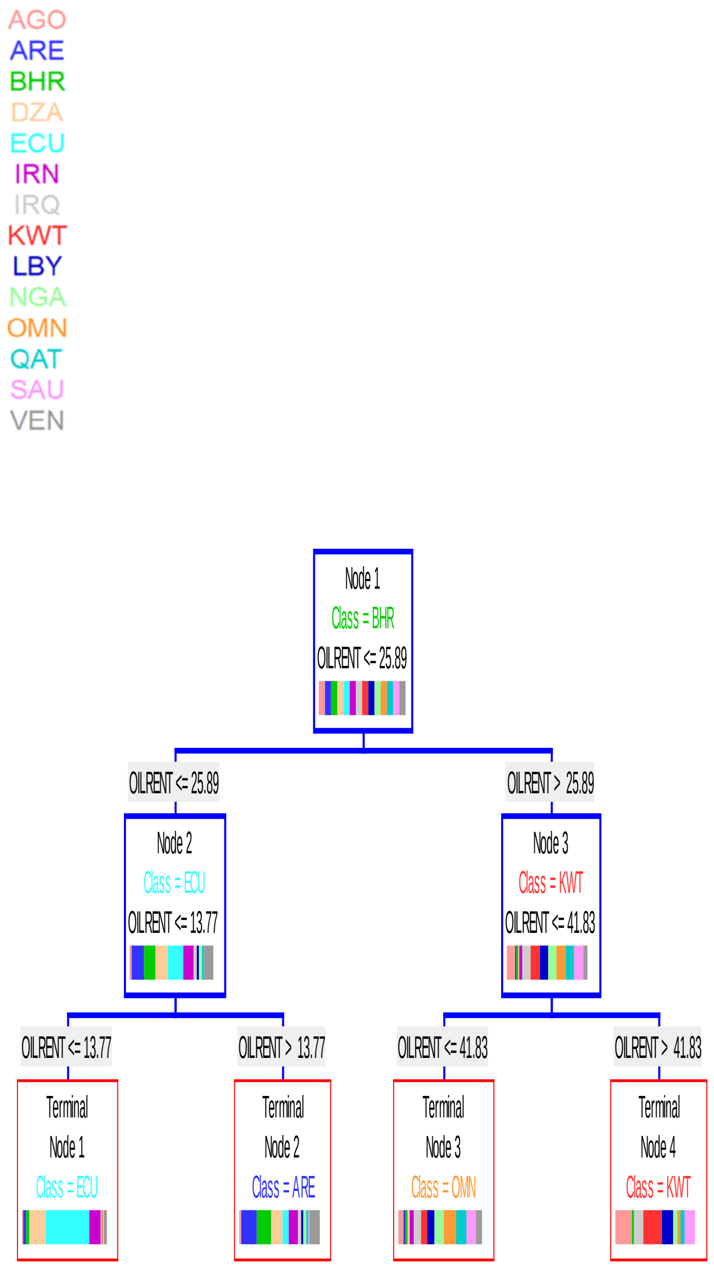


Figure 3. Classification Trees Based on the Level of Per Capita Oil Reserve



Note: PEROIL represents per capita oil reserve. Different colours stand for different countries specified on the left-hand side.

Figure 4. Classification Trees Based on the Level of Oil Rent



Note: OILRENT represents oil rent. Different colours stand for different countries specified on the left-hand side

Chapter 3

Oil Price Volatility and Financial Contagion in Oil Exporting Countries

Abstract

In this chapter, we examine the oil's role in the interconnectedness of the Arab Gulf financial markets with the global system. Specifically, we use the financial contagion framework and the Global Financial Crisis to assess: i) how affected were the six GCC nations stock markets; ii) what has been the role of oil in the transmission of the financial shocks, given that the six GCC nations are amongst the largest oil-producing countries in the world. Our data span from 2004 to 2015; thus giving us good coverage of the Global Financial Crisis and the recent Oil Crisis with the persisting low oil prices. We adopt a DCC-GARCH framework which allows for dynamic properties of correlations across the financial markets. We find that all GCC stock markets show statistical evidence of financial contagion, with Abu Dhabi and Saudi Arabia being the ones that were affected the most, as evidenced by the higher change in the correlation levels. By contrast, Kuwait has been the least affected, since financial contagion is only verified at the 10% significance level. Our findings could be of practical importance to investors and policy makers, particularly in the GCC area.

Keywords: Oil • DCC-GARCH • GCC • Financial Contagion • Oil shocks

JEL Classification: C5; G1; Q4

3.1 Introduction

Volatility transmission across capital markets has increased due to the high financial interconnectedness of the global financial markets, often aided by trade and political unions, such as the European Union, the GCC and the Association of South East Asian Nations (ASEAN). Therefore, volatility transmission becomes increasingly relevant to the financial community, policy makers, investors and regulators throughout the world. If, for example, there is evidence of stock market return and volatility spreading across markets, investors and policymakers would need to adjust their exposure and actions so as to prevent contagion risks following a market crisis.

This issue has received much attention in the context of international asset markets (Forbes and Rigobon, 2002; Syriopoulos, 2007 for stock markets; Barassi et al., 2005; Wang et al., 2007 for monetary markets; and Skintzi and Refenes, 2006; Johansson, 2008 for bond markets). Most of these previously mentioned studies uncover evidence of important spill overs of return and volatility across financial markets. The respective authors argue that the intensity of the spill over is highly dependent on economic and financial integration and also on how aligned the monetary policies are. Market situations and geographical proximity also seem to play a crucial role in explaining the intensity of shock spill overs since the latter are found to be more important during crisis periods than during normal (or tranquil) ones, and more pronounced at the regional level than at the international level.

The link between financial and commodity markets is also of great importance. For example, the link between oil prices and stock market performance has attracted a significant attention over the recent years, mainly driven by the oil crises and their repercussions on both the global economy and the local ones (that is, of the oil-producing countries), economies. Indeed, there is considerable transmission of volatility shocks across these markets due to cross-market hedging and changes in common information, which may affect the expectations of market participants. Therefore, any empirical investigation of the spill over intensity between the respective markets offers insights into building accurate asset pricing models and forecasts of the return and volatility, and therefore accurate predictions of the reliance of the economy on stock market and commodity market movements and co-movements.

3.2 Oil Price Dynamics

The interrelation between oil and stock markets can be observed from Figure 1, which clearly shows why the studies on shock transmission between the two markets are needed. Furthermore, it demonstrates that all investors should be aware of the risk of important fluctuations of oil prices affecting the value of their portfolios, especially in recent years.

[Figure 1 around here]

The price dynamics of the markets being considered differed largely between November, 2005 and May, 2006, as the WTI oil price rose by around 30%, while the GCC market index experienced a sharp decline of around 25%. Afterwards, both indices shared some common trends, with a notable exception, in that the spectacular increase of oil barrel prices during the first half of 2008 was not closely followed by the stock market index. The rapid swings in oil prices would normally lead to significant adjustments in energy risk management and policies, as oil is a pricing benchmark for various financial instruments and plays a crucial role in international asset hedging strategies. However, the swings in the oil price are not only a result of the Global Financial Crisis. Figure 2 presents the WTI crude oil prices, in dollars, from January 1987 to March 2016.

[Figure 2 around here]

Oil price movements show important peaks and troughs during this period. Significant peaks are observed around October 1990, with oil prices doubling within a year. Another peak is observed in September 2000, due to a continuing increase in oil prices since 1999. During 1992 and 2008, a continuing increase in oil prices is observed, with some disruptions (e.g., during 2007). A final peak is observed in June 2009, with prices climbing more than 60% with regards to the January 2009 price levels. The main troughs are observed in the early part of 1999, with prices dropping by 50% since 1997, and then in December 2001, where oil prices fell by 50% since September 2000. In January 2007, prices dropped by almost 40% compared to the mid-2006 prices, while in early 2009, a drop of about 70% vis-à-vis the June 2008 levels is observed.

Demand-side oil price shocks have been driving the majority of oil price changes. One occurred during the 1997-98 Asian economic crisis, while a second took place in 2000, with interest rates decreasing significantly; thus, creating pressure on the housing and construction industries (Filis et al., 2011). A third took place in the period 2006–2007 due to the rising demand of oil from China, whereas a fourth demand-side oil price shock occurred in the most recent global financial crisis of 2008. Factors like the demand growth in emerging economies (e.g., China and India), and supply disruptions due to the US invasion of Iraq and related geopolitical risk, and a weakening dollar coupled with rising speculation in the oil market were responsible for these shocks. More recently, another factor was the recession in the US and other OECD countries, triggered by the global financial crisis in the wake of the collapse of Lehman Brothers in September 2008 (Hamilton, 2009).

3.3 Oil and Financial Market Indices

Following the major oil price shocks of the 1970s, a large body of literature finds significant effects of oil price shocks on the US economy[6] and on other economies around the world (see e.g., Cologni and Manera, 2008 on OECD countries, and Cunado and Perez de Garcia, 2005 on Asian countries). Given the importance of oil to the world economy, a large body of research has investigated the effects of oil price shocks not only on output but also on stock markets.

An early strand of the literature has investigated the link between oil prices and economic activity. In this context, the studies of Gisser and Goodwin (1986) and Hickman et al. (1987) confirm an inverse relationship between oil prices and aggregate economic activity, while Burbidge and Harrison (1984) and Bruno and Sachs (1982) generalise this finding in a cross-country setting. The study by Hamilton (1983) is the one that links the previously documented inverse relationship to events of crisis, finding that oil price dynamics are able to predict economic crises. Explaining the fundamental reasons for this inverse relationship typically rests upon the classic supply-side model, which proposes that rising oil prices slow GDP growth and stimulate inflation (Rasche and Tatom, 1977, 1981; Barro, 1984; Brown and

[6] See for example, seminal studies on the relationship between oil prices and macro-economy (Hamilton, 1983). Other studies establishing the relationship between oil shocks and real economic activity are provided by (Hamilton, 2003), Balaz and Londarev (2006). Recent studies in this area include Lee and Chang (2007), Kilian and Park (2007), and Kilian (2008).

Yücel, 2002; Gronwald, 2008; Cologni and Manera, 2008; Kilian, 2008; Lardic and Mignon, 2006;, 2008; Lescaroux and Mignon, 2008).

A separate strand of the literature is focused on the effects of oil shocks on stock market returns in the US, Canada, Japan, and the UK (Jones and Kaul, 1996), Australia (Faff and Brailsford, 1999), Emerging Markets (Basher and Sadorsky, 2006), the Asia–Pacific region (Nandha and Faff, 2008), and in a combination of US/European stock markets (Park and Ratti, 2008).

In our study we use the asymmetric dynamic conditional correlation (ADCC)-GARCH framework using data over the 2004-2016 period for the GCC countries: namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. The ADCC-GARCH model can be successively estimated for large time-varying covariance matrices, while it requires the estimation of a lesser number of parameters than other multivariate models, such as BEKK. To the best of our knowledge, this is the first attempt to examine the stock market – oil relationship allowing for asymmetries in the conditional correlation process, and thus, this paper significantly adds to the methodological aspect of this research area. A separate contribution, this time to the field of financial contagion, is that our study visits the stock market – oil relationship from a perspective of a shock transmission channel, whereby correlations increase during periods of financial crisis (Forbes and Rigobon, 2002). Therefore our study asserts that even though GCC markets may be financially segmented from the international markets, they are still vulnerable to financial contagion through the oil transmission channel.

3.4 Globalization, Market Integration and Shocks Propagation

3.4.1 Definition of Contagion

In an early contagion definition by Eichengreen and Rose (1999), contagion is defined as a situation where a country experiences a crisis, given that a crisis has hit another country. Yet, no single contagion definition exists. Relatedly, Pericoli and Sbracia (2003) have summarized the five most used descriptions. According to these authors, contagion may be defined as: i) a significant increase in the probability of a crisis in one country, given that a crisis has hit another country; ii) a volatility spill over on asset prices from the crisis country to other countries; iii) cross–country co-movements of asset prices over and above those explained by fundamentals; iv) a significant increase in co-movements of price quantities across markets, conditional on a crisis occurring in one market; v) an intensification or more generally a creation of a transmission channel after a shock occurs in a market (shift-contagion).

Shift-contagion, introduced by Forbes and Rigobon (2002), is one of the most widely used definitions in the recent literature. Correlation coefficients are utilized to identify contagion, but because they are conditional on market volatility, when markets are volatile, for example during periods of crisis, the coefficients present an upward bias. Therefore, an adjustment for heteroscedasticity is necessarily implemented; hence contagion evidence can change dramatically, as for example in the cases of the 1997 East Asian and the 1987 US market crises. The underlying cause for this change lies in the fact that strong linkages that exist even in calm periods may carry on during periods of turmoil. By contrast, an actual increase in those linkages is the subject of investigation under contagion (Forbes and Rigobon, 2002). In the first case, where contagion does not exist, the term *interdependence* is used in order to describe the constantly high correlations between the markets.

Much research has been executed based on the pioneering work of King and Wadhwani (1990), who use correlation coefficients; albeit without adjusting for heteroscedasticity. The idea presented by Forbes and Rigobon (2002) as an extension of the research conducted by King and Wadhwani (1990) is more representative of the reality of contagion and will be used throughout this research dissertation as the base for empirical examination.

3.4.2 Channels of Contagion

Desai (2003) identifies two channels for contagion: trade and fund withdrawal. The former would usually materialize due to an economic crisis affecting the amount of trade of goods between countries. The latter is more related to financial destabilization with investors withdrawing funds from highly distressed and risky countries in an attempt to reduce their exposure. Glick and Rose (1999) suggest that an examination of international trade patterns is more pertinent, as currency crises, and consequently withdrawal of funds, tend to have a regional character. On the other hand, Van Rijckehem and Weder (2001) provide evidence that fund withdrawal explains contagion more accurately. In reality, both channels are interrelated and usually cause each other. As financial problems in a country unveil, investors start withdrawing funds, thereby reducing liquidity, which deepens the original crisis and as a consequence the amount of business conducted with that country reduces, based on fears of counterparty risk.

Bekaert et al. (2014) provide an extensive analysis of six potential contagion channels. The first two, banking sector links and domestic financial policies, are closely linked. With a crisis starting from the banking sector, the financial crisis spreads mainly within the sector and as a result financial policies and capital injections are introduced. The result effect of these policies is to transfer any potential risk from banks to governments thus initiating possible contagion.

The remaining four contagion channels of Bekaert et al. (2014) are more closely related to the fund withdrawal theory of Desai (2003), and are also supported from Pericoli and Sbracia (2003) and Coudert and Gex (2010). The first one refers to the *globalization hypothesis* and is based on the fact that a crisis mostly affects economies that are highly integrated on a global scale, as the shock from one country can easily be transferred to another. The second channel, *information asymmetries decrease,* refers to the preference of investors relying on cheap public information during a crisis, increasing correlation on fund flows.

The *wake-up call* is another important channel, according to Bekaert et al. (2014). During a crisis event, investors re-assess their exposure to vulnerable countries that pose a high risk to their portfolios; as a result, they tend to withdraw investments from those countries, thereby initiating a contagion effect. The wake-up call phenomenon has been one of the main reasons for the European Sovereign Debt Crisis (ESDC) in 2010. The last channel is attributed to, the *herding behaviour* of investors, and is closely correlated with the wake-up call. As some investors start to withdraw funds from a country, all the investors will follow this strategy. According to Bekaert et al. (2014), the wake-up call and the financial policies are the two main channels that have affected the global economy for a number of years but the remaining channels are treated as equally important.

However, the GCC countries have a certain peculiarity: their reliance on oil revenue. As such it may be expected that abrupt oil price changes could be used to transmit any instability from other parts of the globe into the region. It has been suggested that shocks in oil prices can affect the economic conditions (see, for example, Wu and Cavallo, 2012, for an investigation on the US economy and oil-related events over the period 1984 – 2006. A focal point in oil-related studies is to disentangle whether oil shocks are demand or supply driven, which is not always clear-cut (Melolinna, 2012).[7] In this paper we are more interested in the way oil price shocks, irrespectively of their origin, affect the financial markets. A CAPM application for the Central and Eastern European (CEE) oil and gas sectors is offered in Mohanty, Nandha and Bota (2010) over the period from 1998 to 2010 period. They did not find any significant association between oil prices and stock returns for the full period but their analysis supports the contention that an oil risk factor is in place during a global financial crisis. In the context of emerging stock markets, the effect of oil shocks is generally found to be significant over both the short and long run (Papapetrou, 2001; Basher and Sadorsky, 2006; Maghyereh and Al-Kandari, 2007). The study by Malik and Ewing (2009) employs a bivariate GARCH model and finds evidence of volatility transmission among several US sectorial equity indices and oil prices. However, some of the smaller emerging markets, especially in the GCC, have not received the proper attention, given the importance of oil in these economies. One of the reasons may be

[7] For a more detailed overview of demand and supply oil shocks and how they affect the macroeconomic environment we direct you to Killian (2009, 2010).

the fact that the GCC stock markets are largely segmented from the international markets and are highly sensitive to political events (Arouri et al., 2011).

Zarour (2006) employed a VAR model to study the oil-stock market short-run links in Saudi Arabia and Oman, finding evidence that encompassing oil price changes in a stock market return model can enhance its predictive power. In a similar setting, Arouri and Fouquau (2009) used a nonparametric method to investigate the short-run relationships between oil prices and stock markets and showed some evidence of nonlinearities for the cases of Qatar, Oman, and UAE.

Arouri and Rault (2010) evaluate the sensitivity of GCC stock markets to oil prices over the period 1996 to 2007, using monthly data and a Granger causality approach. The authors verify the presence of a causal relationship for the case of Saudi Arabia between stock markets and oil price changes. Therefore, the authors conclude that investors in the GCC stock markets should look at the changes in oil prices. Causality and co-integration tests have been adopted by Hammoudeh and Aleisa (2004) and Hammoudeh and Choi (2006) that also show a long-run bidirectional relation between the Saudi Arabian stock market and oil price changes that persists when controlling for the global market sentiment and macroeconomic environment. Lescaroux and Mignon (2008) investigate long-run and short-run relationships between oil and stock prices and find evidence of positive causality from oil prices to stock prices in some GCC countries.

The seminal paper by Maghyereh and Al-Kandari (2007) shows evidence of a nonlinear impact of oil prices on stock prices, which affects the course of future research towards models that allow for non-linearities. A VAR-GARCH approach has been used in the study by Arouri et al. (2011) to investigate the return links and volatility transmission between oil and stock markets in the GCC over the period 2005 to 2010. The findings are in support of the contention that oil prices carry an influential power over the return and volatility of the GCC stock markets. Fayyad and Daly (2011) examine the relationship between oil price and stock market returns for the GCC, the UK and the US, adopting a VAR framework over the period from September 2005 to December 2010. Their findings suggest that during periods of crisis the predictive power of oil price changes over stock market returns increases, with Qatar and the UAE being the most responsive to oil shocks.

Filis et al. (2011) use a DCC GARCH set up to investigate time-varying correlation between the stock market prices and oil prices of oil-importing and oil-exporting countries, albeit the GCC countries are not included in their sample. The authors fail to find significant differences between the two types of countries; they do find, however, that global business cycle fluctuations affect the oil demand-side and consequently the correlations with the stock market. Therefore, oil prices can work as a transmission channel for economic instability across countries.

3.4.3 From Market Integration to Contagion

All empirical work on contagion focuses on one important characteristic, the integration of financial markets. Potential market integration is one of the main reasons for contagion, as the shocks can be transferred easily from one market to the other (Bekaert et al., 2005; Cappiello et al., 2006). As expected, most of the literature around the concepts of stock market integration and financial contagion is focused on the European Union. At the same time the link between stock market integration, financial contagion and oil prices has not received the proper attention it deserves.

Hardouvelis et al. (2006) examine the stock market integration among 11 EU countries over the 1992-1998 period, based on the initial assumption that market integration occurred before the adoption of the Euro, while these countries were converging towards a common currency. Using weekly data and an empirical asset-pricing model based on the model of Bekaert and Harvey (1995), they observe significant market integration between the EU countries, with the exception of the UK. The evidence of integration within Europe is straightforward prior to the introduction of the Euro, which resulted from the efforts of EU countries to satisfy the Maastricht criteria and converge towards German levels (Hardouvelis et al., 2006).

In addition, Baele and Inghelbrecht (2009, p.2) argue that globalization – and as a consequence, integration – "have led to a gradual convergence of country to industry betas, especially in Europe", and this results in a gradual decrease in country- specific risk. The reasons that market betas vary is based on three facts. First, as markets become increasingly integrated, global factor exposure tends to increase. Second, changes in industry and regulations will lead to changes in betas over time. Third, country and industry betas usually fluctuate over a business cycle even if no structural changes are observed. Based on this approach of betas they use the two factor model of Bekaert et al. (2005), extending it by including a regime-switching intercept to capture cyclical variation in betas or structural changes. Their study of 21 countries and 18 global industries evaluates the superiority of country to industry diversification strategies, but as a side result offers insightful observations on integration. Baele and Inghelbrecht (2009) observe that while global industry betas are mostly unaffected by structural changes, European market betas have converged towards one as an effect of the introduction of the Euro, which reduced the home bias of European investors (Baele et al., 2007; Gérard and De Sandris, 2006). This provides evidence of substantial market integration within Europe and, to a smaller extent, within the global economy.

One other main result of this study is the apparent importance of geographical diversification to industry diversification. Industry diversification is important, as presented in other studies (Baur, 2012), while geographical diversification will ensure the minimization of investors' risks. Industry diversification is also very topical in the GCC countries, where over-exposure to the oil industry has caused economic recessions during the oil crises of the 1970s and 1980s, thereby forcing the governments to invest in diversifying their industries into manufacturing, financial services and tourism, so as to withstand any future impact on economic growth due to oil price fluctuation.

The results from Baele and Inghelbrecht (2009) are reinforced from the study performed from Bekaert et al. (2009) on stock co-movements. The widely used two-factor CAPM model from Bekaert et al. (2005), alongside an arbitrage pricing theory (APT) model, examines the correlations of portfolio returns from 23 developed countries from 1980 until 2005. Market integration appears to be significant between European markets, followed by a global integration to a smaller extent. This increase in return correlations, which is likely to be permanent, results from trade openness (Baele and Inghelbrecht, 2009) and erodes potential diversification. Nevertheless, the main findings of this study agree with the results from Baele and Inghelbrecht (2009) that international diversification is superior to industry benefits.

Similarly, Bley (2009) examines the degree of market integration, focusing on Europe. The author follows a sectorial approach that is similar to that used by Phylaktis and Xia (2009), but extends the data from 1998 to 2006, incorporating six industry sector indices for 11 European countries. It is evident from this study that significant market integration occurred in European markets after 1992 but that the monetary policy convergence has led, possibly temporarily, to a decline in market integration.

Following the same approach of sector and industry examination, Bekaert et al. (2013) study the impact of the European Union and Eurozone on market integration. This approach is based on industry expected earnings, growth and valuation differentials from 1990 until 2007. Based on their analysis, the researchers conclude that EU membership contributes towards financial integration regardless of whether a country adopted the Euro; these results support the previous studies by Engel and Rogers (2004), Goldberg and Verboven (2005), and Hardouvelis et al. (2006).

Through the examination of the related literature it is observed that the studies above present clearly the increasing integration of the global markets. However, the financial integration during this time poses significant contagion threats. Interestingly, early contagion studies precede market integration studies, focusing on significant market crashes in the 1980s and 1990s. However, due to the primary focus of these studies in terms of country composition, the oil channel has not received the proper attention.

Hamao et al. (1990) offers one of the early studies on contagion, focusing on stock return variances based on trading information and volume, and the study of Barclay et al. (1990), who examine stock returns on international markets. King and Wadhwani (1990) are the first to coin the term *contagion*, though, for their study related to the October 1987 market crash. Correlation coefficients were used in order to search for volatility transmission, setting the first step for the subsequent studies.

While the remaining decade studies focused mostly on a more theoretical approach using simpler CAPM models (Glick and Rose, 1999; Van Rijckehem and Weder, 2001), Forbes and Rigobon (2002) examine the 1997 Asian crisis, 1994 Mexican devaluation and 1987 US market crash using correlation coefficients. After correcting for the heteroscedasticity criticism, it has become clear there is no risk contagion or “shift-contagion”. The results observed indicate a high level of market co-movement known as interdependence.

Forbes and Rigobon (2002) use the 24 largest markets in terms of market capitalization and another four markets (Argentina, Chile, Philippines and Russia). Their results are consistent with other studies (Basu, 2002; Corsetti et al., 2005; Bordo and Murshid, 2006). However, the correction proposed by Forbes and Rigobon (2002) was criticized by Corsetti et al. (2005) on the basis that if the data include a common factor (such as oil prices or changing interest rates), the bias adjustment is not allowed.

Based on the work of Forbes and Rigobon (2002), Serwa and Bohl (2005) investigated contagion between Western European stock markets (already sufficiently integrated) and Central and Eastern European markets, related to seven financial shocks from 1997 to 2002. They find that contagion hardly occurred between the two regions during the crises examined. Some of the results presented directly contrast with the study by Glick and Rose (1999), which suggests that geographical proximity is a driver for contagion. One of their main findings is that Western markets are more globally integrated compared to markets such as Greece, Ireland or Portugal, because the former are more mature and larger markets compared to the latter.

Bekaert et al. (2005) examine data of on 22 countries across Asia, Europe and Latin America from 1980 until 1998, in order to uncover evidence of market integration and contagion. They criticize the approach of Forbes and Rigobon (2002) according to the view of Corsetti et al. (2005). For this reason, they use a version of the conditional CAPM model where two factors are defined as the US market and a regional market. The variance of the idiosyncratic return shocks is then examined using a GARCH model similarly to that of Coudert and Gex (2010). As a result, even though increases in residual correlations are found, no contagion from the Mexican crisis is observed.

The study of contagion performed by Phylaktis and Xia (2009) investigates the equity market co-movement and contagion at the sector level in Europe, Asia and Latin America from 1990 until 2004. It is recognized that shocks propagate through some sectors of the economy while other sectors offer diversification benefits despite the contagion the market experiences. According to Kaminsky and Reinhart (1999) and Tai (2004), sectors such as banking may constitute a major channel of contagion. Even though Phylaktis and Xia (2009) recognize that the correction on biased correlations is sensible, they do not neglect the critique by Corsetti et al. (2005). The model used in this study is based on the study of by Bekaert et al. (2005), along with an examination of the residuals based on a GARCH model with asymmetric effects in conditional variance.

Phylaktis and Xia (2009) focus their analysis on 10 industry sectors in 29 smaller markets and observed a sudden shift from regional beta to universal beta dominance. This shift indicates that contagion may be persistent at the sector level and while they observed global contagion through several sectors during the Mexican crisis (in contrast to Bekaert et al., 2005), no such result was observed during the Asian crisis.

Coudert and Gex (2010) assess contagion in the credit default swaps (CDS) market, examining the automotive industry crisis in the US in 2005 and whether it affected other sectors of the economy. Correlation in the CDS prices was adjusted for a possible bias (Boyer et al., 1997; Forbes and Rigobon, 2002). The use of Exponentially Weighted Moving Average (EWMA) and Dynamic Conditional Correlation (DCC) GARCH models was considered important in order to verify the results, as the limitation of the Forbes and Rigobon (2002) calculation is that it provides correlations without analysing the underlying dynamics, while these techniques can achieve that (Beltratti and Morana, 1999; Lopez and Walter, 2000; Ferreira and Lopez, 2005). Coudert and Gex (2010) conclude that there is evidence of a significant rise in correlations from the strong interdependence in the industry that influences the financial sector through counterparty risk and the slight "shift contagion" that is observed.

Albeit early examinations of crises had concluded that contagion was rare or did not exist (Forbes and Rigobon 2002; Bekaert et al. 2005), an increasing number of studies, using more advanced techniques, have concluded that there are several instances of contagion – particularly during the global financial crisis of 2007.

More recently, Baur (2012), following partly the model of Bekaert et al. (2005), examines 10 sectors in 25 developed and emerging economies from 1979 until 2009. This study examines the Global Financial Crisis of 2007 (GFC hereafter) by setting the crisis period according to both the economic events and the statistical results, and observes significant contagion among stock markets and sectors. Even though strong contagion is observed and the effect of the financial sector is significant, there are sectors in the different economies that are not significantly affected. Sectors like Healthcare, Telecommunications and Technology still provide diversification benefits.

Bekaert et al. (2014) analyse the potential contagion transmission of the GFC to 415 country industry equity portfolios across 55 countries. Even though they accept the definition of contagion from Forbes and Rigobon (2002), they use a factor model very similar to the one proposed by Bekaert et al. (2005): volatility that exceeds the estimate of the model is considered to be contagion. Based on their model analysis, it is realized that contagion exists during the financial crisis but their model has to allow for shifts in factor exposures that have not originally been taken into account. One of the most interesting conclusions after their analysis is that the contagion experienced is mainly domestic and not global.

So far the research has focused on integration and contagion worldwide, revealing presenting a lack of evidence of contagion during the early studies. However, as globalization and consequently integration increase, more instances of contagion are likely to be observed. One of the most profound examples of an integrated economic union, and therefore a workhorse for contagion studies, is the European Monetary Union (EMU). Important research has been conducted on the integration of the EMU countries and the possible instances of contagion experienced during recent financial crises.

3.4.5 The EMU Case: Market integration and contagion

Yang et al. (2003) examine the market indices for 11 EMU countries and the US from 1996 until 2001 in one of the earliest studies on EMU integration. Using vector autoregressive (VAR) models, the authors present the correlation coefficients and observe that EMU markets are have become significantly more integrated after since the union formation. Non-member countries (UK) show reduced integration compared to the member countries.

Kim et al. (2005) extend the study of by Yang et al. (2003). First, they take in all the pre-enlargement EU-15 member countries. Secondly the data collected span over a larger time period. While Bley (2009) has not taken into account the view of Forbes and Rigobon (2002), Kim et al. (2005) realize the presence of heteroscedasticity in the market returns and examine the data using a bivariate GARCH model. Their results indicate that spill overs in returns and volatility from one country to the other have significant effects to on the recipient; thus confirming contagion. As stock market integration increases, it poses a danger to potential diversification strategies within the EMU. However, smaller member states are not fully integrated so diversification opportunities still exists (Kim et al., 2005).

Cappiello et al. (2006) introduce a new variation of the dynamic conditional correlation (DCC) GARCH model of Engle (2002), (the asymmetric generalized (AG) DCC-GARCH model), in order to examine linkages between countries. Based on a sample of 21 countries, the authors conclude that conditional equity correlations have increased within the EMU after since the introduction of the single currency, even for the UK (thus contradicting part of the results of Kim et al., 2005).

Syllignakis and Kouretas (2011) use the DCC-GARCH model to examine seven Central and Eastern European (CEE) equity markets from 1997 until 2009, and the US S&P500 and German DAX as factors. The results suggest that increased market integration and the partaking participation of foreign investors have reduced the diversification benefits. According to the authors, the contagion observed in the results is an outcome of the herding behaviour in the financial markets of CEE around the financial turmoil of 2007-2009, when international investors started liquidating their positions.

Pappas et al. (2016) examine the financial market integration and contagion effects in the EU during the recent financial crisis. A wide range of countries was selected and the stock market data examined spans from 2001 until 2011. The authors follow the definition of contagion proposed by Forbes and Rigobon (2002), and use the DCC-GARCH model of Engle (2002) to examine the correlations. The results indicate contagion effects in several countries but the Markov-Switching regime model used to indicate the initiation of different crises shows clear results of varying financial market integration. It is evident that contagion within the EU was not only observed but also showed a varying synchronization pattern across the countries concerned.

Olbrys and Majewska (2014) examine the potential crisis period on the eight CEE stock markets from 2004 until 2013. Following the work of Pagan and Sossounov (2003), they divide the markets into bullish and bearish periods, and then execute the test to conclude that the period of the GFC (2007-2009) coincides with the CEE crisis and that Slovenia and Slovakia have been considerably influenced from by the ESDC.

On the other hand, Claeys and Vašíček (2014) focus their study on the ESDC that started in 2010 with the bailout reform package issued for Greece. Their approach is focused on EU sovereign bond markets and examines the magnitude and direction of linkages by proposing an original approach based on the VAR approach of Diebold and Yilmaz (2009). The analysis suggests that there was significant contagion from Greece to the other EMU countries, followed by sudden spikes in the spill over index that originated from Portugal and Ireland, especially due to the uncertainty created from by financial assistance packages.

The studies presented above recognize the increased integration in the EMU and the contagion experienced as a result, yet they focus only on the financial sector, without looking at other factors that could be related to the transmission of the crisis. Albeit the EMU and the GCC have several commonalities in terms of a union (i.e., the GCC have proposed the introduction of a common currency) they have important differences too. Most importantly, the GCC are reliant on oil export income which, given the highly volatile oil prices, can severely destabilize their economies. As a result, a financial contagion study for the GCC needs to take into account the role of oil prices, similarly to the studies of Filis et al., (2011) and Fayyad and Daly (2011).

3.5 Methodology

In modelling the interactions between oil prices and stock markets the literature has followed a variety of approaches. Most of these studies can fall into two broad categories according to their focus. The first category uses approaches that focus on modelling the mean process (e.g., VARs, Granger causality), while the second (and more recent) focuses on the volatility (e.g., multivariate GARCH models). Volatility modelling supersedes chronologically the approaches dealing with the mean process, while it has certain advantages over its older counterpart. Most importantly, the volatility is more responsive (i.e., more informative) with respect to crisis events. In addition, recent multivariate volatility models (e.g., DCC) are easy to estimate and interpret, whereas multivariate modelling of the mean process is still subject to the dimensionality curse.

3.5.1 Studies modelling the mean process

Jones and Kaul's (1996) initial study tests the reaction of advanced stock markets (Canada, UK, Japan, and US) to oil price shocks, using a standard cash-flow dividend valuation model. Their finding is that for the US and Canada stock markets, reactions can be predicted by the scale of the oil shocks.

Huang et al. (1996) use unrestricted vector autoregressive (VAR) to confirm a significant relationship between a set of US oil company share prices and oil price changes, while no link was established between the market proxy and oil price respectively. When Sadorsky (1999) introduced GARCH effects to an unrestricted VAR he documented a significant relationship between oil price changes and aggregate stock returns. The method used by Miller and Ratti (2009) focuses on the long-run relationship between oil price and international stock markets during the 1971 – 2008 period. Their findings support the well-documented inverse relationship till the early 21st century, when stock markets may have been subjected to bubble events.

Zarour (2006) apply a VAR focusing in on the Gulf Countries and finding evidence in support of the response of the stock markets to oil price shocks, particularly during oil crises. Maghyereh and Al-Kandari (2007), allow for nonlinearities in the stock market – oil price relationship in the GCC countries and their results supported the statistical analysis of a nonlinear modelling relationship between oil and the economy, which is consistent with Mork et al. (1994), and Hamilton (2000). Arouri and Rault (2010) adopt a seemingly unrelated regression (SUR) approach coupled with Wald tests and Granger causality to analyse the sensitivity of GCC stock markets to oil prices over the 1996 – 2008 period. The authors find evidence of a bi-directional causal relationship between stock markets and oil prices for the case of Saudi Arabia only. The remaining GCC markets show evidence of a uni-directional relationship where oil prices Granger-cause stock market price changes.

3.5.2 Studies modelling the volatility process

Studies investigating the relationship between stock market and oil prices using the volatility channel are increasing. An early approach by Ewing and Thompson (2007) in this field uses the cyclical components of oil prices and stock prices when modelling the dynamic co-movements, and their findings support the procyclicality of oil prices and stock prices by around 6 months.

Bharn and Nikolovann (2010) use a bivariate EGARCH model to account for asymmetries in the volatility spill overs between oil prices and stock markets in Russia. They identified three major events (i.e. the September 11th, 2001 terrorist attack, the war in Iraq in 2003 and the civil war in Iraq in 2006) which gave rise to negative correlations between the Russian stock market and the oil prices.

A univariate regime-switching EGARCH model is applied by Aloui and Jammazi (2009) to crude oil shocks and the UK, French and Japanese stock markets. The authors provided evidence that common recessions coincide with the low mean and high variance regime. Lee and Chiou (2011) use a similar framework to examine the relationship between WTI oil prices and S&P500 returns. Their conclusion during periods of crisis verifies that oil price changes, particularly negative ones, lead to negative impacts on the S&P 500.

Cifarelli and Paladino (2010) use a multivariate constant conditional correlation (CCC)-GARCH model and their analysis shows evidence of a negative link between oil price changes and stock price/exchange rate changes. Choi and Hammoudeh (2010) utilise a dynamic conditional correlation (DCC)-GARCH model to study fluctuations in a variety of oil price measures (Brent, WTI) and their relationship to commodities (e.g., gold, copper, silver) and stock markets. Their findings are in support of the negative relationship between oil price and stock market changes, albeit the finding does not hold for the commodities. Chang, McAleer, and Tansuchat (2010) further verify the same negative relationship while allowing for a variety of US stock market indices. The study of by Filis et al., (2011) uses a DCC-GJR GARCH model in an attempt to consolidate the multivariate framework with asymmetric effects in the volatility process, with and their findings are in line with earlier studies.

The extensive use of the DCC-GARCH (Dynamic Conditional Correlation) model and its ability to capture the time-varying nature of correlations and volatilities make it an appealing candidate for use in our context as it can provide robust results. Our analysis uses a similar approach to those of Billio and Caporin (2005), Pelletier (2006), and Chiang et al. (2007) and summarized by Pappas et al. (2016).

3.5.3 DCC-GARCH

The DCC-GARCH was developed by Engle (2002) as a direct generalization of the Constant Conditional Correlation (CCC) GARCH model of Bollerslev (1990). As GARCH models can be used to deal with the problem of volatility bias presented by Forbes and Rigobon (2002) they can be useful in financial contagion studies. The DCC-GARCH model has the flexibility of the univariate GARCH model but not the complexity of VEC models (Engle and Kroner, 1995) or of the conventional multivariate GARCH. In addition, it eliminates the restricting assumption of a CCC-

GARCH on time-invariant correlations. As DCC allows combination with univariate GARCH it has the potential to capture asymmetric or long-memory effects.

In the first stage of the analysis, univariate GARCH models are fit for the daily returns on each of the equity indices. Following a demeaning process (Engle and Sheppard, 2001), the residual returns are obtained according to the following regression model:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \varepsilon_t \quad (1)$$

where r_t is the returns of the equity index.

In the second step, the parameters of the variance model are estimated using the residual errors (ε_t) from the first step and a simple GARCH model is utilized such that:

$$\varepsilon_t = D_t \nu_t \sim N(0, H_t) \quad (2)$$

where ε_t is a m x 1 column vector of the residuals from equation (1), m is the number of time series (countries) considered and ν_t is a m x 1 column vector of standardized residual returns. H_t is the m x m conditional covariance matrix:

$$H_t = D_t R_t D_t \quad (3)$$

Where $D_t = diag(h_{1t}^{1/2}, \dots., h_{Nt}^{1/2})$

R_t is a m x m matrix of correlations differing from CCC-GARCH in the sense that the correlations in the latter are constant while in DCC they are time-varying. D_t is the diagonal matrix of the standard deviations of the time-varying residual returns, of size m x m, obtained from univariate GARCH (1,1). More specifically,

$$h_t = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 h_{t-1}^2 \quad (4)$$

The model is estimated via a log-likelihood function assuming conditional normality. Even though the distribution is often misspecified, the quasi-maximum likelihood estimator exists, resulting in consistency and normality (Engle and Sheppard 2001). According to Engle (2002), the log-likelihood function that helps determine the parameters in Equations (4) and (6) is:

$$l = -\frac{1}{2}\sum_{t=1}^{T}(n\, log(2\pi) + \log(|H_t|) + \varepsilon_t' H_t \varepsilon_t)$$

$$= -\frac{1}{2}\sum_{t=1}^{T}(n\, log(2\pi) + \log(|D_t R_t D_t|) + \nu_t' D_t^{-1} R_t^{-1} D_t^{-1} \nu_t)$$

$$\text{Since, } \varepsilon_t' D_t^{-2} \varepsilon_t = \varepsilon_t' D_t^{-1} D_t^{-1} \varepsilon_t = (D_t^{-1}\varepsilon_t)' D_t^{-1} \varepsilon_t = \nu_t' \nu_t, \quad (5)$$

$$\begin{aligned} l = &-\frac{1}{2}\sum_{t=1}^{T}(n \log(2\pi) + 2\log(|D_t|) + \varepsilon_t' D_t^{-2} \varepsilon_t \\ &-\frac{1}{2}\sum_{t=1}^{T}(\log(|R_t|) + \varepsilon_t' R_t^{-1} \varepsilon_t - \nu_t' \nu_t) \end{aligned} \quad (6)$$

(7)

From equations (6) and (7), it is observed that the log-likelihood function is separated into parts for variances and correlations. Variance parameters are determined without determinations of the correlation parts by maximizing (6).

In the final step, correlation coefficients at t are determined between equity index i and j from the following equation:

$$\rho_{ijt} = \frac{E_{t-1}[\varepsilon_{it}\varepsilon_{jt}]}{\sqrt{E_{t-1}[\ \varepsilon_{it}^2]}\sqrt{E_{t-1}[\ \varepsilon_{jt}^2]}} = \frac{E_{t-1}[\sqrt{h_{it}}\nu_{1t}\sqrt{h_{jt}}\nu_{jt}]}{\sqrt{E_{t-1}[h_{it}\ \nu_{it}^2]}\sqrt{E_{t-1}[h_{jt}\ \nu_{jt}^2]}} = \frac{E_{t-1}[\nu_{it}\nu_{jt}]}{\sqrt{E_{t-1}[\ \nu_{it}^2]}\sqrt{E_{t-1}[\ \nu_{jt}^2]}} =$$

$$E_{t-1}[\nu_{it}\nu_{jt}]$$

where:

$$E_{t-1}[\nu_{it}^2] = E_{t-1}[h_{it}^{-1}\varepsilon_{it}^2] = h_{it}^{-1}E_{t-1}[\varepsilon_{it}^2] = 1$$

R_t matrix is constituted from the correlations ρ_{ijt} and its diagonal elements are unity. So:

Let $Q_t = E_{t-1}[\nu_t'\nu_t]$. Then,

$$R_t = (diag(Q_t))^{-\frac{1}{2}}Q_t(diag(Q_t))^{-\frac{1}{2}} \tag{8}$$

It is assumed that $\mathrm{Q_t}$ follows an autoregressive process in order to parameterize the correlation coefficient ρ_{t}.

$$Q_t = (1-\alpha-\beta)S + \alpha\nu_{t-1}\nu_{t-1}' + \beta Q_{t-1} \tag{9}$$

Where α and β are scalar parameters and the following restrictions need to hold.

$\alpha > 0, \beta \geq 0$

$\alpha +\ \beta < 1$

where S is the unconditional correlation coefficient matrix comprised of the residuals ε_t. The correlations are estimated in the second stage of the analysis and are used as predetermined values in this stage. The parameters of the time-varying correlations are estimated by maximizing equation (7).

3.5.4 Statistical analysis of DCC behaviour

Following the approach used by Kenourgios (2014), four dummy variables are created which are equal to one for each period of the crises and zero otherwise according to the period identification above. Using various dummy variables allows identifying one to identify which of the phases, across the stable and turmoil periods, exhibit a statistically significant contagion (rise in conditional correlations) for the indices examined. This approach is based on:

$$\rho_{ij,t} = c_0 + \sum_{k=1}^{7} d_k dum_{k,t} + \varepsilon_{ij,t} \qquad (10)$$

where $\rho_{ij,t}$ is the pairwise conditional correlation (DCC) between different indices and the dummy variable $dum_{k,t}$(k=1….7) corresponds to the four phases of the global financial crisis.

3.6 Data

The data compromises daily stock market equity indices of ten stock markets denominated in USD, in line with similar financial contagion studies, see for example, Baur (2012) and Pappas et al. (2016), among others. The data has been acquired from Datastream and covers the period from 1st January 2004 until 2nd March 2016, leading to a sample size of 3,175 observations per sector per country. We also include the

S&P 500, a benchmark for the global economy and two oil price series Oil WTI and Oil Brent. The reason for selecting this range of years is to avoid any missing observations that occur for several stock markets before 2004. At the same time our range gives us a good coverage of the Global Financial Crisis of 2007.

The main stock markets in our study are located in the following countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE (Abu Dhabi and Dubai), Ecuador, Nigeria and Venezuela. The first six countries comprise the GCC and share similar characteristics, such as, common history and language, fixed exchange rates to the USD, heavy reliance on oil exports (apart from Bahrain) and a high income with respect to other developing economies. The latter three oil exporting countries do not belong to any organization, apart from OPEC, and serve as a benchmark.

3.7 Results

3.7.1 Dataset and Initial Analysis

For each stock index the continuously compounded return is estimated as $r_t = \ln(p_t/p_{t-1})$, where p_t is the price at the end of the day t.[8] Tables 1-4 report key descriptive statistics for the full, pre-crisis, crisis and post-crisis periods. For the definition of the crisis we have used the official timelines provided by the Bank for International Settlements (BIS, 2009) and the Federal Reserve Board of St. Louis (2009), which separate the Global Financial Crisis into four phases. Phase 1 starts on the 1st of August 2007 and ends on the 15th of September 2008 and is termed the “initial financial turmoil”. Phase 2, spanning from 16th September 2008 until 31st

[8] To remove excessive spikes, we winsorise at the 99.9% of the return series, a standard practice in this field.

December 2008, is a period of "sharp financial market deterioration". Phase 3 is termed as "macroeconomic deterioration" (1st January 2009 – 31st March 2009) and Phase 4 as "stabilization and tentative signs of recovery" from 1st April 2009 onwards. Therefore, the crisis can be defined as running from August 2007 until March 2009 covering the first three phases. In our analysis, we term this period as "Crisis", while every observation preceding and following this period is termed as pre-crisis and post-crisis respectively

All stock markets featured gains during the pre-crisis period, with most markets exceeding the S&P 500 global benchmark. This finding is in line with the risk-return doctrine whereby developing markets compensate investors that are willing to take on greater risk. For example, Dubai recorded the highest daily gain (0.156 %) in the pre-crisis period but also the second largest loss during the crisis period (-0.230%). Interestingly, Bahrain shows the lowest volatility across all sub-periods. This is quite important, given that the Kingdom relies mostly on financial services.

Financial returns of all stock market indices exhibit the usual characteristics of excess kurtosis and skewness across all periods. Interestingly, autocorrelation is strongly present for most of these developing markets but at a varying extent. For instance, the GCC countries show lower coefficients than the remaining oil exporting economies, a potential sign of a more developed financial system. The US, as proxied by the S&P 500, does not show any evidence of stock returns predictability across all periods but the post-crisis. Lastly, the two commodity prices remain unpredictable across all market periods. In terms of volatility in the financial markets of the respective countries, there are a few cases, namely Kuwait, Dubai and Bahrain, which are more stable than the S&P 500 over the full sample and during the crisis period. Others, such as Saudi Arabia and Qatar are either of comparable or of slightly higher volatility during the same periods. In terms of stock market development, the efficient market hypothesis holds for the S&P 500 across the full sample and the pre-crisis period, while it collapses under crisis and post-crisis. In the GCC the findings are mixed. Some of the most developed financial markets (in terms of market capitalisation and openness) such as Bahrain and Dubai are not weak form efficient pre-crisis. However, Dubai shows evidence that the weak form efficiency holds during the crisis and post crisis times. Conversely, for the Bahraini stock market, the efficient market hypothesis holds only in the post-crisis period.

[Tables 1 – 4 around here]

Figures 3-4 show the evolution of the stock market price and returns for the sample under investigation. As most of these are either developing or frontier markets, the existence of pronounced spikes or evidence of a stock market developing in the last few years is evident. For all stock markets the impact of the global financial crisis is clear around the 2007-2009 period with an upward trend leading to the start of the crisis and a sustained price drop onwards. Some countries show more than one crisis experiences. For example, Saudi Arabia experienced a stock market crisis from around the late 2005- to early 2006, which is evident in the specific graph. Similarly, the stock market in Venezuela reflects the dire economic situation in the country where the local currency (bolivar) has collapsed and rampant inflation (above 100% annually) has been recorded. As a market response, investors are using the stock market to hedge their risks, as it is preferable to hold stocks than bolivars. As a result, the main equity index (which also consists of just 11 stocks) has been recording phenomenal growth (around 600% in 12 months). However, this growth should be reflective of the fear in the Venezuelan economy rather than promising investment opportunities. Likewise, the US in the early 2001-2002 shows evidence of the dot.com bubble (see Figure 3-4). However, to understand how oil may affect the financial sector of these countries it suffices to compare the spikes in the oil prices with the evolution of the Nigerian stock exchange.

[Figures 3-4 around here]

Table 5 presents the bi-variate correlation coefficients for the full sample. A quick inspection of the figures gives evidence of positive interrelations across all the stock markets. For example, in the GCC, correlation between Kuwaiti and Bahraini stock markets is around 0.22, while correlation between two of the oil exporting countries (e.g., Venezuela and Nigeria) is much lower at around 0.012. Most countries are quite unrelated to the US stock market, as evidenced by the very low correlations to the SP500. The only exception is Saudi Arabia, with a correlation coefficient around 0.142. Correlation with the oil is also quite low, particularly for the non-GCC oil producers. Still Saudi Arabia shows the largest correlation coefficient, at 0.142, possibly due to the large reliance of the country to on oil exports and its size (as a producer) among both the GCC and the OPEC.

[Table 5 around here]

3.7.2 The ADCC-GARCH estimates

Table 6 reports the estimated coefficients, standard errors and goodness-of-fit statistics for the univariate GARCH models for all the stock markets of the sample. The estimated coefficients are highly significant, providing giving evidence of the time-varying volatility dynamics. Table 7 presents the estimated coefficients of the

ADCC model, which are statistically significant. The significantly positive estimate of the asymmetric term, the information criteria and a likelihood ratio test suggest that the ADCC has a slightly better fit than the standard DCC, as it captures asymmetric effects in the conditional correlations. Naturally, the dynamic correlations for all pairs exhibit fluctuations over the entire sample period, suggesting that the assumption of constant correlations is not appropriate in our context. In addition, the dynamic correlations for the majority of the stock market indices and oil pairs show downward/upward spikes and decreased/increased volatility across the relevant sub-periods (i.e., pre-crisis, crisis, post-crisis). A direct consequence of this is that investors change their risk appetitive appetite according to the prevailing market conditions, but also the relationship between stock markets and the oil commodity is not unaffected by the prevailing market sentiment. The latter relationship is analysed in greater detail in the following section.

[Tables 6 and 7 around here]

3.7.3 Stock Markets and Oil: Correlation dynamics

This section tests for changes in the estimated varying correlations across the periods of stability and turmoil. Furthermore, it assesses the role of oil across the identified periods. Specifically, we estimate the following regression model:

$$\tilde{\rho}_{ij,t} = \sum_{k=1}^{3} \beta_k \, dummy_{k,t} + \gamma Oil_t + \sum_{k=1}^{3} \delta_k \, dummy_{k,t} Oil_t + \eta_{ij,t} \qquad (11)$$

where $\rho_{ij,t}$ is the pairwise dynamic conditional correlation estimate from the previous section for each of the stock markets vis-à-vis the US stock market and $\eta_{ij,t}$ is the usual normally distributed stochastic error term. A dummy is used to identify the three periods of interest, namely the pre-crisis, crisis and post-crisis (k=1, 2, 3 respectively). The dates for these are defined in an earlier section. Oil denotes the volatility of oil, as estimated from the ADCC-GARCH of the previous section, while the dummy×Oil denotes the respective interaction term.

As the model implies, the significance of the estimated coefficient on the dummy variables indicates structural changes in the mean process of the correlation across the three identified sub-periods; namely pre-crisis, crisis and post-crisis.

Hence, the estimated parameters in models I-V for each country in the sample have their own unique contribution to our story. In particular, the estimated coefficients on the period dummies (pre-crisis, crisis, post-crisis) would show with their statistical significance the existence (or not) of financial contagion for the respective country. Specifically, a positive and statistically significant coefficient would, according to Forbes and Rigobon (2002) provide evidence of financial contagion. The coefficients on the Oil Volatility would provide evidence whether the volatility in oil prices affects the interconnectedness of each country's stock market with the US. Statistical significance on this variable would denote that the oil volatility channel is used to transmit shocks between these economies. The interaction terms between the period dummies and the oil volatility are used to show whether this channel has increased/decreased in importance during the Global Financial Crisis.

Table 8 reports the estimated coefficients and standard errors for the conditional correlation regressions. Each panel assesses the bivariate conditional correlation between the stock market of each oil producing country against the US. Five models are estimated, each with an increasing number of explanatory variables. The first only includes the sub-period dummies, the second adds the oil related volatility, while models 3-5 further add each add one of the three interaction terms.

[Table 8 around here]

First we analyse the existence of financial contagion, which according to the Forbes and Rigobon (2002) definition is defined as a statistical difference in the bi-variate correlation measure. All GCC stock markets show statistical evidence of financial contagion, with Abu Dhabi and Saudi Arabia being those that were affected more severely as evidenced by the higher change in the correlation levels. By contrast, Kuwait has been the least affected, since financial contagion is only verified at the 10% significance level.

Even though the Kuwaiti stock market was not affected by financial contagion per se, the financial crisis saw certain Kuwaiti banks recording unexpected losses. For example, the third-largest bank lost around $1.4 billion (Sharma, 2014). Amidst these developments the response from the regulator has been fast, with customer deposits guarantees, financial-stability laws and the establishment of a stock-market stabilisation fund with assets amounting to 3% of GDP. Overall, Kuwait has had the most timely and efficient response to the global financial crisis among the GCC countries (IMF, 2009).

As far as the remaining three oil producing countries are concerned, only Ecuador shows evidence of financial contagion, while Nigeria and Venezuela are on the one hand affected significantly but the correlation drops during the crisis. This could be evidence of negative financial contagion, a situation which could plausibly be attributed to the low degree of financial integration of those countries' financial systems with the rest of the world. Table 9 summarises the contagion evidence for the countries under investigation.

Turning now to the role of oil volatility, we assess the statistical significance of the γ and δ coefficients (see Equation 11). The statistical significance of the former would suggest that there is a feedback relationship between conditional correlations and the volatility of the oil. This is the case for Dubai, Kuwait Saudi Arabia and Oman from the GCC group of countries and Ecuador and Venezuela from the remaining oil producing economies. For these countries the stock market shows a significant exposure to the fluctuations in the oil prices.

For some countries, the magnitude of this relationship is time-varying, as evidenced by the statistical significance of the interaction (δ) terms. Specifically, during the crisis period we observe that certain countries show an even larger exposure to oil price fluctuations (e.g., Kuwait) while for others a relationship between conditional correlations and oil volatility emerges during the crisis (e.g., Nigeria). Finally, there are countries which maintain the same level of exposure to oil volatility (e.g., Saudi Arabia). For the two former cases, regulation and policy measures should focus on alleviating the exposure of the economy to the oil cycles. This may be achieved by economic planning where emphasis is placed on other business lines (e.g., tourism, manufacturing) so that the economic output of the country is not heavily reliant on the oil industry. This is the case of the UAE, where diversification of GDP away from oil and into tourism and financial services is proving to be beneficial. This may be supported by the fact that the two stock market exchanges of the country show opposite reliance on oil volatility: when during a period of crisis the oil-dependent Abu Dhabi shows higher exposure to oil volatility, Dubai shows a counterbalancing behaviour. Venezuela is an interesting case as the coefficient on the interaction terms has changed sign between crisis and post-crisis periods, while it records one of the largest changes in magnitude as well. This may be plausibly linked to the economic situation in the country where the low oil prices towards the end of our sample, have greatly affected the stability of the local economy, with deterioration in all macroeconomic variables and also a shunning of international investors in the local stock market.

[Table 9 around here]

3.7.4 Stock Markets and Oil: Volatility Dynamics

Figure 5 shows the percent annualised volatility for the oil prices, as this is estimated from the DCC-GARCH model discussed in Section 4. Observing the graph, the spike in oil volatility around the GFC and the ESDC crises is quite dominant around the 2008 – 2010 period. Recent developments post 2014 show a rising volatility for this particular commodity, indicating potential trouble for the oil exporting economies.

[Figure 5 around here]

In the earlier sections we examined how the oil exporting economies performed during key crisis events of the early 21st century, namely the GFC and the ESDC. However, on-going developments in the oil price dynamics could have a minimal impact on the European or the US economy but could substantially affect these oil exporters. Hence in this section we firstly identify breakpoint in the oil volatility which could demonstrate causes of concern primarily for the oil exporting economies. Secondly, we use these breakpoints as crisis timelines to gauge how the interconnectedness of these countries' stock markets to the global financial system changes.

Table 10 reports the Bai and Perron (2003) structural breakpoint test on the annualised oil price volatility series. The estimated breakpoints define the following six periods. First, 1/1/2004 – 8/11/2005, second 9/11/2005 – 19/2/2008, third 20/2/2008 – 16/12/2009, fourth 17/12/2009 – 10/1/2012, fifth 11/1/2012 – 6/5/2014 and sixth 7/5/2014 – 2/3/2016. Of these six periods, the first is largely dominated by the 2nd Iraq war and the instability caused in the area. The third and fourth correspond broadly to the GFC and the ESDC crises. The sixth identifies the recent developments in the oil industry with record-low prices (even falling below $30 a /barrel), the reluctance of OPEC to reduce the oil supply, and the lifting of the sanctions on Iran, which allows the Iranian oil to be sold internationally. The second and fifth periods are periods of relative tranquillity between crisis events.

[Table 10 around here]

Table 11 shows the estimated coefficients and standard errors for a modified version of Equation 11 that is shown here. Specifically, we estimate the following regression model:

$$\tilde{\rho}_{ij,t} = \sum_{k=1}^{6} \beta_k \, dummy_{k,t} + \varphi \tilde{\rho}_{ij,t-1} + \eta_{ij,t} \qquad (12)$$

where $\tilde{\rho}_{ij,t}$ is the pairwise dynamic conditional correlation estimate from the previous section for each of the stock markets vis-à-vis the US stock market and $\eta_{ij,t}$ is the usual normally distributed stochastic error term. A dummy is used to identify the six periods of interest, as these have been identified by the Bai and Perron (2003) breakpoint test of the previous section.

The estimated coefficients represent the average conditional correlation change during each period where a positive value indicates an increase in correlation between the two financial markets.

Of particular interest is the magnitude of the recent oil crisis. A comparison of the estimated coefficients between the recent oil crisis (d_6) and the calm period that precedes it (d_5) shows a significant increase, and hence evidence of financial contagion. This is quite important in the context of these economies as the oil crisis does not appear to have any documented impact on the developed economies of the US and Europe. Nevertheless, it shows that the oil exporting economies are significantly affected. Amongst the most affected are Bahrain, Kuwait, Qatar and the UAE, but with varying intensity and duration. Bahrain, Dubai and Kuwait show evidence of de-contagion during this 2015-onwards sustained low oil price crisis; thus they present themselves as less interconnected to the financial markets. By contrast, Abu Dhabi and Qatar have become more interconnected; thereby showing evidence of financial contagion. Saudi Arabia remains largely unaffected during the oil crisis.

[Table 11 around here]

3.8 Conclusions

In this chapter we examine the impact of oil shocks and financial crisis on the financial sector of the GCC vis-à-vis three other key oil exporters with regards to the exposure to financial contagion during the global financial crisis through the oil transmission channel. Our data span from 2004 to 2015 covering the period before the GFC, the GFC itself and the period that followed with the European Sovereign Debt crisis, as the EU is one of the most important markets for the GCC exports. Our methodology builds on the popular multivariate dynamic conditional correlation models which we apply to the equity indices. In a follow-up stage the estimated conditional correlations are regressed on the phases of the GFC to identify financial contagion according to the Forbes and Rigobon (2002) definition of significant increase in the bi-variate correlation measure. Following this, we account for the volatility of oil to act as a transmission channel throughout the period. Furthermore, we allow for a varying contribution across the phases of the GFC. We find that all GCC stock markets show statistical evidence of financial contagion, with Abu Dhabi and Saudi Arabia being those that were affected more severely as evidenced by the higher change in the correlation levels. This may be plausibly related to the relationship of these economies to oil production, where Saudi Arabia is the largest economy in the region and largest exporter of oil. Abu Dhabi, the ruling emirate of the UAE, is the one most dependent on oil exports.

By contrast, Kuwait has been the least affected, since financial contagion is only verified at the 10% significance level. The response to the global financial crisis of the Kuwaiti government has been the most timely and efficient, as the IMF (2009) have noted, which could in part explain the lack of statistical evidence of financial contagion in this case.

For the remaining three non-GCC oil exporters, there is no verification of financial contagion. Some of these countries show evidence of de-contagion, a process where following a crisis, correlation with the rest of the world drops. This could be explained by the lower integration of such countries with the financial system and the reliance on external funds (e.g., FDI) whose flows decreased following the GFC. The measures that the GCC countries have taken with respect to diversifying their income away from oil and gas sectors haves paid off. Specifically, we document that oil reliance for the UAE, a country whose two largest emirates are collectively dependent on oil exports and financial services and tourism, shows a countercyclical behaviour, with Abu Dhabi being affected by oil volatility during a crisis but at the same time Dubai not being affected. In addition, Saudi Arabia maintains the same level of exposure to oil volatility across the different phases of the country, and this is an important finding for further planning and stabilization of the economy against future crisis events.

Table 1. Descriptive Statistics (Returns) – Full Sample.

	Abu Dhabi	**Bahrain**	**Dubai**	**Kuwait**	**Oman**	**Qatar**	**Saudi Arabia**	**Ecuador**	**Nigeria**	**Venezuela**	**S&P 500**	**Oil WTI**	**Oil Brent**
Mean	0.033	0.003	0.045	0.002	0.028	0.038	0.024	0.033	0.028	0.187	0.021	0.015	0.022
Std. Dev.	1.610	0.578	1.854	0.947	1.056	1.475	1.662	0.785	1.349	1.463	1.216	2.318	1.987
Skewness	1.095	-0.451	-0.100	-0.301	-0.919	0.053	-0.606	0.551	0.024	-0.634	-0.340	-0.032	0.087
Kurtosis	221.779	9.533	8.789	12.801	18.933	10.862	14.524	172.230	5.273	28.727	15.148	8.270	6.729
Minimum	-0.3649	-0.0492	-0.1216	-0.0752	-0.0870	-0.0985	-0.1168	-0.1667	-0.0557	-0.2065	-0.0947	-0.1283	-0.1113
Maximum	0.3982	0.0361	0.1220	0.0746	0.0804	0.1420	0.1640	0.1746	0.0848	0.1056	0.1096	0.1641	0.1350
JB stat	5863969	5328	4111	11812	31514	7573	16449	3508401	633	81276	18134	3402	1707
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q(10) stat	5.03	32.99	11.65	24.68	18.02	27.20	13.21	7.85	230.20	20.39	13.71	17.55	7.53
p-value	0.889	0.000	0.309	0.006	0.055	0.002	0.212	0.644	0.000	0.026	0.187	0.063	0.675
ARCH LM	409.03	44.02	139.45	76.67	293.08	96.37	115.89	251.88	242.23	52.17	174.78	95.10	55.66
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ADF Stat	-20.21	-18.45	-18.23	-20.11	-21.56	-19.96	-20.70	-21.04	-19.99	-18.24	-22.56	-22.12	-19.82
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Obs	3,175	3,175	3,175	3,175	3,175	3,175	3,175	3,175	3,175	3,175	3,175	3,175	3,175

Notes: Mean and Std. Dev. are expressed in percentages. Q stands for the Ljung-Box Q test for autocorrelation. The ARCH LM test utilizes 4 lags. We have employed ADF test with automated lag selection, where the optimal lag length is determined using the Akaike Information Criterion. AIC selected lag length between 5 and 10 lags for the series we consider.

Table 2. Descriptive Statistics (Returns) – Pre-Crisis Sample.

	Abu Dhabi	**Bahrain**	**Dubai**	**Kuwait**	**Oman**	**Qatar**	**Saudi Arabia**	**Ecuador**	**Nigeria**	**Venezuela**	**S&P 500**	**Oil WTI**	**Oil Brent**
Mean	0.073	0.070	0.156	0.087	0.092	0.073	0.056	0.072	0.124	0.069	0.029	0.094	0.101
Std. Dev.	1.426	0.578	1.839	0.915	0.793	1.592	2.076	0.740	1.246	1.582	0.667	2.048	2.023
Skewness	0.130	0.791	-0.050	-0.076	0.407	0.052	-0.429	1.297	-0.089	-2.851	-0.286	-0.201	-0.058
Kurtosis	10.275	8.177	7.967	8.905	9.157	4.423	11.522	27.223	4.803	43.464	4.240	4.775	4.477
Minimum	-0.0865	-0.0231	-0.1216	-0.0474	-0.0477	-0.0627	-0.1168	-0.0523	-0.0480	-0.2065	-0.0353	-0.1225	-0.0848
Maximum	0.0825	0.0361	0.0844	0.0588	0.0480	0.0631	0.1640	0.0644	0.0452	0.0840	0.0213	0.0841	0.1030
JB stat	2062	1140	960	1358	1501	79	2855	23097	128	64986	73	129	85
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q(10) stat	95.94	73.21	49.87	952.42	114.48	85.89	74.18	10.71	280.94	203.32	18.80	14.66	16.82
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.381	0.000	0.000	0.043	0.145	0.078
ARCH LM	104.22	66.77	64.74	1310.61	370.44	198.59	376.45	0.53	231.05	436.89	319.42	122.67	111.23
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.970	0.000	0.000	0.000	0.000	0.000
ADF Stat	-14.75	-28.46	-29.15	-11.46	-44.76	-23.67	-21.17	-57.96	-21.08	-23.87	-62.14	-62.74	-62.46
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Obs	934	934	934	934	934	934	934	934	934	934	934	934	934

Notes: Mean and Std. Dev. are expressed in percentages. Q stands for the Ljung-Box Q test for autocorrelation. The ARCH LM test utilizes 4 lags. We have employed ADF test with automated lag selection, where the optimal lag length is determined using the Akaike Information Criterion. AIC selected lag length between 5 and 10 lags for the series we consider.

Table 3. Descriptive Statistics (Returns) – Crisis Sample.

	Abu Dhabi	**Bahrain**	**Dubai**	**Kuwait**	**Oman**	**Qatar**	**Saudi Arabia**	**Ecuador**	**Nigeria**	**Venezuela**	**S&P 500**	**Oil WTI**	**Oil Brent**
Mean	-0.077	-0.110	-0.230	-0.178	-0.075	-0.094	-0.107	-0.004	-0.240	0.008	-0.138	-0.104	-0.117
Std. Dev.	3.111	0.749	2.369	1.518	2.005	2.194	2.237	1.350	1.620	1.045	2.288	3.731	2.915
Skewness	1.122	-0.984	0.137	0.096	-0.707	-0.447	-0.689	1.060	0.032	1.163	-0.030	0.161	0.321
Kurtosis	106.479	6.701	7.168	8.042	8.007	6.257	7.846	120.239	4.451	8.454	7.097	5.832	5.613
Minimum	-0.3649	-0.0372	-0.0881	-0.0752	-0.0870	-0.0985	-0.1033	-0.1667	-0.0490	-0.0398	-0.0947	-0.1283	-0.1113
Maximum	0.3982	0.0262	0.1022	0.0746	0.0804	0.0794	0.0909	0.1746	0.0489	0.0642	0.1096	0.1641	0.1350
JB stat	194172	319	316	461	491	207	460	249207	38	637	304	147	131
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q(10) stat	32.73	34.59	14.45	23.85	35.44	28.70	17.83	73.29	290.80	35.77	29.06	33.14	10.52
p-value	0.000	0.000	0.154	0.008	0.000	0.001	0.058	0.000	0.000	0.000	0.001	0.000	0.396
ARCH LM	158.36	45.37	116.68	30.54	118.92	79.70	31.80	158.17	170.76	51.08	58.26	41.33	29.38
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ADF Stat	-26.86	-16.57	-20.02	-17.30	-16.61	-17.51	-18.27	-17.20	-9.87	-17.33	-18.47	-9.57	-19.91
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Obs	435	435	435	435	435	435	435	435	435	435	435	435	435

Notes: Mean and Std. Dev. are expressed in percentages. Q stands for the Ljung-Box Q test for autocorrelation. The ARCH LM test utilizes 4 lags. We have employed ADF test with automated lag selection, where the optimal lag length is determined using the Akaike Information Criterion. AIC selected lag length between 5 and 10 lags for the series we consider.

Table 4. Descriptive Statistics (Returns) – Post-Crisis Sample.

	Abu Dhabi	**Bahrain**	**Dubai**	**Kuwait**	**Oman**	**Qatar**	**Saudi Arabia**	**Ecuador**	**Nigeria**	**Venezuela**	**S&P 500**	**Oil WTI**	**Oil Brent**
Mean	0.039	-0.007	0.056	0.001	0.019	0.054	0.040	0.021	0.045	0.307	0.061	0.001	0.013
Std. Dev.	0.981	0.516	1.687	0.728	0.774	1.108	1.106	0.569	1.317	1.479	1.024	1.925	1.613
Skewness	-0.303	-0.879	-0.205	-0.818	-0.614	1.330	-0.425	-2.718	0.178	0.778	-0.400	-0.154	-0.039
Kurtosis	15.673	10.943	9.620	13.170	15.372	25.421	16.988	73.626	5.675	16.240	6.964	6.255	6.061
Minimum	-0.0868	-0.0492	-0.0962	-0.0573	-0.0641	-0.0664	-0.0755	-0.0984	-0.0557	-0.1347	-0.0690	-0.1113	-0.0915
Maximum	0.0763	0.0200	0.1220	0.0464	0.0537	0.1420	0.0904	0.0494	0.0848	0.1056	0.0463	0.0990	0.1009
JB stat	10536	4332	2879	6946	10118	33368	12855	328438	477	11632	1070	700	614
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q(10) stat	34.25	20.76	20.34	32.32	91.45	13.72	25.68	19.40	244.54	113.29	52.21	20.43	10.72
p-value	0.000	0.023	0.026	0.000	0.000	0.186	0.004	0.035	0.000	0.000	0.000	0.025	0.379
ARCH LM	169.01	34.71	220.37	123.50	267.33	24.54	171.54	6.18	271.29	178.59	264.64	83.07	28.33
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.186	0.000	0.000	0.000	0.000	0.000
ADF Stat	-35.98	-37.58	-37.70	-36.05	-32.31	-25.90	-37.34	-41.17	-24.27	-23.04	-25.25	-41.73	-38.37
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Obs	1571	1571	1571	1571	1571	1571	1571	1571	1571	1571	1571	1571	1571

Notes: Mean and Std. Dev. are expressed in percentages. Q stands for the Ljung-Box Q test for autocorrelation. The ARCH LM test utilizes 4 lags. We have employed ADF test with automated lag selection, where the optimal lag length is determined using the Akaike Information Criterion. AIC selected lag length between 5 and 10 lags for the series we consider.

Table 5. Unconditional correlation coefficients for the full sample

	Abu Dhabi	**Bahrain**	**Dubai**	**Kuwait**	**Oman**	**Qatar**	**Saudi Arabia**	**Ecuador**	**Nigeria**	**Venezuela**	**S&P 500**	**Oil WTI**	**Oil Brent**
Bahrain	0.169	1.000											
	(0.000)												
Dubai	0.514	0.219	1.000										
	(0.000)	*(0.000)*											
Kuwait	0.186	0.223	0.219	1.000									
	(0.000)	*(0.000)*	*(0.000)*										
Oman	0.273	0.251	0.341	0.218	1.000								
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*									
Qatar	0.302	0.210	0.370	0.218	0.364	1.000							
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*								
Saudi Arabia	0.252	0.077	0.282	0.129	0.185	0.205	1.000						
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*							
Ecuador	0.003	0.015	0.016	0.013	-0.013	-0.002	0.020	1.000					
	(0.887)	(0.414)	(0.385)	(0.472)	(0.496)	(0.899)	(0.285)						
Nigeria	0.019	0.002	0.056	-0.024	0.030	0.032	0.010	0.021	1.000				
	(0.296)	(0.914)	*(0.002)*	(0.193)	(0.104)	(0.082)	(0.597)	(0.253)					
Venezuela	-0.004	0.018	-0.016	-0.021	-0.014	-0.003	-0.014	-0.001	0.012	1.000			
	(0.837)	(0.338)	(0.389)	(0.254)	(0.452)	(0.862)	(0.457)	(0.950)	(0.518)				
S&P 500	0.041	0.011	0.107	0.034	0.049	0.060	0.142	-0.035	-0.004	-0.002	1.000		
	(0.026)	(0.553)	*(0.000)*	*(0.067)*	*(0.008)*	*(0.001)*	*(0.000)*	*(0.061)*	(0.844)	(0.934)			
Oil WTI	0.045	0.019	0.085	0.027	0.086	0.074	0.101	-0.003	0.015	-0.008	0.286	1.000	
	(0.015)	(0.295)	*(0.000)*	(0.139)	*(0.000)*	*(0.000)*	*(0.000)*	(0.879)	(0.426)	(0.676)	*(0.000)*		
Oil Brent	0.090	0.033	0.122	0.025	0.124	0.095	0.136	0.021	0.025	-0.012	0.185	0.584	1.000
	(0.000)	*(0.071)*	*(0.000)*	(0.184)	*(0.000)*	*(0.000)*	*(0.000)*	(0.262)	(0.184)	(0.513)	*(0.000)*	*(0.000)*	

Notes: Table reports the Pearson correlation coefficients for the stock market and oil returns. Numbers in brackets are p-values for the statistical significance test of zero correlation.

Table 6. ADCC-GARCH Estimation Univariate Results.

	Bahrain	**Kuwait**	**Oman**	**Qatar**	**Saudi Arabia**	**Abu Dhabi**	**Dubai**	**Oil WTI**	**S&P 500**
Mean Equation									
μ	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.001
	(0.091)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[0.499]	[-18.061]	[2.936]	[3.177]	[6.192]	[2.342]	[2.654]	[1.346]	[3.860]
	{0.618}	{0.000}	{0.003}	{0.002}	{0.000}	{0.019}	{0.008}	{0.178}	{0.000}
AR(1)	0.120	0.108	0.240	0.145	0.095	0.212	0.047	-0.046	-0.058
	(0.025)	(0.015)	(0.023)	(0.025)	(0.022)	(0.034)	(0.022)	(0.021)	(0.019)
	[4.834]	[7.103]	[10.350]	[5.861]	[4.373]	[6.206]	[2.105]	[-2.200]	[-3.132]
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.035}	{0.028}	{0.002}
Variance Equation									
ω	1.834	0.000	0.014	0.003	0.034	0.032	0.076	0.026	0.018
	(0.897)	(0.000)	(0.005)	(0.004)	(0.013)	(0.011)	(0.029)	(0.014)	(0.005)
	[2.044]	[0.011]	[2.745]	[0.908]	[2.638]	[2.767]	[2.632]	[1.774]	[3.611]
	{0.041}	{0.992}	{0.006}	{0.364}	{0.008}	{0.006}	{0.009}	{0.076}	{0.000}
α	0.148	0.093	0.160	0.091	0.137	0.232	0.138	0.052	0.092
	(0.047)	(0.002)	(0.025)	(0.027)	(0.020)	(0.047)	(0.025)	(0.014)	(0.013)
	[3.165]	[46.666]	[6.418]	[3.327]	[6.905]	[4.944]	[5.582]	[3.844]	[7.022]
	{0.002}	{0.000}	{0.000}	{0.001}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}
β	0.807	0.902	0.842	0.919	0.861	0.795	0.848	0.944	0.890
	(0.064)	0.001	0.023	0.027	0.017	0.025	0.028	0.015	0.014
	[12.670]	[1027.769]	[37.370]	[33.520]	[50.450]	[31.850]	[29.930]	[62.490]	[62.610]
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}
Log-Likelihood	11264.015	13227.070	10333.910	9075.236	8824.196	9299.284	8076.494	7341.991	9650.361
Obs	3,175	3,175	3,175	3,175	3,175	3,175	3,175	3,175	3,175

Notes: Table reports estimated coefficients, standard errors in parentheses, t-statistics in square brackets and p-values in curly brackets for the univariate GARCH models of the ADCC-GARCH estimation.

Table 7. ADCC-GARCH Estimation Multivariate Results.

	ADCC	**DCC**
a	0.006	0.007
se	(0.001)	(0.002)
t-stat	4.323	3.689
p-value	0.000	0.000
b	0.981	0.983
se	(0.008)	(0.007)
t-stat	130.200	131.100
p-value	0.000	0.000
g	0.003	
se	(0.002)	
t-stat	1.990	
p-value	0.047	
Log-Likelihood	87726.28	87718.31
Obs	3,175	3,175

Notes: Table reports estimated coefficients, standard errors in parentheses, t-statistics in square brackets and p-values in curly brackets for the multivariate part of the ADCC-GARCH estimation. See equation 9 in the main text.

Table 8(a). Correlation Regressions

Model	**I**	**II**	**III**	**IV**	**V**
			Abu Dhabi		
Pre-Crisis	0.005	0.004	0.038***	0.009***	0.003
	(0.003)	(0.003)	(0.006)	(0.003)	(0.003)
Crisis	0.052***	0.049***	0.046***	0.045**	0.049***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Post-Crisis	0.076***	0.075***	0.074***	0.080***	0.076***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Oil Volatility		1.929	4.152***	-10.412**	2.410
		(1.581)	(1.467)	(4.354)	(1.565)
Oil Volatility×Pre-Crisis			-78.931***		
			(12.130)		
Oil Volatility×Crisis				15.563***	
				(4.552)	
Oil Volatility×Post Crisis					-2.688
					(4.829)
R2	60.23%	60.29%	63.40%	61.00%	60.29%
Obs	3,175	3,175	3,175	3,175	3,175
			Dubai		
Pre-Crisis	0.060***	0.058***	0.046***	0.058***	0.057***
	(0.002)	(0.003)	(0.004)	(0.004)	(0.003)
Crisis	0.077***	0.071***	0.071***	0.070***	0.069***
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Post-Crisis	0.127***	0.125***	0.125***	0.125***	0.127***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Oil Volatility		4.723**	3.982*	3.260	5.968***
		(2.163)	(2.188)	(6.305)	(2.089)
Oil Volatility×Pre-Crisis			26.311***		
			(7.725)		
Oil Volatility×Crisis				1.845	
				(6.601)	
Oil Volatility×Post Crisis					-6.965
					(6.732)
R2	59.43%	59.84%	60.19%	59.84%	59.97%
Obs	3,175	3,175	3,175	3,175	3,175

Notes: Estimates are based on Eq. (11) in the text and standard errors are given in brackets. Pre-crisis, crisis and post-crisis refer to the three dummy variables that identify the periods of the global financial crisis as explained in the test. Oil Volatility refers to the conditional volatility estimate for the oil commodity. ***, **, *: denote statistical significance at the 1, 5 and 10% respectively.

Table 8(b). Correlation Regressions

Model	**I**	**II**	**III**	**IV**	**V**
			Bahrain		
Pre-Crisis	0.025***	0.024***	0.037***	0.028***	0.024***
	(0.002)	(0.002)	(0.007)	(0.003)	(0.002)
Crisis	0.037***	0.034***	0.033***	0.031***	0.032***
	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)
Post-Crisis	0.018***	0.017***	0.017***	0.021***	0.019***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Oil Volatility		2.557	3.415	-6.051	3.713
		(2.161)	(2.218)	(4.454)	(2.459)
Oil Volatility×Pre-Crisis			-30.447*		
			(16.007)		
Oil Volatility×Crisis				10.855**	
				(5.154)	
Oil Volatility×Post Crisis					-6.460
					(5.224)
R2	6.55%	6.83%	8.02%	7.73%	7.09%
Obs	3,175	3,175	3,175	3,175	3,175
			Kuwait		
Pre-Crisis	0.011***	0.012***	0.008***	0.009***	0.012***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Crisis	0.013***	0.015***	0.016***	0.017***	0.017***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Post-Crisis	0.011***	0.012***	0.012***	0.010***	0.010***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Oil Volatility		-2.234***	-2.474***	2.708***	-3.195***
		(0.621)	(0.618)	(0.858)	(0.635)
Oil Volatility×Pre-Crisis			8.532***		
			(2.603)		
Oil Volatility×Crisis				-6.232***	
				(1.065)	
Oil Volatility×Post Crisis					5.376***
					(1.081)
R2	1.38%	6.30%	8.24%	12.60%	10.48%
Obs	3,175	3,175	3,175	3,175	3,175

Notes: Estimates are based on Eq. (11) in the text and standard errors are given in brackets. Pre-crisis, crisis and post-crisis refer to the three dummy variables that identify the periods of the global financial crisis as explained in the test. Oil Volatility refers to the conditional volatility estimate for the oil commodity. ***, **, *: denote statistical significance at the 1, 5 and 10% respectively.

Table 8(c). Correlation Regressions

Model	I	II	III	IV	V
			Qatar		
Pre-Crisis	0.041***	0.042***	0.052***	0.044***	0.042***
	(0.002)	(0.002)	(0.006)	(0.003)	(0.002)
Crisis	0.066***	0.070***	0.069***	0.068***	0.069***
	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
Post-Crisis	0.092***	0.093***	0.093***	0.095***	0.094***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Oil Volatility		-2.668	-2.042	-6.744	-2.382
		(1.756)	(1.749)	(4.597)	(1.805)
Oil Volatility×Pre-Crisis			-22.232		
			(16.146)		
Oil Volatility×Crisis				5.140	
				(4.916)	
Oil Volatility×Post Crisis					-1.602
					(5.287)
R2	44.69%	44.86%	45.20%	44.96%	44.85%
Obs	3,175	3,175	3,175	3,175	3,175
			Saudi Arabia		
Pre-Crisis	0.075***	0.061***	0.076***	0.059***	0.062***
	(0.003)	(0.003)	(0.006)	(0.004)	(0.003)
Crisis	0.142***	0.100***	0.099***	0.102***	0.104***
	(0.007)	(0.005)	(0.006)	(0.006)	(0.006)
Post-Crisis	0.161***	0.148***	0.147***	0.146***	0.143***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Oil Volatility		32.893***	33.870***	38.074***	30.430***
		(3.191)	(3.372)	(6.148)	(3.355)
Oil Volatility×Pre-Crisis			-34.708***		
			(11.020)		
Oil Volatility×Crisis				-6.533	
				(7.126)	
Oil Volatility×Post Crisis					13.770*
					(8.356)
R2	50.54%	61.90%	62.24%	61.96%	62.18%
Obs	3,175	3,175	3,175	3,175	3,175

Notes: Estimates are based on Eq. (11) in the text and standard errors are given in brackets. Pre-crisis, crisis and post-crisis refer to the three dummy variables that identify the periods of the global financial crisis as explained in the test. Oil Volatility refers to the conditional volatility estimate for the oil commodity. ***, **, *: denote statistical significance at the 1, 5 and 10% respectively.

Table 8(d). Correlation Regressions

Model	**I**	**II**	**III**	**IV**	**V**
			Oman		
Pre-Crisis	0.049***	0.053***	0.114***	0.056***	0.055***
	(0.004)	(0.004)	(0.007)	(0.004)	(0.004)
Crisis	0.062***	0.073***	0.068***	0.071***	0.077***
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Post-Crisis	0.079***	0.082***	0.081***	0.085***	0.077***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Oil Volatility		-8.936***	-4.959**	-15.458**	-11.998***
		(2.398)	(2.009)	(7.253)	(2.972)
Oil Volatility×Pre-Crisis			-141.224***		
			(15.609)		
Oil Volatility×Crisis				8.225	
				(7.586)	
Oil Volatility×Post Crisis					17.121**
					(6.791)
R2	14.78%	16.82%	30.94%	17.08%	17.91%
Obs	3,175	3,175	3,175	3,175	3,175
			Ecuador		
Pre-Crisis	-0.035***	-0.038***	-0.037***	-0.039***	-0.038***
	(0.002)	(0.002)	(0.005)	(0.003)	(0.002)
Crisis	-0.053***	-0.061***	-0.061***	-0.060***	-0.060***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Post-Crisis	-0.036***	-0.038***	-0.038***	-0.039***	-0.040***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Oil Volatility		6.265***	6.316***	9.070**	5.497***
		(1.896)	(1.936)	(4.631)	(2.015)
Oil Volatility×Pre-Crisis			-1.824		
			(9.495)		
Oil Volatility×Crisis				-3.537	
				(5.079)	
Oil Volatility×Post Crisis					4.293
					(5.630)
R2	4.68%	6.24%	6.21%	6.29%	6.32%
Obs	3,175	3,175	3,175	3,175	3,175

Notes: Estimates are based on Eq. (11) in the text and standard errors are given in brackets. Pre-crisis, crisis and post-crisis refer to the three dummy variables that identify the periods of the global financial crisis as explained in the test. Oil Volatility refers to the conditional volatility estimate for the oil commodity. ***, **, *: denote statistical significance at the 1, 5 and 10% respectively.

Table 8(e). Correlation Regressions

Model	**I**	**II**	**III**	**IV**	**V**
			Nigeria		
Pre-Crisis	0.011***	0.010***	0.044***	0.020***	0.009***
	(0.003)	(0.003)	(0.006)	(0.004)	(0.003)
Crisis	-0.001	-0.004	-0.007*	-0.012***	-0.008**
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Post-Crisis	0.030***	0.029***	0.028***	0.037***	0.034***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Oil Volatility		2.874	5.126**	-19.072***	5.743***
		(2.145)	(2.062)	(6.129)	(1.823)
Oil Volatility×Pre-Crisis			-79.954***		
			(13.752)		
Oil Volatility×Crisis				27.676***	
				(6.375)	
Oil Volatility×Post Crisis					-16.037**
					(6.834)
R2	15.06%	15.31%	21.18%	19.52%	16.55%
Obs	3,175	3,175	3,175	3,175	3,175
			Venezuela		
Pre-Crisis	0.008***	0.013***	-0.002	0.024***	0.009***
	(0.003)	(0.003)	(0.006)	(0.004)	(0.003)
Crisis	-0.004*	0.009***	0.010***	0.000	-0.001
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Post-Crisis	0.004**	0.008***	0.009***	0.019***	0.023***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Oil Volatility		-10.154***	-11.107***	-36.345***	-2.423
		(1.927)	(2.006)	(5.875)	(1.786)
Oil Volatility×Pre-Crisis			33.858**		
			(13.491)		
Oil Volatility×Crisis				33.028***	
				(6.137)	
Oil Volatility×Post Crisis					-43.226***
					(7.754)
R2	2.06%	6.71%	8.10%	14.81%	19.14%
Obs	3,175	3,175	3,175	3,175	3,175

Notes: Estimates are based on Eq. (11) in the text and standard errors are given in brackets. Pre-crisis, crisis and post-crisis refer to the three dummy variables that identify the periods of the global financial crisis as explained in the test. Oil Volatility refers to the conditional volatility estimate for the oil commodity. ***, **, *: denote statistical significance at the 1, 5 and 10% respectively.

Table 9. Contagion Evidence

Panel A: Contagion Evidence					
	Significant Difference	**Higher correlation**	**Contagion Verified**	**t-test**	**p-value**
Abu Dhabi	Yes	Yes	Yes	11.455	0.000
Dubai	Yes	Yes	Yes	3.871	0.000
Bahrain	Yes	Yes	Yes	2.525	0.012
Kuwait	Yes	Yes	Yes	1.875	0.061
Qatar	Yes	Yes	Yes	6.652	0.000
Saudi Arabia	Yes	Yes	Yes	8.604	0.000
Oman	Yes	Yes	Yes	2.301	0.021
Ecuador	Yes	Yes	Yes	5.031	0.000
Nigeria	Yes	No	No	2.688	0.000
Venezuela	Yes	No	No	3.433	0.000
Panel B: Oil Relevance					
	Overall	**Pre-Crisis**	**Crisis**	**Post-Crisis**	
Abu Dhabi	No	Yes	Yes	No	
Dubai	Yes	Yes	No	No	
Bahrain	No	Yes	Yes	No	
Kuwait	Yes	Yes	Yes	Yes	
Qatar	No	No	No	No	
Saudi Arabia	Yes	Yes	No	Yes	
Oman	Yes	Yes	No	Yes	
Ecuador	Yes	No	No	No	
Nigeria	No	Yes	Yes	Yes	
Venezuela	Yes	Yes	Yes	Yes	

Notes: Panel A presents the summarized conclusion on the existence of financial contagion for each of the examined countries. Panel B assesses the impact of oil volatility in each of the sub-periods for each country where crisis refers to the Global Financial Crisis (GFC).

Table 10. Bai and Perron Structural Breakpoint test results.

D1	36.0931***
	(0.6034)
D2	29.6070***
	(0.4201)
D3	53.7920***
	(2.6661)
D4	31.8073***
	(0.6268)
D5	23.0184***
	(0.4874)
D6	40.4543***
	(1.6583)
Adjusted R-squared	0.396
Observations	3,175

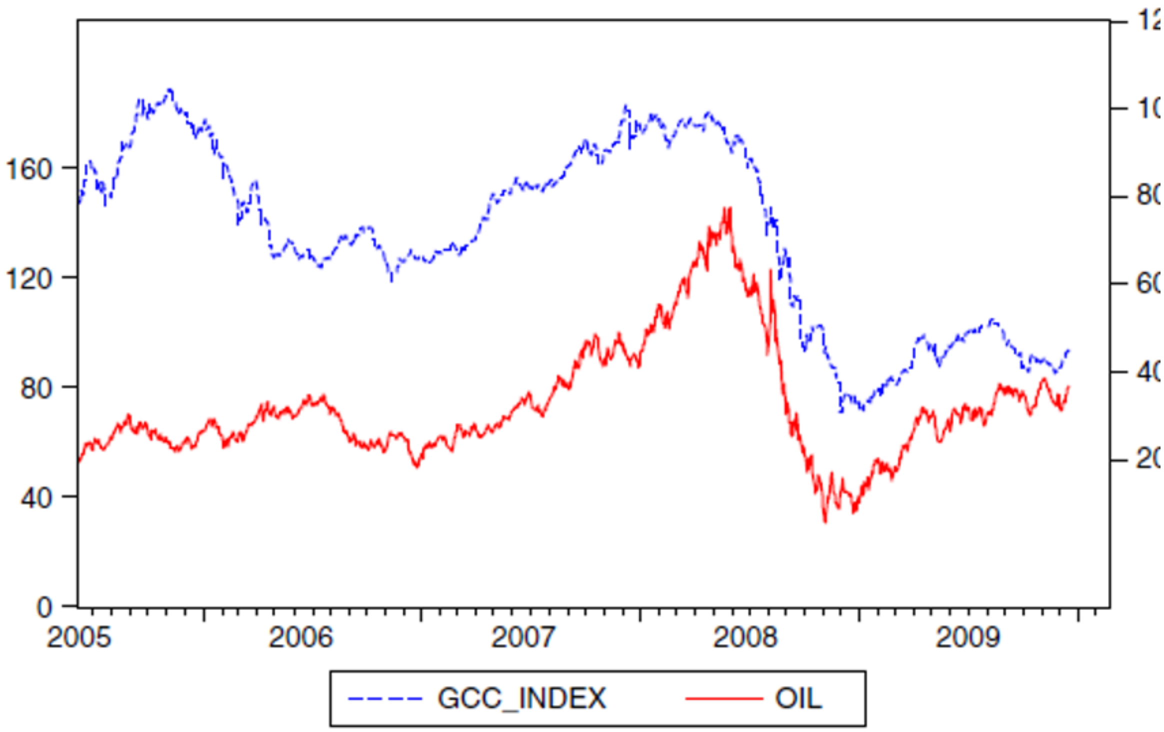
Notes: estimated coefficients and standard errors in brackets. Estimated breakpoints (Ds) are discussed in section 5.4. ***,**,*: denote statistical significance at the 1, 5 and 10% significance level.

Table 11. Estimation results for within-country, cross-sector financial contagion.

SP500	Abu Dhabi	Bahrain	Dubai	Kuwait	Oman	Qatar	Saudi Arabia	Ecuador	Nigeria	Venezuela	Oil
d_1 2nd Gulf War	0.0614***	0.0206***	0.1159***	0.0526***	0.0810***	0.0973***	0.1514***	-0.0290***	0.0123*	0.0062	0.2515***
	(0.0183)	(0.0055)	(0.0195)	(0.0106)	(0.0163)	(0.0209)	(0.0313)	(0.0081)	(0.0071)	(0.0058)	(0.0895)
d_2 Calm period	0.0609***	0.0244***	0.1165***	0.0531***	0.0843***	0.0981***	0.1489***	-0.0292***	0.0137**	0.0031	0.2518***
	(0.0182)	(0.0054)	(0.0195)	(0.0106)	(0.0163)	(0.0208)	(0.0312)	(0.0079)	(0.0070)	(0.0057)	(0.0895)
d_3 GFC	0.0616***	0.0238***	0.1173***	0.0538***	0.0846***	0.0989***	0.1495***	-0.0289***	0.0146**	0.0026	0.2497***
	(0.0182)	(0.0054)	(0.0195)	(0.0105)	(0.0162)	(0.0208)	(0.0312)	(0.0079)	(0.0069)	(0.0057)	(0.0894)
d_4 ESDC	0.0621***	0.0235***	0.1178***	0.0555***	0.0853***	0.0996***	0.1494***	-0.0291***	0.0159**	0.0023	0.2482***
	(0.0181)	(0.0054)	(0.0194)	(0.0105)	(0.0162)	(0.0207)	(0.0311)	(0.0078)	(0.0068)	(0.0058)	(0.0894)
d_5 Calm period	0.0633***	0.0238***	0.1190***	0.0605***	0.0827***	0.0846***	0.1512***	-0.0290***	0.0192***	0.0047	0.2484***
	(0.0180)	(0.0055)	(0.0193)	(0.0105)	(0.0161)	(0.0207)	(0.0310)	(0.0078)	(0.0068)	(0.0060)	(0.0892)
d_6 Recent Oil Crisis	0.0708***	0.0182***	0.1166***	0.0567***	0.0824***	0.0858***	0.1512***	-0.0277***	0.0173**	0.0064	0.2476***
	(0.0180)	(0.0055)	(0.0193)	(0.0105)	(0.0161)	(0.0207)	(0.0310)	(0.0078)	(0.0068)	(0.0061)	(0.0892)
φ	0.9962***	0.9880***	0.9965***	0.9932***	0.9961***	0.9965***	0.9976***	0.9915***	0.9907***	0.9906***	0.9991***
	(0.0014)	(0.0030)	(0.0014)	(0.0022)	(0.0018)	(0.0017)	(0.0012)	(0.0021)	(0.0022)	(0.0023)	(0.0007)
LM(2) statistic	1.989	9.292***	0.866	4.997*	15.25***	2.633	4.658*	0.164	5.322*	4.430	1.200
t-statistic (d5-d6)	16.12***	7.10***	5.09***	4.07***	0.54	-2.06**	0.12	-1.51	3.14***	-1.68*	6.40***
t-statistic (d3-d6)	8.10***	-2.52***	0.63	-1.09	1.77*	9.50***	-2.43**	-0.61	-1.20	-1.99**	5.85***
Observations	3,174	3,174	3,174	3,174	3,174	3,174	3,174	3,174	3,174	3,174	3,174

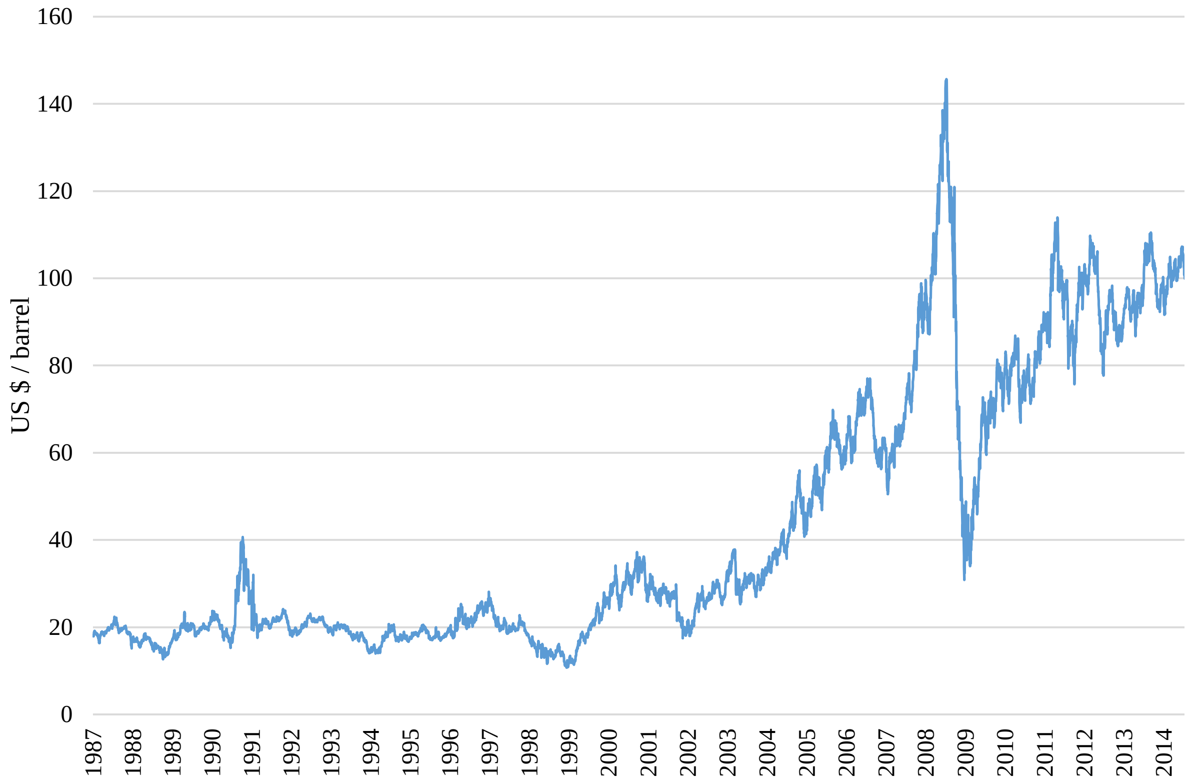
Notes: The table reports estimated coefficients and standard errors in brackets for equation (12) in the text. LM(2) denotes the Breusch-Godfrey LM test statistic for autocorrelation allowing for up to two lags. ***,**,*: denote statistical significance at the 1, 5 and 10% significance level.

Figure 1. Dynamics of Oil prices and GCC stock markets.



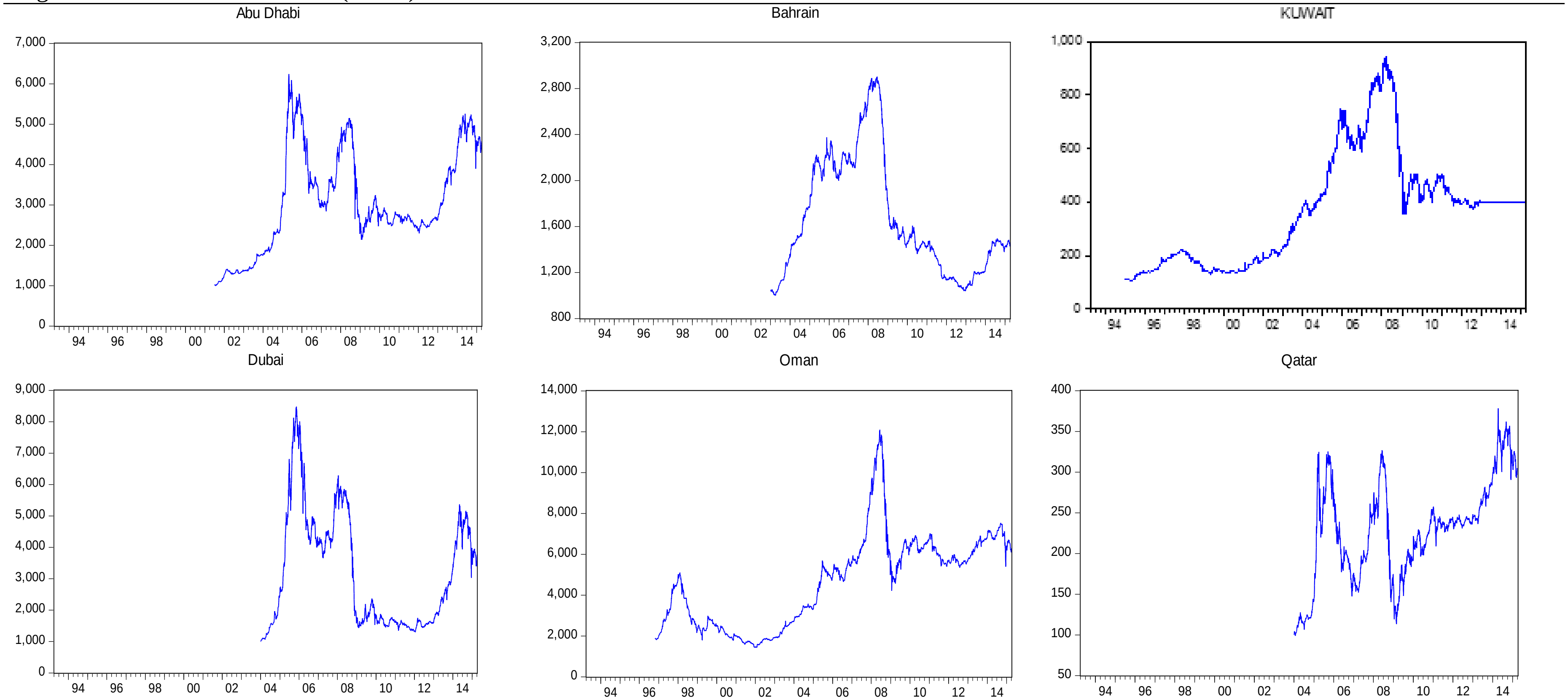
Notes: Figure shows the evolution of the WTI oil prices and GCC stock market index around the period of the Global Financial Crisis.

Figure 2. WTI crude oil price, in US dollars, from January 1987 to April 2016.



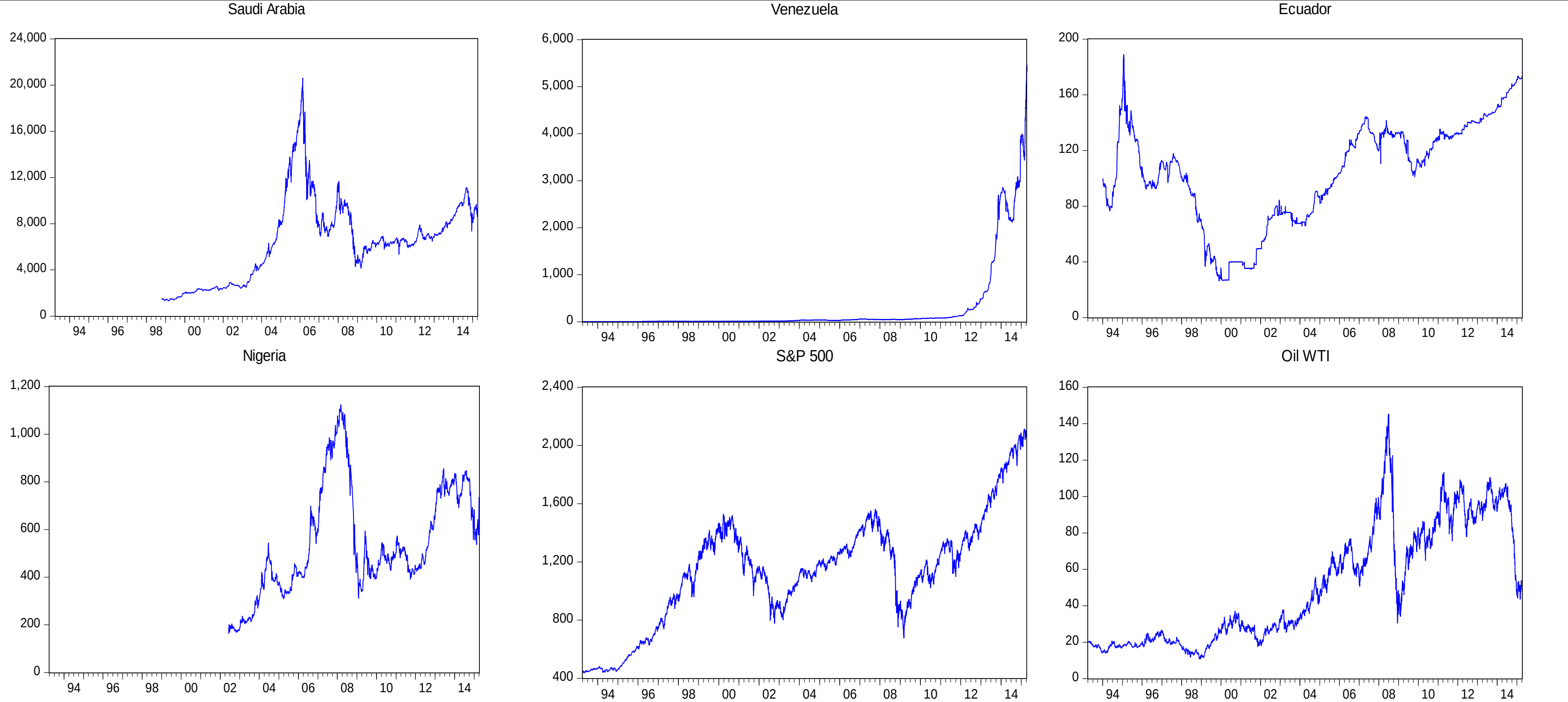
Notes: Figure shows the evolution of the WTI oil prices.

Figure 3a. Stock Market Indices (Prices)



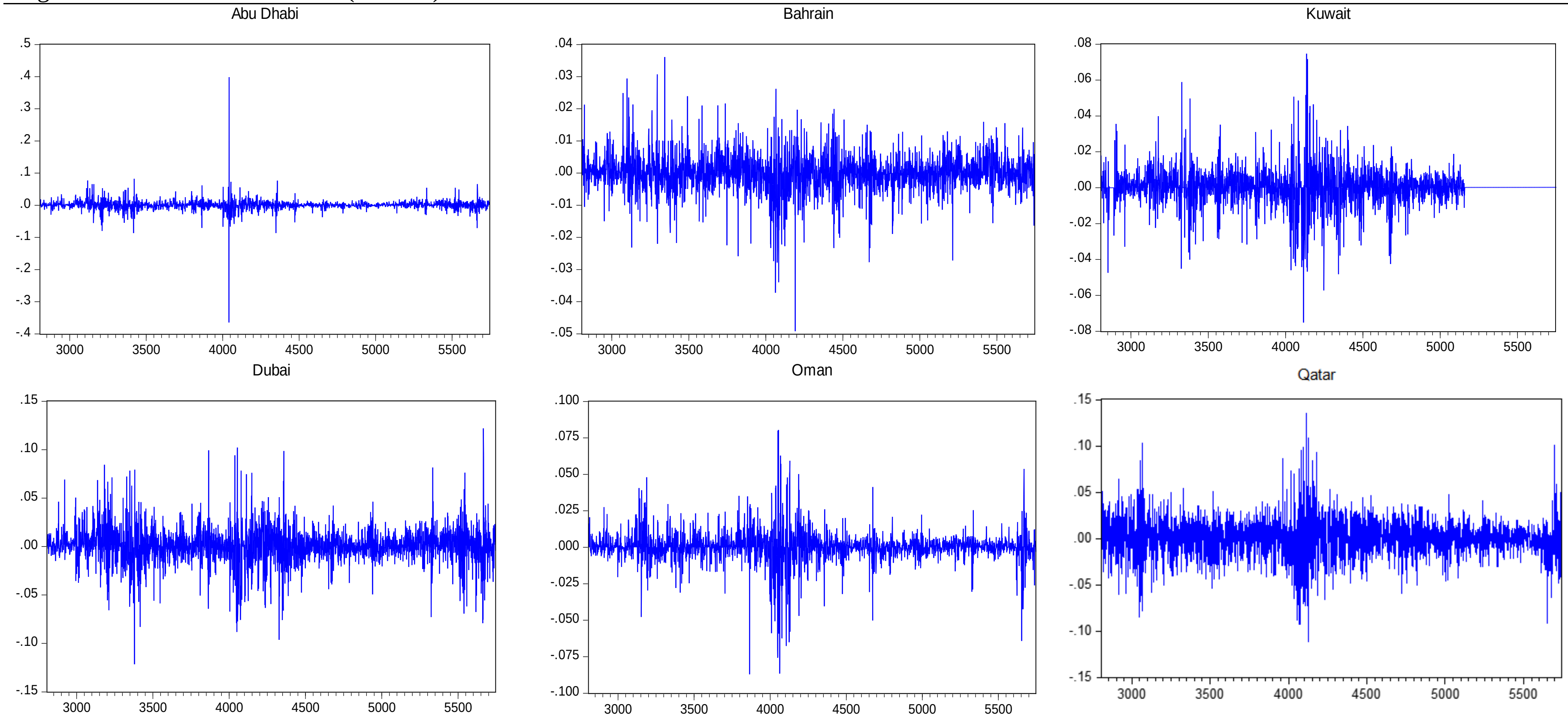
Notes: All data are from Datastream.

Figure 3b. Stock Market Indices (Prices)



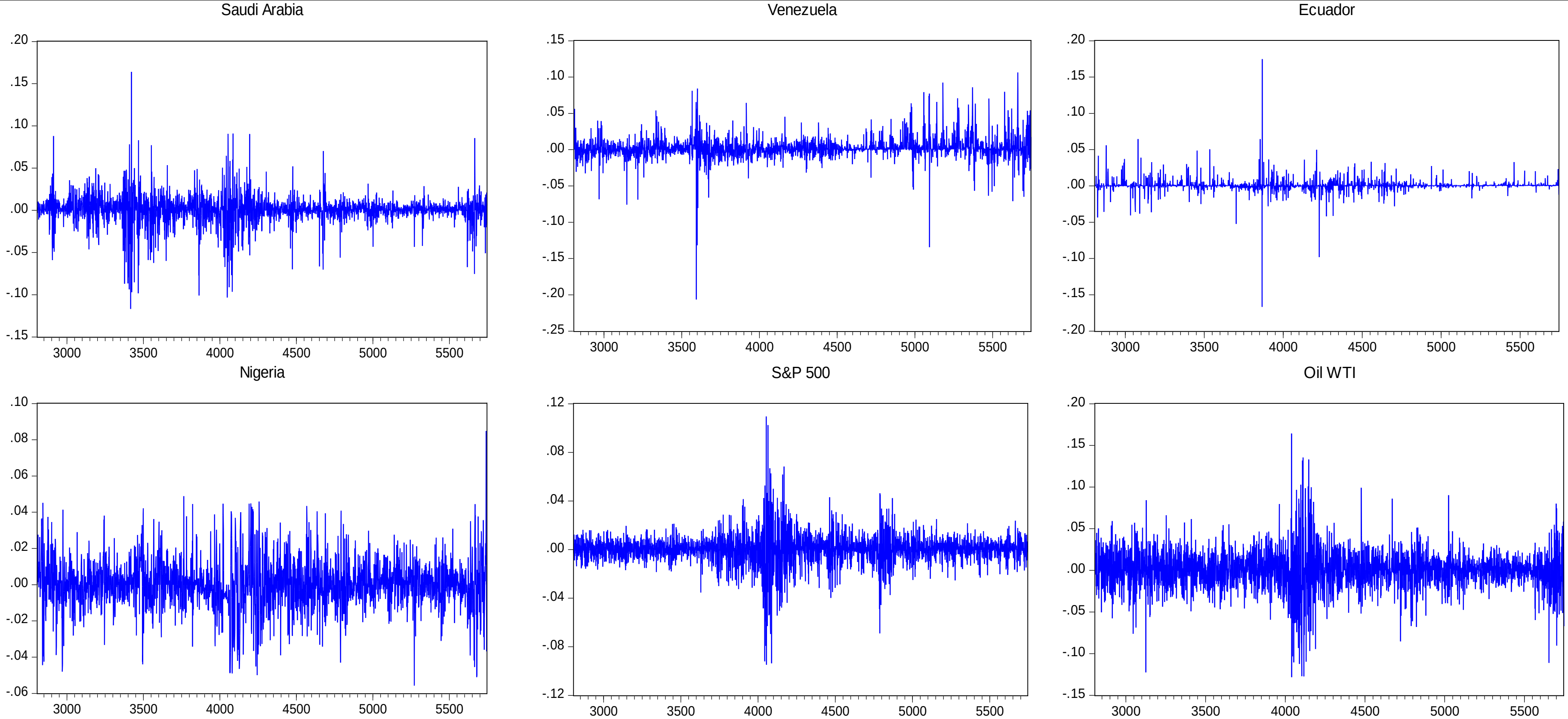
Notes: All data are from Datastream.

Figure 4a. Stock Market Indices (Returns)



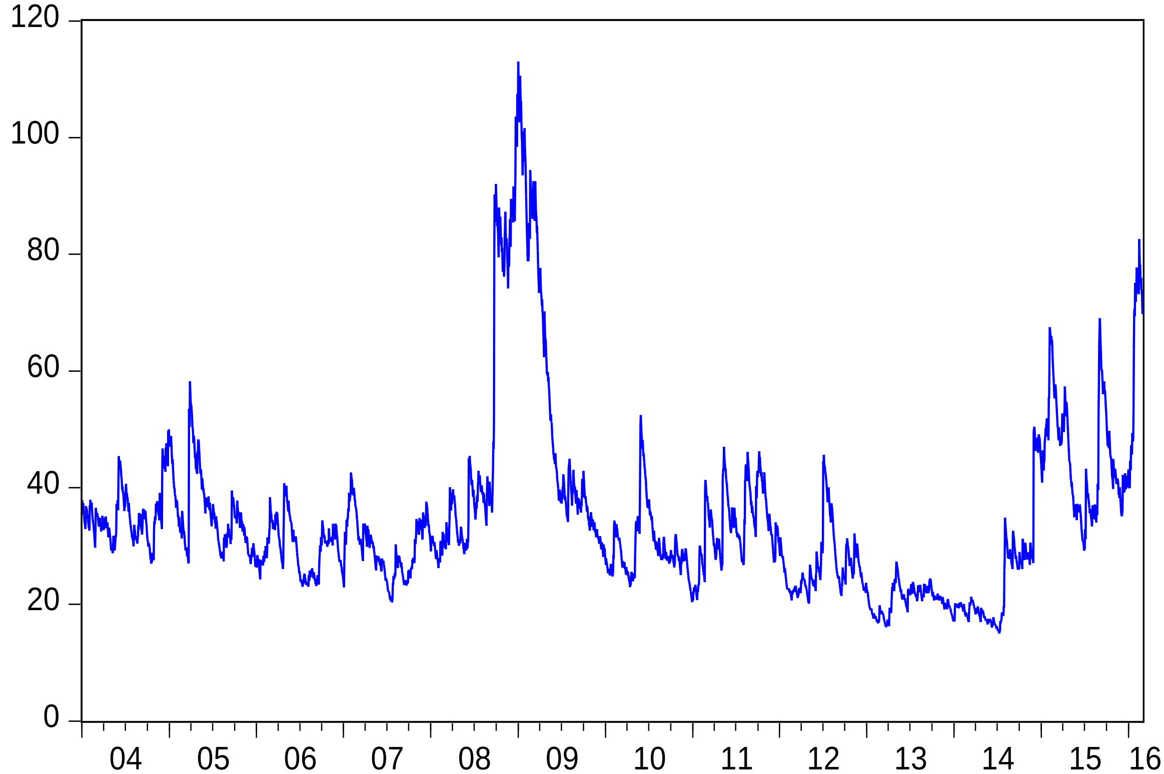
Notes: All data are from Datastream.

Figure 4b. Stock Market Indices (Returns)



Notes: All data are from Datastream.

Figure 5. Annualized Oil Volatility



Notes: Figure displays the annualized oil volatility as estimated from the DCC-GARCH model described in section4.

Chapter 4

Conclusions

The Gulf Cooperation Council (GCC) is apolitical and economic union of the Arab states that was founded in May 1981 among the six countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE. The GCC states show significant homogeneity among them on various geopolitical, macroeconomic and institutional aspects (IMF, 2005). At first the six countries share the same language and history. All GCC countries are large oil and gas exporters and participate in the OPEC. Most notably, Saudi Arabia is the single largest exporter of oil worldwide. With regards to the economic structure, all GCC members maintain long-standing fixed exchange rates to the US dollar with Kuwait being the only exception after switching to an undisclosed basket of currencies in May 2007. Furthermore, all GCC states have generally low inflation rates compared to other developing countries (IMF, 2005).

The over-reliance on oil exports as the main driver of economic growth has led to significant revenues of the GCC countries in the past, notably the late 1970s and early 1980s with the two oil crises. However, the temporary growth could not be sustained once oil prices reverted to normal levels. Ever since, the GCC states have embarked on a series of structural reforms to reduce their exposure to the volatile energy prices; thus achieving a sustainable path to economic growth. In this regard, some countries have taken significant steps towards income diversification with Bahrain, which has established itself as a financial hub in the region offering exquisite products such as Islamic finance. Tourism and transportation are also promoted. The UAE have diversified into tourism, manufacturing and financial services (IMF 2012d). Although Kuwait recently has engaged with financial services, its dependence on oil remains high. Saudi Arabia, by far the largest economy in the region (469.4 USD billion - 44.3% of GCC total), has the huge revenues from energy related products (89.3% of total revenue in 2008); construction and manufacturing are increasingly important as revenue sources (IMF, 2011a). As a result of this diversification process, non-oil sectors in the GCC have been expanding at 7.3% yearly, while the non-oil GDP represented 65% of total GDP in 2008, up from about 56-58% in the early90's. Economic growth is no longer entirely energy related. An important stress test for the oil exporters worldwide, including the GCC has been the remarkable oil price increase (around 150 USD/barrel) in the period around the Global Financial Crisis, namely 2007-2010 coupled with the persistently low oil prices (around 40 USD/barrel). The GCC have fared remarkably well and this is mainly attributed to their income diversification process that has been taking place since the oil crises of the 1970s and 1980s. As such, bad policies of the past seem to have been overcome. By contrast, oil-exporting economies outside the GCC have either not identified their over-reliance on oil revenues as a major problem or have not taken successful steps in diversifying their income sources (e.g., Venezuela, Nigeria).

The second chapter of the thesis provides an empirical assessment to how the reliance on natural resources, and oil in particular, has affected the economic growth in the period 1980 – 2014. The sample contains 14 countries that are oil exporters and special mention is made to the GCC. The research question is placed within the context of the resource curse, which dates back to the early papers of Sachs and Warner (1995, 1997) whereby an inverse relationship between oil endowments and economic growth is observed. In our analysis we use two resource proxies, the per capita oil reserve and oil rents to ensure robustness of our results. We control for an array of macroeconomic, institutional and demographic factors in line with the most recent literature. Hence, we include variables such as Tertiary Enrolment, Fertility, Mortality, Consumption, Investment, Trade Openness and Democracy – a proxy for the quality of institutions. Our estimation builds on the panel random effects and GMM methods that control for endogeneity. We augment our analysis using a novel technique in the field, namely classification trees so as to categorize the countries into groups in line with the magnitude of their oil curse (or oil blessing). Our results support the notion that the oil curse is not a cause of concern for the sampled countries, particularly for the GCC. Indeed, a positive link between oil abundance and economic growth (i.e., oil blessing) is evidenced in the majority of specifications. Even when allowing for different country groups using the classification trees, we fail to find any evidence in favour of the resource curse. Indeed, we find evidence of oil blessing to various degrees.

Income diversification in the GCC has favoured the expansion of the finance sector with Bahrain and the UAE quickly achieving status of well-reputed financial hubs in the region (IMF, 2010). Still the financial sector in the GCC is largely bank dominated, with a few domestic players dominating the market. Most of the banks operate on a deposit-taking/loan-making business model without any specialisation on securities trading. Complex financial and debt instruments are also not in line with the Islamic Law (Shariah), the relevance of which may be evidenced through the expansion of the Islamic banking industry that accounts for almost 30-40% in terms of total banking assets in the GCC (EY, 2015). The GCC is therefore characterised by a large degree of financial exclusion from the world capital markets (Al-Hassan, Khamis and Oulidi, 2010). However, the expansion of the finance industry over the recent years has somewhat ameliorated the situation with many of the GCC states opening up their stock markets to foreign investors; albeit with certain quotas. Hence, the GCC has been on a steady path to integration with global capital markets.

The third chapter of the thesis examines whether the rise of the financial services in the GCC have increased the integration with global capital market. In particular, whether the increased integration has led to increased vulnerability of these economies through imported financial contagion in light of the global financial crisis of 2007-2010. Given the relative importance of oil price volatility for these economies we modify the original financial contagion framework of Forbes and Rigobon (2002) to our needs by allowing the oil volatility to act as a transmission channel. We use daily price data for the stock markets of the GCC and several other oil exporting economies for completeness over the period 2004 – 2015. The examined period spans over periods of calm markets, global financial crisis and the recent period of prolonged low oil prices. Our methodological approach builds on the popular multivariate dynamic conditional correlation models (DCC-GARCH) to estimate the conditional correlations which are then regressed on the phases of the Global Financial Crisis to identify financial contagion as per the Forbes and Rigobon (2002) definition. Our findings show that all GCC stock markets show statistical evidence of financial contagion, with Abu Dhabi and Saudi Arabia being those that were affected more severely as evidenced by the higher change in the correlation levels. This may be plausibly related to the relationship of these economies to oil production, where Saudi Arabia is the largest economy in the region and largest exporter of oil. Abu Dhabi, the ruling emirate of the UAE, is the one more heavily dependent on oil exports. By contrast, Kuwait has been the least affected, since financial contagion is only verified at the 10% significance level. The response to the global financial crisis of the Kuwaiti government has been the timeliest and efficient, as the IMF (2009) have noted, which could in part explain the lack of statistical evidence of financial contagion in this case.

The remaining non-GCC oil exporters, there is no verification of do not verify financial contagion. In fact, some even show evidence of de-contagion, a process where following a crisis, correlation with the rest of the world drops. The low development of a financial industry in these countries and their reliance on external funds (e.g., FDI) whose flows were decreased following the GFC could explain, in part, this finding.

In sum, the measures that the GCC have taken with respect to diversifying their income away from oil and gas sectors haves paid off. Specifically, we document that oil reliance for UAE, a country whose two largest emirates are collectively dependent on oil exports and financial services and tourism, shows a countercyclical behaviour, with Abu Dhabi being affected by oil volatility during a crisis but at the same time Dubai not being affected. In addition, Saudi Arabia maintains the same level of exposure to oil volatility across the different phases of the country, and this is an important finding for further planning and stabilization of the economy against future crisis events. Most importantly, the income diversification process of the GCC has render its economic growth sustainable and less dependent on oil; however, the expansion of the financial sector facilitates the transmission of economic shocks from other parts of the world and could destabilise the economy if not proper and timely steps are taken.

We believe that higher frequency macroeconomic data would be desirable as it would enable us to track more accurately the government regulations and policy changes to the reliance on oil revenues; hence oil curse. Currently, as the oil curse models build on a relatively large array of macroeconomic variables, the limiting degrees of freedom require the use of a fairly large time span, without being able to split the sample timewise as we would have liked. Directions for future research include the collection and analysis of higher frequency macroeconomic data and the analysis of the macroeconomic reliance on oil with the stock market development and stability. In other words, how the volatility of oil prices, through the stock market can impact the economy and the real sectors.

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Appendix

Table 1. Literature Review Table

Authors	Sample	Period	Methodology	Curse / Blessing	Dependent variable	Resource proxy
Sachs and Warner (1995)	97 developing countries (Not included: Bahrain- Iraq- Kuwait -Oman- Saudi Arabia- UAE)	1971 - 1989	OLS (cross sectional growth regression)	Curse	Real per capita growth rate of GDP per annum	Ratio of primary export in GDP
Sachs and Warner (1997)	83 developing countries (Not included: Bahrain- Iraq- Kuwait -Oman- Saudi Arabia- UAE)	1965 - 1990	OLS (cross sectional growth regression)	Curse	Growth rate per capita	Share of natural resources export in GDP
Gylfason (2001)	86 resource rich countries (OPEC included)	1965 - 1998	OLS, SUR estimate	Curse	Real per capita GNP growth	Share of natural capital in national wealth
Sachs and Warner (2001)	Panel of developing countries (GCC and OPEC included)	1970 - 1990	OLS (cross sectional growth regression)	Curse	Real growth per capita	Share of natural resources export in GDP
Lederman and Maloney (2003)	65 countries (Algeria and Ecuador included)	1975 - 1999	Cross section &Panel data	Blessing	GDP per capita growth rate	Resource exports over GDP Share of natural resources exports in total exports
Neumayer (2004)	97 developing countries (OPEC included)	1970 - 1998	OLS	Curse	Genuine income	Share of exports of primary products
Stijns (2005)	29 countries had average growth rates above 2 per cent for the period 1970–1989	1970 - 1999	OLS	Blessing	Average growth rate of GDP per capita	Natural resource reserves

Mehlum et al. (2006)	42 Resource rich countries (Included: Nigeria, Algeria, Ecuador, and Venezuela)	1965 - 1990	Panel data analysis	Curse	Average growth rate of real GDP per capita	Share of primary exports in GNP
Dietz et al. (2007)	115 Resource rich countries (OPEC and GCC included)	1970 - 2001	Panel-data estimator (GMM)	Curse	Gross and genuine saving	Share of exports of fuel and mineral products in total exports
Brunnchweiler (2008)	84 Resource rich countries (Ecuador and Venezuela included)	1970-2000	OLS and 2SLS	Blessing	Income growth	Per capita mineral Total natural resource abundance
Brunnchweiler & Bulte (2008)	80 Mineral endowed and exporting countries (Ecuador and Venezuela included)	1970 - 1989	2SLS, 3SLS	Blessing	Average natural resource (Mineral) exports over GDP	Total natural capital and mineral resource assets per capita
Alexeev and Conrad (2009)	OPEC members and major non-OPEC oil producers	1970 - 2000	2SLS	Blessing	GDP per capita	Oil as a ratio of GDP
Boyce and Emery (2011)	US states	1970 - 2001	OLS (cross sectional growth regression)	Curse	Real per capita income	Natural resource exports
James & Aadland (2011)	United states counties (3092 counties)	1980 - 2005	GLS	Curse	Annual growth in per capita personal income	Percent earnings from agriculture, fishing, forestry and mining industries
Collier and Goderis (2012)	Global data	1963 - 2008	Panel error correction methodology	Curse	Real GDP per capita	Resource-export prices
Boos & Holm-Muller (2013)	87 developing and industrialized countries	1970 - 2008	Cross countries analysis	Curse	Average annual growth rate of GDP per capita Genuine savings	Share of primary exports in GNI

Oskenbayev et.al. (2013)	14 region in Kazakhstan	2003 - 2009	Panel data analysis	Curse	Real gross regional product (GRP) per capita growth rate	Energy (Agriculture) production as a share of GRP Share of primary exports in GRP
Escobar and Le Chaffotec (2015)	OPEC Countries	1930-2003	OLS and GMM Panel Data	Blessing	Per capita GDP	Oil reserves
Smith (2015)	OECD and non-OECD countries (Algeria, Ecuador, Libya, Nigeria, and Oman)	1950 - 2007	Panel fixed effect estimation	Blessing	Per capita GDP	Natural resource (oil, gas, and diamond) discoveries since 1950
Badeeb et al. (2016)	Malaysia	1970 - 2013	Auto-regressive distributed lag (ARDL)	Blessing	Real GDP per worker	Oil and gas rent to GDP
Cockx and Francken (2016)	140 countries (Iraq, Qatar, Libya, and Nigeria not included)	1995 - 2009	Panel data	Curse	Public spending on education as a percentage of GDP	Share of natural capital in total national wealth