Sectoral Impacts of Crude Oil Price Movements on Stock Markets: Evidences from Selected Emerging Market Economies

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ABSTRACT

This thesis investigates the impacts of Brent crude oil price shocks on sector returns in selected net crude oil exporting and importing emerging market countries. The data includes stock market returns on a Wednesday to Wednesday market trading days. This helps to remove cross-country time differences and to capture day-of-the-week effects. The sample period spans from 2003-2016, 2005-2016 and 2007-2016 depending on the availability of data for various sectors for selected countries namely—Saudi Arabia, The United Arab Emirates (UAE), China and India categorized as crude oil exporting and importing countries, respectively. The selected sector returns are—the banking and financial services sector returns, the agriculture or food/consumer durable sector returns and the construction/industrial sector returns. The VIX index reported by the Chicago Board of Option Exchange (CBOE) is also included as an indicator of investor sentiment about the financial markets, another global factor affecting stock markets in addition to Brent crude oil price changes. A regime switching approach is considered for two regimes as stable with high mean low variance and as recession with low mean high variance regimes with both fixed and time-varying transition probabilities.

The estimates of the Markov-switching dynamic regression (MS-DR) model with fixed smoothed transition probabilities support a dynamic non-linear relationship betwen stock returns and crude oil price changes with two regimes. Probabilities to stay in each regime are close to 1 indicating persistence of the regimes. Regarding the net crude oil-exporting countries, Saudi Arabia and UAE, the evidence shows that, in general, both the positive and negative crude oil price shocks have positive

impacts on the sector returns during the stable regime but no significant effect during the recession regime. Yet, an asymmetric oil price effect is observed such that both positive and negative oil price shocks have positive impact on all sectors in the stable regime but with a greater magnitude of the negative shock. Regarding the net oil importing countries, oil price rises are positively related with all sector returns during stable regime except that of consumer durables in India. While oil price falls positively affect the Indian banking and construction sectors during stable regime, they are of same magnitude as the positive oil price shocks during the same regime indicating no asymmetric effect. However, the asymmetric effect is observed for the case of China. The oil price falls, in general, has no significant effect on any sector returns during recession regime for the case of oil importing countries. The positive influences of oil price rises, at least in the short-run, during stable regime may be interpreted as arising from the demand side oil price shocks rather than supply disruptions. The VIX index, in general, has highly significant negative relationship with all sector returns in both oil exporting and importing countries during the stable regime. Relaxing the fixed transition probabilities indicate that rises in oil prices and VIX index significantly decreases the probability of staying in stable regime in Saudi Arabia and in China.

Keywords: Oil price shocks, sectoral stock market returns, Markov-switching dynamic regression, time-varying smoothed transition probabilities.

ÖZ

Tezde, örneklenen net ham petrol ihracatçı ve ithalatçı ülkelerin sektör bazındaki hisse senedi getirileri üzerindeki Brent ham petrol fiyat değişimlerinin etkileri incelenmektedir. Kullanılan veriler, is günü baz alınarak Çarşamba'dan Çarşamba'ya haftalık değişimler olarak hesaplanmıştır. Böylelikle, analiz sırasında, ülkeler arasındaki zaman farklılıkları ile haftanın günlük etkilerinin sorun olmaması sağlanmaktadır. Çalışmanın zaman boyutu, ülkelerin sektörler itibariyle mevcut olan zaman serilerinin sürelerine göre tespit edilmiş olup 2003-2016, 2005-2016 ile 2007-2016 arasında yer almaktadır. alışmda, net ham petrol ihracatçısı olarak Suudi Arabistan ile Birleşik Arap Emirlikleri ve net petrol ithalatçısı olarak ise Çin Halk Cumhuriyeti ile Hindistan örneklenen ülkeler arasında yer almaktadır. Her ülke için, genel olarak, bankacılık ve veya finans servis sektörü, tarım veya gıda snayı ve inşaat/dayanıklı tüketim malları/sanayi sektörleri incelenmektedir. Hisse senedi piyasaları ile petrol fiyatlarını etkileyen küresel etken olarak, yatırımcı beklentilerini yansıtmakta olan ve "Chicago Board of Option Exchange" tarafından yayımlanan VIX endeksi ise ekonometrik modelde kontrol değişkeni olarak kullanılmıştır. Temel analiz aracı olarak ise, iki rejimli (genişleme ve daralma) Markov Rejim değişimi yaklaşımı kullanılmıştır. Sabit probabilite varsayımı altındaki Markov-değişim dinamik regresyon (MS-DR) modeline ait bulgular, ham petrol fiyat değişimleri ile sektörel hisse senedi getirileri arasındaki ilişkinin doğrusal olmadığını ortaya koymuştur. Ayrıca rejim değişim olasıklarının 1'e yakın olması heriki rejimin de süreklilik gösterdiğine işaret etmektedir. Petrol ihracatçısı ülkeler için elde edilen sonuçlara göre, petrol fiyatlarındaki artış ve düşüşler, sektörel hisse getirilerini genişleyen rejimde olumlu etkilerken daralan rejimde statistiksel olarak anlamlı bulunmamaktadır. Ayrıca, petrol fiyat şokunda asimetrik etki de gözlenmekte, şöyleki petrol fiyat düşüşlerinin fiyat artışlarına göreli olarak olumlu etkisinin daha fazla olduğu görülmektedir. Net petrol ithalatçısı ülkelerde ise, genişleyen rejimde, petrol fiyat artışları tüm sektör getirilerini pozitif yönde etkilemektedir. Ancak, negative petrol şoku, genişleyen rejimde Hindistan'da bankacılık ve inşaat sektörlerini olumlu yönde etkilerken bu etkinin pozitif petrol şoku ile aynı değerde olması petrol artış ve düşüşlerinin Hindistan'da sözkonusu sektörlerde asimetrik etki yaratmadığına işaret etmektedir. Diğer yandan, negative petrol fiyat şoklarının daralan rejimde petrol ithalatçısı olan ülkelerde etkili olmadığı görülmektedir. Genel olarak, tüm ülkelerde pozitif petrol fiyat şoklarının hisse senedi getirilerini genişleyen rejimde, en azından kısa dönemde, olumlu etkilemesi şöyle açıklanabilir; petrol fiyat artışları arz yönlü olmayıp, talep yönlü olması nedeniyle. VIX index artışları ise,genişleyen rejimde tüm ülkelerde, tüm sektörleri anlamlı olarak negative yönde etkilemektedir. Petrol fiyat artışları ile VIX endeks değişimlerinin Suudi Arabistan ve Çin'de rejim değişim probabilitesini negative etkilediği elde edilen diğer bulgular arasında yer almaktadır.

Anahtar Kelimeler: Petrol fiyat şoku, sektörel hisse senedi getirisi, Markov değişim dinamik regresyon, zaman-değişim geçiş probabilitesi.

DEDICATION

In the name of Allah, Most Beneficent, Most Merciful

TO THE MEMORY OF MY FATHER

&

TO MY FAMILY

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LIST OF ABBREVIATIONS

ARCH	Autoregressive Conditional Heteroscedasticity
BEKK	Baba, Engle, Kroner, Kraft
CBOE	Chicago Board of Option Exchange
CIA	Central Intelligence Unit
CNX Nifty	National Stock Exchange of Indian benchmark stock market index
EIA	Energy Information Administration
FGE	Fact Global Energy
GARCH	General Autoregressive Conditional Heteroscedasticity
GCC	Gulf Cooperation Council
LPG	Liquefied Petroleum Gas
MS–DR	Markov Switching Dynamic Regression
MS–GARCH	Markov Switching- General Autoregressive Conditional
S&P 500	Standard and Poor’s 500
S–MS	Simple-Markov Switching
VIX	Volatility Index released by the CBOE based on S&P500 returns
WDI	World Development Indicators
WFB	World Fact Book

Chapter 1

INTRODUCTION

1.1 Background and Motivation

Crude oil is of significant importance in driving economic growth and development for both crude oil exporting and importing economies. However, the price of crude oil has not been stable during recent decades. This has been an important consideration for economists in understanding how the global economy in its structure responds to crude oil price shocks and volatility. These issues have gained the attention of many researchers especially, when the crude oil price hike hit most economies starting with the 1973 oil price crisis. Since then, there is a growing body of literature analyzing how such movements affect economies while some research paid attention on the sources of such sudden oil price jumps. According to theory, there is an expectation that a positive oil price shock would increase cost of production in the real sector slowing down economic activity, increasing inflation and reducing international trade. Following the pioneering work of Hamilton (1983) substantial body of literature evidenced a negative relationship between oil price rises and economic activity. Therefore, an appropriate resolution of this issue is central in formulating economic policies in avoiding the adverse effects of crude oil price movements on the aggregate economy. As crude oil price is an important commodity price worldwide, sudden price changes and its volatility also have important implications for portfolio decision making and asset risk management.

Within the new era of the global economy with increasing integration of financial markets and trade linkages, the relationship between stock markets and crude oil price movements have gained importance in recent research. The dynamics in the crude oil price movement is held as an essential variable for comprehending stock price swings (Kilian and Park, 2007). However, most studies focus on the impacts of sudden oil price movements on stock markets in developed economies (For instance, among others, see Kling, 1985; Chen et al. 1986, Jones and Kaul, 1996; Wei, 2003; Aloui and Jammazi, 2009). Furthermore, while the findings of such studies are not in agreement about the direction of the relationship, some reported even no significant impact. Parallel to the developments in the global economy, rapid growth of emerging markets within the share of the world economy also attracted attention of researchers in analyzing the impact of the dynamic crude oil price movements via stock markets in such economies. This is in addition to the episodic events in the global crude oil market resulting in severe financial and economic uncertainties and that emerging markets are more sensitive to such risk perceptions.

In summary, the abrupt movements in the global commodity market with particular reference to crude oil prices becomes of significant focus. Crude oil price movements have been found to impact directly the growth level in an economy, industrial venture, inflationary pressure, stock spread and returns (Jones and Kaul, 1996; Hamilton, 2003; Lardic and Mignon, 2008; Khalifa et al., 2013).

The transmission effect of crude oil price movements into emerging market economies generates distinct reaction given the extent of their reliance on crude oil resources in the case of exporting countries and their demand for investment and consumption in the case of importing countries. This fact is in addition to the structure of their economy, the depth of their financial and economic development and their interconnectedness with the rest of the world (Ebrahim et al., 2014). In line with the changing structure of the developing economies, some sectors become less sensitive to oil price shocks than others. For instance, while the industry sector is more dependent on oil, the newly developing services sector in emerging economies will be less reliant on oil. In this respect, there are also several studies which focus on the relationship incorporating the industry factor into their analysis (Grinold et al., 1989; Drummen and Zimmermann, 1992; Heston and Rouwenhorst, 1994; Hammoudeh and Choi, 2006). However, such studies for emerging countries are rare in the literature.

Apart from the industry factor, it is well documented in the literature that stock markets are influenced by other factors that also drive the oil price movements such as the global factors and regional and political factors. Most important global factors include the U.S financial markets, commodity markets and economic policy (Hammoudeh and Choi, 2006). For instance, the attribution of the downward spiral in the stock market in the United States (US) to a surge in the price of crude oil in 2006[1] was triggered by the geopolitical unrest in the Middle-Eastern region of the globe.

On the other hand, according to the theory, while oil exporting countries benefit from oil price increases adding to their export revenues, oil importers' cost of production increases and adversely affect their economic activity. In that case, stock markets of an importing country would react negatively to oil price rises (For instance, among others see Sadorsky, 1999). However, there are studies which determined positive

[1] The Financial Times, August 21 2006.

influence of oil price rises on stock markets of oil importing countries. Yet, there are studies suggesting that the final impact of positive oil price shocks on stock markets also depends on the sources of oil price rise whether it originates from demand or supply side. As explained in Filis et al. (2011)[2] in the case when oil price shock is driven by demand side, stock markets would respond positively and negatively if it originates from supply side.

Considering the recent financial liberalization and integration among financial markets and economies, the relationship between stock markets and crude oil price movements continues to attract more attention. This is especially so given the recent trend in crude oil prices following a long period of near stability in crude oil prices over United State Dollar (USD) 100 per barrel (bbl) beginning in 2000. Despite a large body of literature on the impacts of oil price movements, however, most studies concentrate on developed economies. Although there are some studies on developing or emerging market economies, empirical work on emerging markets using sectoral stock markets of importers and exporters are few. Furthermore, there is hardly any agreement among economists with respect to the relationship between crude oil prices and emerging market equity prices. Yet, mix evidences exist in the literature with regard to the aforementioned relationship for emerging markets indicating room for research.

1.2 Objective and Methodological Approach

With this motivation, the aim of the thesis is to analyze the effects of crude oil price rises on different economic sectors for a set of important emerging market economies which includes Saudi Arabia, the United Arab Emirates (UAE), China and India.

[2] This study adopted a DCC-GARCH-GJR approach using data from six countries categorized as crude oil exporting and importing namely, Canada; Mexico; Brazil; USA; Germany and Netherland.

These countries are important emerging markets from two perspectives; Saudi Arabia and the UAE are important crude oil exporters while India and China are important importers. In addition, among the oil producing emerging markets, Saudi Arabia and UAE have relatively highly capitalized financial markets. The research question is to what extent does an oil price shock affects different sectors in this oil exporting and importing emerging market economies for which studies are limited in the literature indicating room for further research. Broadly speaking, specific sectors included in the analysis are the banking sector, consumer sector and the industrial sector in Saudi Arabia, United Arab Emirate (UAE), India and China. In this way, this thesis will also allow us to analyze the impact and the potential effects of the recent crude oil price movements on importing and exporting emerging market countries. The data covers recent time periods from 2003 for UAE and India and 2007 for Saudi Arabia and 2005 for China up until end of 2016 depending on the availability of data for different sectors for each country. The time period of study includes the recent crude oil price trends of sudden price jumps and troughs that are evidenced since 2000s. More importantly, the recent crises originating from the US and the Eurozone and the political distress in the Middle East coincide during the sampled period which may affect demand for and or supply of oil.

The empirical literature suggests that crude oil prices and stock returns are not linearly related. (see inter alia Naifar and AlDohaiman, 2013; Rafailidi and Katrakilidis, 2014; Ho and Huang, 2016; and Coronado et al., 2016). The feature of the sample period also seems to support the proposition. Among others, following Hamilton (1989), Hamilton and Susmel (1994) and Cai (1994), the objectives of the thesis are pursued employing a Markov-switching framework in analyzing the relationship between oil price movements and sectoral stock returns of two oil exporting and two oil importing emerging market economies. The adoption of the Markov-switching framework makes the empirical results of this study intuitively appealing and straightforward. The thesis identifies two states as stable and recession regimes respectively to study the regime induced dynamics with fixed and time-varying transition probabilities for the selected sector level stock returns in the respective emerging market countries.

1.3 Thesis Contribution

This thesis is unique in that it seeks to investigate the research question posed based on a sector specific level focusing on significant economic sectors, banking and financial services, agriculture and food/consumer durables, and the industrial sector for two oil producing and net exporting countries, Saudi Arabia and UAE, and two largest net oil importing emerging economies, China and India. To the best of our knowledge, there is no such empirical work for these emerging countries investigating the link between oil price dynamics and economic activity through stock returns at the sectoral level.

Therefore, the contribution of this thesis to the volume of empirical studies relating to crude oil and sector level stock returns study are three folds. This thesis distinguishes the significant difference between crude oil exporter and importers in the selected emerging market countries based on their proven crude oil reserves. This is based on the most recent data from the United States Central Intelligence Agency World Fact Book (CIA, WFB, 2016). Secondly, by adopting a sector level approach based on the selection of important economic sectors, we are able to avoid the assumption that all sectors respond in a similar fashion to crude oil price shocks and able to detect their different responses to oil price shocks. This is very important in terms of the structure of the economy under consideration and thus for the policy makers in designing appropriate macroeconomic policies; optimal portfolio holding and diversification strategies for international investors. Third, the research findings will allow a comparison of the link between the oil dynamics and the sectoral stock returns of the two major crude oil producing and two major demanding emerging countries within the most recent developments across the world.

The structure of the remainder of this thesis is as follows. Chapter two reviews the theoretical and empirical literature. Chapter three addressed the data and methodological approach used. Chapter four summarizes the empirical findings and chapter five presents summary and the concluding remarks of the study.

Chapter 2

THEORETICAL AND EMPIRICAL LITERATURE

The opening decade of the current millennium is characterized by significant movements in the real crude oil prices. The period of the 1970s also witnessed similar increases in the real crude oil price. This is attributed to the 1973/74 embargo and cut back in production by the OPEC Arab members (OAPEC), the 1978/79 revolution in Iran and the 1980 Iran-Iraq war. These events caused a rare disruption in crude oil supply leading to significant changes in crude oil prices. Thus, according to Hamilton (1983), the dramatic events of the 1970s were mostly followed by severe economic recessions such that only one of the 11 economic recessions in the United States after World War II was not a result of crude oil price increases. Hamilton (1983, 1996) maintained that the negative relationship between crude oil price movements and economic activity appear not to be a mere coincidence. Following Hamilton (1983) several other researchers also studied crude oil price movements in the energy price literature in seeking to analyze the effects of crude oil price changes in an economy and found supporting evidences for a negative relationship such as Burbidge and Harrison (1984), Gisser and Goodwin (1986), Mork (1989), Hooker (1996) and Hamilton (1996, 2003, 2009) among many others. In addition to Mork (1989), Hamilton (2000) draw attention to the asymmetric effect of oil price movements in the sense that a higher oil price has more impact on economic activity than an oil price fall would boost economic activity. A rise in crude oil price would typically lead to increase in production cost and speed up inflation and eventually reduce aggregate demand and output. On the other hand, a fall in oil price would have less impact in boosting the economy. Such literature is mostly based on the findings of empirical work in developed economies such as the United States, Canada, France, Japan, United Kingdom and European countries. As the recent developments of the global economy witnessed the integration of emerging market economies with developed countries, research on the impacts of crude oil price movements in emerging countries have also gained attention. In this respect, there are two strands of literature related with the crude oil price movements. The first investigates the impacts of crude oil price changes on economic activity and the transmission mechanism while the second explores the sources of such abrupt movements in oil prices. Although, the focus of this thesis is the analysis of such oil price hikes on economic activity, a summary of the literature on the sources of crude oil price movements will be helpful in understanding the significance of crude oil price swings on economies of oil exporting and oil importing countries.

2.1 Sources of Crude Oil Price Movements

The sources of variations in crude oil prices have been well documented in the literature. The major factors influencing crude oil prices are the dynamic movements in demand and supply conditions in the global crude oil market. The supply-side shocks are related with supply-disruptions in the crude oil market triggered by the political events in the Middle East. These geopolitical events which started with 1973/74 production cuts by the Arab members of OPEC were followed by the Iranian revolution in 1978/79 and the Iraq war in 1980, Iraq’s invasion of Kuwait in 1990. However, recent research in the literature shows that supply disruptions had little effect on major oil price fluctuations (Kilian, 2009, Hamilton, 2009). Rather, there is a growing body of literature evidencing the role of demand side shocks being responsible for major oil price swings in the globe. Hamilton (2008, 2009) related the recent oil price movements to fast economic expansion of the Asian countries, mainly China leading to higher demand for oil in support of their industrialization process. Other researchers which also investigated the sources of oil price movements also evidenced that while the global crude oil supply has increased considerably overtime, the increments in the level of crude oil supply are less than the level of demand (Schalck and Chenavaz, 2015). For instance, Cevik and Saadi-Sedik (2011) maintained that despite the lower levels of crude oil demand by advanced Western economies resulting from their efficiency in energy usage, the increased intensity of energy demand required to support the growth process of emerging market economies led to higher aggregate demand for crude oil. In this respect, there has been a consensus among economists that supply-side shocks are less important than demand-side shocks. Due to Kilian (2009) demand side shocks are categorized as aggregate-demand shocks and precautionary-demand shocks (or oil-specific demand shocks). The latter is driven by expectations about oil-supply disruptions in future which reflect uncertainties. The aggregate demand shocks, on the other hand, are related with unanticipated increase in demand that cannot be met by the existing supply. As the cost of storing oil is high, an unanticipated rise in demand for oil creates shortage thus leading to spot oil price hikes in the short-run (Fong and See, 2002).

Theoretically, not only the demand but also the supply of crude oil in the short run is strongly inelastic with respect to crude oil price movements as oil plants require large amounts of investments. Over time, however, crude oil price elasticities have become more inelastic in its demand and supply which led to significant movements in crude oil prices beginning from the 1980s (Baumeister and Peersman, 2013).

Hence, more inelastic nature of crude oil supply is associated with factors such as the decreasing capacity in conventional crude oil production in addition to the diminishing rate in the discovery of new crude oil fields and blockage of investment in crude oil exploration in major oil fields.

In theory, the demand for crude oil exhibits a cyclical and seasonal variation such that the empirical association between crude oil demand and real economic output is contemporaneously pro-cyclical (Tawadros, 2013). This means that the volatility in business cycle is inherently linked to crude oil price movements. The theoretical association between crude oil price and the business cycle is due to the reason that crude oil demand is likely to be more sensitive to income as much as it is to the movements in prices (Hamilton, 2000). Finally, from the demand-side point of view the steadily increasing patterns in crude oil consumption in emerging market countries do not adequately reflect the dynamic movements in crude oil prices. More so, an explanation for the significant movements in crude oil prices is being found in the growing financialization and complexity of the crude oil market arrangement. (Ebrahim, 2014)

Apart from the supply and demand forces as the sources of oil price movements, another strand of literature is related with the view that oil is considered as an asset whose price is determined by the demand for stocks (Kilian, 2009). Accordingly, changes in expectations of traders will be reflected in the real price of oil and changes in inventories. Another suggestion is that speculative trading may also play a role in driving oil prices. For instance, Ebrahim et al. (2014) argued that the new evidences point to the significance and dominance in herding behavior in the crude oil market in explaining crude oil price movements. The evidence shows that future expectations regarding crude oil price movements affect the sensitivity of global trader of energy commodities. Further empirical evidence shows that herding behavior in the global crude oil market is due to the inadequacies of transparent, accurate and available crude oil market data—such as data on the inventory, estimates of future crude oil supply and demand including production, stocks and reserves. In this regards, Lipsky (2009) shows that crude oil price is significantly affected by the uncertainties in crude oil production variable which shifts market information to uninformed trend thereby causing severe movements in price.

Even more so, the movements in crude oil prices are attributed to the role of the Organization of Crude oil Producing Countries (OPEC). According to Wirl and Kujundzic (2004), OPEC can be considered as a price setter organization seeking to maximize the net present value of crude oil revenue for its members. Their study considers OPEC's market behaviour in terms of price reaction function where the price of crude oil is determined in relation to the demand and production gap of OPEC member countries. Thus, in their study on the correlation between OPEC summits and the global crude oil price movements, they found the decision taken in the OPEC energy conferences as having significant impacts on crude oil price movements. Kaufman et al. (2004) also reported the presence of a significant relationship between global crude oil prices, OPEC production quota and capacity utilization. Finally, Tayyabi-Jazayeri (2004) found evidence that a production quota compliance of between 94-99% by OPEC member countries led to substantial movements in the global crude oil price in general.

2.1.1 Empirical Literature on the Sources of Crude Oil Price Movements

Empirical evidence shows that whereas demand and supply side condition is significant in explaining crude oil price movements, it is often cumbersome to disentangle the sources of such dynamic movements in real time. Killian (2009) adopts a structural VAR technique to disentangle the respective sources of innovation that are associated with the movements in crude oil prices. This study identifies three fundamental types of innovations that drive crude oil price movements—these are the crude oil supply side innovation defined as an unpredictable shock to major source of global crude oil production; global demand side shock on industrial goods defined in terms of price shock to real global economic activity and the crude oil specific demand-side innovations which reflect the precaution in crude oil demand as a result of uncertainties of diminishing crude oil supply in the future time period. The empirical evidence in this study shows that increase in precautionary demand for crude oil increases lead to a very persistent and enormous rise in the real price of crude oil. The study also found that global crude oil demand side innovations exclusively for all goods lead to a slowing but sustained increase in the crude oil price. In addition, the evidence in empirical literature shows that a historical decomposition of crude oil price changes is much more influenced by shock to aggregate global demand and precautionary demand (Barsky and Kilian, (2002) and (2004); Hamilton (2003); Kilian (2008); Kilian and Park (2009); Astveit et al. (2015); Zhu et al. (2015) among many others). However, the recent academic research on crude oil price movements shows that crude oil supply-side shock alone is not sufficient to explain and analyze the dynamic movements in crude oil prices. Hamilton(1996) argued that an increase in crude oil prices have significant negative implication on a country's economic activity, particularly when economic units reduce their consumption and investment demand as a direct response to the price increases.

2.2 The Relationship between the Crude Oil Price Movements and Aggregate Economy

The impact of crude oil price movements on aggregate economy gained significant attention following the economic recession in the 1970s which was preceded by crude oil price shocks (Hamilton, 1983). There have been ample of academic studies dealing with the nexus between crude oil price variations and the aggregate economic variables (among many others, see Hamilton, 1983; Sadorsky, 1999; Papapetrou, 2001; Papapetrou and Ferderer, 1996). The general consensus among researchers is that the relationship between crude oil prices and the macro economy is negative. The pass-through channels of crude oil price shocks to the aggregate economy vary for the demand and supply channels, the trade channel, monetary policy and valuation channels (Kilian, 2009). In addition to crude oil price changes, crude oil price volatility is also found to have a direct effect on the aggregate economic variables of consumption and investment expenditures and industrial production (Ferderer, 1996). Evidence shows that the degree to which the mentioned macroeconomic variables are affected by crude oil price shocks depend on the depth of uncertainties triggered by the price shock and the behavioural responses of economic agents to the price shocks (Ebrahim et al., 2009). Crude oil price shock is also reported to indirectly impact inflation and unemployment levels through their effects on consumption by household and investment expenditures by businesses. Therefore empirical studies on crude oil price shocks and the macro economy indicate that shocks to crude oil price indirectly depress the aggregate economy over the short run to medium term. The deteriorating short run effects is generally due to depression in aggregate demand components as the impact of the shocks deepens (Ferderer, 1996). In this instance, consumption and investment expenditures dwindles as an effect of crude oil price shock in the immediate time period reinforced by rising level of unemployment due to the business cycle dynamics (Ferderer, 1996; Castillo et al., 2010; Rafiq et al., 2007; Elder and Serletis, 2010; Plante and Traum, 2012). Industrial productivity is also reported to be affected in the short term due to decreasing aggregate demand levels as the crude oil price shocks deepens. Finally, significant crude oil price shocks in the aggregate economy also triggers inflationary pressure in the medium term. The inflationary pressure is the outcome of an uncertainty premium in compensation for the rising cost of production.

In terms of the impact of crude oil price movements on crude oil exporting and importing countries, Bjornland (2009) and Jimenez-Rodriguesz and Sanchez (2005) all maintained that crude oil price increases should have a significant positive effect in crude oil exporting countries leading to increase in the level of investment necessitating a rise in productivity and reduce unemployment. On the other hand, LeBlanc and Chinn (2004) and Hooker (2002) argue that an increase in crude oil price for importing countries has an opposite effect leading to increase in production costs as crude oil is considered to be a significant production input (Arouri and Nguyen, 2010; Backus and Crucini 2000; and Kim and Lougani 1992). This rising cost is passed onto the consumer negatively impacting consumer demand and expenditures.

2.2.1 Channels of Transmission

Crude oil price movements are observed to affect an economy via various transmission channels such that the efficiency and effectiveness of the transmission channels depend on whether a country is a net exporter or importer of crude oil. The most important channels of transmission are summarized below.

2.2.1.1 Monetary Policy Transmission Channel

This channel is mostly seen in the inflationary impact of higher crude oil price movements. In this regard, Barsky and Killian (2002; 2004) maintained that the transmission channel via which the monetary policy effect is felt in an economy is mostly in response to the expectation of higher inflation and economic growth. Inflation arises as a premium for uncertainty that the industrial owner adds to the cost of their product under production uncertainty condition in situation of volatile crude oil prices. Thus, whereas inflationary pressure is generated by supply-side response to crude oil price movements, the corresponding response of the demand-side effect creates a deflationary situation. Thus, the dynamics in inflation expectations significantly affect the monetary policy orientation as a result of the changes in crude oil price movements. Crude oil price movements worsen the dilemma in monetary policy formulation by either reducing interest rate in order to stimulate economic growth or increasing interest rate to curb the inflationary pressure in the economy. In this instance the monetary authority is faced with a choice between an accommodative monetary policy and restrictive monetary policy. Therefore, in a low inflationary environment, the monetary authorities can stimulate economic growth using expansionary policy rather than tight monetary policy in the face of significant crude oil price increases.

2.2.1.2 Expectations Channel

The monetary policy transmission channel often neglects the impact of expectations of economic units in influencing the efficiency and effectiveness of monetary policy choice in a situation of significant higher crude oil prices. According to Ebrahim et al. (2014), the major factor in adopting an expansionary policy measure in boosting the economy during a period of increasing crude oil prices often leads to liquidity trap. The concept of liquidity trap is associated with the economist John Maynard Keynes which is used to describe a situation that arises due to the inability to reverse the preferences for saving even as nominal interest rate reaches zero. This means that conventional approach to monetary policy will become ineffective. In other words, since negative interest rates are not admissible, the conventional approach to monetary policy will become ineffective as the nominal rate of interest tends to zero. Thus, higher crude oil prices adversely affect consumer confidence increasing the danger of a liquidity trap (Baskaya et al., 2013 and Traum, 2002). In any economy where the consumer confidence is low the availability of cheap money is unable to discourage the precautionary saving attitude of people due to the expectation of higher future prices of crude oil.

2.2.1.3 Investment Channel

The analysis of the investment channel in the transmission of crude oil price movements on the macro economy stems from the investment theory during uncertainty due to Henry (1974) and Bernanke (1983). According to this theory uncertainty in crude oil price movements can depress significantly the current level of aggregate investment causing a pro-long negative effect on output levels in an economy. Bernanke (1983) contends that uncertainty in crude oil prices induces producers to postpone their current investment plans leading to a fall in their total output. The literature also emphasizes the indirect effects of such investment decisions by firms driven by uncertainty effect that lead to reallocation of resources across sectors leaving resources idle. For instance, rises in energy prices reduce both investment and consumption expenditures on automobile industry leading to unemployment in the case when factors of production shifted away from this industry cannot be fully absorbed by another sector. As explained in Hamilton (1988) such indirect effects may impose a large effect on output and unemployment if the values of such commodities are large. Also, Kilian (2009) emphasizes the amplified effects of reallocation of resources across sectors and intra-sectors under the presence of imperfect capital and labor markets and that the economists consider this as the primary channel of rising energy prices affecting an economy. The investment channel also means that countries with high investment expenditure and high consumption expenditure share to GDP will be more affected by an energy price shock relative to those with lower investment expenditure share (Aastveit et al, 2015).

2.2.1.4 Trade Channel

As reported in Kilian (2009), shocks to crude oil demand and supply in the global crude oil market have varying impacts on trade balance of oil and non-oil trades for net crude oil exporters and importers. Theoretically, crude oil supply disruptions due to exogenous factors lead to a short run rise in the real price of oil. The significance of this effect depends on the share of crude oil in production and the relative substitutability of crude oil and other production resources. With imperfect markets, the oil supply disruptions means that higher oil prices will eventually lead to a trade deficit in oil importing countries, in general, but with a perfect market, the balance on trade of non-oil items remains unaffected. Although, oil exporting countries are not affected from a positive oil price shock in the short-run, it may be affected in the long-run as other net oil importing countries may reduce their imports from the net oil-exporting countries through their volume of trade.

2.2.1.5 Valuation Channel

This channel is determined by the asset price movements due to crude oil demand and supply side shocks. Theoretically, the extent of the gains and losses due to an asset price movement is dependent on the total liabilities and holdings of foreign assets by the crude oil importing and exporting countries and the currencies in which the asset is held. According to the theoretical underpinning of portfolio diversification, crude oil exporters will opt to maintain a proportion of their financial assets in crude oil importing countries while the importers do the same in exporting economies. Based on the portfolio diversification theory, a rise in crude oil price leads to rising profitability and rising asset value for oil-exporting countries with the opposite result for oil-importers, and thus, the additional gains from the rising crude oil prices flow from crude oil exporting economies to importing countries. This leads to a short run loss in capital for crude oil exporters with a direct positive shock to crude oil demand and a negative shock to supply. Over the long time period, the valuation mechanism ceases as assets adjust back to their initial value. Theoretically, shocks to aggregate demand may offset the gains and losses in capital working through other transmission channels (Kilian, 2009). The adjustment in portfolio valuation predicts that the valuation effect will be more significant for crude oil exporters compared to importing countries due to the relatively small size of their asset holdings in the gross asset position of crude oil importers.

Accordingly the most important transmission channel of crude oil price shocks to the aggregate economy is felt via the expectation channel. In this regards, an unanticipated rise in real crude oil price negatively impacts the aggregate economy more than the unanticipated fall in price have boosting it for both the crude oil exporters and importers alike (see among others, Hamilton, 1983).

2.2.2 Net Oil Importing Countries versus Net Oil Exporting Countries

There is a large body of literature that investigated the impacts of crude oil price shocks on net crude oil importing countries and net crude oil-exporting countries.

According to Hamilton (1988 and 1996) oil shocks adversely influence the macro economy of an oil importing country by depressing consumption and investment, ultimately reducing aggregate output. From this perspective, crude oil is considered to be an intermediate production input for domestic producers in the net oil importing countries. The implication of crude oil price increases for both consumption and investment decisions is that it leads to a decrease in global aggregate component of demand due to uncertainty about future crude oil price directions. Empirical studies such as Davis (1987) and Hamilton (2008) have shown that changing levels of consumption and investment expenditures due to uncertainty and increasing production cost effects—triggers a sectoral rebalancing impact on the economy. In this instance, a reduction of demand for intensive energy durable goods like automobile leads to a shift of production factors i.e. labour and capital from the affected sector (Kilian, 2009). This affects output and employment generation for the sector. A possible reallocation effect becomes the case when the household demand shifts away from more intensive energy durables to more efficient durable goods (Hamilton 1988; Bresnahan and Ramey 1993).

The bulk of crude oil exporting countries depend heavily on the accruals and proceeds from the export of crude oil as their primary revenue source. The downward movement in crude oil prices affects the revenue and trade account of crude oil exporters impacting negatively and adversely on their national economies. Thus, an increase in crude oil prices is more easily appreciated by crude oil exporter in contrast to decreases with the extra accruals from increased crude oil prices channeled in financing importation from elsewhere around the globe. More so, there are significant benefits in channeling the extra revenues from crude oil export by oil exporters into the global economy (Kilian, 2009).

A rise in the real price of crude oil triggered by exogenous factors also constitutes a shock to the country's terms of trade balance. Abeysinghe (2001) distinguishes between direct and indirect effects of oil price shocks on trade balance of oil importers and exporters. Accordingly, oil importing countries' terms of trade is directly and negatively affected by oil price shocks while oil exporters' terms of trade is positively affected due to higher export revenues. The indirect effect on the oil exporting countries stems from reductions in the volume of imports of the oil importing countries from these oil exporting countries. Therefore, in addition to the direct positive terms of trade effect, the oil exporting countries will also be affected negatively from an oil price shock in the long-run. The net effect will depend on the magnitudes of the direct and the indirect effects on the oil exporting countries. This implies that the repercussions of this indirect impact on the oil importing countries can further be felt if these countries are close trade partners.

2.2.3 Review of the Literature on the Impact of Crude Oil Price Shocks on Aggregate Economy

The researchers have concentrated on investigating the effects of sudden crude oil price rises on aggregate economy following the economic recession that preceded the 1970 crude oil price shock in the United States. The pioneering work of Hamilton (1983) found significant correlation in crude oil price swings and economic growth in the United States (US) over the period of 1948 to 1981. In this study, Hamilton (1983) estimated the bivariate correlations between oil price and economic growth measure adopting a reduced form econometric model to study the partial effects of crude oil price movements on the US economy. Using a five-quarter lag distribution for the adopted variables, the author concluded that oil price increases were mostly followed by decreases in output growth in the US. Past empirical studies before the seminal contribution by Hamilton (1983) also reported negative association between crude oil price rises and economic growth such as Pierce and Enzler (1974), Rasche and Tatom (1977), Mork and Hall (1980) and Darby (1982).

Pierce and Enzler (1974) employed a quantitative econometric model to estimate the effect of crude oil price shock on individual sectors and the economy-wide impact for the US. Overall, they found that a rise in crude oil price significantly adversely affected the aggregate demand component in the US. Rasche and Tatom (1977) estimated a production function model to examine the impact of the 1973 and 1974 crude oil price shock for the US economy. The evidence presented in their study showed that crude oil price potentially diminishes output growth in the US for the period of the study. Darby (1982) also employed a production function model to analyze the effect of the oil price shock from the world economy to the US. The simulation from this study, however, did not find a negative effect of high crude oil price on output growth. Yet, the earlier studies were mostly in support of the inverse relationship between crude oil price shocks and economic activity. Thus, the earlier generation of empirical studies prior to Hamilton (1983) mostly employed the production function analysis to explore the link between oil price and aggregate economy.

Later studies following the pioneer research of Hamilton (1983), such as Mork (1989) also found evidence for the negative impact of crude oil price movements for the US economy. This study was an extension of Hamilton (1983) which employed a vector autoregressive methodology for the period of 1948 and 1988. Mork (1989) estimated a six variable vector autoregressive (VAR) model similar to Hamilton (1983) but laid particular emphasis on the possible asymmetric effect of crude oil prices on output growth. His results provided evidence that positive oil price shocks had more impact than negative shocks in the US. Furthermore, the extension of Mork (1989) by Mork et al. (1994) for a group of industrialized countries, namely, Japan, Germany, France, Canada, the United Kingdom and Norway over an extended period between 1967 and 1992 documented similar evidences except for Norway in cases of oil price increases.

Lee et al. (1995), Ferderer (1996) and Sadorsky (1999) have contributed to the literature extending the analysis further. For instance, Lee et al. (1995) examined the casual impact of real crude oil price changes on the macro economy between 1950 and 1992 by adopting a GARCH type of modelling to allow for time-varying volatilities. Their results showed that during the period of economic stability, crude oil price shocks had a stronger significant effect than in a more volatile economic environment. Ferderer (1996) investigated the asymmetric effect of oil price shock on the U.S economy through the sectoral shock and the uncertainty channel and the responses of the monetary policy for period between 1970 and 1990. The evidence in this study shows that the volatility and crude oil price movements significantly exert more effect on the macro economy than aggregate monetary variables. Ferderer (1996) therefore documented evidences for the significant negative link between oil price volatility and the macro economy. Furthermore, his results indicated that the monetary policy responses contributed to the asymmetric effect of oil prices. Sadorsky (1999) utilizing an unrestricted VAR model also studied the association between crude oil price changes and the U.S macroeconomic variables namely; industrial production variable, interest rate, crude oil price, stock returns and inflation. The study used monthly data set covering the period between 1947 and

1996. Hence, like in the earlier studies, Sadorsky (1996) also found evidence in support of the negative impact of crude oil price for the economy.

Hooker (1996) in his study for the period between 1948 and 1994 challenged the empirical conclusion about the negative relationship between crude oil price and aggregate economic output that stem from the pioneering study of Hamilton (1983). He also questioned the asymmetric effect of the crude oil price on the economy due to Mork (1989). Hamilton (2001) later developed a nonlinear approach for oil-macro economy relationship providing support to Hooker (1996). Also, Hamilton (2003) proposed that oil price increases have more impact on an economy than oil price decrease has boosting the economy. Hence, the evidence from Hooker (1996) and Hamilton (2001, 2003) stimulated further empirical studies to investigate the nonlinear link between oil prices and the economy as well as the asymmetry issue on the aggregate economy. Even more so, the empirical non-linearity between crude oil price and the macro economy was also confirmed later by other studies such as Jiménez-Rodríguez (2004) and Zhang (2008) among many others. Recent studies capture the nonlinearity by using Markov-switching models in their analysis such as Aloui and Jammazi 2009), Roboredo (2010), Jammazi and Nguyen (2015), (Alsamara et al., 2016).

In addition to nonlinear relationship between oil price movements and economic activity, oil prices had asymmetric impact on the economy in the sense that increase in crude oil prices depresses the economy while decreases in crude oil prices do not stimulate the economy (Mork, 1989; Hamilton; 1996, 2003). According to Hamilton (1996) oil price rises lead to concerns about the price and availability of energy thus postponement of irreversible investment decisions of business. Kilian (2009) also explains this asymmetric effect as the offsetting positive impact of falling prices that may occur due to higher levels of investments in oil importing countries by higher levels of imported consumption goods by these countries.

In the literature, Mork's (1989) proposition was to capture the asymmetric effect of oil price rises by using a regressor representing positive magnitudes in oil changes which had the value of zero for negative changes. However, Hamilton (1996) suggested that it would be more appropriate to compare oil price increases with the previous year's highest value. Thus, he constructed net oil price increase (NOPI) as the difference between current months' price of oil and previous year's maximum price if positive and zero otherwise. On the other hand, Lee et al. (1996) suggested to transform the oil price by an AR(12)-GARCH(1,1) error process. The empirical literature, in general, provided support for the asymmetric impact of oil prices on the economy (Federee, 1996; Cong et al., 2008; Aloui and Jammazi, 2009). However, Du et al. (2010) which investigated the relationship between oil price shocks and China's macro economy reported that world oil prices significantly affected China's GDP for the period of 2002:1 – 2008:12 in an asymmetric way but in the opposite direction in the sense that positive oil price shock had no significant impact while negative shocks decreased China's GDP significantly.

There is a large body of empirical literature which investigated the above mentioned issues regarding the nonlinearity in the relationship of oil prices and economic activity as well as the asymmetric effect of oil price rises for developed versus emerging economies as well as net oil exporter versus net oil importer countries. The researchers employed various methodologies for their empirical analysis of these issues. Numerous studies employed structural VAR methodology extensively to analyze the empirical impact of crude oil price shocks on the macro economy. For instance, Jiménez-Rodríguez and Sánchez (2005) empirically examined the impact of crude oil price shock on the real aggregate economic activities for the industrialized nations in the OECD using a multivariate VAR model with both linear and non-linear framework. The study documented evidence confirming the non-linear impact of crude oil for the industrialized nations in general. Specifically, they found that higher crude oil price significantly impact the GDP growth of larger magnitude than the decreases in the crude oil price. Thus, for the crude oil importing industrialized nations, the rise in crude oil price was reported to negatively affect the aggregate economic activity in all the countries considered expect for Japan. For the crude oil exporting countries, crude oil price shock affected GDP differently in the sample. Thus, whereas the United Kingdom is reported to be adversely affected by crude oil price increase, Norway was affected positively.

Peersman and Robays (2012) in their study summarizes the cross-country impact of crude oil price for the advanced industrialized countries categorized as net importers and exporters, respectively. This study employed a time dependent VAR technique in their empirical estimation over the period between 1986 and 2010. The study reported that the impact of crude oil shocks varies considerably based on the source of the oil price volatility. The authors reported that a positive crude oil price shock permanently slowed down the aggregate economic activity of the net crude oil importing countries. The effect for the net exporters was found to be positive but insignificant in general. Furthermore, this study found that reductions in crude oil demand triggered by the change in the global economy and the specific crude oil demand shock had a similar impact on the net exporting and importing countries. Furthermore, they found transitory rise in output of the sampled countries following a global crude oil demand shock. However, it is reported that the cross-country impact of crude oil supply side shock differed in magnitude for the countries depending on their reliance on the crude oil resources and the ones which were less reliant on crude oil have been the least affected ones by the disruptions in global crude oil supply side shock.

The bulk of the literature related with the correlation of crude oil price shocks and the economic activity have mostly focused on the US economy and other industrialized countries. However, the literature nowadays has become even more diverse including research on the developing countries as well. Regarding the crude oil-macro economy relationship in the emerging market economies, Du et al. (2010) examined the empirical relationship between global crude oil price movements and the macroeconomic responses in China. The study covered the period between 1995 and 2008 using a multivariate VAR model. The findings of the study provided support for a significant non-linear negative relationship between oil price and China's economic growth. More importantly, they provided support for the exogeneity of the world oil price with respect to China.[3] This result was first evidenced by Chen et al. (2009) which examined the influence of China on oil price volatility during 1997 and 2007. The authors concluded that the activities in the global crude oil market had substantial impact on the Chinese economy while the reverse did not hold although China had large amount of oil consumption. More recently, Ratti and Vespignanin (2016) employed a comprehensive global-factor-augmented error correction technique to examine the impact of crude oil changes on the aggregate macroeconomic variables in China, India as emerging markets as well

[3] Others supporting exogeneity of oil price included Hamilton (2003) and Kim and Hammoudeh (2013) for the GCC countries.

as the Euro area, Japan and the US as developed regions. The study covered the period of 1999–2013. The authors reported, among other findings, that the rise in global crude oil price is associated with global interest rate tightening and the US, Euro area and China are the main drivers of the global macroeconomic factors rather than the developments in the crude oil market. On the other hand, Nusiar (2016) examined the impact of crude oil price shock for the Gulf Cooperation Council (GCC) employing both a non-linear framework within a panel data analysis and ARDL technique. The estimation period vary according to the availability of data from 1968 to 2014 for the case of Saudi Arabia and from 1975 to 2014 for the UAE. Accordingly, most of the empirical studies on the GCC focused more on the association between crude oil prices and stock market indices of the region rather than the relationship between the crude oil prices and economic fundamentals. The study generally upholds the asymmetric effect of the crude oil price movements for the GCC. Especially, it was found that on a country base, the decrease in crude oil price had no significant impact on the real gross domestic product (RGDP) of Saudi Arabia and the United Arab Emirates (UAE).[4]

2.2.4 Impact of Crude Oil Price Movements through Stock Markets

Theoretical literature holds that financial asset price is determined mainly by the expected discounted cash flows from the asset over time (Fisher, 1930 and Williams, 1938). This means that in the case when a factor changes the expected cash flow of the asset, it will distort the asset value (Filis, et al. 2011). Thus, a rise in oil price which is associated by increased costs and thus reduction in profits is expected to decrease the stock prices reducing the value of their shareholders wealth. It is argued in the literature that the impact of crude oil price movements on international stock

[4] Although there is a vast empirical literature expanding in this area of reserach, we suffice with this limited number of studies to save space.

market activities is an indirect effect that is transmitted through macroeconomic variables.

2.2.4.1 The Empirical Literature on the Impact of Crude Oil Price Movements through Stock Markets

There is a growing body of empirical literature on the association between crude oil price movements and the global stock market returns. The empirical literature reported mixed results. For instance, Kling (1985), Jones and Kaul (1996) are among the earlier studies which found that higher oil prices affected stock returns negatively. Others reporting negative association include Gjerde and Saettem (1999); Ciner (2001); Driesprog et al. (2008); Part and Ratti (2008) Nandha and Faff (2008); Miller and Ratti (2009) Chen (2009) and Filis (2010) among many others. Findings of Sadorsky (1999) also indicate that both crude oil price movements and volatility impact stock returns negatively. On the other hand, Chen et al. (1986), Huang et al. (1996) and Wei (2003) are among those who reported no significant link between oil price movements and stock returns. The findings of further empirical literature suggested that crude oil price movements affect the international stock markets as a result of the uncertainty they generate to global finance, the magnitude of which depend on the nature of the impact—whether they are triggered by demand or supply side shocks. For instance, among others, some researchers who have investigated the origins of shocks whether they arise from aggregate demand side or precautionary demand side or supply side shocks and their influences on stock markets are Terzian (1985), Barsky and Killian (2004), Lascaroux and Mignon, (2008), Hamilton, (2009), Killian and Park (2009) and Filis et al. (2011). This group of empirical studies agrees that the origin of shocks impacting crude oil price movements is important in seeking to study the nature of the relationship between crude oil price changes and international stock market returns. For instance, Lascaroux and Mignon (2008) evidenced that any increase in crude oil prices is associated with shocks to the supply-side. On the other hand, Hamilton (2009) added that demand-side effect further contribute to the rising crude oil prices as a result of the increasing industrialization activities. More so, Killian and Park (2009) have shown that international stock prices tend to be influenced more by the demand-side innovations relative to the crude oil price supply-side innovations. The evidence in this study shows that shocks due to the supply-side effect are less important for the US real stock returns than the shocks originating from global demand-side effect or precautionary demand for oil. These shocks originating from demand side effect have negative impact on stock value as a result of the precaution in the future crude oil demand leading to uncertainty in the availability of future supply of oil. Authors also conclude that a rise in oil prices due to an unanticipated increase in global demand would affect the stock markets positively during a year. This result was also supported by (Hamilton, 2009) and Filis (2011).

In terms of the sectoral impact of crude oil price movements in the US economy Malik and Eromy (2009) found a negative correlation between the volatility of crude oil price returns and stock market returns for three important sectors—the technology, health and consumer-service sectors. Lee et al. (2012) using an unrestricted VAR model studied the impacts of crude oil price changes for sector specific indexes in the Group of Seven (G-7) economies[5]. The study examined 12 sector indexes[6] over the period of January 1991-May 2009. It reports a causal negative relationship in the short run between oil price and sector price changes; four

[5] These are Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

[6] They are the Composite, consumer discretionary, consumer staple, energy, financial, health care, industrial, information technology, material, utilities, transportation and telecommunication.

out of seven sectors in Germany, two in the United States and one in France were significantly affected by crude oil price changes among which the most affected sectors were information technology and consumer staples followed by the financial, transportation and utilities sectors. Cunado and Perez de Gracia (2014) examined crude oil price shocks and stock market returns for twelve oil importing European countries between 2 February 1973 and 12 December 2011. The authors specified the oil supply and oil demand shocks separately in their VAR and VECM models. They found that the responsiveness of the real stock returns in Europe to crude oil shocks varies significantly based on the causes of the crude oil price changes. They also noted the presence of a negative and substantial impact of crude oil price changes on most of the European stock markets and that the main driver of the changes is the oil supply shocks.

In contrast to the above, studies that found positive correlation between crude oil price shocks and sector returns include among others El-Sharif et al. 2005; Boyer and Fillion, 2007; Nandha and Faff, 2008; Goodwin, 1993; Faff and Brailsford, 1999; Arouri, 2011; Sadorsky 2011. For instance, Sadorsky (2011) and Boyer and Fillon (2007) both found evidence that a positive association exit between crude oil price movements and the stock market returns of oil and gas companies in Canada. Similar conclusion is also reached for oil and gas sector in the United Kingdom by El-Sharif et al. (2005). Hence the oil and gas sector in Europe is significantly impacted by the volatility and crisis in the global economy such as the 2008 to 2010 global meltdown (See Honoré, 2011 and Stern, 2014).

Nandha and Faff (2008) in a comprehensive study covered all the 35 leading industries and found that crude oil prices affected equity returns positively in the oil and gas sectors more significantly than other industries studied. Also the study by Al-Musharraf and Goodwin (1993) found that crude oil price rises have positive impact on stock returns for firms that are closely linked to the oil industry of the 29 firms studied that are listed on the exchange in New York. Also, Mohanty et al. (2011) studied the dynamic impacts of crude oil price changes and the equity market returns for the Gulf Cooperation Council (GCC) economies[7]. This study employed weekly data from June 2005 to December 2009. The results from the country level analysis in their study showed a positively significant correlation between crude oil price and equity returns for the GCC markets.

There are also studies that have also found bidirectional relationship between crude oil price changes and stock markets around the world. These include, among others, Hammoudeh and Aleisa (2004) and Arouri et al. (2011). In this regards, Hammoudeh and Aleisa (2004) found a long-run bi-directional association between the stock market in Saudi Arabia and crude oil price changes. Arouri et al. (2011) adopted a VAR-GARCH technique to study the impact of volatility transmission from crude oil to equity markets in Europe and the United States using sector indices. They found evidence of both unidirectional and bidirectional spillover in volatility from crude oil to the sector return indexes. This study reveals the presence of heterogeneity in the cross-effect of volatility for the various sector level data examined. Maghyereh and Al-kandari (2007) also report a significantly nonlinear effect for the Saudi Arabian stock market in the long run period as a result of the movement in crude oil prices.

At the industrial level — for four GCC markets, namely Bahrain, Kuwait, Oman and Qatar, Mohanty et al. (2011) also found that 12 out of 20 industries respond

[7] Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE

positively to crude oil price shocks across the countries examined. The authors also reported the presence of asymmetric effect of oil price changes on stock market returns at the sectoral level. Hamman et al. (2014) examined the effect of crude oil price volatility on stock returns[8] in Tunisia based on sector-specific indices. They employed a bivariate GARCH-BEKK model based on weekly data from 2 April 2006 to 12 July 2012. This study reported the presence of significant crude oil price shock and volatility spillovers with varying intensity across the sector studied. They also found unidirectional spillover of volatility from crude oil market to the equity market.

Broadstock and Filis (2014) used Scalar- BEKK model to examine the time-varying correlations between crude oil price shocks and equity market returns in the United State and China for both the aggregate index and some key selected industrial sector indices[9]. Following Kilian (2009) the study considers origins of the oil price shocks as supply-side, aggregate demand and oil-market specific demand to disentangle their impact on aggregate index and sectoral indices. The sample covers the period of January 1995 to July 2013. The authors' results indicate some key points that first the correlations between crude oil price shocks and equity market returns were time-varying, second, that crude oil price shocks of different origin have different impacts on stock markets and vary across sectors. Finally, they conclude that China is more resilient to crude oil price shocks compared to the United States.

On the other hand, there is also a group of studies that found no evidence of empirical association between crude oil price movements and stock market returns

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[8] Such as the automobile parts, banks, basic materials, utilities, industrials, consumer services and financial services.

[9] These include metals and mining, oil and gas, retail, technology and banking.

which include, among others, Chen et al. (1986); Henry et al. (1996); and Cong et al, (2008). A further deduction shows the sector responsiveness to crude oil price changes may be asymmetric such that some sectors are more severely impacted than others. Even more so, the extent of responsiveness of sector returns to crude oil prices is significantly determined by the extent to which crude oil serves as an input to the sector.

The above literature on the sectoral responses to various forms of oil price shocks implies that there is still a gap in the theoretical and empirical literature which remains an issue of evolving research and of utmost concern to market participants and policy makers.

Chapter 3

DATA AND METHODOLOGY

3.1 DATA

For the purpose of analyzing the impacts of oil price movements on various sectors of importing and exporting emerging economies, this research utilizes weekly stock market data calculated from Wednesday to Wednesday which is a working day for all countries in the sample namely, Saudi Arabia, United Arab Emirates, China and India. The use of weekly data also overcomes the problem of time differences across the sampled countries. The sample estimation period starts from 3rd September 2003 in the case of the United Arab Emirates (UAE) and India, 5th January 2005 for China and 17th January 2007 for Saudi Arabia extending to January 27th 2016 for the entire sample. The sample estimation period for each country are determined by availability of data. The data set is comprised of stock indices for each of the three sectors in each country and the Brent crude oil price indices retrieved from data stream data base. The stock price series for the selected sectors are obtained from the respective stock markets of interest namely; Saudi Arabia stock exchange (TADAWUL); the United Arab Emirates (Abu Dhabi stock exchange); China (Shenzhen stock exchange); and India (CNX Nifty). The selected sectors include banking and financial services, agriculture and food, industrial sector for Saudi Arabia; banking, consumer staple (food), industry for the United Arab Emirates; financial sector, consumer staple (food), industry for China; banking, consumer durables and construction sectors for India. Choice of the sectors are such that various sectors are represented in the sample such as the service sector by banking and finance sector, industry sector which may be affected by petrol price and the consumer staple which is an important sector for consumers. Sectors may vary slightly from country to another due to availability of data. The Brent crude oil is used as a proxy for crude oil price as it makes up over 60 percent of the global oil production and transactions (see Maghyereh, 2004; Filis et al, 2011; Arouri et al., 2011; Degniannkis et al., 2013; Ghosh and Kanjilal 2014). In addition, while Brent crude oil is the primary benchmark in Europe and Africa, West Texas Intermediate (WTI) is influential mainly in the US. Therefore, Brent crude oil is considered as an appropriate proxy for crude oil for the purpose of this thesis. To take cognizance of the impact of global economic factor, the VIX index is included in our estimation as a control variable and proxy for the global economic uncertainties.

Our choice of the emerging market countries is motivated by their growing energy needs in view of their demand for sustainable economic growth and development for the case of net oil importers being China and India. For instance, the evidence documented by Aloui et al. (2012) from the International Monetary Fund (IMF) statistics indicates that whereas the GDP of emerging market economies recorded 1.7% growth rate in 2009, that of developed economies fell on average to -3.6% during the same year. The evidence with respect to the projection of global GDP growth in 2050 shows that emerging market countries will account for 50% growth rates. This makes them significant drivers of global growth. Among the net oil exporting countries, Saudi Arabia and United Arab Emirates are selected for the sample based on their capacity of crude oil production. Both are important member countries of the Gulf Cooperation Council (GCC) and their crude oil export constitutes a significant share of their respective national GDP’s. Furthermore, Saudi

Arabia holds 16% of global petroleum proven reserve and is classified as number 1 largest exporter of petroleum constituting 45% of its GDP and 90% of its export earnings. It has a market value of publicly traded share of USD 373.4 billion as at 31/12/2012 (CIA World fact book, 2016). The United Arab Emirates hold 6% global crude oil proven reserve and ranked the 7th largest in the world. Crude oil accounts for 25% of its GDP and 45% of its export earnings. The UAE also has a market value of traded shares of USD 67.95 billion as at 31/12/2012 (WFB, 2016). Both of these countries have the largest and most liquid stock markets in terms of market capitalization and turnover ratio in the region (Demirer et al, 2015).

Furthermore, the crude oil proven reserve in China is estimated to be 24.6 billion barrels, an increase of 0.3 billion barrels from its 2014 levels. Yet, China was ranked as the largest net crude oil importer in 2014 overtaking the United States (See Energy Information Administration, 2015). The net crude oil import in China was estimated as 6.1million barrels per day in 2014 with a consumption growth rate of 43% of global crude oil consumption (EIA, 2015). China has an estimated market value of publicly traded shares of USD6.065 trillion as at 31/12/2014. The country is ranked as the 4th crude oil and petroleum consuming nation in the world in 2013 (EIA, 2015). In India, crude oil import demand grew from 42% in 1990 to about 71% in 2012. With a GDP growth rate of 7.3% in 2014, India market value of publicly traded shares was estimated as USD1.263 trillion as at 31/12/2014 (WBF, 2014). Table 1 gives an overview of the highlighted statistics in the selected countries.

Table 1: Some statistics on selected countries

	Saudi Arabia	**United Arab Emirate**	**China**	**India**
Number of Equity Listings (2015)	171	125	2827	5835
Market Value of Traded shares.	373.4 Billion*	67.95 Billion*	6.065 Trillion***	1.263Trillion*
Global Petroleum Proven Reserve (barrel/day, 2015)	268.3 Billion	97.8 Billion	24.65 Billion	5.675 Billion
Crude Oil Production (barrel/day, 2014)	9.735 Million	2.82 Million	4.189 Million	767,600
GDP by Sector Composition (2015)				
Industry	46.9%	49.4%	42.7%	29.5%
Agriculture	2.3%	0.7%	8.9%	16.1%
Services	50.8%	49.8%	48.4%	54.4%

Note: Data retrieved from CIA World fact book 2015. * denotes value in December 2012. ** denotes value in 2013. *** denotes value in 2014. Agricultural sector comprises of farming, fishing, and forestry. Industry comprises mining, manufacturing, energy production, and construction. Services include government activities, communications, transportation, finance, and all other private economic activities.

The VIX index is reported by the Chicago Board of Option Exchange (CBOE) as an indicator of the expectation of market volatility over the near future time—usually 30 days. It is employed to gauge the sentiments of investors about the implied market volatility of the Standard & Poor (S&P) 500 index option (Han et al., 2015). It is also known as the fear measure or index. In this thesis, it is adopted as a proxy for the global economic factor reflecting global uncertainties that affect stock markets.

3.1.1 Descriptive Statistics

The descriptive statistics on the data used are given in table 2. The weekly returns, on average, are mostly positive over the sample estimation period for both the Brent crude oil and for the majority of the selected sectors including the VIX index. The exceptions are banking/financial and industrial sectors in the case of Saudi Arabia for which, however, the magnitudes are small, as well as the consumer durable sector in India. The periods of positive returns in the crude oil prices may be interpreted to arise because of the periods of growth and significant strong demand in the emerging market economies, notably, China and India. According to the World Bank (2011) Financial Assessment Review, the over dependence on crude oil and the dynamic risky environment in Saudi Arabia financial system might be leading to negative mean returns in two sectors in this country. The negative returns in consumer durable sector in India can be attributed to the less penetration in the rural markets in the country affecting the overall growth of the sector (IBEF, 2017).

In the sample, the maximum returns are recorded in the UAE banking (70.4258) and food (49.8877) sectors. Generally, the average volatility across the sample is positive and significant. The sample average volatility is 4.85—volatility is relatively low for the Saudi Arabia sector returns relative to the sample average. Specifically, with standard deviation of 6.0341 for China's financial sector and 6.3479 for India's construction sector — these sectors exhibit the highest volatility in the sample whereas Saudi Arabia agriculture and food sectors has the lowest volatility of 3.7467. From the table, it can also be observed that the entire sector return series are leptokurtic with large kurtosis coefficient. This means that the sample return distributions display thick tails relative to normal distribution. Similarly, for all the sector return series considered, the Jarque-Bera statistics is statically significant at 1% level of significance leading to the rejection of the null hypothesis of normality for the stock returns as expected for any financial time series.

The Engle test for the presence of ARCH effects is significant for the return series leading to the rejection of the null hypothesis of no ARCH effects in the distributions. More so, the Lung-Box portmanteau Q^2 for the squared return series reveals the presence of serial correlations in the sample.

Table 2: Descriptive statistics on return series

Panel A			**Saudi Arabia**			**United Arab Emirates**		
Statistics	Crude Oil Price	VIX Index	Banking/ Financial	Agric& Food	Industry	Banking	Food	Industry
Mean	0.018	0.027	-0.097	0.083	-0.002	0.187	0.095	0.065
Maximum	21.768	68.723	18.796	12.496	16.899	70.426	49.888	23.237
Minimum	-22.564	-42.765	-19.500	-21.773	-24.003	-63.290	-44.877	-20.258
Std. dev.	4.770	12.459	3.823	3.747	4.168	5.118	4.955	4.200
Skewness	-0.113	0.605	-0.076	-1.234	-1.543	0.744	0.449	0.434
Kurtosis	5.073	6.166	8.449	9.726	10.608	93.846	29.684	8.926
JB	117.239	309.645	534.928	924.008	1213.246	222545.5	19216.44	967.125
JB (Prob)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ARCH Test	15.204 [0.000]	1.779 [0.061]	13.725 [0.000]	5.612 [0.000]	3.686 [0.000]	36.031 [0.000]	24.119 [0.000]	6.666 [0.000]
Q statistics	29.491 [0.079]	43.012 [0.000]	22.158 [0.332]	32.164 [0.042]	21.585 [0.364]	67.546 [0.000]	59.426 [0.000]	37.674 [0.010]
Q^2statitics	422.390 [0.000]	18.388 [0.049]	110.199 [0.000]	87.738 [0.000]	53.79 [0.000]	151.734 [0.000]	140.299 [0.000]	102.336 [0.000]
Observation	649	649	433	433	433	649	649	649

Panel B.	**China**			**India**		
Statistics	Financial	Food	Industry	Banking	Consumer durable	Constructi on
Mean	0.229	0.306	0.196	0.322	-0.116	0.201
Max	21.696	13.391	14.968	29.420	40.882	39.083
Min	-32.611	-23.880	-28.446	-17.435	-31.068	-22.139
Std. dev.	6.034	4.286	5.033	4.814	5.724	6.348
Skewness	-0.171	-0.740	-0.767	0.263	0.458	0.025
Kurtosis	5.363	6.876	6.171	6.559	9.653	6.141
Jarque-Bera	137.070	413.812	298.328	348.792	1215.757	266.031
P-value	0.000	0.000	0.000	0.000	0.000	0.000
ARCH Test	2.368 [0.010]	10.810 [0.000]	10.923 [0.000]	3.858 [0.000]	9.016 [0.000]	6.430 [0.000]
Q(20)	25.320 [0.190]	54.955 [0.000]	45.566 [0.001]	41.151 [0.004]	36.687 [0.013]	36.389 [0.014]
Q^2 (20)	56.439 [0.000]	166.729 [0.000]	193.964 [0.000]	168.528 [0.000]	187.723 [0.000]	131.923 [0.000]
Observation	**578**	**578**	**578**	**578**	**578**	**578**

Note: [ ] are *p*-value; Q and Q^2 are Ljung-Box Q statistics at alternative lags which follow χ^2 distribution with degree of freedom depending on the lag length. ARCH Test is reported for ARCH lags (1-10).

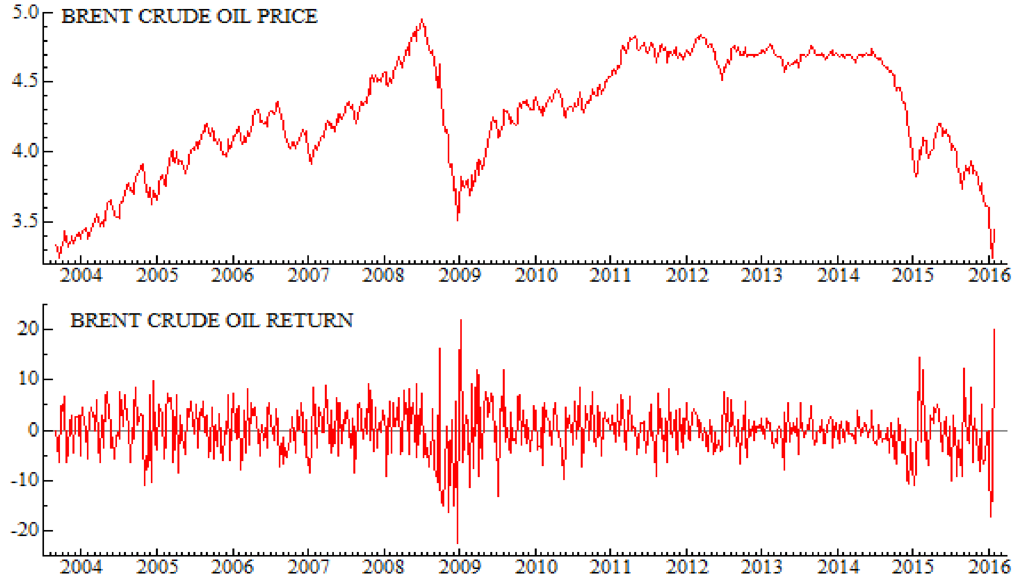


Figure 1: The Brent crude oil price series and returns

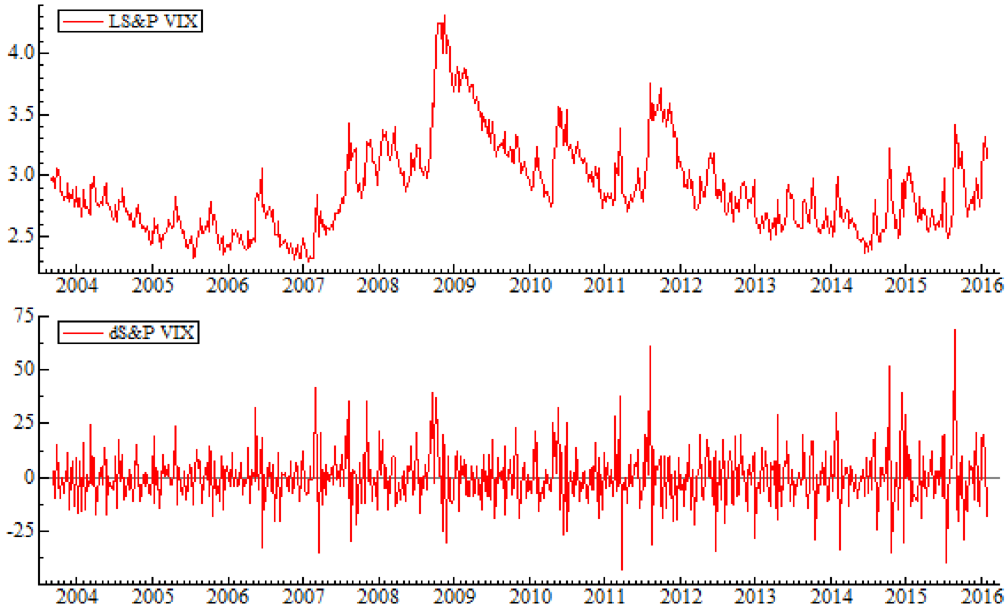
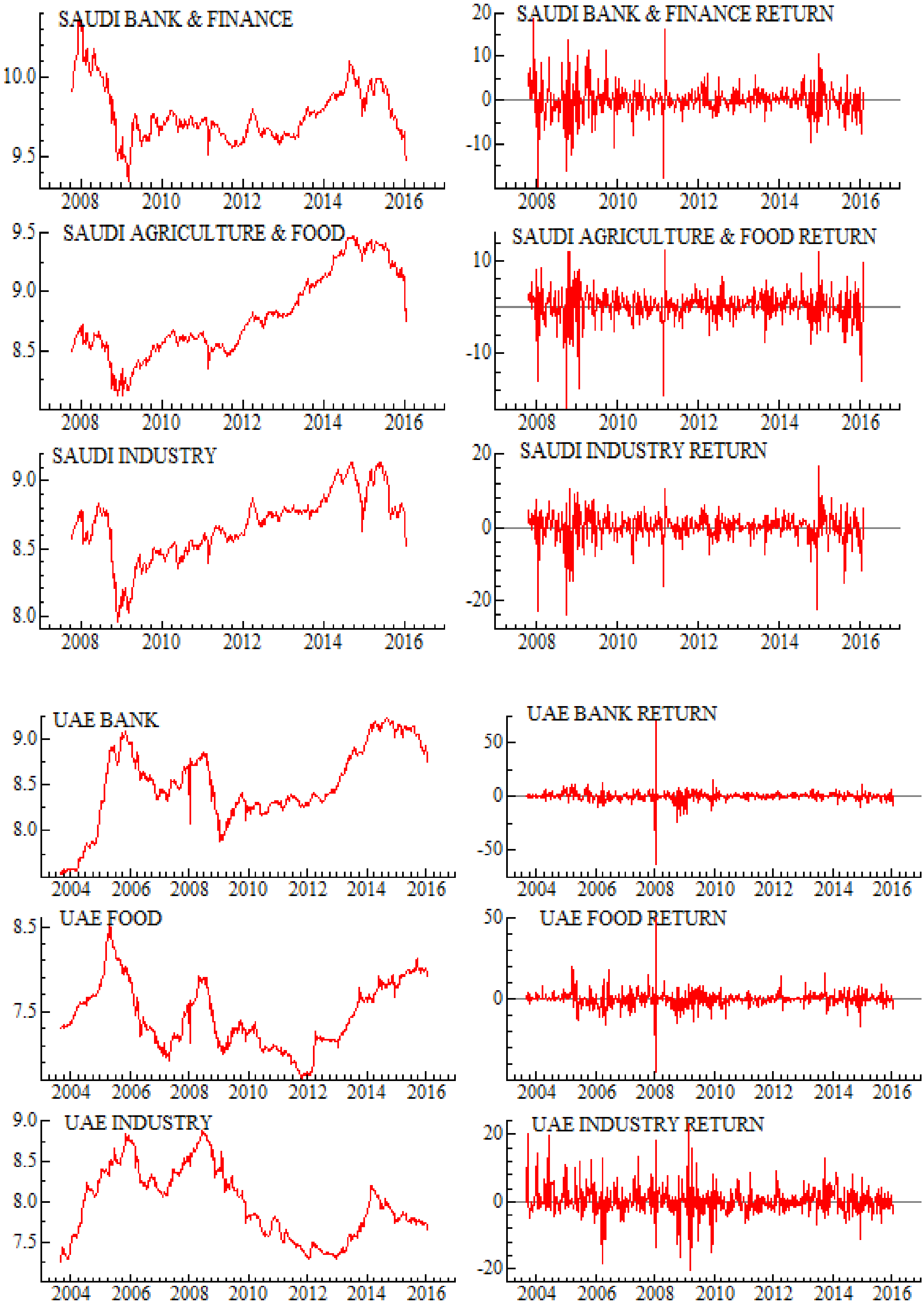


Figure 2: Graph of the VIX Index and changes in VIX Index

Figure 1 presents the graphs of the logarithmic Brent crude oil price series on top panel and the oil price returns on the lower panel while Figure 2 gives the graph of the VIX index logarithmic series and returns. Hence, in Figure 1, falling crude oil prices associated with high volatility clustering in return series is observed very clearly around 2009 which was the period of the Global financial crisis and at the end of the sample period representing the recession in the globe that may be due to the political events in the Middle East, repercussions of the sovereign debt crisis in the European area and the US and the European sanction against Russia which can be considered as exogenous events in the sample period. In Figure 2, the VIX index mostly increases significantly in cases where volatility is very high as observed around 2009 during the global financial crisis in the graph. Figure 3 below gives the weekly sector stock indices and returns for the sample countries**.**


SAUDI BANK & FINANCE
10.0
9.5
2008
2010
2012
2014
2016
SAUDI BANK & FINANCE RETURN
20
10
0
-10
SAUDI AGRICULTURE & FOOD
9.5
9.0
8.5
SAUDI AGRICULTURE & FOOD RETURN
10
-10
SAUDI INDUSTRY
9.0
8.5
8.0
SAUDI INDUSTRY RETURN
20
0
-20
UAE BANK
9.0
8.5
8.0
2004
2006
2008
2010
2012
2014
2016
UAE BANK RETURN
50
0
-50
UAE FOOD
8.5
7.5
UAE FOOD RETURN
50
0
UAE INDUSTRY
9.0
8.5
8.0
7.5
UAE INDUSTRY RETURN
20
0
-20

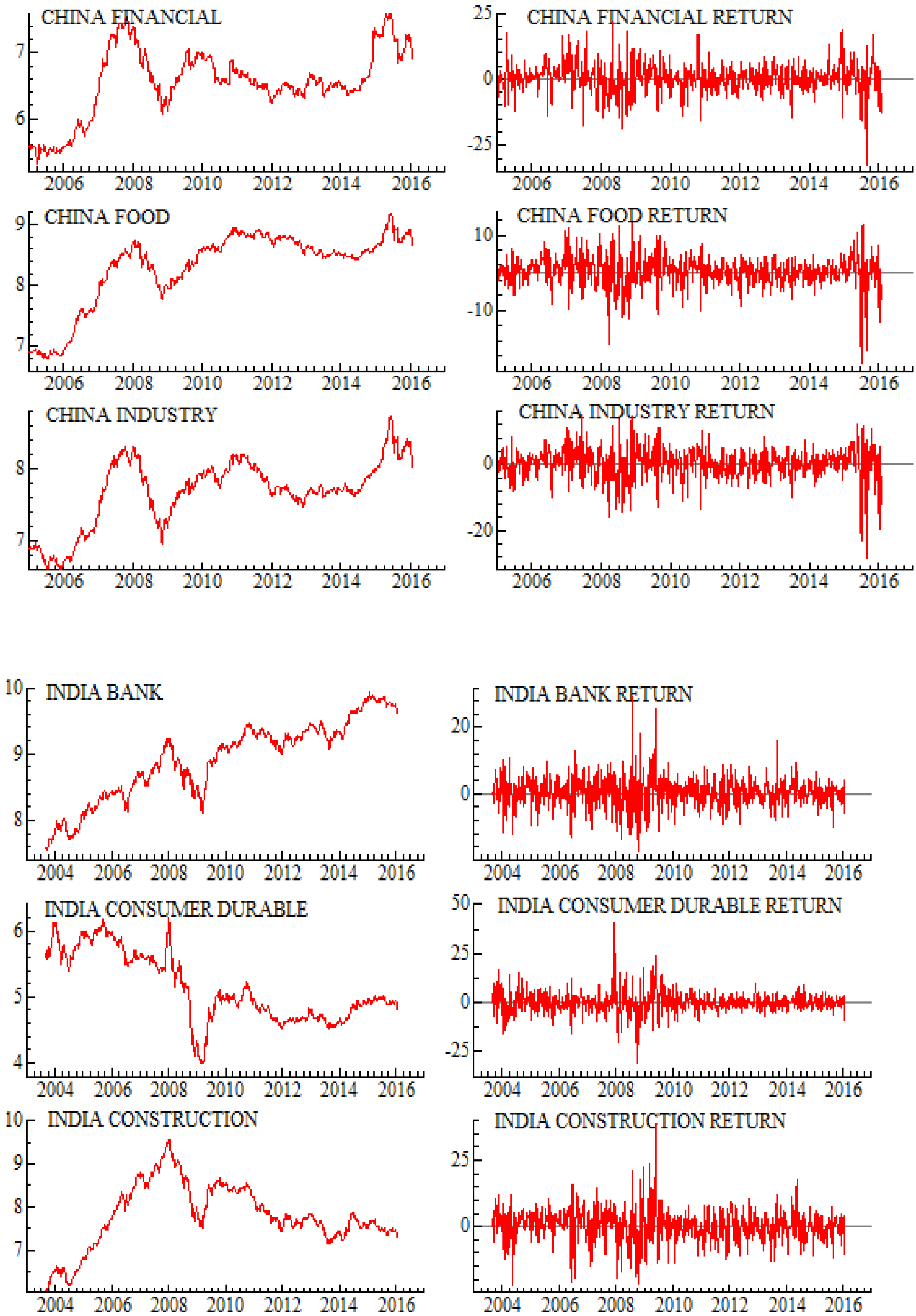


Figure 3: Weekly sector stock indices and returns for Saudi Arabia; the United Arab Emirates; China and India.

Looking at the top panel for the movements of the crude oil prices over the sample period of September 2003 and January 2016, the figure depicts important troughs and peaks during specific dates. The Brent crude oil was affected by two significant events in 2003: these are the war in Iraq and the decision to cut crude oil production quota by the Organization of crude oil producing countries (Pfanner, 2003).

Afterwards, the Brent crude oil price rose steadily reaching a peak in 2008 just before the global financial crisis became severe. The trough observed in this interim was in 2007 when the Brent crude oil fell by about 40% and in 2009 it declined in excess of 70% relative to its peak level in 2008 (Filis et al, 2011). Thus from mid-2004 to 2008, the Brent crude oil price rose steadily reaching its peak level of about USD146 per barrel. From the mid-2008 to 2009, the oil price decreased rapidly to a trough of USD40 per barrel before adjusting to USD60 in 2010. From the mid-2010 to 2014, the Brent crude oil price gradually increased and stayed relatively more consistent at this high level, around USD120 although price showed some volatility in response to the dynamic global situations. From the mid-2014 to early January 2016, the Brent crude oil fell significantly from a relatively stable peak of over a USD100 per Barrel to under USD40. The fall in crude oil price according to the research department of the World Bank group is attributed to the increased production of unconventional energy, weakening of global demand, geopolitical tensions, the appreciation of the US dollar and the shift in OPEC energy policy (see Baffes et al. 2015).

Figure 2 presents the sector stock price and the return series for each country. The graph of the respective returns series corroborates the explanations from the sample descriptive statistical analysis showing volatility clustering during certain periods of distress in the financial markets. The price series, on the other hand, all indicate sharp falls during 2008-2009 and at the end of the sample period similar to the behavior of the Brent crude oil price.

3.2 Methodology

Literature suggests crude oil price shocks affect economic activity nonlinearly. In addition, the Markov regime-switching methology is adequate in cases when shocks are mainly driven by exogeneous events such as the global financial crisis in 2007-2008, European sovereign debt crisis as from 2009, the US and European sanction against Russia in 2014. Such dynamic occurences may lead to volatility clustering. In the literature, the financial markets are characterized by volatility clustering, unconditional distribution leptokurtosis which are known to be well captured by the Generalized Autoregressive Conditional Heteroskedastic (ARCH/GARCH) volatility models (Engle, 1982 and Bollerslev, 1986). This class of models is the most basic and robust of the volatility specification models and highly successful in modeling volatility (see Hassan and Malik, 2007; Narayan and Narayan, 2007; Agnolucci, 2009; Kang et al., 2009; Oberndorfer, 2009; Choi and Hammoudeh , 2010 and Arouri et al., 2011)[10]. The GARCH model requires the conditional variance of returns to be expressed as a function of lagged market shocks and of its own previous lags. Consider a GARCH (p, q) model with conditional mean and conditional variance equations simply specified as

$$r_t = \varphi_0 + \varphi_1 r_{t-1} + u_t \quad \text{where } u_t = \sqrt{h_t z_t}$$

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i {u_{t-1}}^2 + \sum_{i=1}^{p} \beta_i h_{t-1} \tag{1}$$

where $z_t \sim NID(0,1)$

[10] They all noted that the GARCH class of models has elucidated much interest in financial volatility modeling amongst researchers in general.

where the first equation represents the conditional mean equation and r_t is the stock returns calculated as the first difference of the logarithmic stock price index multiplied by 100, and the second equation is the conditional variance equation with α_i and β_i being the ARCH and GARCH coefficients respectively. The condition necessary to achieve stationarity in a GARCH model requires that the estimated coefficients of the model— α_i and β_i are both positive and their sum is less than one. This allows the model to be mean-reverting and conditionally heteroskedastic.

However, in GARCH models, there often arises a drawback that is not uncommon to observe that $\alpha_i + \beta_i > 1$, in which case the conditional variance process is not weakly stationary, and thus explosive (Bollerslev, 1986). For instance, among others some authors who reported $\alpha_i + \beta_i > 1$ are Engle, Ng and Rothschild (1990), Kees et al. (1994) and Hong (1988). Nevertheless, the closer the sum of $\alpha_i + \beta_i = 1$, the stronger is the persistence in volatility. According to Lamoureux and Lastraped (1990) structural changes in the unconditional variance may be the reason leading to high persistence in volatility as a result of misspecification of the GARCH process. As explained in Gray (1996) this implies that regime shifts are missed and instead thought to be volatility clustering. In other words, volatility clustering suggests that conditional volatility is changing over time. In this regard, to incorporate any possible regime changes into the analysis of the relationship between stock returns and crude oil prices, the thesis employs Markov-switching models originally introduced by Hamilton (1989), Hamilton (1990). Employment of the Markov-switching dynamic regression (MS-DR) model will allow for switching regimes in both the intercept and the standard deviation parameters of the estimated model. Markov-switching heteroscedasticity model which will incorporate the GARCH effects will also be estimated for which the details of the models will be explained in the next section.

3.2.1 MS-DR Model with Fixed Transition Probabilities

Since Lamoureux and Lastrapes (1990) proved that persistence in volatility may be spurious and may actually be due to the presence of structural breaks in the data, a simple Markov-switching model may be able to deal with volatility clustering. In this respect, the MS-DR model is able to capture any such dynamic phenomenon in general in which the specification in each regime is linear but the mean and or the variance are allowed to depend on different regimes. Hamilton (1989) is credited in his famous research on recession and expansion of the business cycle for popularizing the model. The motivation for the regime switching model is its ability to capture non-linear patterns in economic variables based on linear specifications but the resulting time-series model is linear. This makes the model tractable and analytically appealing (Ang and Liu 2007; Ang and Timmermann, 2011; Rossi and Timmermann, 2011). Thus, the basic simple model can be specified as follows;

$$r_{st} = \varphi_{st} + u_{st}$$

$$u_{st}|\Omega_{t-1} \sim N(0, h_{st}) \qquad s = 0{,}1 \text{ states} \tag{2}$$

where r_{st} is the return of an asset and θ_{st} and h_{st} are the conditional mean and conditional variance respectively which are regime (state) dependent. The simple MS-DR model allows to add explanatory variables which also may be regime dependent. In this way oil price and VIX index are included into the model as follows;

$$r_t = \varphi_{st} + \sum_{m=1}^{q} \delta_{st}\, r_{t-m}{}^{oil} + \sum_{n=1}^{p} \omega_{st}\, VIX_{t-n}{}^{Gf} + u_t \tag{3}$$

where $u_t \approx i.i.d\; N(0, h_{st})$.

where the coefficients δ_{st} and ω_{st} gives the dynamic effect of Brent crude oil price movements and the global factor (VIX index) on the respective sector stock returns r_t. s_t is the dynamic regime dummy with 0 denoting the stable regime and 1 recession regime.

The model is specified following Hamilton (1989) original specification. This comprised of the unobserved state dependent variable (s_t) that follows a first order Markov process to describe the regime transitions as specified below;

$$\begin{aligned} p(s_t = 0 \mid s_{t-1} = 0) &= \gamma^{00} \\ p(s_t = 0 \mid s_{t-1} = 1) &= 1 - \gamma^{11} \\ p(s_t = 1 \mid s_{t-1} = 0) &= 1 - \gamma^{00} \\ p(s_t = 1 \mid s_{t-1} = 1) &= \gamma^{11} \end{aligned} \tag{4}$$

where the $p(s_t = i|s_{t-1} = i) = \gamma^{ii}$ for $i = 0,1$ is the probability that the economy switches at time $t - 1$ to t. According to Hamilton (1994), for the m regime case, the transition probability is generalized as;

$$p = \begin{bmatrix} \gamma^{11} & \gamma^{12} & \cdots & \gamma^{1m} \\ \gamma^{21} & \gamma^{21} & \cdots & \gamma^{2m} \\ \vdots & \vdots & \cdots & \vdots \\ \gamma^{m1} & \gamma^{m1} & \cdots & \gamma^{mm} \end{bmatrix} \tag{5}$$

the transition probability from a regime i to a regime j is given by γ^{ij}. Since the economic variable to be estimated must be in one regime at a time, it is the case that $\sum_{j=1}^{m} \gamma^{ij} = 1 \forall i$. Furthermore, the regime expected duration $(E(D))$ is computed as $E(D) = \frac{1}{1-\gamma^{i}}$. Following the original Hamilton (1989) specification, the constant transition probabilities are assumed to be governed by a logistic function of the form;

$$\gamma^{00} = \frac{exp(\varphi_0)}{1+exp(\varphi_0)} \text{ and } \gamma^{11} = \frac{exp(\theta_0)}{1+exp(\theta_0)} \tag{6}$$

where $\varphi_0$and θ_0 are the parameters of the model to the estimated, respectively.

3.2.2 MS-DR Model with Time-varying Transition Probabilities

Given the nature of the recursive system in the Markov-switching process, the extension from a fixed transition probability to a time–varying transition probability is relatively straight forward (see Filardo, 1994; Diebold et al., 1994; Gary, 1996). Relaxing the assumption of fixed transition probabilities, will allow checking whether the state transition probabilities vary as a function of crude oil price and the VIX index changes. In other words, one examine whether the oil prices and the global factors affect the regime switching? In this case, the transition probabilities can be specified as follows,

$$\gamma_t{}^{00} = \frac{\exp\{\varphi_0+\delta_0 r_{t-1}{}^{oil}+\omega_0 VIX_{t-1}{}^{gf}\}}{1+\exp\{\varphi_0+\delta_0 r_{t-1}{}^{oil}+\omega_0 VIX_{t-1}{}^{gf}\}}, \text{ and } \gamma_t{}^{11} = \frac{\exp\{\varphi_1+\delta_1 r_{t-1}{}^{oil}+\omega_1 VIX_{t-1}{}^{gf}\}}{1+\exp\{\varphi_1+\delta_1 r_{t-1}{}^{oil}+\omega_1 VIX_{t-1}{}^{gf}\}}. \quad (7)$$

where $r_{t-1}{}^{oil}$ and $VIX_{t-1}{}^{gf}$ is the crude oil returns and the dynamic global economic factor parameters. Thus, the impact of the crude oil price and the global factor on the regime transition probabilities is determined by the significant values of the parameters δ_0 and δ_1 in addition to φ_0 and φ_1 respectively. For instance, the sector returns are likely to stay in regime (0) when the estimated coefficient of δ_0 is positive and the crude oil price is rising, whereas they are most likely to move to regime (1) when the estimated coefficient of δ_0 is significant and negative with rising crude oil prices. The opposite holds for δ_1. Hence, in the absence of crude oil impact on regime volatilities, the parameters φ_0 and φ_1 give the regime transition probabilities.

3.2.3 MS-GARCH Model

In estimating a simple Markov-switching model, it is possible to incorporate GARCH effects into the model. Regime switching GARCH models are developed by Hamilton and Susmel (1994), Cai (1994) and Gray (1996) where the conditional volatility process is also allowed to switch across regimes. Gray (1996) extended the

Markov-switching model with ARCH effects introduced by Hamilton and Susmel (1994) and Cai (1994) by introducing a new algorithm to solve for the path-dependence problem during the estimation process of the model with GARCH effects. Again, the transition probabilities may be fixed within each regime or may be time-varying. Considering the standard GARCH model specified in equation (1) the exogenous variables of Brent oil price and VIX index changes are included into the model.

3.2.4 Estimation of the Markov-Switching Models

The most widely used econometric method in the estimation of the regime switching models is the maximum likelihood (ML) estimation method. The log-likelihood is a function of the parameters as well as the transition probabilities where the probabilities are constrained to fall between 0 and 1 and sum to unity. The likelihood value for an observation can be written as a weighted average of the likelihood using the regime probabilities as weights. There are alternative approaches for optimization of the log-likelihood in the literature. Literature suggests the expectation–maximization (EM) algorithm by Hamilton (1988; 1989) and Gray (1996). Others include nonlinear programming using the sequential quadratic programming approach (SQP), unconstraint optimization where parameter transformations are used to avoid the constraints due to Hamilton (1990) and the filtering procedure and the Kim (1994) smoothing algorithm with the Broyden–Fletcher–Goldfarb–Shanno (BFGS). This thesis used the BFGS algorithm.

3.2.5 Asymmetric Specification

To capture the asymmetric impact of crude oil price movements on the sector returns, the Mork (1989) specification is adopted. This allows for asymmetric effect in the crude oil price so as to derive the impacts of positive and negative price shocks on stock returns. Thus, the crude oil price is modeled as follows;

$$\mathrm{POP_t}^{+} = \mathrm{Max}\ 0, (\log \mathrm{oil}p_t - \log \mathrm{oilp}_{t-1}) \tag{8}$$

$$\mathrm{NOP_t}^{-} = \mathrm{Min}\ 0, (\log \mathrm{oilp}_t - \log \mathrm{oilp}_{t-1}) \tag{9}$$

In this specification, $\log \mathrm{oilp}$ gives the nominal crude oil price in time t, $\mathrm{POP_t}^{+}$ gives the crude oil price increases and $\mathrm{NOP_t}^{-}$ gives the crude oil decreases.

Chapter 4

ESTIMATIONS AND ANALYSIS OF RESULTS

Emerging market countries have been important drivers of global economic growth. Evidence in literature suggests that the emerging markets generally out performed their counterparts in the developed market during the global financial crisis (Arouri et al., 2011). Although, Saudi Arabia and the United Arab Emirates are determined to successfully diversify their economies from primary commodity, they remain significant producer and exporter of crude oil to the global energy market. In 2015, the Gross Domestic Product (GDP) of Saudi Arabia was USD 672 billion with an annual growth rate of 3.5%. In the United Arab Emirates (UAE), the Gross Domestic Product (GDP) was USD 360 billion in 2014 with an annual growth rate of 4.6%.

China and India are two significant crude oil importers in the emerging markets. China transformed to market oriented economy from a closed central command economy. In 2015, it surpassed the United States as the largest economy (CIA, World Book Fact, 2016). China recorded a GDP of USD 8,897 billion with a growth rate of 6.9% per annum in 2015. In India, the government liberalization policy in 1991 helped opened the Indian economy to significant foreign investment and market oriented reforms. In 2014, the GDP in India was USD 2,200 billion with a GDP growth rate of 7.2%. Thus, in 2014 the Indian economy ranked third largest measured on the basis of purchasing power parity (FocusEconomics, 2016).

With the drop in crude oil price since 2014, economic contraction and the fiscal deficit in Saudi Arabia widened with government cutting back its public expenditure and halting investment project. In UAE, the economy is however faired moderately well compared to Saudi Arabia in view of its successful energy diversification policy reducing dependency on crude oil. Overall, we expect the slump in crude oil price to affects the crude oil exporting countries relatively negative.

Furthermore, although weak global demand affects China, the Chinese economy nonetheless recorded a GDP of 6.7% in 2016 first quarters. China economy is facing a slowing down of private consumption and external demands (see FocusEconomics, 2016). In India, the domestic demand and private consumption remains significantly strong expanding at a rapid fast pace compared to China. Even more so, the performance of the external sector activities in India is growing. The economic profile of the selected emerging market countries is presented in Table 3 in view of the analysis above.

Table 3: Economic profile of the selected countries

Panel A						
Saudi Arabia						
Year	GDP (USD bn)	GDP Growth Rate (%)	Net Oil Export Revenues (USD bn)	Export (%GDP)	Import (%GDP)	Market Cap (%)
2003	347	7.66	-	46.12	24.12	-
2004	379	9.25	-	50.99	24.10	-
2005	407	7.26	171.1	57.05	24.90	-
2006	429	5.58	194.3	59.83	30.11	-
2007	455	5.99	203.8	59.94	34.93	-
2008	493	8.43	287.9	62.11	33.99	-
2009	502	1.83	159.5	47.09	37.77	74.28
2010	526	4.76	211.5	49.70	33.07	67.08
2011	579	9.96	296.3	56.19	29.57	50.62
2012	610	5.38	306.8	54.42	29.32	50.87
2013	636	2.67	283.8	52.08	30.89	62.79
2014	659	3.64	246.8	47.03	33.88	64.09
2015	672	3.49	130.1	33.75	38.78	65.18
Panel B						
United Arab Emirates						

2003	221	8.80	-	55.92	46.38	20.38
2004	242	9.57	-	63.57	53.05	37.54
2005	263	4.86	29.6	67.59	51.97	67.90
2006	288	9.84	36	68.63	50.85	31.99
2007	287	3.18	38.2	72.38	64.41	48.93
2008	297	3.19	51.4	78.87	69.65	34.03
2009	281	-5.24	29.8	79.65	73.81	54.52
2010	286	1.64	36.7	78.75	72.25	45.97
2011	310	5.21	57.1	90.33	72.29	26.89
2012	331	6.89	60.6	100.63	75.33	27.13
2013	345	4.32	58.2	101.34	76.82	46.57
2014	360	4.57	53.1	97.96	77.92	50.47
2015	362	3.18	28.5			52.90

Panel C						
China						
Year	GDP (USD bn)	GDP Growth Rate (%)	Petroleum Consumption (000’ bbl.)	Export (%GDP)	Import (%GDP)	Market Cap (%)
2003	2,890	10.02	5578.111	26.57	25.04	31.09
2004	3,281	10.08	6437.484	30.55	28.89	23.06
2005	3,642	11.35	6795.444	33.70	29.20	17.71
2006	3,992	12.69	7263.328	35.65	29.12	41.96
2007	4,559	14.19	7479.921	34.93	27.35	127.13
2008	5,001	9.62	7697.132	31.70	25.11	39.02
2009	5,459	9.23	8069.821	23.73	19.85	70.62
2010	6,039	10.63	8938.357	26.53	22.85	66.69
2011	6,612	9.48	9504.048	26.78	24.36	45.54
2012	7,224	7.75	10175.14	25.71	22.97	43.70
2013	7,672	7.68	10480	24.81	22.33	41.61
2014	8,230	7.27	-	23.92	21.17	58.01
2015	8,897	6.90	-	22.37	18.83	75.35
Panel D						
India						
2003	982	7.86	2426.328	14.69	15.37	45.13
2004	1,060	7.92	2571.551	17.55	19.31	53.75
2005	1,258	9.28	2550.25	19.28	22.03	66.30
2006	1,365	9.26	2701.63	21.07	24.23	86.28
2007	1,474	8.61	2888.055	20.43	24.23	146.86
2008	1,428	3.89	2957.302	23.60	28.67	52.87
2009	1,549	8.48	3067.781	20.05	25.43	95.69
2010	1,708	10.26	3305.45	21.97	26.34	95.51
2011	1,921	6.64	3460.983	24.54	31.08	55.47
2012	1,924	5.62	3617.852	24.52	31.24	69.23
2013	2,151	6.64	3660	25.32	28.30	61.12
2014	2,200	7.24	-	22.91	25.89	76.30
2015	2,367	7.57	-			73.12

Source: World Databank- World Development Indicators and Energy Information Administration: International energy statistics. Market capitalization of listed domestic companies (% of GDP).

The economic profile presented in Table 3 panels A–D confirms the significance of the selected countries as important crude oil exporter and importers, respectively. In panel A–B, it can be seen that Saudi Arabia enjoyed a steady increase in its Gross

Domestic Product (GDP) over the period of 2003 to 2014 as crude oil price rose steadily. The same is the case for the UAE. The only exception was in 2009 during the global financial crisis having negative impact on growth in the UAE. Thus, the net crude oil export revenues and exports in general were positive for the crude oil exporters with positive trade balances especially in Saudi Arabia over the sample period.

The net crude oil revenue however fell in 2015 for the crude oil exporters as crude oil price decline to an unprecedented level. Relative to the UAE, Saudi Arabia has the largest and most liquid stock market in the Gulf region with a market capitalization of over USD 421 million in 2015 about 65% of its GDP. Whereas, the UAE stock exchange has 125 listed domestics companies as at 2015, the Saudi stock exchange has 171 (see WDI, 2016).

Panel C–D gives the economic outlook of the crude oil importers. China and India have significant growth rate over the sample period with high volume of crude oil consumption in both countries. This justifies their classification as significant crude oil consuming nations and importers. Thus in panel D, the average GDP growth rate in China over the period of 2003 to 2015 was 11.5 percent while the average petroleum consumption was 7420.30 billion barrels per day over the period of 2003 to 2013. According to the CNBC (2016) oil and gas reports, China oil demand increased by about 4.3 percent in 2016 reaching 11million barrels per day while the net crude oil import rose by 7.3 percent to reach 7.14 million barrels daily.

China also has the largest stock exchange and market capitalization in our data set with over 2,827 domestic companies listed on its exchange. In panel D, relative to

China, India import demand expressed as percentage of the country's GDP exceeds the country's export with a resulting negative trade balance for the country. This is attributed to the growth in the petroleum demand in India widening the trade deficit gap. Thus in panel D, with an average growth rate of about 6.92 percent, the average petroleum consumption in India is 2773.23 billion barrels daily expected to increase even much more with the fall in the global crude oil price. Finally in 2015, the market capitalization of traded share in Indian reached about 73% of its GDP typifying the maturity of the Indian stock market.

4.1 Single-Regime GARCH Model

Beginning with a single regime GARCH model for all the selected countries in the data set, the estimated results of the GARCH (1, 1) model for the sector returns in almost all cases show that the sum of the GARCH terms ($\alpha + \beta$) is very close to one indicating very high persistency of volatility in the model. In some cases, the sum ($\alpha + \beta$) is not less than one, resulting in non-stationarity in variance indicating that the model is unstable and explosive. Even more so, the single regime model for the majority of the sectors studied reveal the presence of correlation in both the standardized residuals (Q statistics) and standardized squared residuals (Q^2 statistics). This suggests the need to check for more than one regime. Thus, the correlations in the standardized residuals confirm that the single regime GARCH model is inadequate. The results of the single regime GARCH models are presented in the appendix section of this thesis.

4.2 MS-DR Model with Fixed Transition Probability Estimates and the MS-GARCH Estimates

To check for more than one regime, we first estimate a two regime Markov switching dynamic regression model (MS-DR) with fixed transition probabilities. This is adopted as the baseline model for the current thesis. Thus, from the estimation of the two regime Markov dynamic regression models, it is observed that the sector returns are mostly positive and significant across the sample in regime (0), whereas for regime (1), it is mostly negative. Hence, it is noted that returns differ in the specified regimes. Furthermore, volatility pattern also differ across the regimes. Specifically, in regime (1) volatility is found to be more than 3 times higher than regime (0) confirming the presence of two significant dynamic regimes. These are namely–the stable regime which coincides with regime (0) with positive returns and low volatility; and a recession regime coinciding with regime (1) with negative returns and high volatility. This observed pattern is a confirmation of the presence of two distinct regimes in the estimated models. The estimated models also included the oil price changes as well as the global factor variable proxy with the VIX index into the switching models with switching regime parameters. The two regime Markov switching dynamic regression models improve the estimated results in general. For the p-value of the linearity likelihood ratio (LR) test, Davies (1987) upper bound is reported which rejected linearity in all cases. However, in some cases such as the sectors of UAE, the Q and Q^2 statistics indicated significant correlations. Yet, in general, crude oil price changes exerted significant positive impact on most sector returns including both the oil exporters and importers. Furthermore, the smoothed transition probabilities produced have been able to well capture the regime changes as presented in Figure 4. However, the significant correlations in standardized residuals indicate the need for improvement of the estimates. In this respect, the MS-GARCH models have also been estimated for the countries where significant correlations have been observed. Thus, the estimation results of the two-regimes MS-DR are presented in Table 4, panel A–B where appropriate. The MS-GARCH estimates are presented in Appendix D of the Appendices section. As observed from the table, the estimated ARCH and GARCH coefficients (a_1 and β_1) are negligibly small although significant. In this respect, the MS-DR model is considered as the baseline model of the study.

Table 4: MS-DR estimates with fixed transition probabilities

Panel A.	**Saudi Arabia**			**United Arab Emirates**		
Sectors	**Banking & Financial**	**Agric & Food**	**Industry**	**Banking**	**Food**	**Industry**
Models	MS-DR	MS-DR	MS-DR	MS-DR	MS-DR	MS-DR
Constant regime switching						
φ_0	-0.023 (0.119)	0.394*** (0.136)	0.399*** (0.139)	0.211** (0.107)	0.189* (0.111)	1.385** (0.676)
φ_1	-0.082 (0.531)	-0.818 (0.735)	-1.339 (0.961)	0.066 (1.740)	-0.062 (0.510)	-0.328*** (0.125)
Crude oil movement						
δ_0	0.149*** (0.036)	0.086** (0.036)	0.182*** (0.042)	0.103*** (0.027)	0.082*** (0.027)	0.163 (0.136)
δ_1	0.151* (0.084)	0.121 (0.098)	0.169 (0.120)	0.038 (0.230)	0.097 (0.093)	0.020 (0.025)
Global economic factor						
ω_0	-0.022** (0.018)	-0.037*** (0.011)	-0.048*** (0.012)	-0.023*** (0.008)	0.001 (0.010)	-0.053 (0.051)
ω_1	-0.078** (0.037)	-0.121** (0.048)	-0.123** (0.055)	-0.165 (0.139)	-0.014 (0.042)	-0.031** (0.010)
Regime switching volatility						
$\sqrt{h_0}$	1.795*** (0.138)	2.196*** (0.118)	2.290*** (0.127)	2.389*** (0.092)	1.897*** (0.123)	2.156*** (0.151)
$\sqrt{h_1}$	5.934*** (0.470)	6.398*** (0.707)	7.238*** (0.780)	13.886*** (1.467)	7.726*** (0.475)	7.479*** (0.671)
Regime probabilities (%)						
γ^{00}	0.951	0.975	0.960	0.981	0.921	0.654
γ^{11}	0.889	0.908	0.830	0.836	0.865	0.895
Model diagnosis						
log-likelihood	-1074.813	-1074.843	-1105.556	-1653.910	-1766.319	-1709.154
Linearity LR-test	194.20*** [0.000]	168.56*** [0.000]	178.14*** [0.000]	626.74*** [0.000]	368.02*** [0.000]	262.22 [0.000]
$Q20$	14.854 [0.785]	26.251 [0.158]	23.481 [0.266]	15.487 [0.748]	55.847*** [0.000]	25.715 [0.175]

Panel B.	**China**			**India**		
Sectors	**Financial**	**Food**	**Industry**	**Banking**	**Consumer durable**	**Constructio n**
Models	MS-DR	MS-DR	MS-DR	MS-DR	MS-DR	MS-DR
Constant Regime Switching						
φ_0	0.223 (0.232)	0.333** (0.165)	0.370* (0.200)	0.491*** (0.166)	-0.032 (0.165)	0.526** (0.223)
φ_1	0.223	0.396	-0.348	-0.274	-0.405	-1.266

	(0.568)	(0.499)	(0.820)	(0.629)	(0.635)	(0.899)
Crude oil movement						
δ_0	0.155* (0.073)	0.074** (0.039)	0.158*** (0.047)	0.097** (0.041)	0.016 (0.041)	0.181*** (0.053)
δ_1	-0.080 (0.101)	0.009 (0.085)	-0.155 (0.145)	0.020 (0.100)	0.226 (0.110)	-0.052 (0.133)
Global economic factor						
ω_0	-0.056 (0.022)	-0.023* (0.013)	-0.029* (0.017)	-0.056*** (0.014)	-0.036*** (0.013)	-0.053*** (0.018)
ω_1	-0.137** (0.044)	-0.175 (0.042)	-0.231*** (0.065)	-0.268*** (0.057)	-0.262*** (0.059)	-0.454*** (0.098)
Regime switching volatilities						
$\sqrt{h_0}$	3.476*** (0.233)	2.715*** (0.155)	3.479*** (0.161)	3.569 (0.129)	3.456 (0.132)	4.775 (0.203)
$\sqrt{h_1}$	8.158*** (0.570)	6.047*** (0.449)	7.378 (0.629)	6.949 (0.486)	8.494 (0.480)	8.968 (0.635)
Regime Probabilities (%)						
γ^{00}	0.945	0.968	0.981	0.990	0.994	0.990
γ^{11}	0.935	0.934	0.947	0.961	0.979	0.957
Model Diagnosis						
log-likelihood	-1792.492	-1575.865	-1672.147	-1854.135	-1906.215	-2028.556
Linearity LR-test	101.78*** [0.000]	128.62*** [0.000]	124.64*** [0.000]	108.33*** [0.000]	245.46*** [0.000]	120.56*** [0.000]
$Q20$	21.575 [0.364]	46.825*** [0.001]	40.386*** [0.005]	25.785 [0.173]	26.722 [0.143]	20.916 [0.402]

Note: The table gives the result of the estimated models with constant regimes switching parameter φ_i; the switching Brent crude oil parameter–δ_i; the global factor–ω_i; regime switching volatility–$\sqrt{h_i}$; regime probability – γ^{ii}; and the GARCH terms are α and β. ( ) are robust standard errors; [ ] are *p*-values; *** indicates significance at 1%, ** indicates significance at 5% and * indicates significance at 10% level. $Q^2(20)$ statistics are for serial correlation of the standardized squared residuals at lag 20 which follow χ^2 distribution with df 20. The p-value for the linearity LR test is reported for the approximate upper-bound of Davies (1987).

4.3 Does Crude Oil Price Shocks Have Asymmetric Impact on the Sector Returns?

To investigate the asymmetric effect of crude oil price changes, an asymmetric Markov switching dynamic regression model (MS-DR) with fixed and time-varying transition probabilities are estimated, respectively. The estimation of the model follows the Mork (1989) asymmetric specification. This incorporates both positive and negative crude oil price changes to capture the resulting asymmetric effect if any. In the literature, the presence of crude oil asymmetric effect is used to describe a scenario in which positive crude oil price shocks (POP) decreases real output growth whereas negative crude oil price shocks (NOP) do not stimulate growth in economic output as much (See inter alia Hamilton, 1996). The results of the estimated MS-DR asymmetric models with fixed transition probability is presented in Table 5 while the results of the asymmetric time-varying transition probability estimates are presented in the appendix section of this thesis.

Table 5: Asymmetric model for the fixed transition MS-DR models

Panel A: Saudi Arabia ($\boldsymbol{POP_{t-1}}^{+}$)				Saudi Arabia ($\boldsymbol{NOP_{t-1}}^{-}$)		
	Banking/ Financial	**Agric & Food**	**Industry**	**Banking/ Financial**	**Agric & Food**	**Industry**
Intercept						
φ_0	-0.164 (0.143)	0.313* (0.163)	0.157 (0.167)	0.438*** (0.143)	0.609*** (0.153)	0.792*** (0.171)
φ_1	-0.592 (0.571)	-1.467** (0.744)	-2.105** (0.917)	0.498 (0.742)	-0.521 (1.023)	-0.340 (1.064)
Crude oil price						
δ_0	0.116** (0.053)	0.087 (0.053)	0.181*** (0.062)	0.322*** (0.051)	0.159** (0.067)	0.314*** (0.071)
δ_1	0.171 (0.130)	0.203 (0.158)	0.296* (0.178)	0.211 (0.149)	0.126 (0.168)	0.225 (0.177)
Global economic factor (VIX)						
ω_0	-0.029*** (0.011)	-0.039*** (0.012)	-0.054*** (0.012)	-0.025** (0.010)	-0.038*** (0.011)	-0.0521*** (0.0110)
ω_1	-0.092*** (0.033)	-0.127*** (0.041)	-0.136*** (0.046)	-0.083* (0446)	-0.133** (0.055)	-0.125** (0.054)
Regime volatility						
$\sqrt{h_0}$	1.767*** (0.138)	2.162*** (0.117)	2.287*** (0.120)	1.926*** (0.122)	2.235*** (0.128)	2.282*** (0.129)
$\sqrt{h_1}$	5.763*** (0.431)	6.150*** (0.588)	6.916*** (0.657)	6.244*** (0.506)	6.644*** (0.827)	7.136*** (0.731)
Regime Probabilities (%)						
γ^{00}	0.950	0.975	0.964	0.970	0.976	0.966
γ^{11}	0.90	0.920	0.870	0.911	0.901	0.870
Model Diagnosis						
log-likelihood	-1082.354	-1076.334	-1111.394	-1069.129	-1075.356	-1106.543
Linearity LR-test	191.29*** [0.000]	174.40*** [0.000]	182.89*** [0.000]	203.04*** [0.000]	166.23*** [0.000]	175.13*** [0.000]
$Q^2(20)$	15.759 [0.731]	24.516 [0.221]	21.737 [0.355]	17.209 [0.639]	26.095 [0.163]	23.570 [0.262]

Panel B: UAE ($\boldsymbol{POP_{t-1}}^{+}$)				UAE ($\boldsymbol{NOP_{t-1}}^{-}$)		
	Banking	**Food**	**Industry**	**Banking**	**Food**	**Industry**
Intercept						
φ_0	0.010 (0.127)	0.066 (0.136)	1.334* (0.778)	0.558*** (0.122)	0.453*** (0.135)	2.176*** (0.839)
φ_1	-0.712 (1.872)	-0.233 (0.585)	-0.396*** (0.151)	-0.055 (2.135)	0.306 (0.639)	-0.290** (0.141)
Crude oil price						

δ_0	0.092** (0.043)	0.083* (0.051)	-0.005 (0.236)	0.223*** (0.042)	0.170*** (0.052)	0.392* (0.211)
δ_1	0.220 (0.386)	0.074 (0.152)	0.037 (0.043)	-0.094 (0.369)	0.168 (0.164)	0.0207 (0.0405)
Global economic factor (VIX)						
ω_0	-0.026*** (0.008)	-0.002 (0.011)	-0.066 (0.049)	-0.023*** (0.008)	0.003 (0.010)	-0.040 (0.053)
ω_1	-0.164 (0.126)	-0.021 (0.040)	-0.031*** (0.010)	-0.178 (0.146)	-0.014 (0.045)	-0.032*** (0.010)
Regime volatility						
$\sqrt{h}_0$	2.374*** (0.092)	1.875*** (0.134)	7.4571*** (0.677)	2.379*** (0.082)	1.953*** (0.131)	7.470*** (0.652)
$\sqrt{h}_1$	13.447*** (1.365)	7.665*** (0.466)	2.140*** (0.153)	14.024*** (1.403)	7.902 (0.532)	2.172*** (0.145)
Regime Probabilities (%)						
γ^{00}	0.979	0.917	0.662	0.981	0.923	0.652
γ^{11}	0.839	0.865	0.894	0.835	0.856	0.897
Model diagnosis						
log-likelihood	-1658.610	-1769.859	-1710.027	-1650.107	-1764.313	-1708.258
Linearity LR-test	619.61*** [0.000]	364.55*** [0.000]	262.57*** [0.000]	635.10*** [0.000]	370.33*** [0.000]	262.12*** [0.000]
$Q^2(20)$	21.447 [0.668]	72.499 [0.0000]	27.866 [0.314]	23.140 [0.569]	67.612*** [0.000]	27.499 [0.331]

Panel C : China ($\boldsymbol{POP_{t-1}}^{+}$)				China ($\boldsymbol{NOP_{t-1}}^{-}$)		
	Financial	**Food**	**Industrial**	**Financial**	**Food**	**Industrial**
Intercept						
φ_0	-0.128 (0.297)	0.097 (0.198)	-0.035 (0.242)	0.527* (0.288)	0.398** (0.196)	0.602** (0.237)
φ_1	0.441 (0.634)	0.590 (0.566)	0.199 (0.786)	0.001 (0.732)	0.692 (0.607)	-0.632 (1.238)
crude oil Price						
δ_0	0.267** (0.118)	0.156** (0.067)	0.271*** (0.077)	0.200 (0.142)	0.036 (0.072)	0.146* (0.083)
δ_1	-0.119 (0.165)	-0.105 (0.143)	-0.240 (0.243)	-0.117 (0.176)	0.130 (0.133)	-0.146 (0.247)
Global economic factor (VIX)						
ω_0	-0.054** (0.021)	-0.024* (0.013)	-0.031* (0.018)	-0.061*** (0.021)	-0.028** (0.013)	-0.036** (0.015)
ω_1	-0.132*** (0.041)	-0.176*** (0.040)	-0.212*** (0.058)	-0.138*** (0.047)	-0.167*** (0.042)	-0.225*** (0.069)
Regime volatility						
$\sqrt{h}_0$	3.475*** (0.221)	2.680*** (0.152)	3.442*** (0.186)	3.527 (0.238)	2.746*** (0.152)	3.549*** (0.154)
$\sqrt{h}_1$	8.0392*** (0.525)	5.983*** (0.438)	7.301*** (0.710)	8.311 (0.577)	6.052*** (0.452)	7.503*** (0.636)
Regime Probabilities (%)						
γ^{00}	0.938	0.968	0.980	0.924	0.969	0.984
γ^{11}	0.919	0.937	0.949	0.884	0.934	0.953
Model Diagnosis						
log-likelihood	-1793.657	-1574.411	-1671.175	-1795.133	-1577.071	-1676.484
Linearity LR-test	99.386*** [0.000]	133.35*** [0.000]	127.44*** [0.000]	96.582*** [0.000]	124.90*** [0.000]	116.61*** [0.000]
$Q^2(20)$	23.163 [0.510]	18.218 [0.573]	12.747 [0.888]	11.102 [0.944]	20.090 [0.452]	17.783 [0.602]

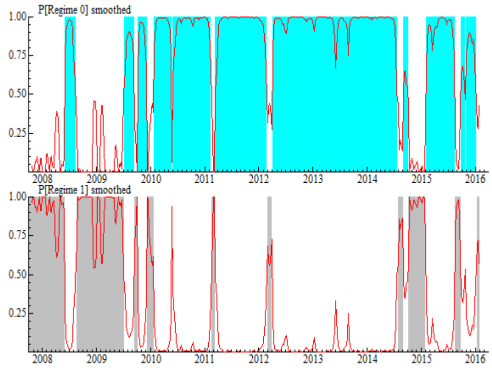
Panel D: India ($\boldsymbol{POP_{t-1}}^{+}$)				India ($\boldsymbol{NOP_{t-1}}^{-}$)		
	Banking	**Consumer durables**	**Construction**	**Banking**	**Consumer durables**	**Construction**
Intercept						
φ_0	0.275 (0.203)	-0.107 (0.197)	0.113 (0.269)	0.717*** (0.201)	-0.038 (0.197)	0.976*** (0.268)
φ_1	-0.762 (0.746)	-0.876 (0.789)	-1.311 (1.082)	-0.594 (0.775)	0.552 (0.744)	-2.160*** (1.169)
Crude oil Price						
δ_0	0.135** (0.067)	0.047 (0.067)	0.251*** (0.089)	0.133** (0.070)	-0.003 (0.068)	0.267*** (0.090)
δ_1	0.202 (0.172)	0.211 (0.192)	0.058 (0.226)	-0.118 (0.165)	0.418** (0.179)	-0.251 (0.225)
Global economic factor (VIX)						
ω_0	-0.058*** (0.014)	-0.036*** (0.013)	-0.058*** (0.018)	-0.058*** (0.014)	-0.038*** (0.013)	-0.057*** (0.018)
ω_1	-0.263*** (0.056)	-0.284*** (0.058)	-0.432*** (0.101)	-0.284*** (0.060)	-0.251*** (0.059)	-0.504*** (0.096)
Regime volatility						
$\sqrt{h_0}$	3.567 (0.138)	3.458*** (0.133)	4.760*** (0.223)	3.585*** (0.127)	3.456*** (0.130)	4.847 (0.178)
$\sqrt{h_1}$	6.867*** (0.485)	8.572*** (0.488)	8.967*** (0.623)	6.964*** (0.482)	8.468*** (0.476)	8.923 (0.655)
Regime Probabilities (%)						
γ^{00}	0.990	0.994	0.989	0.990	0.994	0.992
γ^{11}	0.961	0.979	0.955	0.962	9793	0.959
Model diagnosis						
log-likelihood	-1854.069	-1907.567	-2030.383	-1855.034	-1905.712	-2029.598
Linearity LR-test	107.93*** [0.000]	247.60*** [0.000]	119.40*** [0.000]	108.88*** [0.000]	244.33*** [0.000]	118.98*** [0.000]
$Q^2(20)$	13.582 [0.851]	26.868 [0.139]	19.329 [0.501]	26.495 [0.150]	26.538 [0.149]	25.193 [0.194]

Note: The table gives the result of the Asymmetric model for the fix transition MS-DR with intercept term φ_i; Brent crude oil price– δ_i; the global factor–ω_i; regime switching volatility– $\sqrt{h_t}$; regime probability– γ^{ii}. ( ) are robust standard errors; [ ] are *p*-values; *** indicates significance at 1%, ** indicates significance at 5% and * indicates significance at 10% level. $Q^2(20)$ statistics are for serial correlation of the standardized squared residuals at lag 20 which follow χ^2 distribution with df 20. The p-value for the linearity LR test is reported for the approximate upper-bound of Davies (1987).

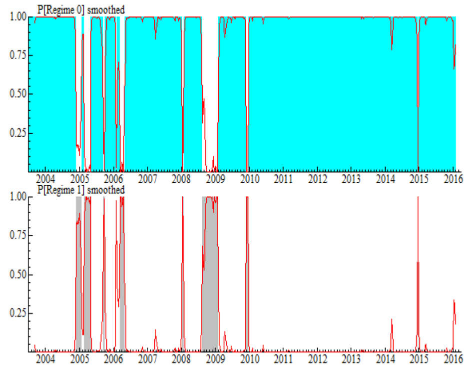
In the crude oil exporting countries in panels A and B, positive crude oil price shocks is found to overwhelmingly have statistically significant positive impact on the sector returns in the stable regime whereas in recession it has no effects in general. More so, the negative crude oil price shocks is also reported to have positive impact on the sector returns in the stable regime. Conversely, in the recession regime positive and negative crude oil price shocks have no sector-wide effect on returns in general. Yet, an asymmetric oil price effect is observed such that both positive and negative oil price shocks have positive impact on all sectors in the stable regime but with a greater magnitude of the negative shock. In the case of net oil exporting countries, these results confirm the presence of asymmetric effect of oil price shocks in stable regime but in the opposite direction such that negative oil price shocks have larger impact of boosting the economy than do the positive oil price shocks.

In the crude oil importing countries, the estimated results in panel C show that positive crude oil price shocks positively impact the sector returns in stable regime in China and exert no effect in recession regime. On the other hand, the negative crude oil price shocks do not have any significant effect on Chinese sector returns in both the stable and recession regimes, respectively.

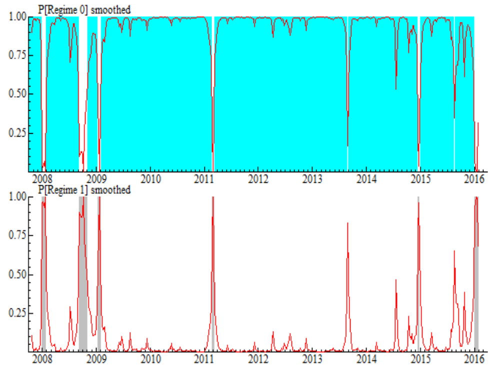
In the case on India, the estimated coefficients are presented in Panel D indicating that positive crude oil price shocks have positive impact on at least two sector returns, namely the banking and construction sectors and no effect on the consumer durable sector in the stable regime. Also, the negative crude oil price shocks are observed to have positive impact on the same sectors, and no effect on the consumer durable sector. In recession, both positive and negative crude oil price shocks are found to have no sector-wide effect. While oil price falls positively affect the Indian banking and construction sectors during stable regime, they are of same magnitude as the positive oil price shocks during the same regime indicating no asymmetric effect. However, the asymmetric effect is observed for the case of China in stable regime. The oil price falls, in general, has no significant effect on any sector returns during recession regime for the case of oil importing and exporting countries. The positive influences of oil price rises, at least in the short-run, during stable regime may be interpreted as arising from the demand side oil price shocks rather than supply disruptions. Furthermore these results also suggest an asymmetric effect of oil prices across regimes. This evidence is not unpopular in the literature. Lee et al. (1995) had shown that crude oil price shocks have more positive impact in stable periods than in volatile regime. The VIX index, in general, has highly significant negative relationship with all sector returns in both oil exporting and importing countries during the stable regime. The smoothed transition probabilities derived from the estimated MS-DR models are presented in Figure 4. While the smoothed regime probability—p (regime [0]) is the stable regime, the p (regime [1]) corresponds to the recession regime. The smoothed regime switching probability graphs generally captures the switching regime behavior in the models. These correspond to varying dates matching the peak and trough of both the stable and recession regimes.



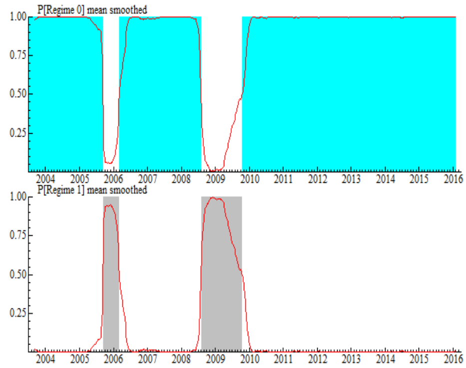
Saudi Arabia Banking/Financial Sector



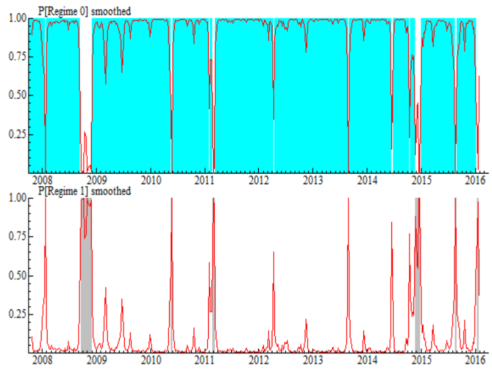
United Arab Emirates Banking Sector



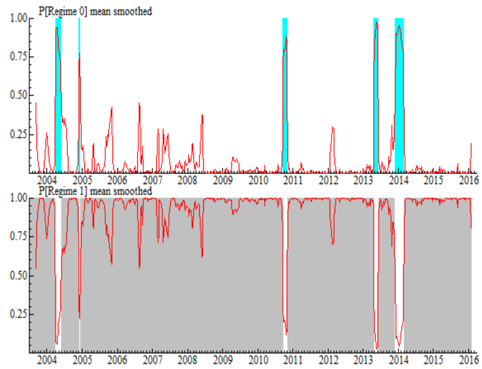
Saudi Arabia agriculture /food sector



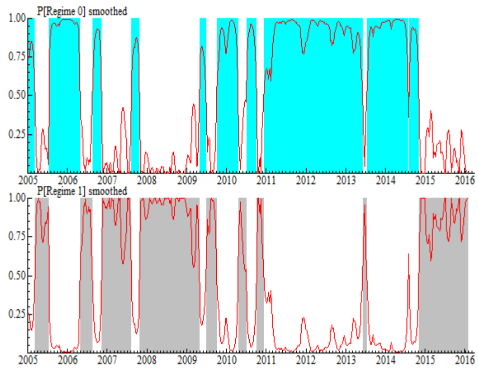
United Arab Emirates food sector



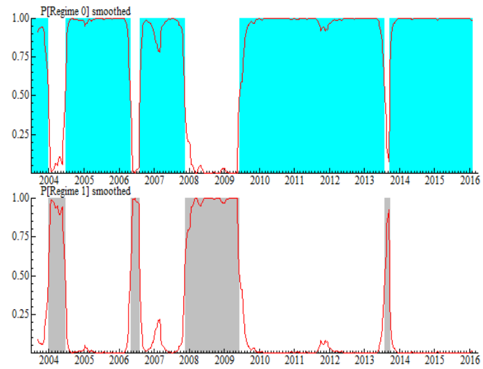
Saudi Arabia industrial sector



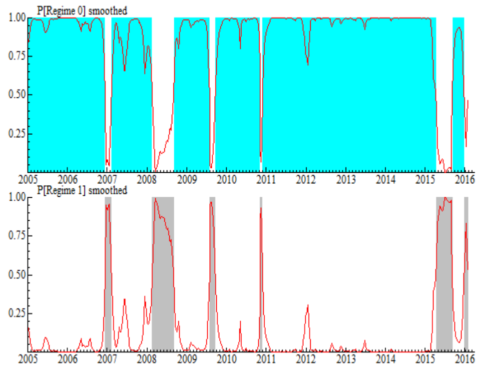
United Arab Emirates industrial sector



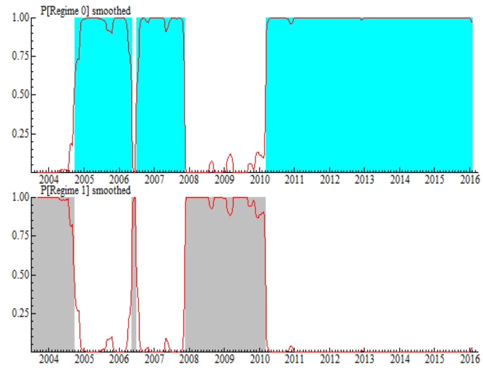
China financial sector



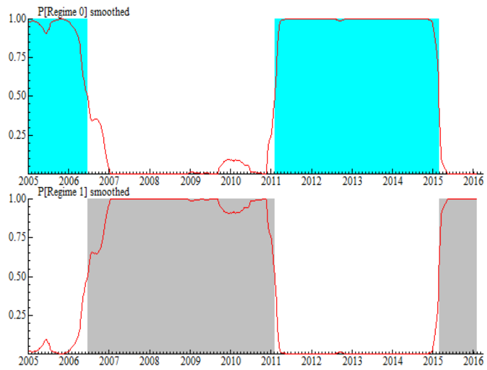
India banking sector



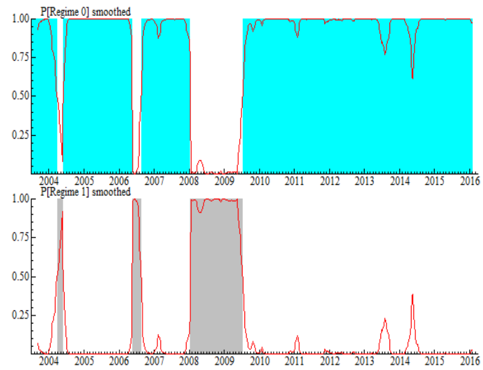
China food sector



India Consumer durable sector



China industrial sector



India construction sector

Figure 4: Smoothed probability graphs from the Markov switching dynamic regression models.

The most frequent reoccurring recession dates across the sectors in the recession regime are mainly as from 2009 to 2012, 2013 and recent years of 2015 and 2016. A chronological events corresponding to the mentioned dates for crude oil exporting and importing countries are summarized in Table 6.

Table 6: Summary of event chronology corresponding to crisis periods

Crude oil exporting countries	
2006	OPEC member states were called to cut down crude oil production as price fell below USD 59 showing no sign to strengthen.
2009	Crude oil exporting countries agreed to cut down production by a significant 2.2 Billion barrels daily—the single largest cut in daily production—in view of the 70% fall in crude oil price from USD 150 in the summer of 2008.
2009	Massive debt hit the national government investment arm in the UAE–The Dubia World– triggering fear of loan default in the country.
2010/2011	Crude oil exporting members fail to agree upon a decision to increase crude oil production to reverse crude oil price increase. This impacted global growth negatively increasing global uncertainties.
2012/2013	Competition from unconventional oil production affected the revenue in the crude oil exporting countries. The exporters fail to agree to maintain a crude oil production ceiling of about 30 million barrel daily. This is in spite of concerns of oversupply and competition from unconventional crude oil production–the shale oil.
2015/2016	The global glut in crude oil production persisted affecting crude oil price negatively. An agreement is finally reached with non-OPEC crude oil exporters to cut down daily production to ease global growth.
Crude oil Importer	
2004	India was severely hit by the 2004 Tsunami devastating its coastal cities and impacting investment in the region
2004–2008	The Brent crude oil price reached a peak of USD146 affecting global growth especially in significant crude oil importing countries.
2008/2009	Chinese Government stressed that the impacts of global financial downturn in China’s economy was severe than expected while announcing a stimulus package of USD 576 Billion
2008/2009	The global meltdown significantly hurt India stock market with a 50% decline in the stock market benchmark indexes. This led to massive outflow of equity by the Foreign portfolio investors.
2009/2010	Rising trade deficit hit the emerging economies in China and India as crude oil price rose to a record level slowing global growth.
2010–2014	The Brent crude oil persistency in an upward trend continues to hurt growth in China and India.
2016	China economic growth declined to a 25 years low from an annual growth rate of 7.5%.

Source: Author’s compilations, 2017.

4.4 Time Varying Transition Probability Estimates and Comparison between Net Oil Exporting vs Importing Countries

The objective in estimating the time-varying transition probability model is to adequately capture the dynamic regimes switching behavior in the estimated models. In other words, the motivation behind estimating this model is to examine whether oil price changes affect regime switching. However, the control variable, the changes in VIX index is also included as a predetermined variable into the transition probability equations in (7). Thus, the model is estimated with lagged independent variables of oil returns and VIX index changes such that the value of the independent variables at time *t* corresponds to the value influencing the dynamic transition in the model from *t-1* to *t*. This has the advantage to eliminate the remaining correlations in the standardized squared residuals where necessary. Even more so, the time varying transition probabilities makes the decomposition of the impact of crude oil price shocks and the global economic factor easy in explaining the dynamic regime switching behavior in the estimated models (see Reboredo, 2010). The result of the MS-DR with time–varying transition probability estimates is presented in Table 7.

Table 7: MS-DR estimates with time–varying transition probability estimates

Panel A. Saudi Arabia				**United Arab Emirates**		
	Banking/ Financial	**Agric & Food**	**Industry**	**Banking**	**Food**	**Industry**
Intercept						
φ_0	4.297*** (0.862)	4.120*** (0.738)	7.669*** (1.975)	4.421*** (0.541)	2.487*** (0.317)	2.117*** (0.270)
φ_1	-2.301*** (0.616)	-1.830** (0.712)	-1.526** (0.740)	-2.009** (0.784)	-1.903*** (0.338)	-0.747** (0.340)
Crude oil transition						
δ_0	0.522*** (0.165)	0.370** (0.150)	1.018*** (0.297)	0.303*** (0.095)	0.026 (0.137)	-0.023 (0.069)
δ_1	-0.061 (0.096)	-0.020 (0.097)	-0.025 (0.090)	0.023 (0.063)	-0.013 (0.050)	-0.063 (0.071)
Global economic factor transition						

ω_0	0.033 (0.035)	0.003 (0.042)	0.057 (0.038)	-0.019 (0.022)	-0.039 (0.035)	-0.000 (0.025)
ω_1	-0.100* (0.053)	-0.120* (0.066)	-0.080 (0.056)	0.023 (0.063)	-0.003 (0.033)	-0.046 (0.031)
Regime transition volatility						
$\sqrt{h_0}$	0.629*** (0.059)	0.802*** (0.051)	0.863*** (0.044)	0.850*** (0.037)	0.587*** (0.076)	0.752*** (0.070)
$\sqrt{h_1}$	1.818*** (0.077)	1.923*** (0.108)	2.023*** (0.099)	2.603*** (0.099)	2.017*** (0.062)	1.979*** (0.088)
Model Diagnosis						
Log-likelihood	-1064.366	-1065.781	-1086.777	-1642.764	-1762.510	-1699.747
$Q^2 20$	11.850 (0.921)	7.1311 (0.996)	8.4311 (0.989)	2.6341 (1.000)	27.905 (0.112)	17.368 (0.629)

Panel B. China				**India**		
	Financial	**Food**	**Industry**	**Banking**	**Consumer durable**	**Constructi on**
Intercept						
φ_0	4.309*** (1.072)	7.455*** (2.381)	10.028** (4.063)	3.870*** (1.223)	5.453*** (1.025)	3.820*** (1.105)
φ_1	-3.017*** (0.692)	-4.404*** (1.576)	-4.586*** (1.174)	-5.107*** (0.866)	-5.018*** (1.239)	-5.704*** (1.208)
Crude oil transition						
δ_0	-0.419*** (0.152)	0.733** (0.292)	-1.178** (0.588)	0.147 (0.192)	0.402*** (0.143)	0.060 (0.093)
δ_1	0.126 (0.155)	-0.251* (0.130)	0.211** (0.094)	0.278*** (0.099)	-0.041 (0.103)	0.137 (0.199)
Global economic factor transition						
ω_0	0.025 (0.042)	0.052 (0.047)	-0.141 (0.098)	0.156** (0.064)	0.008 (0.037)	0.088 (0.080)
ω_1	-0.054 (0.053)	0.133 (0.082)	0.211** (0.094)	0.118*** (0.042)	-0.041 (0.103)	0.086* (0.047)
Regime transition volatility						
$\sqrt{h_0}$	1.275*** (0.057)	1.1309*** (0.0423)	1.2131*** (0.0435)	1.2270*** (0.0491)	1.220*** (0.046)	1.579*** (0.034)
$\sqrt{h_1}$	2.066*** (0.053)	1.9115*** (0.076)	1.930*** (0.061)	1.946*** (0.076)	2.173*** (0.064)	2.186*** (0.072)
Model Diagnosis						
Log-likelihood	-1787.069	-1569.275	-1664.292	-1846.388	-1897.674	-2023.010
$Q^2 20$	9.530 (0.976)	26.129 (0.162)	20.936 (0.401)	26.284 (0.157)	25.549 (0.181)	15.524 (0.746)

Note: φ_i is the intercept term; δ_i—crude oil transition; ω_i—global factor transition; $\sqrt{h_i}$—regime volatility. ( ) are robust standard error. *****, **** and ***** indicates significance at 1%, 5 % and 10% levels, respectively. $Q^2(20)$ statistics are for serial correlation of the standardized squared residuals at lag 20 which follow χ^2 distribution with df 20. The p-value for the linearity LR test is reported for the approximate upper-bound of Davies (1987).

Table 7 examines whether the dynamic movements in crude oil price and the changing global economic conditions are important in determining dynamic regimes in the estimated models. We expect in priori that the time-varying impact in the evolution of crude oil price shocks and the global economic uncertainties induces regime switches in the models. Hence, the summary of these impacts is presented in the Table 8.

Table 8: Summary of the dynamic time-varying transition probability estimates

Saudi Arabia				**United Arab Emirates**		
	Banking/ Financial	**Agric & Food**	**Industry**	**Banking**	**Food**	**Industry**
Stable Regime (0)						
φ_0	+	+	+	+	+	+
δ_0	+	+	+	+	X	X
ω_0	X	X	X	X	X	X
Recession Regime (1)						
φ_1	-	-	-	-	-	-
δ_1	X	X	X	X	X	X
ω_1	-	-	X	X	X	X

China				**India**		
Parameter	**Financial**	**Food**	**Industry**	**Banking**	**Consumer durable**	**Constructi on**
Stable Regime (0)						
φ_0	+	+	+	+	+	+
δ_0	-	+	-	X	+	X
ω_0	X	X	X	+	X	X
Recession Regime (1)						
φ_1	-	-	-	-	-	-
δ_1	X	-	+	+	X	X
ω_1	X	X	+	+	X	+

Note: + gives positive coefficient estimates; – gives coefficient estimates and x indicates no effects

The results give mixed impacts in the effects of crude oil price shocks and the dynamic global economic conditions on the specified regimes. However, it is possible to establish a regime induced pattern particularly in the impact of crude oil price shocks on the sector returns. The estimated positive coefficients of crude oil and the global factor for the respective sectors give the probability for the sector returns to remain in the stable period overtime as crude oil price increases. The negative sign shows that the increase in crude oil price and rising uncertainties in the global economy induces the regime switch into recession. Hamilton has explicitly proved that most of the economic recessions recorded in the United States (US) were preceded by significant crude oil price shocks.

For the exporters—crude oil price shocks have positive sector-wide impact on returns in the sectors in Saudi Arabia as well as the banking sector in the UAE in the stable regime. It has no effects for the food and industrial sector returns in the UAE during the stable regime. In recession, the shocks to crude oil price also have on sector-wide effects on returns for the entire sectors in the crude oil exporting countries. The result establishes a regime induced asymmetric effects in the impacts of crude oil price shocks on sector returns such that the oil price shocks have more significant impact during the stable regime than in recession.

For the importers—in stable regime, crude oil price shocks have negative effects on returns in China financial and industrial sectors with positive effect in the food sector and no effects for the banking and construction sectors. In recession, whereas the crude oil price shocks have no effect in the China financial sector, it affects returns negatively in the food sector and positively in the industrial sector.

In India, while crude oil price shocks have no effect on returns in the banking and construction sectors, it affects returns positively in the consumer durable sector in the stable regime. In recession crude oil price shocks have no effects on the consumer durable and construction sector returns in India. However, it impacts returns positively in the banking sector switching the regime to stable regime.

Thus, whereas the crude oil shocks generally have more negative impact on the sector returns in the specified regimes in China, it has more positive impact on the regimes in India. This gives mixed effect in the impact of crude oil price shock on the dynamic regimes in the crude oil importing countries.

Furthermore, the global economic factor is found to have no significant impact on the entire sector returns in the crude oil exporting countries during stable regime in inducing a regime switch. Whereas in the recession regime it has no effect on returns in the UAE, in Saudi Arabia, it has negative impact on the banking/financial sector and the agriculture/food sector returns and no effects in the industrial sector.

For the importers, the global factor also have no sector-wide effects to induce regime change for the entire sector in China as well as the consumer durable and construction sectors in India during the stable regime but it has positive impacts on the banking sector returns in India.

Similarly in recession while the global factor has no effects on the financial and food sector in China, it has positive impacts on returns in the industrial sector. Also whereas, the global uncertainty factor is insignificant in the India consumer durable sector, it has positive impact on returns in the banking and construction sector.

The evidence shows that global uncertainty factor affects the crude oil exporters more adversely than importers—especially during recession as seen in the case of Saudi Arabia.

4.5 Robustness Checks

Considering the model diagnostic tests, we found sufficient evidence for nonlinearity in the estimated models. This is revealed by the significant linearity LR test statistic.

Markov switching model can induce serial correlation in the standardized residuals of a time series demonstrating the ability of the model to show persistence.

The diagnostic tests shows that there are no ARCH effects left in the residuals of the estimated models. This is true even for sectors in which we observed evidence of persistently re-occurring turbulence accompanied by significant volatility. Although, the estimates have been achieved after strong convergence, they have been checked for robustness using the SQPF algorithm since with the BFGS algorithm, estimation of probabilities on the boundary becomes difficult. The estimated results with the SQPF algorithm have been similar. In addition, our conclusions estimated with oil price changes and the separate positive and negative oil price estimates also produced similar results indicating the robustness of the estimates.

Chapter 5

SUMMARY AND CONCLUSION

5.1 Concluding Remarks

This thesis set forth to investigate the sectoral impact of crude oil price shocks on sector returns in selected crude oil exporting and importing emerging market countries. The sample was based on a weekly stock market data. The estimation dates were determined by data availability. The data covered stock market returns from the selected countries. Thus, considering the differential time zone in the operating hours of the respective stock markets, a weekly stock market returns based on a Wednesday to Wednesday market trading days was followed in the estimation. This way it was possible to reduce cross country effects in the sample to a minimal level taking into cognizance the day-of-the-week effects in the data set. The Brent crude oil price was chosen as a measure of crude oil price movement since over 2/3 of global crude oil transactions are often undertaken via the Brent crude oil price.

The stock markets of interest in this thesis were the Saudi Arabia stock exchange (Tadawul), the United Arab Emirates–Abu Dhabi stock exchange, the China Shenzhen–stock exchange and the India–CNX Nifty. The sectors covered included the banking and financial services sector, the agriculture and food/consumer durable sectors and the construction/industrial sectors. To take into account the global economic factor, the VIX index reported by the Chicago Board of Option Exchange was also included in the analysis. The global factor captured the dynamic condition of the global financial market; movements in the United State dollar exchange rate; crude oil global demand and supply patterns and the upheaval in the Middle East affecting crude oil supply to the global market.

This study therefore examined the sectoral impact of crude oil price shocks in the selected crude oil exporting countries—Saudi Arabia and the United Arab Emirates and the crude oil importers namely—China and India. This was motivated by the theoretical asset price determination and the expected discounted cash flow form asset returns (See Fisher, 1930; Williams, 1938 and Jones et al., 2004). The dynamic movements in crude oil price was found to affect sector returns widely held as financial asset in a nonlinear fashion in both positive and negative direction impacting directly or indirectly production cost and earnings of firms (see also Demirer, et al., 2015). The choice of the emerging markets countries selected for this study was as a result of their growing need for energy in driving the process of industrialization and economic growth in their national economies for the crude oil importers. Conversely, the crude oil exporters are selected in recognition of their significant crude oil production capacity.

Based on the estimated results from the Markov switching dynamic regression model in the baseline models, we found evidence of a possible regime induced opposite asymmetric effect in the impact of crude oil price shocks on sector returns. However, the impact varies according to the sensitivities of the respective sector to crude oil price changes and also across the sectors. Specifically, in the crude oil exporting countries during stable regime, the evidence shows that positive crude oil price shocks had positive growth stimulating effects on the sector returns whereas in recession—crude oil price shocks had no effects on returns in the respective sectors.

Also, the impact of the global economic uncertainties on sector returns was found to be adverse in the stable regime for the crude oil exporting countries in general whereas in recession it had no significant effect.

The evidence of a possible regime induced asymmetric effects of crude oil price shocks is also observed in the crude oil importing countries. The results indicated that whereas crude oil price shocks had positive impact on sector returns in stable regime, in recession it had no significant sector-wide effects on returns in the crude oil importing countries in this study. Furthermore, the global economic factor was found to affect sector returns negatively in both the stable and recession regimes for the crude oil importers, respectively.

Empirical findings also showed that the average duration in the stable and the recession regimes is much longer in the crude oil importing countries relative to the crude oil exporting countries. Hence, China's industry sector returns exhibited the longest weekly duration in recession—about 145 weeks on average. The longest duration in the stable regime, on the other hand, was exhibited by the UAE food sector with an average of 186.33 weeks. These results have obvious implication for crude oil importing nations particularly during recession. These results are supportive of those of Jammazi and Nguyen, 2015 which explain the importance as such nations have to contemplate energy diversification strategies to ensure their stable access to alternative energy sources.

The results of the asymmetric MS-DR model with fix transition probabilities confirm the presence of asymmetric effect in the impact of crude oil price shocks on sector returns for some selected sectors whereas it gives no asymmetric effect for others.

Beginning with the net crude oil-exporters, Saudi Arabia and the UAE, the evidence shows that, in general, both the positive and negative crude oil price shocks have positive impacts on the sector returns during the stable regime but no significant effect during the recession regime. However, an asymmetric oil price effect is observed such that both positive and negative oil price shocks have positive impact on all sectors in the stable regime but with a greater magnitude of the negative shock.

In the case of the crude oil importers, both the positive and negative crude oil price shocks affect returns positively in the stable regime in India. But in recession, the negative and positive crude oil price shocks do not have effect on the sector returns, respectively. Thus, while crude oil price increases have positive effect on the sector returns except the consumer durable sector, negative oil shocks also have positive affect on the banking and construction sectors. The impacts of the price shocks are observed to be the same magnitude in the stable regime indicating no asymmetric effect for India. However, the asymmetric effect is observed for the case of China. Thus, for China, whereas the positive crude oil price shocks generally had positive impacts on sector returns in the stable regime, it had no effect in the recession regime. On the other hand, negative crude oil price shocks had no sector-wide effects on returns in both the stable and recession regimes. The positive impact of the crude oil price shocks in the short-run during the stable regime may be due to growing demand side impact of the crude oil price shocks rather than arising from supply side disruptions.

These findings are not yet popular in the empirical literature on crude oil price shocks. According to Sauter and Awerbuch (2003), although oil price increases matters more than decreases—the extent of these effects is determined by the past level of the oil price volatility. Thus volatility might weaken the asymmetric effect of oil shocks on output especially in the immediate to short run period. Furthermore, based on a counter-inflation model examining sectoral shock and uncertainty effects, Federer (1996) reported symmetric nexus between oil price shocks and economic growth. This study suggested that the apparent breakdown of the asymmetric effect of oil price shock is likely due to the sectoral re-balance and uncertainty effect. Also, the statistical insignificance of the oil price asymmetric effect can been attributed to decrease in the share of crude oil in production since the 1980s due to the growth in technology and innovations (Iwayemi, 2011).

Finally the importance of crude oil price shocks and the dynamic global economic conditions in inducing regime changes for the sector returns was examined via lagged MS-DR transition probability models. The result in the estimated fixed and time–varying transition models suggest mixed evidences overall. Hence, crude oil price shocks and the global economic factor play some roles in the dynamic transition between regimes in the estimated models.

The empirical deductions in this thesis are useful for macroeconomic policy makers contemplating appropriate policies to combat the dynamic effects of oil price shocks and global economic uncertainties on their national economies. It is also important to global managers and investors while evaluating the impact of international crude oil price changes on their financial portfolio so as to envisage efficient hedging strategies.

This thesis reveals evidences of dissimilar effects in the impact of crude oil price shocks in general on sector returns in both crude oil exporting and importing countries. This evidence is also found by Elyasiani et al., (2011) and Filis et al., (2011) among many others. The findings imply that policy measures to address the impact of crude oil price shock must take into consideration the dynamic sectoral sensitivities to shocks—since sectoral exposure to shocks varies in magnitude. This consideration will reduce the illusion of considering uniform macroeconomics policies in addressing external shocks in an economy.

Also, bearing in mind the evidence of non-linear relationship between crude oil price and stock market returns—macroeconomic policy makers in emerging market countries needs to understand this dynamism when advocating policies to address oil price shocks and volatility. More so, macroeconomic policies toward curtailing oil price shocks must take into account the overall impact and effect of the shocks on production costs across economic sectors and dynamic regimes in a country. Policy measure also needs to recognize the fact that oil price shocks drives up production cost especially in highly energy intensive sectors with negative impact and effect on production. The price shocks can curtail the ability of firms to invest in energy efficient production inputs.

Furthermore, to the degree that international investors are considering the international diversification of their portfolios —it is important for portfolio managers to critically analyse the sectoral exposure in their desired investment destinations to crude oil price shocks. This way they can adopt appropriate strategies to minimize the potential down side risk to their investments due to the fluctuation in crude oil prices and the dynamic global economic uncertainties.

Finally, energy policy makers also need to consider energy diversification strategies where appropriate to reduce the dominance and reliance on crude oil in production activities. Policy in this direction should consider the viability of renewable energy for industrial production and domestic usage. Hence, energy policy towards energy diversifications to renewable will help to ensure energy security by freeing up energy resources and boosting energy efficiency. The diversification policy towards efficient energy mix will help to reduce the adverse economic impact of fluctuations in the global crude oil price for both the crude oil exporting and importing emerging economies.

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APPENDICES

Appendix A: Unit Root Test

	ADF		KPSS	
Brent-Crude Oil	Trend & Intercept	Trend no Intercept	Trend & Intercept	Trend no Intercept
Test Statistic	-0.8616	9.6674	0.3699	0.4731
Critical Value	(-3.9724)	(-3.4403)	(0.2160)	(0.7390)
Probability	[0.9581]	[0.0000]	-	-
Lag Length	3	4	21	10
VIX index				
Test Statistic	-3.44891	-31.3048	0.3572	0.0503
Critical Value	-3.9723	-3.9723	0.2160	0.7390
Probability	0.0460	0.0000	-	-
Lag Length	1	0	20	26

	ADF		KPSS	
A:Saudi Arabia	Trend & Intercept	Trend no Intercept	Trend & Intercept	Trend no Intercept
(1) Banking/financial				
Test Statistic	-2.4090	-22.1729	0.3258	0.0758
Critical Value	(-3.9796)	(-3.4453)	(0.2160)	(0.7390)
Probability	[0.3743]	[0.0000]	-	-
Lag Length	4	0	16	4
(2) Food				
Test Statistic	-1.1709	-7.0200	0.3041	0.17611
Critical Value	(-3.9795)	(-3.4404)	(0.2160)	(0.7390)
Probability	[-3.1328]	[0.0000]	-	-
Lag Length	2	7	16	2
(3) Industry				
Test Statistic	-2.7389	-10.3200	0.1698	0.0771
Critical Value	(-3.9796)	(-3.4454)	(0.2160)	(0.7390)
Probability	[0.2214]	[0.0000]	-	-
Lag Length	3	2	16	7

	ADF		KPSS	
B:United Arab Emirate	Trend & Intercept	Trend no Intercept	Trend & Intercept	Trend no Intercept
(1) Banking				
Test Statistic	-2.3767	6.8522	0.2674	0.1835
Critical Value	(-3.9725)	(-3.4404)	(0.2160)	(0.7390)
Probability	[0.3914]	[0.0000]	-	-
Lag Length	8	7	21	12
(2) Food				
Test Statistic	-1.8502	-7.0200	0.4319	0.1259
Critical Value	(-3.9725)	(-3.4404)	(0.2160)	(0.7390)
Probability	[0.6789]	[0.0000]	-	-
Lag Length	8	7	21	10
(3) Industry				
Test Statistic	-2.8300	-8.5143	0.2832	0.3370
Critical Value	(-3.9724)	(-3.4403)	(0.2160)	(0.7390)
Probability	[0.1869]	[0.0000]	-	-

Lag Length	6	5	21	12

	ADF		KPSS	
C:China	Trend & Intercept	Trend no Intercept	Trend & Intercept	Trend no Intercept
(1) Financial				
Test Statistic	-2.0168	-15.5514	0.2814	0.1243
Critical Value	(-3.9741)	(-3.4415)	(0.2160)	(0.7390)
Probability	[0.5904]	[0.0000]	-	-
Lag Length	2	1	28	6
(2) Food				
Test Statistic	-1.827	-6.3774	0.5035	0.4019
Critical Value	(-3.9744)	(-3.4417)	(0.2160)	(0.7390)
Probability	[0.6904]	[0.0000]	-	-
Lag Length	11	10	28	0
(3) Industry				
Test Statistic	-2.2699	-6.5577	0.2692	0.1181
Critical Value	(-3.9743)	(-3.4416)	(0.2160)	(0.7390)
Probability	[0.4493]	[0.0000]	-	-
Lag Length	8	7	28	2

	ADF		KPSS	
D: India	Trend & Intercept	Trend no Intercept	Trend & Intercept	Trend no Intercept
(1) Banking				
Test Statistic	-2.9300	-13.4069	0.2028	0.0930
Critical Value	(-3.9724)	(-3.4403)	(0.1460)	(0.7390)
Probability	[0.0529]	[0.0000]	-	-
Lag Length	1	2	21	8
(2) Food				
Test Statistic	-2.6909	-23.6974	0.3485	0.0552
Critical Value	(-3.9727)	(-3.4402)	(0.2160)	(0.7390)
Probability	[0.2408]	[0.0000]	-	-
Lag Length	17	0	21	8
(3) Industry				
Test Statistic	-1.9810	-10.0066	0.5521	0.5264
Critical Value	(-3.9724)	(-3.4403)	(0.2160)	(0.7390)
Probability	[0.6101]	[0.0000]	-	-
Lag Length	5	4	21	10

Note: ADF and KPSS critical value reported at 1%. ADF Lag length selection based on AIC Information criteria while KPSS based on Bandwidth selection using Bartlett kernel.

Appendix B: Single Regıme GARCH Estimates

Single-regime GARCH (1, 1) Models of sectors

A: Saudi Arabia	(1)Banking/ Financial	(2)Agriculture/Food	(3) Industrial
Parameters	GARCH(1, 1)-N	GARCH(1, 1)-N	GARCH(1, 1)-N
$\boldsymbol{\alpha}$	0.0270 (0.1359)	0.3172*** (0.1217)	0.3007* (0.1590)
$\boldsymbol{AR_1}$	1.2570*** (0.1177)	0.7161*** (0.1708)	-
$\boldsymbol{AR_2}$	-0.9064*** (0.0969)	-	-
$\boldsymbol{MA_1}$	-1.2143*** (0.1219)	-0.7464*** (0.1373)	-
$\boldsymbol{MA_2}$	0.9020*** (0.0640)	-	-
$\boldsymbol{\alpha}$	0.9280 (0.7052)	1.5464** (0.6531)	1.3338** (0.5222)
$\boldsymbol{\alpha_1}$	0.2930* (0.1549)	0.3966*** (0.1400)	0.3584*** (0.1236)
$\boldsymbol{\beta_1}$	0.6862*** (0.1381)	0.5571*** (0.1100)	0.6475*** (0.0596)
$\boldsymbol{LL}$	-1124.051	-1111.593	-1173.042
$\boldsymbol{\alpha_1 + \beta_1}$	0.97925	0.95374	1.00586
Jarque-Bera	430.42*** [0.0000]	195.56*** [0.0000]	572.93*** [0.0000]
Q(20)	19.9718** [0.0215]	27.9865* [0.0623]	18.1711* [0.0761]
$\boldsymbol{Q^2}$(20)	14.4819* [0.0672]	9.2050** [0.0448]	12.2612** [0.0335]
ARCH Test	0.7978** [0.0309]	0.3463* [0.0677]	0.8208** [0.0288]
Observation	433	433	433

B:UAE	(1) Banking	(2) Food	(3) Industrial
Parameters	GARCH(1, 1)-N	GARCH(1, 1)-N	GARCH(1, 1)-N
$\boldsymbol{\alpha}$	0.1826 (0.1221)	-0.1677 (0.1963)	0.1168 (0.20872)
$\boldsymbol{AR_1}$	-0.3992*** (0.0950)	-	0.7519*** (0.1049)
$\boldsymbol{MA_1}$	0.7414*** (0.082951)	-	-0.6495*** (0.1212)
$\boldsymbol{\alpha}$	0.1613 (0.2747)	0.8501 (0.6411)	4.2264** (1.6476)
$\boldsymbol{\alpha_1}$	0.4484** (0.1918)	0.3793*** (0.1125)	0.2322*** (0.0863)
$\boldsymbol{\beta_1}$	0.7454*** (0.039766)	0.7129*** (0.0795)	0.5225*** (0.1322)
$\boldsymbol{LL}$	-1813.849	-1854.782	-1799.856
$\boldsymbol{\alpha_1 + \beta_1}$	1.19391	1.09219	1.75477
Jarque-Bera	60541***. [0.0000]	11001***. [0.0000]	1064.7*** [0.0000]
Q(20)	85.0710** [0.0110]	33.0804** [0.0331]	37.4801*** [0.0045]

Q^2(20)	0.8040** [0.0200]	14.3407 [0.7066]	23.7343* [0.0639]
ARCH Test	0.0399 [0.7000]	0.1352* [0.993]	0.3314* [0.0727]
Observation	649	649	649

C: China	(1) Financial	(2) Food	(3) Industrial
Parameters	GARCH(1, 1)-N	GARCH(1, 1)-N	GARCH(1, 1)-N
α	0.2605 (0.2310)	0.3245** (0.1624)	0.2707 (0.1988)
AR_1	-	0.6483*** (0.1844)	0.6302*** (0.2087)
AR_2	-	-	-0.5209*** (0.1120)
MA_1	-	-0.5882*** (0.1872)	-0.6669*** (0.1768)
MA_2	-	-	0.6653*** (0.1004)
α	1.2790 (1.0377)	0.7804* (0.4163)	0.6869 (0.5280)
α_1	0.0875** (0.0423)	0.1885*** (0.0530)	0.1401*** (0.0505)
β_1	0.8814*** (0.0618)	0.7810*** (0.0597)	0.8398*** (0.063)
LL	-1827.534	-1588.949	-1682.811
$\alpha_1 + \beta_1$	1.9689	1.9695	0.9799
Jarque-Bera	95.972*** [0.0000]	8.5818** [0.0137]	10.263*** [0.0001]
Q(20)	28.4166* [0.0999]	44.3493*** [0.0005]	23.1428** [0.0100]
Q^2(20)	13.4764* [0.0625]	17.2260*** [0.0076]	24.0737 [0.1526]
ARCH Test	0.7762** [0.0420]	0.65375* [0.0675]	0.9414* [0.0944]
Observation	578	578	578

D:India	(1) Banking	(2)Consumer Durable	(3) Construction
Parameters	GARCH(1, 1)-N	GARCH(1, 1)-N	GARCH(1, 1)-N
α	0.3675*** (0.1637)	-0.0054 (0.1549)	0.2245 (0.2958)
AR_1	-	-	0.7981*** (0.1710)
MA_1	-	-	-0.7330*** (0.1854)
α	0.4546* (0.2463)	0.4808 (0.7253)	1.1658 (0.6762)
α_1	0.0848*** (0.0256)	0.1116 (0.1331)	0.0858*** (0.0224)
β_1	0.8960*** (0.0261)	0.8798 (0.1267)	0.8849*** (0.0327)
LL	-1882.873	-1945.623	-2066.746
$\alpha_1 + \beta_1$	0.98077	0.9913	0.97077
Jarque-Bera	16.557*** [0.0003]	1323.0*** [0.0000]	44.731*** [0.0000]
Q(20)	21.1210* [0.0900]	17.9301* [0.0920]	22.2957** [0.0191]

Q^2(20)	19.2373* [0.0773]	9.3884** [0.0400]	11.7072* [0.0620]
ARCH Test	0.9899** [0.0307]	0.5736** [0.0361]	0.5663** [0.0420]
Observation	649	649	649

Two-regime Simple Markov Switching Model without Crude oil

A:Saudi Arabia			
Estimated Parameters	(1)Banking/Financial	(2)Agriculture/ Food	(3) Industrial
Intercept			
φ_0	0.0376 (0.1292)	0.4837*** (0.1330)	0.4555 (0.1468)
φ_1	-0.3782 (0.5394)	-1.3707** (0.7087)	-1.5500* (0.8060)
Constant Regime volatility			
$\sqrt{h_0}$	1.9115 (0.1396)	2.2362 (0.1106)	2.4105 (0.1256)
$\sqrt{h_1}$	6.10393 (0.4950)	6.6276 (0.5819)	7.2934 (0.6377)
Constant Regime Probability			
γ^{00}	0.9588	0.9771	0.96804
γ^{11}	0.9134	0.9257	0.8981
Model Diagnosis			
LL	-1097.1260	-1092.9192	-1138.5537
LR	189.20*** [0.0000]	180.37*** [0.0000]	181.24*** [0.0000]
Normality Test	3.2249 [0.1994]	2.1953 [0.3337]	4.9359* [0.0848]
$Q(20)$	13.406** [0.0493]	20.359** [0.0357]	15.912** [0.0221]
Q^2(20)	13.406** [0.0593]	9.7793** [0.0120]	15.912* [0.0721]
ARCH Test	0.0517 [0.8203]	0.9296** [0.0355]	1.2644* [0.0615]

B:UAE			
Estimated Parameters	(1) Banking	(2) Food	(3) Industrial
Intercept			
φ_0	0.2642** (0.1058)	0.1946* (0.1126)	1.2714** (0.6468)
φ_1	-0.4228 (1.573)	-0.0782 (0.5165)	-0.3244*** (0.1248)
Constant regime volatility			
$\sqrt{h_0}$	2.3897 (0.0881)	1.9326 (0.1496)	7.4754 (0.6435)
$\sqrt{h_1}$	13.4436 (1.293)	7.7879 (0.5116)	2.1544 (0.1468)
Regime Probability			
γ^{00}	0.9787	0.9190	0.6551
γ^{11}	0.8410	0.8595	0.8897
Model Diagnosis			
LL	-1668.2812	-1771.67597	-1718.4204
LR	611.39*** [0.0000]	362.70*** [0.0000]	255.17*** [0.0000]

Normality Test	66.417*** [0.0000]	215.84*** [0.0000]	12.957*** [0.0015]
$\boldsymbol{Q(20)}$	24.962 [0.4645]	56.225*** [0.0000]	29.855 [0.2297]
$\boldsymbol{Q^2}$(20)	78.854 *** [0.0000]	96.039*** [0.0000]	32.530** [0.0380]
ARCH Test	52.724*** [0.0000]	106.34*** [0.0000]	2.9149 [0.0883]

C:China			
Parameters	(1) Financial	(2) Food	(3) Industrial
Intercept			
$\boldsymbol{\varphi_0}$	0.3858 (0.2371)	0.3987 (0.1729)	0.4108** (0.2076)
$\boldsymbol{\varphi_1}$	-0.0297 (0.6220)	0.0704 (0.6078)	-0.5346 (0.9053)
Constant regime switching			
$\sqrt{\boldsymbol{h_0}}$	3.7683 (0.2048)	2.8191 (0.1782)	3.6154 (0.1642)
$\sqrt{\boldsymbol{h_1}}$	8.5200 (0.5592)	6.6839 (0.5823)	8.1367 (0.7202)
Regime Probability			
$\boldsymbol{\gamma^{00}}$	0.9482	0.9699	0.9841
$\boldsymbol{\gamma^{11}}$	0.918	0.9280	0.9524
Model Diagnosis			
$\boldsymbol{LL}$	-1808.41348	-1593.7500	-1691.7699
$\boldsymbol{LR}$	93.867*** [0.0000]	128.34*** [0.0000]	117.79*** [0.0000]
Normality Test	0.3513 [0.8389]	11.375*** [0.0034]	10.305*** [0.0058]
$\boldsymbol{Q(20)}$	24.216 [0.2331]	41.649*** [0.0031]	35.614** 0.0171]
$\boldsymbol{Q^2}$(20)	15.919** [0.0216]	33.176** [0.0323]	28.061 0.1080]
ARCH Test	1.8896** [0.0698]	0.0598 [0.8069]	2.0409 [0.1537]

D:India			
Estimated Parameters	(1) Banking	(2) Food	(3) Construction
Intercept			
$\boldsymbol{\varphi_0}$	0.4940*** (0.1754)	-0.0312 (0.1667)	0.5689** (0.2415)
$\boldsymbol{\varphi_1}$	-0.3052 (0.6838)	-0.3363 (0.7010)	-1.2150 (0.9698)
Constant regime volatility			
$\sqrt{\boldsymbol{h_0}}$	3.6709 (0.1594)	3.51196 (0.1378)	4.7977 (0.2601)
$\sqrt{\boldsymbol{h_1}}$	7.6114 (0.6003)	9.2684 (0.5593)	10.1930 (0.8440)
Regime Probability			
$\boldsymbol{\gamma^{00}}$	0.9890	9.2697	0.9860
$\boldsymbol{\gamma^{11}}$	0.9590	0.9782	0.9455
Model Diagnosis			
$\boldsymbol{LL}$	-1882.3439	-1924.9905	-2058.9983
$\boldsymbol{LR}$	103.86*** [0.0000]	242.82*** [0.0000]	108.58*** [0.0000]

Normality test	3.1868 [0.2032]	14.289*** [0.0008]	1.9722 [0.3730]
$\boldsymbol{Q(20)}$	20.345** [0.0365]	24.533 [0.2199]	26.868 [0.1390]
$\boldsymbol{Q^2}(20)$	24.740** [0.0115]	32.877** [0.0348]	11.498 [0.9323]
ARCH Test	1.8170 [0.1782]	0.3386 [0.5608]	2.2457** [0.0345]

Two-regime Simple Markov Switching Model with crude oil price

A:Saudi Arabia			
Parameters	(1)Banking/Financial	(2)Agriculture/Food	(3) Industrial
Intercept			
$\boldsymbol{\varphi_0}$	-0.0074 (0.1216)	0.4226*** (0.1387)	0.4610*** (0.1425)
$\boldsymbol{\varphi_1}$	-0.1421 (0.5469)	-0.9708 (0.7804)	-2.0490* (1.217)
Constant crude oil movement			
$\boldsymbol{\delta_0}$	0.1715*** (0.0344)	0.1186*** (0.0382)	0.2362*** (0.0376)
$\boldsymbol{\delta_1}$	0.2167** (0.0798)	0.2209** (0.0945)	0.2497 (0.1328)
Constant regime volatility			
$\sqrt{\boldsymbol{h_0}}$	1.8338 (0.1382)	2.2320 (0.1291)	2.3913 (0.1488)
$\sqrt{\boldsymbol{h_1}}$	6.0600 (0.4892)	6.6538 (0.8118)	7.8498 (0.9534)
Regime Probability			
$\boldsymbol{\gamma^{00}}$	0.9544	0.9750	0.9554
$\boldsymbol{\gamma^{11}}$	0.8946	0.9069	0.7693
Model Diagnosis			
$\boldsymbol{LL}$	-1079.7417	-1084.0593	-1116.8116
$\boldsymbol{LR}$	194.34*** [0.0000]	170.21*** [0.0000]	178.58*** [0.0000]
Normality Test	2.2646 [0.3223]	1.0653 [0.5870]	0.9151 [0.6328]
$\boldsymbol{Q(20)}$	12.616* [0.0933]	24.146** [0.0361]	20.805 [0.4087]
$\mathbf{Q^2}(20)$	20.525 ** [0.0256]	11.111** [0.0433]	39.931*** [0.0051]
ARCH Test	0.30485* [0.0811]	1.2310 [0.2678]	1.0373** [0.1882]

B:UAE			
Parameters	(1) Banking	(2) Food	(3) Industrial
Intercept			
$\boldsymbol{\varphi_0}$	0.2182** (0.1071)	0.1904* (0.1100)	1.2689** (0.6322)
$\boldsymbol{\varphi_1}$	-0.1026 (1.746)	-0.0676 (0.5086)	-0.3409*** (0.1228)
Constant crude oil movement			
$\boldsymbol{\delta_0}$	0.1180 (0.02690)	0.0811*** (0.0270)	0.1697 (0.1247)
$\boldsymbol{\delta_1}$	0.1138 (0.2225)	0.1048 (0.09024)	0.0417 (0.0243)
Constant regime volatility			

$\sqrt{h_0}$	2.4011 (0.0940)	1.8921 (0.1210)	7.3034 (0.6134)
$\sqrt{h_1}$	13.9989 (1.475)	7.7241 (0.4747)	2.1094 (0.1513)
Regime Probability			
γ^{00}	0.9805	0.9199	0.6644
γ^{11}	0.8350	0.8635	0.8858
Model Diagnosis			
LL	-1658.4324	-1766.3799	-1715.525
LR	623.13*** [0.0000]	367.98*** [0.0000]	256.35*** [0.0000]
Normality Test	57.207*** [0.0000]	239.98*** [0.0000]	9.8653*** [0.0072]
$Q(20)$	15.326 [0.7574]	55.896*** [0.0000]	26.0898 [0.1629]
$\mathbf{Q}^2(20)$	68.813*** [0.0000]	97.409*** [0.0000]	31.508** [0.0488]
ARCH Test	46.279*** [0.0000]	107.12*** [0.0000]	3.2509* [0.0719]

C:China			
Parameters	(1) Financial	(2) Food	(3) Industrial
Intercept			
φ_0	0.2388 (0.2349)	0.3515** (0.1637)	0.3429* (0.1914)
φ_1	0.1462 (0.5511)	0.2276 (0.5289)	-0.2862 (0.7332)
Constant crude oil movement			
δ_0	0.2036 (0.07529)	0.0920** (0.0371)	0.1745*** (0.0456)
δ_1	0.0136 (0.09193)	0.1174 (0.08432)	0.0476 (0.1086)
Constant regime volatility			
$\sqrt{h_0}$	3.5719 (0.2114)	2.7380 (0.1583)	3.4908 (0.1674)
$\sqrt{h_1}$	8.1951 (0.5216)	6.4743 (0.5000)	7.8164 (0.6970)
Regime Probability			
γ^{00}	0.9470	0.96930	0.9842
γ^{11}	0.9316	0.9353	0.9603
Model Diagnosis			
LL	-1804.5219	-1589.3967	-1684.4797
LR	99.275*** [0.0000]	129.09*** [0.0000]	124.37*** [0.0000]
Normality Test	0.2587 [0.8787]	11.839*** [0.0027]	0.8232 [0.6626]
$Q(20)$	19.907 [0.4637]	47.092*** [0.0006]	38.411** [0.0079]
$\mathbf{Q}^2(20)$	14.408*** [0.0092]	31.565** [0.0482]	24.973 [0.2025]
ARCH Test	0.63436** [0.0261]	0.0961 [0.7566]	1.0963 [0.2955]

D:India			
Parameters	(1) Banking	(2)Consumer Durable	(3) Construction
Intercept			

φ_0	0.4873 (0.1695)***	-0.0300 (0.1664)	0.5817** (0.2387)
φ_1	-0.3003 (0.6782)	-0.3856 (0.6810)	-1.1366 (0.9017)
Constant crude oil movement			
δ_0	0.1400*** (0.04028)	0.0415 (0.03978)	0.2283*** (0.0515)
δ_1	0.1168 (0.1067)	0.3405 (0.1160)	0.1184 (0.1358)
Constant regime volatility			
$\sqrt{h_0}$	3.6209 (0.1369)	3.5012 (0.1353)	4.6327 (0.2417)
$\sqrt{h_1}$	7.60414 (0.5523)	9.0280 (0.5295)	9.9533 (0.7611)
Regime Probability			
γ^{00}	0.9892	0.99360	0.9846
γ^{11}	0.9596	0.9782	0.9458
Model Diagnosis			
LL	-1875.5346	-1920.0253	-2048.8308
LR	106.32*** [0.0000]	239.67*** [0.0000]	116.07*** [0.0000]
Normality Test	3.7245 [0.1553]	15.419*** [0.0004]	0.8232 [0.6626]
$Q(20)$	19.772* [0.0237]	24.247** [0.0318]	22.019** [0.0395]
$\mathbf{Q^2}(20)$	22.677*** [0.0050]	37.045** [0.0116]	16.138 [0.7081]
ARCH Test	2.9935* [0.0841]	0.2377 [0.6260]	2.9935* [0.0841]

Appendix C: MS-GARCH (1, 1) Models of Sectors with Crude Oil (No Vix)

Two Regimes Markov Switching GARCH (1, 1) Models of sectors with crude oil (No Vix)

A:Saudi Arabia [10.24.2007-27.01.2016]		
Parameters	(1)Banking/Financial	(2)Agriculture/Food
Intercept		
φ_0	0.0090 (0.1181)	0.4460*** (0.1523)
φ_1	0.0430 (0.5442)	-1.3538 (1.388)
Constant crude oil movement		
δ_0	0.1457*** (0.0388)	0.1208*** (0.0406)
δ_1	0.2791*** (0.08684)	0.4248** (0.1700)
Constant regime volatility		
$\sqrt{h_0}$	0.2440 (0.0850)	0.9978 (0.2371)
$\sqrt{h_1}$	2.2480 (1.336)	5.3545 (1.815)
GARCH effect		
α_0	0.0036 (0.0044)	0.1046 (0.0516)
α_1	0.2331 (0.1698)	0.7555 (0.7378)
β_0	0.9656 (0.0187)	0.6763 (0.1152)
β_1	0.7181 (0.1806)	1.14912e-008 (1.855e-006)
Regime Probability		
γ^{00}	0.9050	0.9363
γ^{11}	0.7979	0.5518
Model Diagnosis		
LL	-1075.3247	-1077.6685
LR	203.17*** [0.0000]	182.99*** [0.0000]
Normality Test	2.1595 [0.3397]	1.9975 [0.3683]
$Q(20)$	11.733** [0.0250]	30.833** [0.0574]
$Q^2(20)$	39.262*** [0.0062]	14.819* [0.0866]
ARCH Test	1.8389* [0.0758]	1.8545* [0.0740]

Note: No convergence for Saudi Arabia Industry Two Regimes Markov Switching GARCH (1, 1) Model.

B:UAE			
Parameters	(1)Banking	(2) Food	(3) Industrial
Intercept			

φ_0	0.2650*** (0.1018)	0.1692* (0.1004)	2.5113 (0.9175)
φ_1	-7.2804* (4.175)	-1.11341 (1.219)	-0.3500 (0.1104)
Constant crude oil movement			
δ_0	0.1074*** (0.0271)	0.0775 (0.0241)	0.1991 (0.1558)
δ_1	0.5619 (0.4251)	0.3933* (0.2313)	0.0361 (0.0231)
Constant regime volatility			
$\sqrt{h_0}$	1.2811 (0.2175)	0.757043 (0.2272)	3.4236 (1.371)
$\sqrt{h_1}$	14.5712 (2.823)	9.1472 (1.244)	1.3506 (0.2044)
GARCH effect			
α_0	0.2974 (0.0608)	0.300 (0.0512)	0.61789 (0.4385)
α_1	1.48509e-015 (0.0000)	4.55891e-008 (5.519e-006)	0.1372 (0.0495)
β_0	0.452571 (0.1163)	0.551684 (0.0727)	0.5302 (0.2350)
β_1	3.85534e-008 (5.437e-006)	6.59687e-006 (0.0020)	0.3855 (0.1292)
Regime Probability			
γ^{00}	0.9667	0.8724	0.7310
γ^{11}	0.9200	0.8990	0.8557
Model Diagnosis			
LL	-1631.5000	-1736.5843	-1702.1086
LR	677.00*** [0.0000]	427.58*** [0.0000]	283.18*** [0.0000]
Normality Test	4.2647 [0.1186]	2.9100 [0.2334]	16.488*** [0.0003]
$Q(20)$	24.520** [0.0204]	34.645** 0.0221]	28.578* [0.0964]
$Q^2(20)$	28.086 *** [0.0074]	10.855 [0.9499]	12.209*** [0.0087]
ARCH Test	1.4565** [0.0279]	2.7588 * [0.0972]	1.0730 [0.3007]

C:China		
Parameters	(2) Food	(2) Industrial
Intercept		
φ_0	-0.0528 (0.1801)	-0.2059 (0.2126)
φ_1	1.0239 (0.3394)	0.9612*** (0.3065)
Constant crude oil movement		
δ_0	0.2047*** (0.0630)	0.3544*** (0.0725)
δ_1	0.0260 (0.0446)	0.0225 (0.0486)
Constant regime volatility		
$\sqrt{h_0}$	1.7571 (0.6272)	3.31070 (0.1763)
$\sqrt{h_1}$	1.0003 (0.3782)	0.8385 (0.3144)
GARCH effect		

α_0	0.1205 (0.0700)	0.0824 (0.0681)
α_1	0.2452 (0.0669)	0.2234 (0.0665)
β_0	0.5096 (0.2619)	2.07027e-007 (6.679e-005)
β_1	0.7541 (0.0638)	0.7947 (0.0575)
Regime Probability		
γ^{00}	0.9926	0.9923
γ^{11}	0.9957	0.9958
Model Diagnosis		
LL	-1576.3736	-1669.9721
LR	155.13*** [0.0000]	153.38*** [0.0000]
Normality Test	4.0084 [0.1348]	7.9449** [0.0188]
Q(20)	40.082*** [0.0049]	35.982** [0.0155]
Q^2(20)	18.679 [0.5428]	23.722** [0.0548]
ARCH Test	0.16137** [0.0080]	0.18959* [0.0634]

D:India			
Parameters	(1) Banking	(2)Consumer Durable	(3) Construction
Intercept			
$\boldsymbol{\varphi_0}$	0.5454 (0.4124)	-0.0735 (0.1574)	2.0754*** (0.4382)
$\boldsymbol{\varphi_1}$	0.305388* (0.1812)	0.2661 (1.386)	-1.23113** (0.4814)
Constant crude oil movement			
$\boldsymbol{\delta_0}$	0.4378 (0.1183)	0.0736** (0.0367)	0.0909 (0.0961)
$\boldsymbol{\delta_1}$	0.0695 (0.0465)	0.6564** (0.2664)	0.251063 (0.0819)
Constant regime volatility			
$\sqrt{\boldsymbol{h_0}}$	3.1929 (0.3701)	0.4062 (0.0975)	1.46548 (0.5142)
$\sqrt{\boldsymbol{h_1}}$	0.5484 (0.2165)	1.6775 (0.7127)	9.46508e-021 (0.0000)
GARCH effect			
α_0	5.70550e-013 (0.0000)	0.0212619 (0.0122)	2.08301e-014 (0.0000)
α_1	0.0843 (0.0279)	2.15044e-009 (5.675e-007)	0.0979 (0.0267)
β_0	5.28279e-007 (6.763e-005)	0.9580 (0.0153)	0.8284 (0.1150)
β_1	0.909189 (0.0308)	0.9812 (0.0179)	0.9206 (0.0210)
Regime Probability			
γ^{00}	0.964684	0.9888	0.8864
γ^{11}	0.9948	0.9045	0.926551
Model Diagnosis			
LL	-1869.3734	-1899.6415	-2038.6384
LR	118.64***	280.43***	136.45***

	[0.0000]	[0.0000]	[0.0000]
Normality Test	13.508*** [0.0012]	2.9028 [0.2342]	4.1837 [0.1235]
$Q(20)$	21.163* [0.0876]	17.555 [0.6167]	19.110 [0.5147]
$Q^2(20)$	17.697*** [0.0074]	20.141** [0.0491]	17.208 [0.6394]
ARCH Test	1.5861*** [0.0083]	0.53662* [0.0641]	1.3100** [0.0528]

Note: No convergence for Saudi Arabia Industrial sector and China Finance Sector.

Appendix D: Two Regime MS-GARCH Estimates

Panel A.	Saudi Arabia			United Arab Emirates		
Sectors	**Banking & Financial**	**Agric & Food**	**Industry**	**Banking**	**Food**	**Industry**
Models	MS-GARCH	MS-GARCH	MS-GARCH	MS-GARCH	MS-GARCH	MS-GARCH
Constant regime switching						
φ_0	-0.0093 (0.1168)	0.353*** (0.1278)	0.394*** (0.1414)	2.1328*** (0.7827)	0.0330 (0.0966)	2.5067*** (0.6374)
φ_1	-0.0086 (0.5184)	-1.763 (1.438)	-3.355** (1.540)	-0.1275 (0.1592)	-0.1239 (1.402)	-0.718*** (0.2069)
Crude oil movement						
δ_0	0.1387*** (0.0388)	0.107** (0.0367)	0.174*** (0.0373)	-0.0228 (0.1276)	-0.0047 (0.0204)	-0.2128 (0.1412)
δ_1	0.1547* (0.0869)	0.109 (0.2861)	0.127 (0.2872)	-0.0049 (0.0412)	0.6314** (0.2842)	-0.0230 (0.0415)
Global economic factor						
ω_0	-0.0225** (0.0109)	-0.036*** (0.0112)	-0.043*** (0.0127)	-0.0320 (0.0607)	0.0045 (0.0104)	0.0224 (0.0400)
ω_1	-0.0699* (0.0384)	-0.147 (0.1020)	-0.125 (0.0817)	0.0075 (0.0134)	0.2006** (0.0951)	-0.0052 (0.0200)
Regime switching volatility						
$\sqrt{h_0}$	0.2928*** (0.1206)	1.031 (0.2198)	0.376 (0.0972)	0.3941 (0.6308)	3.47232e-011 (0.0000)	3.1854 (0.9212)
$\sqrt{h_1}$	5.2949*** (0.5832)	6.010 (4.726)	3.756 (2.165)	0.2622 (0.1850)	0.0001 (0.0906)	0.9913 (0.2505)
GARCH effect						
α_0	3.25313e-015*** (0.0000)	0.089 (0.0473)	0.017*** (0.0068)	0.0737 (0.0553)	0.3105*** (0.0838)	1.2497 (0.6924)
α_1	0.2141 (0.1494)	0.166 (0.2582)	0.372 (0.2779)	0.1468 (0.0703)	0.0835 (0.0848)	0.0684 (0.0762)
β_0	0.9696*** (0.0218)	0.701*** (0.1049)	0.939*** (0.0196)	0.9446 (0.0394)	0.5796*** (0.0610)	0.1773 (0.1582)
β_1	1.35051e-008 (3.561e-006)	0.248 (1.044)	0.549 (0.3116)	0.7545 (0.0774)	0.9489*** (0.0456)	0.4494*** (0.2037)
Regime probabilities (%)						
γ^{00}	0.9349	0.967	0.953	0.8341	0.8120	0.6652
γ^{11}	0.8610	0.7030	0.625	0.9098	0.2222	0.7822
Model diagnosis						
log-likelihood	-1071.232	-1071.446	-1089.560	-502.3291	-530.803	-541.910
Linearity LR-test	201.36 [0.0000]	175.35*** [0.000]	210.14*** [0.000]	64.054*** [0.0000]	122.51*** [0.0000]	85.306*** [0.0000]
$Q20$	13.323 [0.8631]	15.314 [0.7582]	27.097 [0.1326]	19.231 [0.5068]	37.574* [0.0100]	28.180 [0.1052]

Panel B.	China			India		
Sectors	**Financial**	**Food**	**Industry**	**Banking**	**Consumer durable**	**Constructio n**
Models	MS-GARCH	MS-GARCH	MS-GARCH	MS-GARCH	MS-GARCH	MS-GARCH
Constant Regime Switching						
φ_0	0.233 (0.2388)	0.377** (0.1505)	0.037 (0.2143)	0.5454 (0.4124)	-0.0735 (0.1574)	0.497** (0.2199)
φ_1	0.047 (0.5455)	-0.091 (0.8185)	0.760** (0.3339)	0.3053* (0.1812)	0.2660 (1.386)	-1.424 (0.9425)
Crude oil movement						
δ_0	0.169** (0.0776)	0.049** (0.0364)	0.156** (0.0613)	0.4377*** (0.1183)	0.0736** (0.0367)	0.181*** (0.0500)
δ_1	-0.048 (0.0928)	0.055 (0.1719)	0.053 (0.0602)	0.0695 (0.0464)	0.6563** (0.2664)	-0.070 (0.1343)
Global economic factor						
ω_0	-0.046** (0.0227)	-0.024** (0.0116)	-0.0007 (0.0163)	-	-	-0.056*** (0.0171)
ω_1	-0.162*** (0.0452)	-0.295*** (0.0741)	-0.150*** (0.0292)	-	-	-0.482*** (0.0912)
Regime switching volatilities						
$\sqrt{h_0}$	2.587 (1.118)	0.753 (0.3099)	3.228 (0.1539)	3.1929 (0.3701)	0.4061 (0.0975)	1.352 (0.4303)
$\sqrt{h_1}$	6.260 (1.642)	1.116 (1.344)	2.007 (0.4959)	0.5483 (0.2165)	1.6775 (0.7127)	8.496 (20.25)
GARCH Effect						
α_0	3.445E-08*** (1.363E-05)	0.069** (0.04965)	2.193E-01*** (0.0000)	5.70550e-013 (0.0000)	0.0212 (0.0122)	0.0341 (0.0228)
α_1	0.125* (0.09333)	1.11E-08*** (2.063E-06)	0.222* (0.0734)	0.0843 (0.0279)	2.15044e-009 (5.675e-007)	0.0007 (0.0098)
β_0	0.452 (0.4630)	0.864* (0.0895)	2.61E-07*** (6.524E-05)	5.28279e-007 (6.763e-005)	0.9580 (0.015)	0.882*** (0.0637)
β_1	0.251 (0.3554)	0.971* (0.0719)	0.683* (0.0925)	0.9091 (0.0307)	0.9812 (0.0179)	0.113 (4.229)
Regime Probabilities						
γ^{00}	0.945	0.981	0.992	0.9647	0.9888	0.991
γ^{11}	0.935	0.898	0.995	0.9948	0.9045	0.957
Model Diagnosis						
log-likelihood	-1792.492	-1572.025	-1664.064	-1869.373	-1899.641	-2024.600
Linearity LR-test	101.78*** [0.000]	136.31*** [0.000]	140.81*** [0.000]	118.64*** [0.0000]	280.43*** [0.0000]	128.48*** [0.0000]
$Q20$	21.575 [0.3640]	23.425 [0.2684]	11.735 [0.9249]	21.163 [0.3876]	17.555 [0.6167]	22.763 [0.3006]

Note: Convergence for the two regime MS-GARCH model for the banking and consumer durable sector in India was achieved by estimating the model without the VIX index.

Appendix E: Asymmetric Model for the Time Varying Transition MS-DR Estimates

Asymmetric model for the Time varying transition MS-DR model

Panel A: Saudi Arabia Time varying transition probability estimates						
$POP_{t-1}{}^{+}$				$NOP_{t-1}{}^{-}$		
	Banking/Financial	**Agric & Food**	**Industry**	**Banking/ Financial**	**Agric & Food**	**Industry**
φ^{00}	2.2089*** (0.4588)	6.4719 (2.7790)	0.8200 (0.6578)	4.5976 (0.8702)	4.4627*** (0.8318)	7.7471*** (1.9329)
$\delta_{t-1}{}^{00}$	4.0049 (4.8600)	-0.2620 (0.2281)	0.1134 (0.1903)	0.5718 (0.1738)	0.4179** (0.1780)	1.0179 (0.2950)
$\omega_{t-1}{}^{00}$	0.0013 (0.0375)	-0.2136** (0.1068)	0.0884** (0.0426)	0.0443 (0.0435)	-0.0057 (0.0470)	0.0567 (0.0406)
φ^{10}	-1.7713*** (0.5459)	-2.5492** (1.0911)	-4.6569*** (0.8812)	-2.2634** (0.9265)	-1.1101 (0.8518)	-1.4919** (0.7770)
$\delta_{t-1}{}^{10}$	-0.2656 (0.2835)	-0.0050 (0.1638)	0.1824** (0.0996)	0.1012 (0.3695)	0.1916 (0.2280)	0.3115 (0.3405)
$\omega_{t-1}{}^{10}$	-0.0251 (0.0349)	-0.0970** (0.0492)	0.1583*** (0.0509)	-0.1140** (0.0618)	-0.0840 (0.0556)	-0.0797 (0.0615)
Regime probability (%)						
γ^{00}	0.9465	0.9606	0.6930	0.9223	0.9404	0.9380
γ^{11}	0.8864	0.8878	0.9438	0.8588	0.7518	0.8216
Model diagnosis						
log-likelihood	-1076.123	-1070.057	-1099.064	-1059.232	-1064.480	-1085.923
$Q^2(20)$	10.506 (0.958)	18.175 (0.576)	15.522 (0.746)	13.615 (0.849)	7.3312 (0.995)	6.2492 (0.999)

Panel B: UAE Time varying transition probability estimates						
$POP_{t-1}{}^{+}$				$NOP_{t-1}{}^{-}$		
	Banking	**Food**	**Industry**	**Banking**	**Food**	**Industry**
φ^{00}	3.4004*** (0.5010)	1.5270*** (0.4322)	0.2560 (0.4180)	4.8577*** (0.5953)	2.6207 (0.3999)	2.1429*** (0.3271)
$\delta_{t-1}{}^{00}$	0.4302 (0.5437)	0.2193 (0.2991)	0.3176 (0.2089)	0.3517*** (0.1169)	0.0687 (0.1565)	0.0098 (0.0823)
$\omega_{t-1}{}^{00}$	-0.0338 (0.0229)	0.0023 (0.0330)	0.0506 (0.0321)	-0.0176 (0.0221)	-0.0218 (0.0407)	-0.0005 (0.0237)
φ^{10}	-1.5372** (0.7106)	-2.8247*** (0.5112)	-2.2698*** (0.3531)	-1.4186* (0.7632)	-1.6849 (0.3770)	-0.6798* (0.4061)
$\delta_{t-1}{}^{10}$	-0.1542 (0.1779)	0.1687 (0.1417)	0.0616 (0.0951)	0.6752 (0.4626)	0.1269 (0.1396)	0.0106 (0.1163)
$\omega_{t-1}{}^{10}$	-0.1241* (0.0732)	0.0481 (0.0453)	0.0020 (0.0239)	-0.1618* (0.0939)	0.0245 (0.0350)	-0.0337 (0.0300)
Regime probability (%)						
γ^{00}	0.9753	0.8606	0.6618	0.9675	0.9193	0.8933
γ^{11}	0.7931	0.9103	0.8955	0.7916	0.8645	0.6617
Model diagnosis						
log-	-1650.165	-1763.585	-1698.723	-1638.867	-1760.339	-1699.553

likelihood						
$Q^2(20)$	5.1851 (1.000)	14.383 (0.811)	46.889 (0.173)	4.3936 (1.000)	31.759 (0.146)	14.586 (0.800)

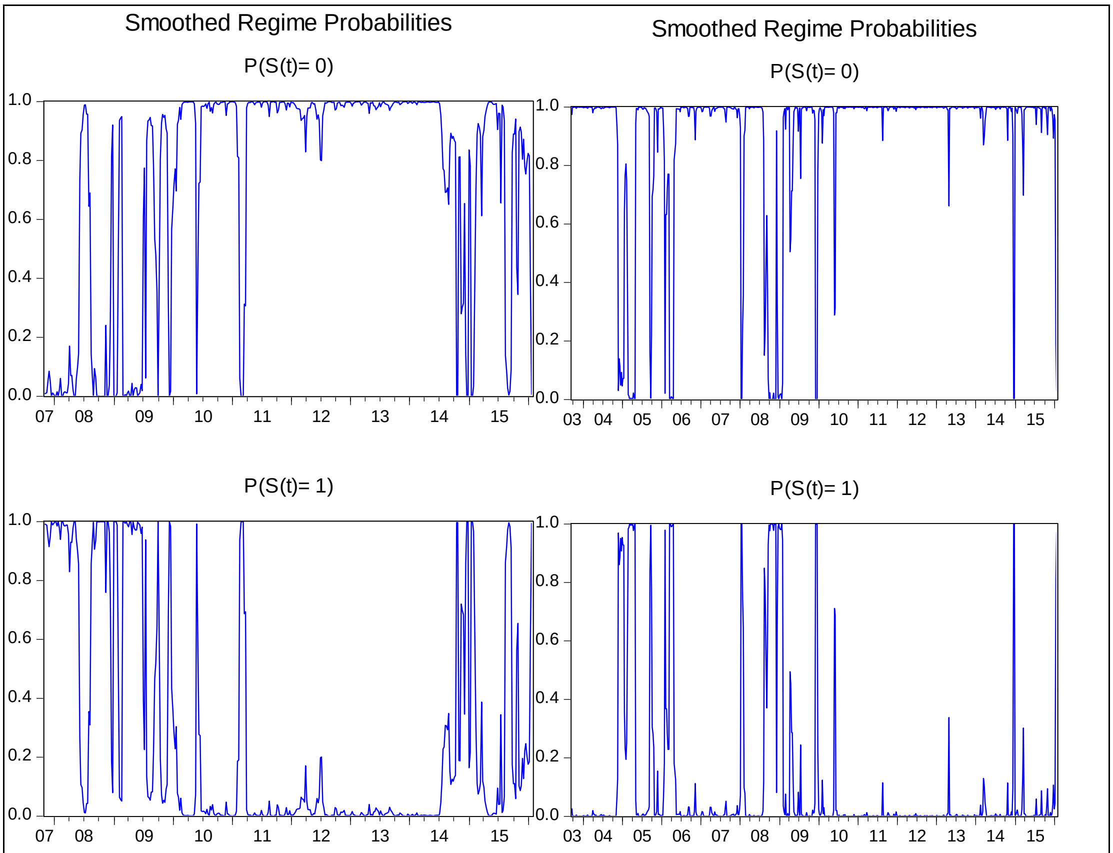
Panel C: China Time varying transition probability estimates						
$\mathrm{POP_{t-1}}^+$				$\mathrm{NOP_{t-1}}^-$		
	Financial	**Food**	**Industrial**	**Financial**	**Food**	**Industrial**
φ^{00}	4.5348*** (1.1081)	5.4704*** (1.5312)	4.7770*** (1.4156)	2.0798 (0.4373)	4.9844*** (1.2486)	3.2857*** (0.5213)
${\delta_{t-1}}^{00}$	-0.4502*** (0.1527)	-0.5556** (0.2469)	-0.2513** (0.1209)	-1823.070 (545673.9)	0.4557** (0.1877)	-861.7814 (23876.36)
${\omega_{t-1}}^{00}$	0.0191 (0.0486)	-0.0230 (0.0464)	-0.1048* (0.0637)	-0.0065 (0.0447)	0.0353 (0.0384)	-0.0447 (0.0535)
φ^{10}	-3.5608*** (0.8568)	-3.1904*** (0.8673)	- 9.2951*** (3.4961)	-2.1925*** (0.5850)	-3.7175*** (1.1420)	-2.0552*** (0.6438)
${\delta_{t-1}}^{10}$	0.2160 (0.1499)	0.0114 (0.2897)	1.0642** (0.4820)	0.2791 (0.2254)	-0.3392** (0.1747)	49.7971 (3999.622)
${\omega_{t-1}}^{10}$	-0.0711 (0.0516)	-0.0767 (0.0491)	0.0922 (0.0693)	0.0467 (0.0340)	-0.0714 (0.0562)	0.0650 (0.0550)
Regime probability (%)						
γ^{00}	0.9485	0.9623	0.9655	0.9449	0.9609	0.9814
γ^{11}	0.9341	0.9427	0.9683	0.9198	0.9280	0.9397
Model diagnosis						
log-likelihood	-1786.007	-1568.734	-1663.611	-1790.061	-1572.596	-1670.791
$Q^2(20)$	9.8508 (0.971)	21.422 (0.373)	21.063 (0.393)	17.394 (0.62)	28.717 (0.193)	22.499 (0.314)

Panel D: India Time varying transition probability estimates						
$\mathrm{POP_{t-1}}^+$				$\mathrm{NOP_{t-1}}^-$		
	Banking	**Consumer durables**	**Construct ion**	**Banking**	**Consumer durables**	**Constructi on**
φ^{00}	5.1250*** (0.7950)	5.1507*** (1.0629)	2.8636** (1.2829)	4.8990*** (1.0481)	4.2474*** (1.0953)	5.6407*** (1.2106)
${\delta_{t-1}}^{00}$	-0.2970*** (0.1144)	-0.2922** (0.1338)	4.1611 (16.575)	-0.6945 (0.4926)	-265.2168 (97076.2)	-0.5443 (0.3573)
${\omega_{t-1}}^{00}$	-0.0857*** (0.0331)	-0.0646** (0.0279)	0.1097 (0.1141)	-0.1200** (0.0536)	0.1148* (0.0712)	-0.1243** (0.0518)
φ^{10}	-3.4438*** (1.0118)	-4.1686*** (1.3539)	- 4.1762*** (0.8268)	-3.4879*** (1.2158)	-7.3402*** (2.0376)	-3.9303*** (1.3426)
${\delta_{t-1}}^{10}$	-0.6087 (0.5352)	-0.2512 (0.3880)	-28.1997 (228.34)	0.0370 (0.2584)	0.7120* (0.4017)	-0.0384 (0.1416)
${\omega_{t-1}}^{10}$	-0.1802** (0.0738)	-0.1738 (0.0649)	0.0416 (0.0283)	-0.0913 (0.0937)	0.1772** (0.0708)	-0.0892 (0.0870)
Regime probability (%)						
γ^{00}	0.9760	0.9811	0.9598	0.9894	0.9808	0.9937
γ^{11}	0.9377	0.9541	0.9904	0.9539	0.9961	0.9663
Model diagnosis						
log-likelihood	-1846.042	-1899.245	-2023.94	-1849.332	-1895.674	-2023.512

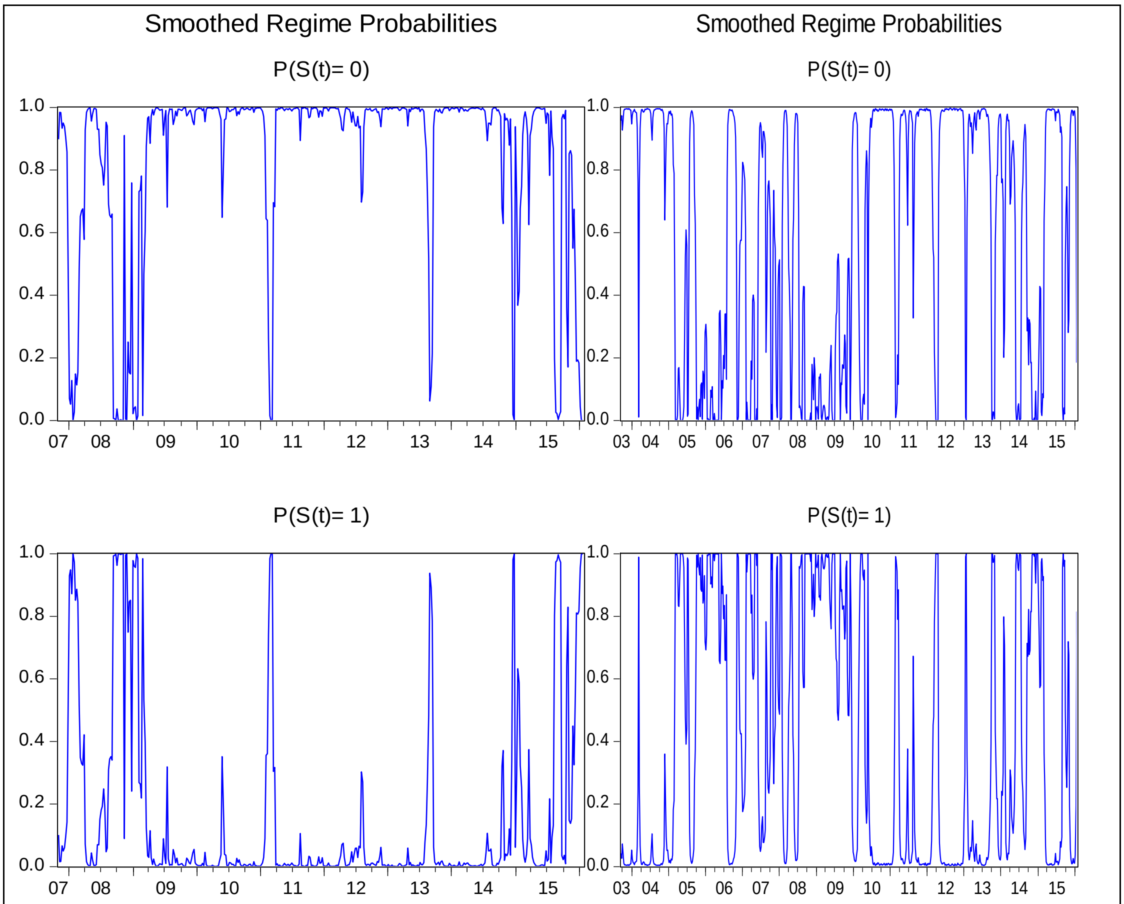
$Q^2(20)$	14.468 (0.806)	22.734 (0.302)	19.507 (0.489)	21.282 (0.381)	23.414 (0.269)	14.648 (0.796)

Note: The table gives the result of the Asymmetric model for the time varying transition MS-DR with intercept term $\varphi_i^{\ ii}$; Brent crude oil price $r_i^{\ il}$; the global factor $VIX_i^{\ ii}$; regime probability γ^{ii}. ( ) are robust standard errors; [ ] are *p*-values; *** indicates significance at 1%, ** indicates significance at 5% and * indicates significance at 10% level. $\mathrm{POP}_{\mathrm{t-1}}{}^{+}$ is the positive crude oil price shocks and $NOP_{t-1}{}^{-}$ is the negative crude oil price shocks. Q statistics are Ljung-Box squared residuals at lags (20) which follow χ^2 distribution with df depending on the lag length.

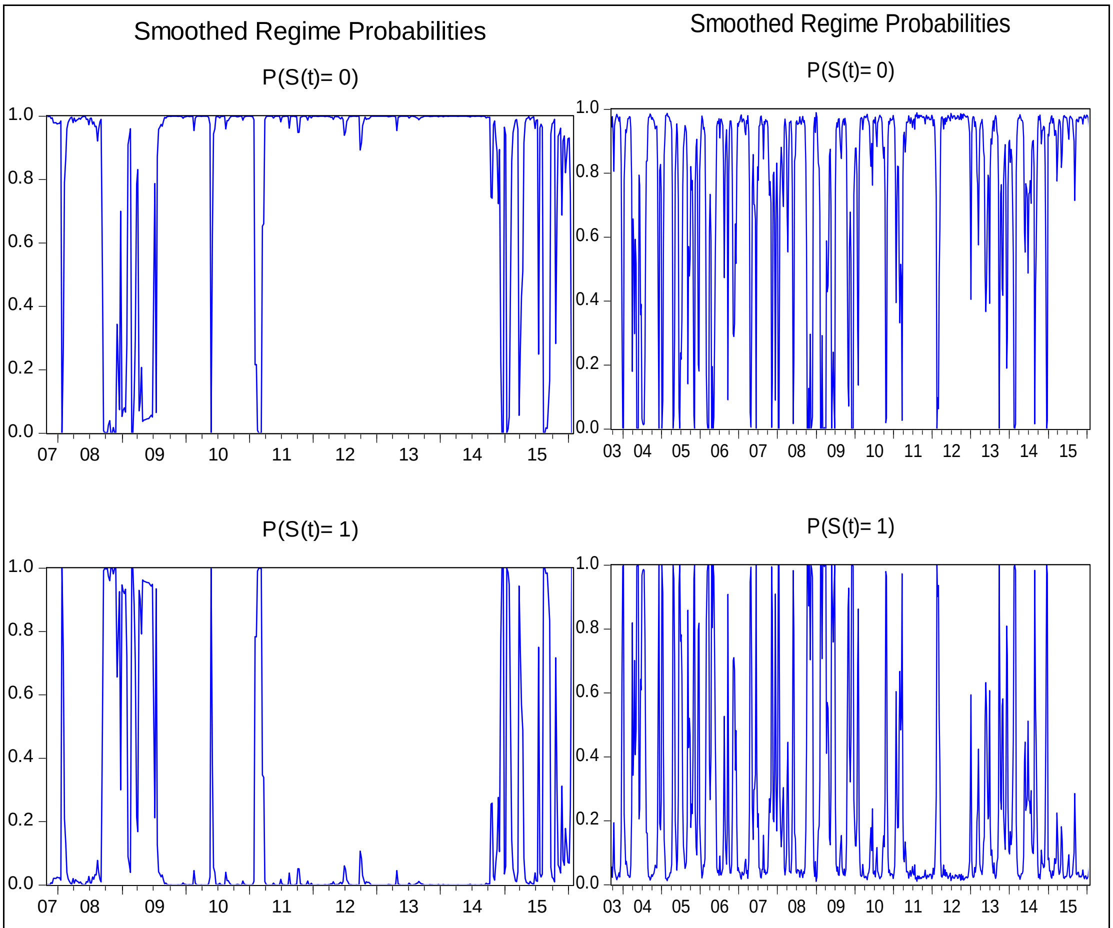
Appendix F: Graphs of the Time Varying Smoothed Regime Transition Probabilities



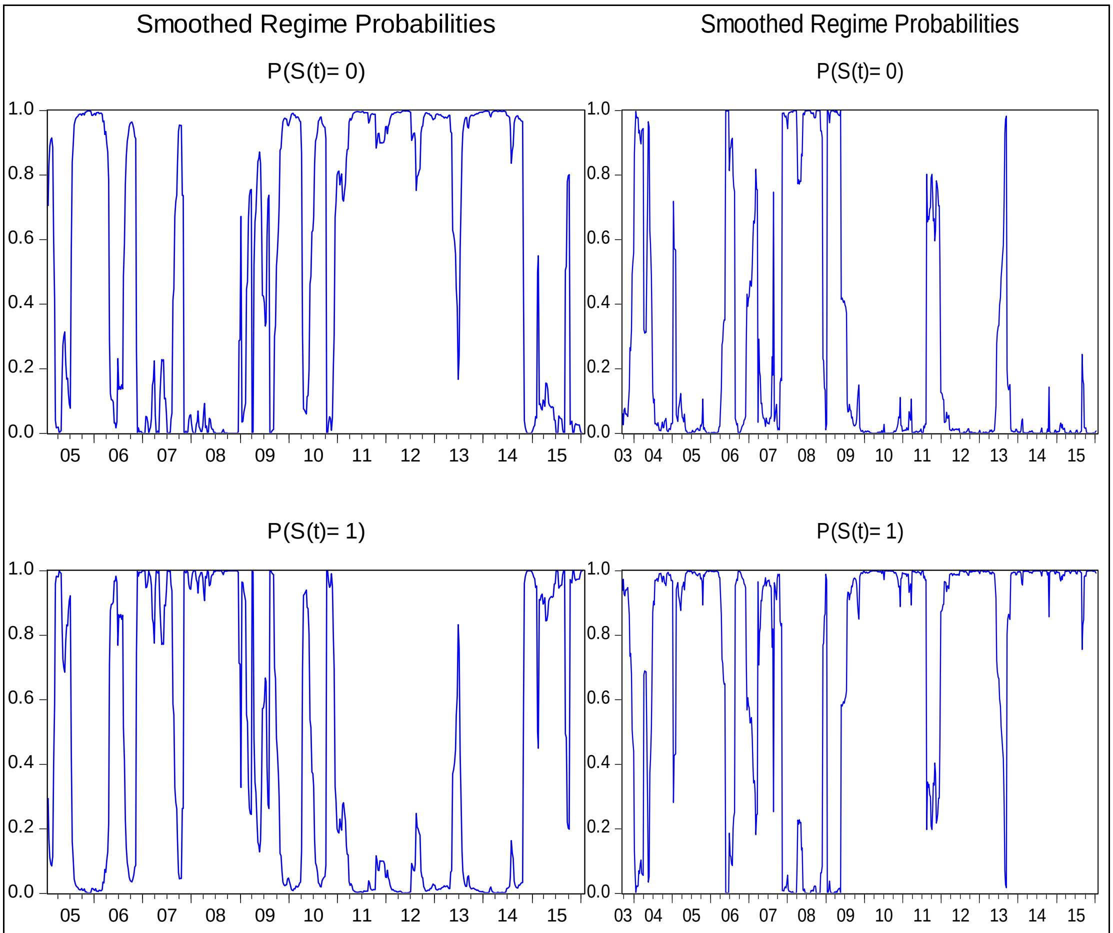
Saudi Banking/Financial Sector **UEA Banking sector**



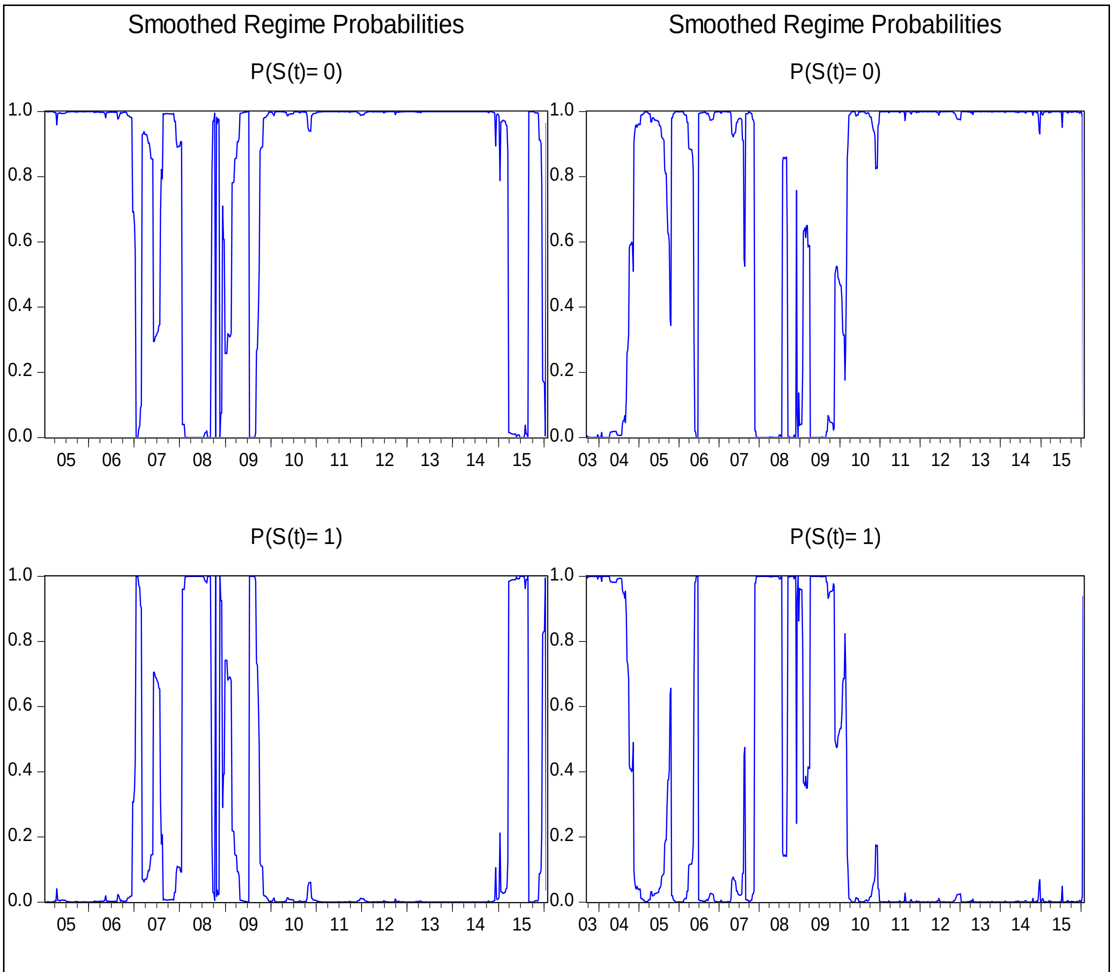
Saudi Agriculture/food sector **UAE Food sector**



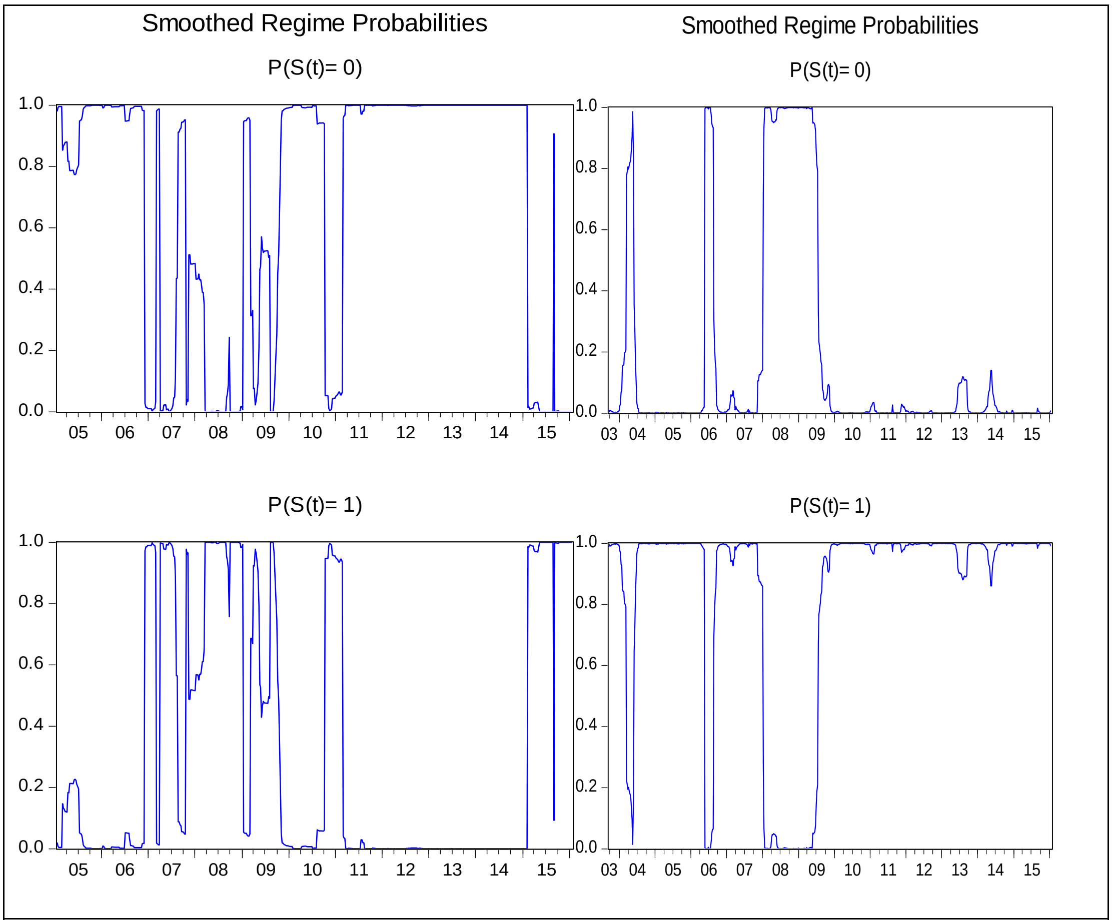
Saudi Industrial sector	**UAE Industry sector**



China Financial sector **India Banking sector**



China Food sector **India consumer durable**



China Industry sector **India construction sector**

Graphs of the time varying smoothed regime transition probabilities.