Do Oil Prices affect Kuwait Sectoral Stock Prices: Non-Linear Cointegration Evidence

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Abstract
This paper tests the asymmetric long-run dynamics between oil price changes and Kuwait stock prices at the sectoral. Our daily data on Brent and West Texas Intermediate nominal spot crude oil prices spans from January 3, 2000 to December 9, 2015 for some sectors and from May 14, 2012 to December 9, 2015 for others. We used a nonlinear cointegration methodology in which the nonlinear autoregressive distributed lags is utilized to allow for estimating asymmetric long run as well as short run coefficients in a cointegration framework. The findings show asymmetric long run effects between oil prices and some Kuwait sectoral stock prices. As for the short run, the findings show asymmetric effect in case of WTI price measure, but symmetric effect in case of Brent price measure. The paper shows that using nonlinear models contribute better to understanding the long run relationships, hence, serving more in policy-making. Finally, the causality tests, show that there is bidirectional causality between Brent positive oil price shock and stock prices of the following sectors: Banks, Consumer goods, Consumer services, Industrials and Real Estate. On the other hand, a unidirectional causality running from Brent negative oil price shock to stock prices of Banks, Consumer goods, Consumer services, Industrials and Real Estate. As for WTI price measure, we find bidirectional causality between WTI positive oil price shock and stock prices of Consumer services and Industrials, and unidirectional causality from WTI negative oil price shock to stock prices of Consumer services and Industrials.

JEL Classifications: G12, F3, Q43
Key words: Oil Price, Kuwait Stock Market, nonlinear cointegration, unit root

1. Introduction

For the last few decades, mainly during the 1970s and 1980s, the world oil prices have shown great volatility given the extensive usage of oil whether as a final consumption product or as a production input. This volatility shows tremendous impact on the global and national markets, reflecting the prominent role of oil prices in the economy. As such, given the seminal contribution of Hamilton (1983), the influence of oil price instability on most macro-economic indicators has been evidenced by a remarkable number of studies where the possibility of non-linearity between oil price changes and economic mobility is sanctioned, demonstrating that oil price increase (negative oil price impact) tend to have wider influence on growth than do oil price decrease (positive oil price impact) (See Lardic and Mignon, 2008; Arouri *et al.* 2011 and Zhang, 2013).

More recently, the focus has shifted to the association between oil price changes and stock markets where the association between the two variables has become a recognizable field of research in energy and financial economics, (see for example: Saorsky, 1999; Blanchard and Gali, 2007; Park and Ratti, 2008; and Driesprong *et al.* 2008; Herrera and Pesavento, 2009;). One rationale for using oil price changes as a factor affecting stock prices is that it is commonly acknowledged that crude oil price changes exert a critical and a prominent impact on most economic activities where stock market acts as the barometer of the overall economy, hence oil price changes are likely to have a dominate influence on the behavior of stock prices, (see Arouri and Nguyen, 2011). Likewise, oil price changes can influence firms' future expected cash flows since oil is counted as major input of production. Henceforth, an increase in oil prices would increase production costs, leading to lower levels of profits, subsequently causing a depreciation in stock prices (see Apergis and Miller, 2009; Arouri and Nguyen, 2010; and Moya-Martinez *et al.* 2014). Additionally, changes in oil prices also influence the discount rate that is usually used while valuing equity securities. An increase in oil prices would create higher inflationary pressures, leading to higher interest rates, causing in turn negative impact on stock prices throughout the higher discount rates, according to the standard equity valuation model (See Miller and Ratti, 2009; and Mohanty *et al.* 2011).[1]

By using a nonlinear cointegration methodology, this paper aims to test for the potential asymmetric dynamics between oil price changes and stock prices at the disaggregate sectoral level for Kuwait as an oil exporting economy, considering that oil price changes affect sectors differently depending on many factors, such as whether the sector is a net producer or net consumer of oil, the extent of the market competiveness, the capability of transferring the increase in oil prices to consumers, and finally, the capability and availability of the hedging instrument in the market place. We argue that the nonlinear cointegration test would lead to the identification of heterogeneity of sector sensitivities to the oil price changes, signaling better understanding for energy policy decision makers. Furthermore, following Moya-Martinez *et al.* (2014), we argue that the effect of oil price changes on stock market has excessive impact on most economies whether oil-importing or oil-exporting markets. As for the oil-importing markets, an increase in oil prices would mean more expensive energy cost, causing a negative impact on the stock market via its negative effect on firms' expected earnings. However, the opposite is correct for the oil-exporting markets where higher income and wealth can be attained.

[1] For example, higher oil prices would result in an increase in cost of inputs, upsurge in imports, leading to a proliferation in the inflation rate. In the market place, this leads to an increase in market interest rate, signaling higher cost of capital for most corporations, leading to lower stock returns. Furthermore, since oil price upsurge increases production costs for non-oil industries, this expected to trigger an increase in the cost of imported capital commodities, hence reversely affecting the possibilities of profits for the market listed corporations. Inclusive, it is quite crucial for market listed firms, given the stock valuation theory in which the fair value of a stock is simply equal to the sum of its discounted future cash flows at different time horizons where an appropriate discount rate is applied. So, ascertaining the persuasive influences impacting these cash flows and its related discount rate is pertinent, considering oil price is one of those foremost inducing factors that cause volatility in the estimated corporate cash flows, hence causing volatility in firm's stock price.

According to the literature, so far, the empirical findings on the association between oil price changes and stock markets show ambiguous outcome, reflecting the volatile dynamics between the two variables over time. Having said this, from sectoral perspective, there is some sort of consensus that the Oil & Gas industries together with the Mining industries both tend to be positively impacted by positive changes in oil prices, meanwhile, the opposite is true for the other industries, namely Transportation, Manufacturing, Food, Chemicals, Medical, Computer, Real Estate and General Services. Uncertain results are also acknowledged for industries such as Electricity, Engineering and financial industries (See for more details: Hammoudeh and Li, 2005; El-Sharif *et al.* 2005; Boyer and Filion, 2007; Nandha and Faff, 2008; Kilian and Park, 2009; Arouri and Nguyen, 2010; Arouri *et al.* 2011; Elyasiani *et al.* 2011; Broadstock *et al*. 2012; Degiannakis *et al.* 2013; and Broadstock and Filis, 2014). On the whole, the above mentioned results on the association between oil price changes and stock markets can be categorized into three major groups; one, positive impact of the oil price changes on oil-related and oil-substitute industries, second, negative effect on oil-using industries, and third, no significant impact on non-oil-related industries such as the financial industry.

On the regional framework basis, few local studies have looked at the effect of oil prices on entire stock markets in developing countries, such as the GCC countries in general and Kuwait in particular, and, moreover, this influence from a sector perspective even received lesser attention.[2] On country specific perception, we argue that for an oil producing economy, Kuwait as per our case, the nexus between oil prices and sectoral stock prices is very much crucial where a change in oil prices would have quite equivocal impact on the country's economy, since oil

[2] Bearing in mind that the stock markets of the GCC countries (including Kuwait) experienced significant growth both in terms of market size and trading activity during much of 2000s, stimulated by the flow of large amounts of petro-dollars into these economies, forming an environment that can be characterized by the phenomenon "too much money chasing too few stocks", (Balcilar *et al.* 2013; Demirer *et al.* 2015).

industry companies are state-owned entities. The consequential upsurge in oil prices would buildup revenues of exports, and hence fostering public expenditures and boosts growth. Such upshot would counts positively to the countries long-term economic robustness and volatility absorption capacity towards fluctuation in many structural economic and wealth influencing factors. On the contrary, an increase in oil prices would have an adverse impact on private-non-oil corporations since an increase in costs is foreseeable, causing an increase in costs of production. Overall, although Kuwait has a stable economic lookout and it is counted as one of the world's top exporters of oil and gas with a relatively low production costs, noticeably, the country's high economic outlook is affected by the latest volatile oil prices where the country has a significant reliance on oil revenues, signaling a negative influence on economic concert since low oil prices exert a significant downward pressure on its economic front.

There are number of motives that rationalize our interest in studying the relationship between oil prices and sectoral stock prices. First, less attention has been devoted to the association between oil price changes and the market stock prices where ambiguous inferences were concluded, signaling the need to conduct additional tests towards the association between the two variables (Li *et al.* 2012). As such, there have been relatively few studies that examined the association between oil price changes and stock markets in which most of such studies were devoted to the industrial or developed economies, namely the United States, Canada, Japan and many European economies, meanwhile few studies looked at the developing or emerging economies. Second, examining the sectoral indices is a more relevant method for capturing the feedback relationship between oil price changes and stock market disturbances, since market aggregation index may hide the characteristics of various sector reports (see Kilian, 2009; Kilian and Park, 2009; Arouri *et al.* 2012; Jouini, 2013; and Degiannakis *et al.* 2013). Third, for market participants, portfolio managers and investors in specific, a complete understanding of the reaction of sectoral indices to oil price fluctuations offers key evidence about which stock market sectors to choose during times of uncertainty as to maximize returns or minimize risk, leading to a better understanding of the oil price transmission mechanism across sectors which is important for traders to make optimal investment portfolio decisions.[3] Fourth, there is a need to broaden the understanding of the association between oil price changes and Kuwait stock market prices on sector-by-sector bases as Kuwait is among the major oil-producers worldwide, hence the country's equity values may be affected by changes in oil prices. Finally, given the perspective of portfolio strategies, Kuwait stock market is largely segmented from the regional as well as the international financial markets, reflecting its position as an alternative promising portfolio diversification for most equity investors, particularly in the regional aspect.

The contribution of this paper to the literature can be summarized in three folds. First, as per the context of Kuwait, the paper examines the asymmetric long run effect of oil price changes on ten sectoral stock prices, namely Banks, Consumer Goods, Consumer Services, Industries, Real Estate, Basic Material, Financial services, Oil & Gas, Technology and Telecommunication, testing whether oil price changes do have alike influence on stock prices regardless discrepancies in the sectors. Second, our data spectrum is represented by relatively recent sample of Kuwait sectoral stock market prices, besides using two measures of oil prices: the British oil price (Brent) and the

[3] More precisely, the feedback between crude oil price changes and sectoral stock market returns would provide an opportunity to explore speculators as well as regular investors' trading behavioral sentiments while buying and selling stocks on daily basis. Those who are anticipating fast return will closely track movement in numerous stocks in order to capitalize on any relationship that might exist (see Louis and Balli, 2014). For instance, in case of inverse association between oil prices and industry sector returns, predictions of an increase in the price of oil may prompt investors to buy oil company stocks while selling industrial company stocks. Furthermore, from portfolio management concern, identifying the heterogeneity of market sector sensitivities to oil price changes would validate the fact where there are sectors that are still show a diversification means during wide swings in oil prices, (see Arouri, 2011). For an economy teetering into recession, Hammoudeh *et al.* (2009) identify that investors may invest in defensive stocks, specifically those on the non-cyclical consumer goods sector, while they may invest in high tech sectors' stocks in terms of a booming economy.

West Texas Intermediate price (WTI). Third, the notable contribution of this paper comes from testing for cointegration using the recently developed nonlinear autoregressive distributed lags (NARDL) model of Shin *et al.* (2011), which extends the autoregressive distributed lags (ARDL) bounds testing approach of Pesaran *et al.* (2001) to allow for estimating asymmetric long run as well as short run coefficients in a cointegration framework.

The paper finds an asymmetric long run effects between oil prices and Kuwait sectoral stock prices. As for the short run, our findings show asymmetric effect in case of WTI price measure, but symmetric effect in case of Brent price measure. On the whole, the findings give support for using nonlinear models as it contribute better to understanding the long run relationships, hence, serving more effectively in policy-making.

The rest of this paper is structured as follows: Section 2 briefly reviews the related literature. Section 3 describes the data and methodology used. Section 4 outlines the empirical findings, while conclusions are postulated in Section 5.

2. Literature Review

Understanding the dynamics that explain the volatility of stock prices is an important issue in the financial economics literature, since it is crucial to all interested parties in the stock market, including investors, practitioners as well as policy makers in making investment decisions. So far, though few studies have been devoted to the impact of oil price changes on stock prices at the sectoral or industry level, there is no consensus on the nature of the relationship between the two variables where the oil price exposure differs deeply among sectors. Up to now, the positive association between stock prices of Oil & Gas companies and oil price increases has been evidenced by many studies, where this is not the case for non- Oil & Gas sectors which show a weak or negative connection to oil price changes. Indeed, sectors that generate a large share of their revenues from oil and oil-related products would usually exhibit a positive oil price exposure; conversely, sectors where oil is a crucial input for their operations would tend to display negative sensitivity to oil price changes (See Faff and Brailsford (1999) for the Australian market, Sadorsky (2001) and Boyer and Filion (2007) as per the Canadian context, and El-Sharif *et al.* (2005) for the UK market).

Faff and Brailsford (1999) show that an increase in oil prices has a negative influence on industries like paper and packaging, banks and transportation, while some other industries are better off in terms of their capability in passing to customers a portion of the extra costs that is triggered by the increase in oil prices, thereby reducing the negative impact on their profitability. Nandha and Faff (2008) examine 35 global industry indices for the period between 1983 and 2005 where they demonstrate that increase in oil prices has negative influence on most industries, however, this is not the case for non- Oil & Gas industries, the mining industry in particular. Arouri and Nguyen (2010) findings suggest that the sensitivity of industries to changes in oil prices differ impressively from one sector to another in Europe, while Gogineni (2010) concludes that the stocks of heavy oil reliance industries are significantly affected by oil price changes. Here he reports that financial and insurance industries are negatively impacted by oil price changes.

Elyasiani *et al.* (2011) document significant evidence in which nine out of the 13 sectors analyzed show statistically significant association between their return and oil price changes. Based on the fact that industries differ in their consumption of oil and, hence, exhibit a different sensitivity to oil price changes. Mohanty *et al.* (2011) used both country level and industry level stock market data and conclude significant positive response of industry specific prices to oil shocks where evidence is shown to only 12 out of 20 industries as per tested sample. By using the linear and asymmetric models, Arouri (2011) tests for short-term association in both mean and variance in the aggregate as well as sector by sector levels in Europe. The responses of European sector stock markets to oil price changes suggest that the strength of the association between the two variables fluctuate considerably across sectors. For comparison purposes, Arouri *et al.* (2011) used the generalized VAR-GARCH approach on a sector level data to examine the extent of volatility transmission between oil price and stock markets in Europe and the United States. Their results reveal the existence of significant volatility spillover between the two variables where the spillover is unidirectional from oil markets to stock markets in Europe; however, it is bidirectional as per the case of the US.

For the G7 countries, Lee *et al.* (2012) show that information technology and consumer staples sectors are found to be impacted most by oil price changes, followed by financial, utilities and transportation sectors. Li *et al.* (2012) investigate the relationship between oil prices and the China's stock market at the sector level, where the panel cointegration relationship between the two variables is confirmed at the disaggregated sector level. Their estimates suggest that the real oil price changes have a positive impact on sectoral stocks in the long run. Based on data from 10 European sectors, Degiannakis *et al.* (2013) suggest that the relationship between sector indices and oil price change over time and they are industry specific, concluding that both the origin of the oil price shock and the type of industry are important determinants of the correlation level between industrial sectors returns and oil prices. Over the weekly period from January 10, 2007 until September 28, 2011, Jouini (2013) examines the links between oil price changes and stock sector markets in Saudi Arabia. His findings show evidence of return and volatility transmission between the two factors. Cong *et al.* (2013) investigate the interactive relationship between oil price changes and Chinese stock market, concluding no statistical significant impact of the oil price changes on the real stock prices of most China's stock market indices, except for manufacturing index and some oil firms.

Broadstock and Filis (2014) examine the time-varying association between oil prices shocks and stock market for China and the US. While considering correlations from key selected industrial sectors, namely Metals & Mining, Oil & Gas, Retail, Technology and Banking they conclude that the effect differs widely across industrial sectors. Martinez *et al.* (2014) investigate the sensitivity of the Spanish stock market at the industry level to changes in oil prices over the period 1993-2010 where they conclude that the degree of oil price exposure of Spanish industries is rather limited, although significant differences are shown across industries.

Hamma *et al.* (2014) examine the transmission of volatility between oil and seven sector stock indices of Tunisia using a bivariate GARCH model. Their results conclude a significant shock and volatility spillovers across oil and Tunisian sector stock market, however, the intensity of volatility interaction varies from one sector to another. By using weekly data on 10 sectoral indices over the period January 1197-February 2014, Caporale *et al.* (2015) explore the time-varying impact of oil price changes on stock prices in China where they conclude that oil price volatility affects stock returns positively during periods characterized by demand-side changes in all sectors, except the consumer services, financials and oil & Gas sectors, in which the later sectors exhibit a negative response to oil price changes during periods with supply-side changes. Huang *et al.* (2015) investigate the multiscale dynamics association between oil price and stock market in China at the sector level where they conclude that the impact of oil price changes vary for different sectors over different time horizons.

The aforementioned studies, though, have examined the relationship between oil price changes and stock market prices at the sector level; however, most are related to the developed economies i.e., USA, UK, Europe, China and Australia. This paper extends the country-level analysis for an emerging market given the limited number of studies that have examined the relationship between oil price changes and stock market in developing (emerging) economies, specifically in terms of sector-by-sector basis. In addition, for the GCC countries in general, most of the empirical work focuses on the causal association between oil price and stock market, for instance see Hammoudeh and Choi (2006), Zarour (2006), Lescaroux and Mignon (2008), Arouri *et al.* (2012) and Jouini (2013), however, though the findings on the relationship between oil prices and industrial sector indices are scarce, the paper sheds light on the sectoral analysis and offers a comprehensive sector-by-sector analysis as per the case of Kuwait.

3. Data and Methodology

To investigate the link between Kuwait sectoral stock prices and oil prices, daily data on Brent and West Texas Intermediate nominal spot crude oil prices are taken from the website of Energy Information Administration (EIA) (www.eia.doe.gov). Data on daily Kuwait sectoral stock market prices is extracted from Kuwait Stock Exchange (KSE) historical data base profile. The stock prices were converted to US dollar using the daily exchange rate reported by Kuwait Central bank. Our daily data spans from January 3, 2000 to December 9, 2015 for some sectors and from May 14, 2012 to December 9, 2015 for others.[4] We utilize ten sectors, namely: Banks, Consumer Goods, Consumer Services, Industries, Real Estate, Basic Material, Financial Services, Oil & Gas, Technology and Telecommunication.

The bulk of research on modeling sectoral stock market prices has been performed in a linear structure, nonetheless, many macroeconomic variables postulate nonlinear characteristics. Moreover, stock market prices are driven by the economic activities implying that its behavior

[4] Daily data was adjusted to match the sequence of the differences between the working days between Kuwait Stock Market and oil markets.

could also demonstrate nonlinearity. Thus, using linear models would not be an appropriate approach in studying the relationships between sectoral stock market prices and other economic variables, as it could provide misleading evidence on such associations. Additionally, under nonlinearity structure, the reaction of stock market prices to the economy's positive shocks may be different from the reaction to negative ones. Likewise, the presence of nonlinearities in the behavior of oil price, the key variable in this paper, has been documented by significant empirical literature (see Kisswani and Nusair, 2013). As such, oil price can cause asymmetric influences on sectoral stock market prices. For this reason, we investigate the potential asymmetric relationship between oil prices and Kuwait sectoral stock market prices for various sectors. This is done by employing the recently developed nonlinear autoregressive distributed lags (NARDL) model of Shin *et al.* (2011). This approach extends the autoregressive distributed lags (ARDL) bounds testing approach of Pesaran *et al.* (2001) to allow for estimating asymmetric long run as well as short run coefficients in a cointegration framework.

To start, we hypothesize the following asymmetric long run equation of sectoral stock market prices:

$$S_t = \alpha_0 + \alpha_1 O_t^+ + \alpha_2 O_t^- + e_t \tag{1}$$

where (S_t) is sectoral stock market price, (O_t) is nominal spot oil price (hereafter oil price),[5] $\alpha = (\alpha_0, \alpha_1, \alpha_2)$ is a cointegration vector or a vector of long run parameters to be estimated, and the disturbance (e_t) follows *iid* process with zero mean and finite variance, and it is independently distributed. All variables are measured in logarithms. In equation (1), O_t^+ and O_t^- are partial sums of positive and negative changes in (O_t):

[5] In this paper, we use nominal oil prices as consumer price index at daily basis is not available. Narayan *et al.* (2007) illustrate that using daily data does not require identifying real values. This approach was also adopted by Ghosh and Kanjilal (2014).

$$O_t^+ = \sum_{i=1}^{t} \Delta O_i^+ = \sum_{i=1}^{t} \max(\Delta O_i, 0) \quad (2)$$

and

$$O_t^- = \sum_{i=1}^{t} \Delta O_i^- = \sum_{i=1}^{t} \min(\Delta O_i, 0) \quad (3)$$

The NARDL setting is a cointegration test that employs positive and negative partial sum decompositions, enabling for the detection of asymmetric effects in both the long and the short run. Indeed, the description of the NARDL allows for joint investigation of the issues of nonstationarity and nonlinearity in the setting of an unrestricted error correction model. From equation (1), the long run relation between sectoral stock market prices and oil price increases is captured by α_1, which is anticipated to be negative. Meanwhile, α_2 captures the long run relation between sectoral stock market prices and oil price decreases, and is, also, expected to be negative, as they are believed to move in the opposite direction. We further expect that the decreases in oil price will cause different long run variations in the sectoral stock market prices as compared to oil price increases of the same magnitude, i.e. $\alpha_2 \neq \alpha_1$. Hence, the long run association as characterized by equation (1) indicates asymmetric long run oil price pass through to the sectoral stock market prices.

Following Shin *et al.* (2011), equation (1) can be outlined in an ARDL context along the line of Pesaran *et al.* (2001) as:

$$\Delta S_t = \alpha + \beta_0 S_{t-1} + \beta_1 O_t^+ + \beta_2 O_t^- + \sum_{i=1}^{p} \gamma_i \Delta S_{t-i} + \sum_{i=0}^{q} (\theta_i^+ \Delta O_{t-i}^+ + \theta_i^- \Delta O_{t-i}^-) + u_t \quad (4)$$

where all the variables are as described in equation (1), beside *p* and *q* are lag orders. The long run coefficients ($\alpha_1 = -\frac{\beta_1}{\beta_0}$ and $\alpha_2 = -\frac{\beta_2}{\beta_0}$) will represent the long run effects of oil price increases and decreases, respectively, on the sectoral stock market prices. $\sum_{i=0}^{q} \theta_i^+$ captures the short run effect of oil price increases on sectoral stock market prices, while $\sum_{i=0}^{q} \theta_i^-$ shows the short run effect of oil price decreases. The specification of equation (4) shows that the model captures the asymmetric short run impact of oil price variations on the sectoral stock market prices as well as the asymmetric long run effect.

To carry out the nonlinear ARDL methodology, we need to apply the following steps. First, run a unit root test to check the order of integration of the variables involved to verify that none is I(2), as if it is the case then this makes the computed F-statistics for testing cointegration invalid, although the ARDL methodology to cointegration is valid irrespective of whether the variables are I(0) or I(1). To this end, we apply the commonly employed ADF and PP unit root tests for determining the order of integration for the sectoral stock market prices and oil price. In the second step, we estimate equation (4) using the standard OLS method incorporating the significant number of lags to capture the most reliable representation of the NARDL model. The third step, by using the estimated NARDL model, we test for existence of a long-run relationship among the variables (cointegration) by conducting an F-test for the joint significance of the coefficients of the lagged level variables. The null hypothesis of no cointegration (H_0: β_0= β_1 = β_2 = 0) is tested against the alternative of cointegration (H_1: $\beta_0 \neq \beta_1 \neq \beta_2 \neq 0$). Two sets of critical value bounds for the F-statistic are generated by Pesaran *et al.* (2001). If the computed F-statistic falls below the lower bound critical value, the null hypothesis of no-cointegration cannot be rejected. On the other hand, if the computed F-statistic exceeds the upper bound critical value; the null hypothesis is rejected, implying a long-run cointegration relationship among the variables in the model. However, if the computed F-statistic value falls within the bounds, the test is inconclusive. In the final step, once cointegration is established, we test the long run and short run asymmetries between oil price and sectoral stock market prices to draw the conclusions and inferences. Within this step, we can also develop the asymmetric cumulative dynamic multiplier effects of a one percent change in O_{t-1}^{+} and O_{t-1}^{-} respectively as:

$$m_k^+ = \sum_{j=0}^{k} \frac{\partial s_{t+j}}{\partial O_{t-1}^+}, m_k^- = \sum_{j=0}^{k} \frac{\partial s_{t+j}}{\partial O_{t-1}^-}, h = 0, 1, 2, ... \quad (5)$$

Note that as $h \to \infty$, $m_k^+ \longrightarrow \alpha_1$ and $m_k^- \longrightarrow \alpha_2$

To further investigate the nexus between oil prices (O_t^+ and O_t^-; partial sums of positive and negative changes in O_t) and the sectoral stock market prices, the paper tests the direction of causality between the series using Granger causality test (1988). This test infers that if two series are cointegrated, then there must be Granger-causation in at least one direction. A variable X Granger causes Y, if Y can be predicted with better accuracy by using past values of X with other factors held constant. The Granger causality test involves estimating the following model:

$$y_t = \mu_t + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=1}^{p} \beta_i X_{t-i} + \varepsilon_t \quad (6)$$

where μ_t denotes the deterministic component and ε_t is white noise. The null hypothesis of non-causality from X to Y in equation (6) can be stated as: $H_0: \beta_i = 0$, for $\forall_i$. Rejecting the null suggests there is Granger causality. The null hypothesis can be tested by using the *F*-test. If the *p*-value is significant, then, this implies that the first series Granger-causes the second series (null is rejected).

4. Empirical Findings

Given that the linear and non-linear ARDL tests can be applied regardless of the series order of integration, the bounds testing procedure requires that no I(2) variables are involved because it invalidates the computed F-statistics. For this reason, it is compulsory to firstly test the integration properties of the participating variables to confirm that none of the used series are I(2). Therefore, we apply the Augmented Dickey-Fuller (1979) and Phillips-Perron (1988) unit root tests. The findings, displayed in Table 1, suggest that the two oil price measures and all sectoral stock prices are nonstationary in levels while, they are stationary in first differences. Thus, we can proceed with the bounds testing procedure (testing for cointegration in the non-linear ARDL framework) since the tests indicate none of the variables is I(2).

INSERT TABLE 1 HERE

In testing for cointegration, we estimate equation (4) using the appropriate lag order. The bounds F-statistics of the non-linear ARDL models are reported in Table 2. The findings document a long run relationship (cointegration) between Brent oil price and the following stock prices: Banks (at the 10% level), Consumer Goods (at the 10% level), Consumer Services (at the 1% level), Industrials (at the 5% level) and Real Estate (at the 5% level), meanwhile; WTI oil price is cointegrated with the following stock prices: Consumer Services (at the 1% level) and Industrials (at the 10% level).[6] As for the rest of the sectors, no cointegration evidence was found. Continuing with this analysis, for the sectoral stock prices that were found cointegrated with oil price measures, we go one further step by estimating the cointegration results; that is the short and long run coefficients. Tables 3 and 4 report these estimates. Additionally, some diagnostic tests such as Jarque-Bera statistics for error normality (J-B) and the LM statistics for autocorrelation up to order 2 are presented in Tables 3 and 4. As well, we also examine the structural stability of the cointegrated relations by the CUSUM and CUSUMSQ statistics, where Figures 1.a and 1.b show the graphs for these statistics.

INSERT TABLE 2 HERE

INSERT TABLE 3 HERE

INSERT TABLE 4 HERE

INSERT FIGURES 1.a AND 1.b HERE

[6] The noticeable result was not finding cointegration between oil price measures and Oil & Gas stock prices. At this point we don’t have any clear explanation for why this could be the case.

The results of the diagnostic tests of both models (in Tables 3 and 4) suggest adequate specifications as the models pass normality tests, and show free autocorrelation errors. Beside all error correction coefficients (ECM) are negative, as required, and are highly significant. However, the ECMs show low rate of convergence to equilibrium, that is any deviation from the long run equilibrium between variables is adjusted and corrected in less than 1% for each period and takes at least more than 33 periods to return to the long-run equilibrium level. Additionally, the CUSUM statistics show that the long run equilibrium is stable, but that is not the case using the CUSUMSQ statistics. Turning now to the short run estimates, the results; reported in Table 3, show that Brent oil price has symmetric effect on the stock prices of Banks, Consumer Services, Industrials and Real Estate sectors, where the coefficients on the partial sums of positive and negative changes in (O_t), O_t^+ and O_t^- , are not significant. However, the effect is asymmetric regarding Consumer Goods sector, where the oil price increase is significant at the 10% level while oil price decrease has no effect. As for WTI measure, the short run coefficients, reported in Table 4, show asymmetric effect for both sectors; Industrials and Real Estate. Turning to the long-run coefficients, that are calculated using the estimated outcomes in Tables 3 and 4 and summarized in Table 5, it appears that all the long run coefficients are negative as expected, but both variables, the partial sums of positive and negative changes in O_t (O_t^+ and O_t^-) carry coefficients that are different in size. This outcome provides evidence of asymmetric effects in the long run.

INSERT TABLE 5 HERE

Finally, we look at the Granger causality test between oil prices (O_t^+ and O_t^-; partial sums of positive and negative changes in O_t) and the sectoral stock market prices that demonstrated long run relation. The causality results, reported in Table 6, show that there is bidirectional causality between Brent positive oil price shock and stock prices of the following sectors: Banks, Consumer goods, Consumer services, Industrials and Real Estate. On the other hand, a unidirectional causality running from Brent negative oil price shock to stock prices of Banks, Consumer goods, Consumer services, Industrials and Real Estate is reported in Table 6. As for WTI price measure, we find bidirectional causality between WTI positive oil price shock and stock prices of Consumer services and Industrials, and unidirectional causality from WTI negative oil price shock to stock prices of Consumer services and Industrials.

INSERT TABLE 6 HERE

5. Conclusions

In this paper we investigated the dynamics between sectoral stock prices and selected oil prices, namely Brent and WTI measures, using Kuwait daily data. The paper contributes to the literature by using a nonlinear cointegration methodology; the nonlinear Autoregressive Distributed Lag cointegration technique, which allows for testing the asymmetric effects in both the long and short run time horizons. We employed daily data from January 3, 2000 to December 9, 2015 for some sectors and from May 14, 2012 to December 9, 2015 for others. Our findings show the presence of asymmetric long run effects. As for the short run, we found asymmetric effect in case of WTI price measure, but symmetric effect in case of Brent price measure. On the whole, we conclude that using nonlinear models contribute better to understanding the long run relationships, thus helping more in policymaking. Our conclusion on non-linearity between oil price changes and stock market go in line with Lardic and Mignon (2008); Arouri *et al.* 2011 and Zhang, (2013). The results on the long run cointegration relationship between the two variables and varying impact of oil price changes on stock prices is supported by Park and Ratti (2008) as for Norway, Arouri (2011) as for Europe, Li *et al.* (2012) as for the Chinese stock market at the sector level, and

Degiannakis *et al.* (2013) for the European sectors, Hamma *et al.* (2014) for Tunisia, Caporale *et al.* (2015) and Huang *et al.* (2015) for China.

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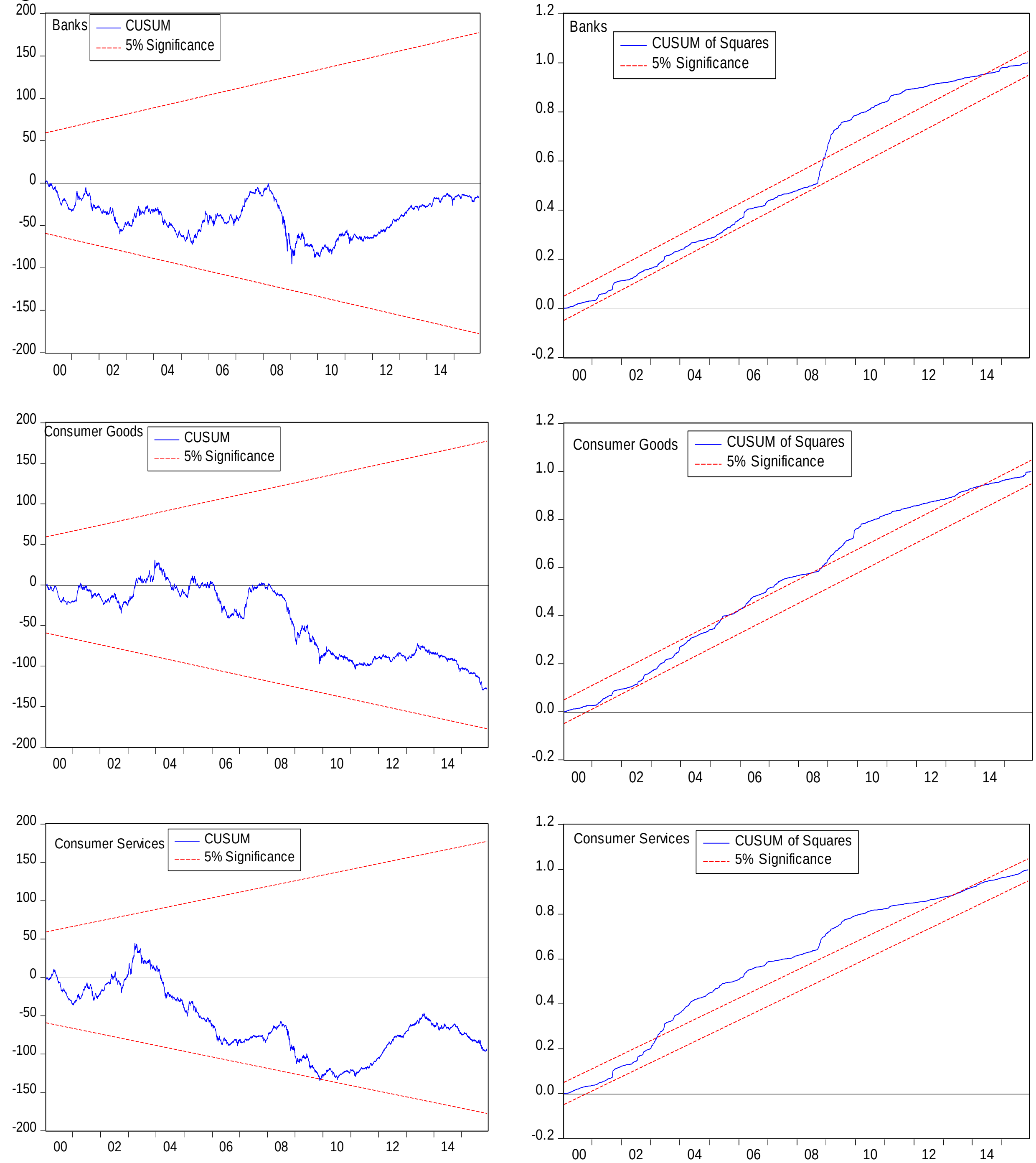
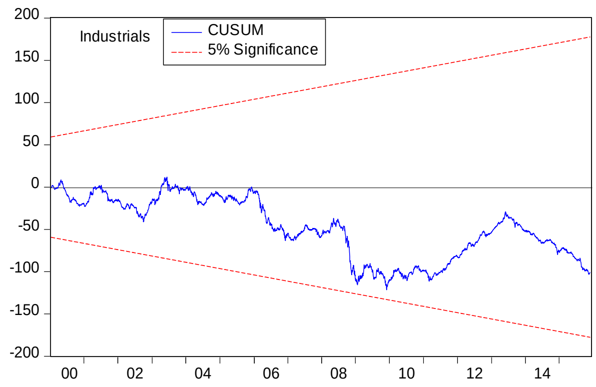
Figure 1.a: Brent Oil Price




Industrials
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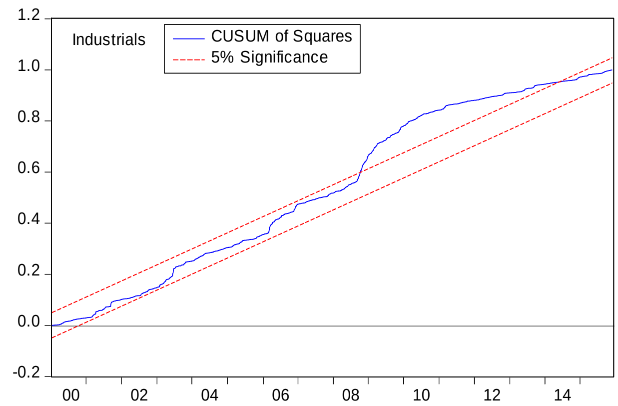
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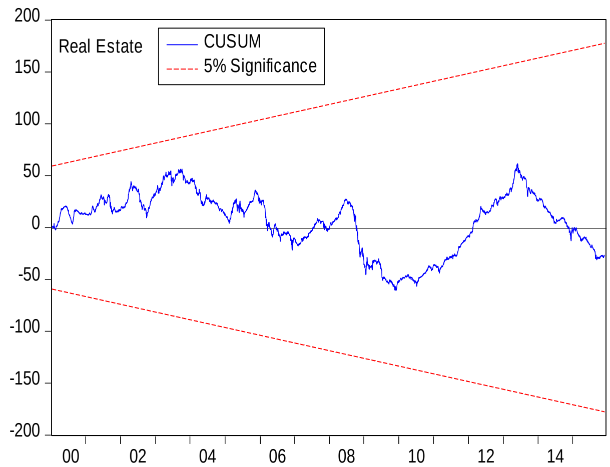
Real Estate
CUSUM
5% Significance
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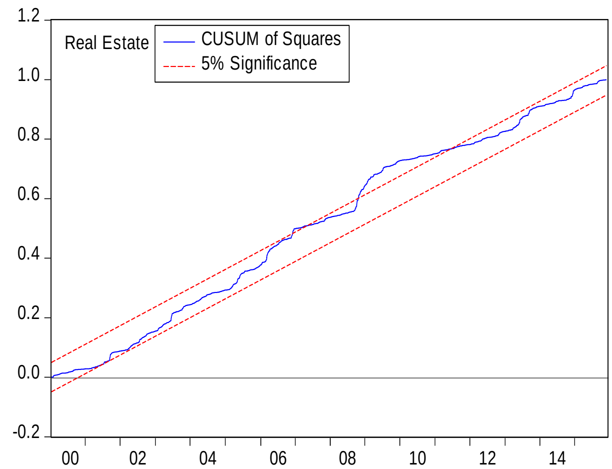
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Figure 1.b: WTI Oil Price

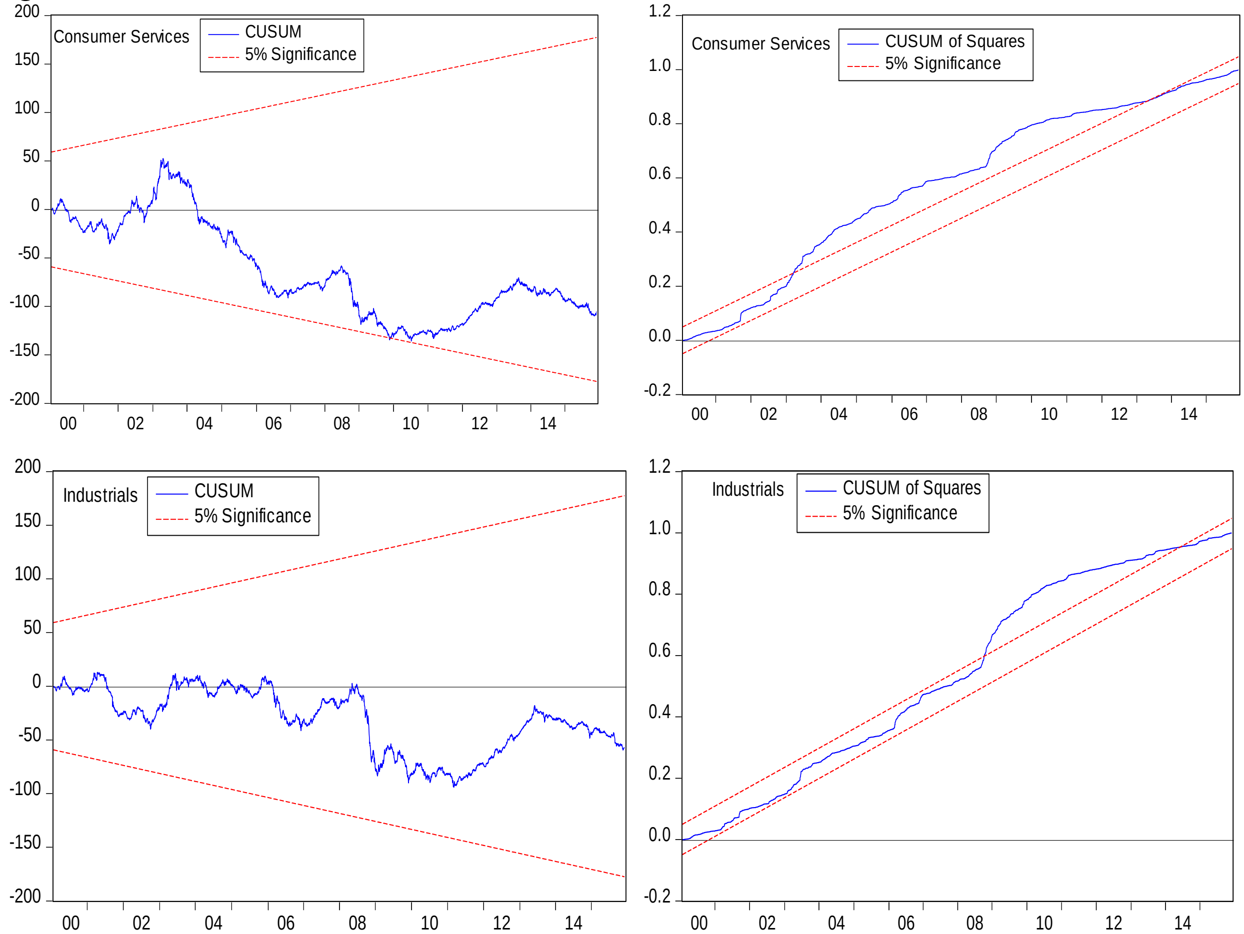

Table 1: ADF and PP unit root tests

	Level		First Difference	
Variable	**ADF**	**PP**	**ADF**	**PP**
Brent	-1.67, [0]	-1.76, [8]	-61.75***, [0]	-61.76***, [6]
	(0.76)	(0.72)	(0.00)	(0.00)
WTI	-1.4, [0]	-1.28, [31]	-64.76***, [0]	-64.80***, [32]
	(0.86)	(0.89)	(0.00)	(0.00)
Banks	-0.64, [1]	-0.61, [5]	-57.39***, [0]	-57.4***, [1]
	(0.98)	(0.98)	(0.00)	(0.00)
Basic materials	-1.01, [1]	-1.1, [5]	-33.87***, [0]	-33.84***, [2]
	(0.94)	(0.93)	(0.00)	(0.00)
Consumer goods	-1.37, [1]	-1.37, [4]	-58.37***, [0]	-58.44***, [3]
	(0.87)	(0.87)	(0.00)	(0.00)
Consumer services	-1.43, [1]	-1.24, [25]	-52.26***, [0]	-55.16***, [23]
	(0.85)	(0.90)	(0.00)	(0.00)
Financial services	-0.44, [1]	-0.58, [12]	-25.23***, [0]	-25.74***, [10]
	(0.99)	(0.98)	(0.00)	(0.00)
Industrials	-1.52, [1]	-1.46, [23]	-51.13***, [0]	-53.27***, [20]
	(0.82)	(0.84)	(0.00)	(0.00)
Oil & Gas	-0.67, [0]	-0.6, [2]	-31.08***, [0]	-31.07***, [0]
	(0.97)	(0.98)	(0.00)	(0.00)
Real estate	-1.4, [1]	-1.39, [23]	-51.26***, [0]	-53.32***, [18]
	(0.86)	(0.86)	(0.00)	(0.00)
Technology	-2.31, [2]	-2.62, [5]	-24.62***, [1]	-33.18***, [1]
	(0.43)	(0.27)	(0.00)	(0.00)
Telecommunications	-2.32, [0]	-2.5, [6]	-19.35***, [1]	-29.94***, [4]
	(0.42)	(0.33)	(0.00)	(0.00)

Notes: The constant and trend terms are included in the test equations and the AIC is used to select the optimal lag order in the ADF test equation. Numbers in parentheses are MacKinnon (1996) p-value of the test. Numbers in [ ] denote optimal lags. ***denote significance at 1% level.

Table 2: Bounds test for non-linear cointegration

	F-statistic	**Conclusion**	**F-statistic**	**Conclusion**
Dependent Variable	**Brent**		**WTI**	
Banks	4.42*	Cointegration	3.44	No Cointegration
Basic materials	1.75	No Cointegration	0.73	No Cointegration
Consumer goods	4.3*	Cointegration	2.74	No Cointegration
Consumer services	6.69***	Cointegration	6.28***	Cointegration
Financial services	1.25	No Cointegration	0.66	No Cointegration
Industrials	5.48**	Cointegration	4.02*	Cointegration
Oil & Gas	1.78	No Cointegration	0.88	No Cointegration
Real Estate	5.57**	Cointegration	2.23	No Cointegration
Technology	1.49	No Cointegration	1.4	No Cointegration
Telecommunications	2.53	No Cointegration	2.53	No Cointegration

	Critical Values	
Significance	**I0 Bound**	**I1 Bound**
10%	3.38	4.02
5%	3.88	4.61
1%	4.99	5.85

Notes: The bounds test includes a linear trend. The bounds test critical values are from Pesaran *et al*.(2001). ***, **, * denote significance at 1%, 5% and 10% level, respectively.

Table 3: Nonlinear ARDL estimation results (Brent oil price)

Independent variable	Banks		Consumer Goods		Consumer Services	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Constant	0.001084**	0.0172	0.000763	0.1529	0.001204***	0.0029
S(-1)	-0.000328	0.1735	-0.000520	0.1609	-0.000147	0.3724
O^+(-1)	-0.000679	0.2916	-0.001636**	0.0232	-0.001841**	0.0014
O^-(-1)	-0.001329**	0.0387	-0.002275***	0.0021	-0.002300***	0.0001
ΔS(-1)	0.087346***	0.0000	0.064437***	0.0001	0.167916***	0.0000
ΔS(-2)	-0.035765**	0.0253	0.018199	0.2561	0.020891	0.1976
ΔS(-3)			0.033593**	0.0357	0.027331*	0.0875
ΔO^+			0.000669	0.9622		
ΔO^+(-1)			0.024682*	0.0785		
ΔO^+(-2)			-0.024426*	0.0821		
Diagnostics tests:						
ECM_{t-1}	-0.000334***		-0.000543***		-0.000153***	
Adjusted R^2	0.011805		0.010554		0.043663	
LM(2)	1.626718		4.575769		0.392729	
JB	2636.45***		1186.49***		1447.81***	

Note: ***, **, * significant at 1%, 5% and 10% level respectively.

Table 3: Nonlinear ARDL estimation results (Brent oil price) - Continue

Independent variable	Industrials		Real Estate	
	Coefficient	p-value	Coefficient	p-value
Constant	0.000807**	0.0457	0.000537	0.2841
S(-1)	-0.000174	0.4862	-0.000156	0.6183
O^+(-1)	-0.001708***	0.0024	-0.002059***	0.0018
O^-(-1)	-0.002030***	0.0004	-0.002564***	0.0002
ΔS(-1)	0.194531***	0.0000	0.191117***	0.0000
ΔO^-			0.014534	0.2276
Diagnostics tests:				
ECM_{t-1}	-0.000182***		- 0.00011***	
Adjusted R^2	0.044515		0.043347	
LM(2)	2.317746		4.660380	
JB	1408.27***		1640.86***	

Note: ***, **, * significant at 1%, 5% and 10% level respectively.

Table 4: Nonlinear ARDL estimation results (WTI oil price)

Independent variable	Consumer Services		Industrials	
	Coefficient	p-value	Coefficient	p-value
Constant	0.001905***	0.0000	0.001425***	0.0015
S(-1)	0.00	0.9743	0.00	0.8101
O^{+}(-1)	-0.001556**	0.0140	-0.001271**	0.0432
O^{-}(-1)	-0.001753***	0.0037	-0.001458**	0.0170
ΔS(-1)	0.168873***	0.0000	0.196715***	0.0000
ΔS(-2)	0.022584	0.1637		
ΔS(-3)	0.029544*	0.0647		
ΔO^{+}			-0.021036*	0.0531
ΔO^{-}	0.012957	0.1731	0.006914	0.4946
ΔO^{+}(-1)			-0.012177	0.2589
ΔO^{+}(-2)			0.017932*	0.0734
ΔO^{-}(-1)	0.018250*	0.0576	0.022330**	0.0290
ΔO^{-}(-2)	0.020447**	0.0334		
Diagnostics tests:				
ECM_{t-1}	-0.000008***		-0.000062***	
Adjusted R^2	0.041265		0.044091	
LM(2)	0.185249		2.738665	
JB	1478.47***		1387.05***	

Note: ***, **, * significant at 1%, 5% and 10% level respectively.

Table 5: Long-run relations

Sector	Brent Oil Price		WTI Oil Price	
	O^{+}	O^{-}	O^{+}	O^{-}
Banks	-2.072	-4.05		
	(0.49)	(0.302)		
Consumer Goods	-3.15	-4.38		
	(0.308)	(0.23)		
Consumer Services	-12.52	-15.64	-289.22	-325.83
	(0.44)	(0.40)	(0.97)	(0.97)
Industrials	-9.8	-11.65	-20.38	-23.37
	(0.54)	(0.51)	(0.82)	(0.82)
Real Estate	-13.35	-16.63		
	(0.65)	(0.64)		

Notes: numbers in ( ) are p-values.

Table 6: Pairwise Granger Causality Tests

1. Brent Oil Price

	O_t^+ does not Granger Cause S_t		S_t does not Granger Cause O_t^+		O_t^- does not Granger Cause S_t		S_t does not Granger Cause O_t^-	
	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.
Banks	3.64**	0.03	5.72***	0.00	3.53**	0.03	1.59	0.20
Consumer goods	3.93**	0.02	4.97***	0.01	4.53**	0.03	0.02	0.89
Consumer services	6.81***	0.00	7.03***	0.00	6.29***	0.00	1.64	0.19
Industrials	3.45**	0.03	6.04***	0.00	3.26**	0.04	0.21	0.81
Real Estate	2.58*	0.08	2.39*	0.09	2.57*	0.08	1.37	0.25

2. WTI Oil Price

	O_t^+ does not Granger Cause S_t		S_t does not Granger Cause O_t^+		O_t^- does not Granger Cause S_t		S_t does not Granger Cause O_t^-	
	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.
Consumer services	7.27***	0.00	5.92***	0.00	7.93***	0.00	0.63	0.53
Industrials	3.58**	0.03	3.87**	0.02	4.75***	0.01	0.37	0.69

Notes: S_t is sectoral stock market price. O_t^+ and O_t^- are the partial sums of positive and negative changes in oil price. Lags included in the test are 2. ***, **, * denote significance at 1%, 5%, and 10% level, respectively.