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New Evidence of Oil Price Fluctuations and Manufacturing Output in Saudi Arabia, Kuwait and United Arab Emirates

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Abstract

Oil is used as an essential source of energy because it is one of the significant inputs of production especially in manufacturing sectors. This study employs symmetric and asymmetric Autoregressive Distributed Lag Model to explore oil price effect on manufacturing output over 1985-2017 in Saudi Arabia, Kuwait and United Arab Emirates. The results of the linear model show that oil price effect manufacturing output negatively in short-run and long-run. The detection of asymmetric behavior of oil price in linear ARDL model show insufficient ability, and this study further estimated the model through the non-linear model and decompose oil price into positive and negative changes. In the non-linear model, the results show that negative oil price changes encourage manufacturing output, while the positive oil price hurts manufacturing output. The study also apply the Granger causality test, and results show one-way causality from oil price to manufacturing output in Saudi Arabia and Kuwait. Based on the findings, the government officials of these countries should take steps in shifting these economies from huge extraction of oil and concentrate on manufacturing, and policymakers should understand the linkage of oil price with manufacturing sector for diversification of their economy and escape from Dutch Disease.

Keywords: oil price effect, manufacturing output, asymmetric behavior, ARDL, NARDL.

1. Introduction

A large turmoil in the oil market has experienced again in previous years, i.e., for, during the mid of 2014 oil price was still 110 dollars per barrel and had lost its value more than

60 percent and by the end of 2015, it was traded 40 dollars per barrel (Raduzzi and Ribba, 2020). Generally speaking, the oil sector is essential in production and exports due to these oil price fluctuations create a vulnerable situation in oil-exporting economies (Farooqi and Zamil, 2019). In oil-rich countries, income rapidly increases due to a boom in the oil sector, and it is a significant contributor to national income (Van Eyden, 2019). Recent years, due to considerable economic consequences, oil price changes have become a hot discussion in academic and government and equally explored its impact on macroeconomic indicators (Nasir et al., 2019). A bulk of studies has confirmed the oil price influence on macroeconomic indicators like inflation (Chang et al. 2011; Lacheheb and Sirag, 2019; Nasir et al., 2020); unemployment (Karaki, 2018; Nusair, 2020); trade balance (Javid et al., 2018; Nasir et al., 2018); exchange rate (Baek and Kim, 2020); poverty (Smith and Wills, 2018); income inequality (Farzanegan and Krieger, 2019); and economic growth (Mork, 1989; Hamilton;1996; Raduzzi and Ribba, 2020).

The oil price fluctuations affects the countries industrial sectors especially manufacturing sector in oil exporting countries. Its fluctuation in surge of price have rapid effect in development oil industries production and lag behind other sectors like manufacturing, agriculture sectors (Dutch disease phenomenon). The several explanations behind this effect on manufacturing sectors like, classical supply-side shock; demand shock and financial sector (Corden & Neary, 1982; Bjørnland, 1998; Sachs and Warner, 2001; Brown et al., 2003). However, the research on effect of oil price on other variables is extensively portrayed to show the relations but still there is a gap to uncover the complex relationship of oil with manufacturing output in oil rich countries to check the theoretical justification.

The oil price has linked to the GDP in oil-exporting countries. Following figure 1 shows the association between oil price and GDP. In other words, high oil prices, the more GDP in the oil-exporting country Saudi Arabia.

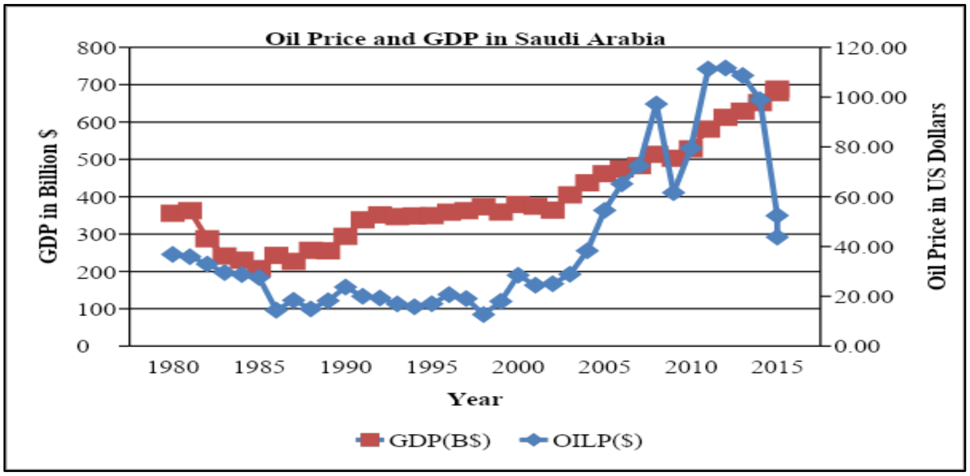

Figure 1: Oil Price and Gross Domestic Product in Saudi Arabia

Data Source: UNCTAD (Author's calculation)

The following figure 2 shows the association between oil price and GDP in the United Arab Emirates. Many empirical studies showed the linkage of oil price with GDP in oil-rich economies (Nusair, 2016; Eltony and AI-Awadi., 2001).

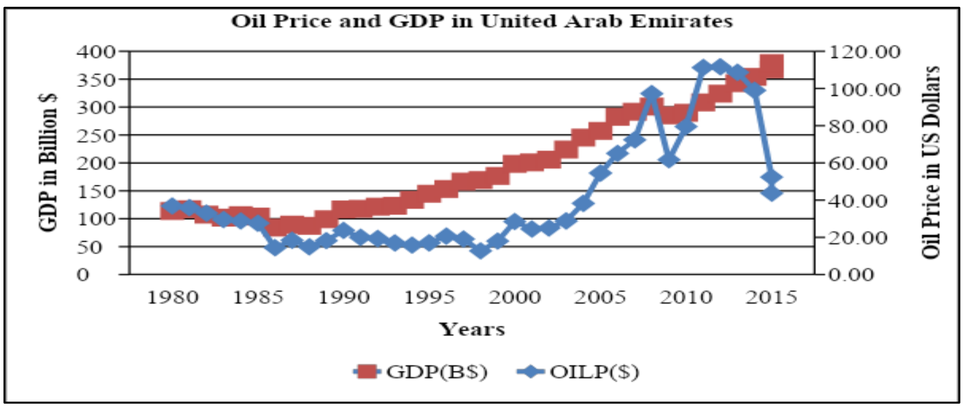

Figure 2: Oil Price and Gross Domestic Product in United Arab Emirates

Data Source: UNCTAD (Author's calculation)

Also, in the case of Kuwait, oil price and GDP relationships have shown in the following figure 3. Due to high oil prices, Kuwait oil revenue increase and that would increase the gross domestic product as well that leads to a significant impact on government expenditures (See Eltony and AI-Awadi., 2001).

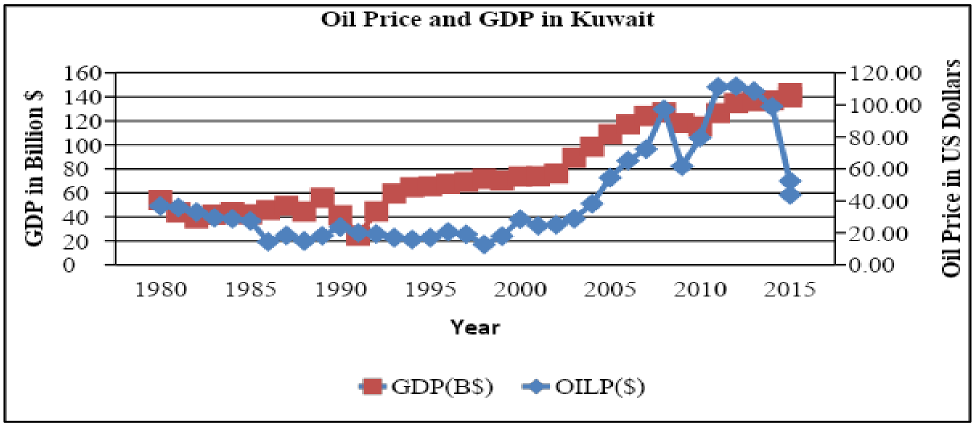

Figure 3: Oil Price and Gross Domestic Product in Kuwait

Data Source: UNCTAD (Author's calculation)

Manufacturing output is the main contributor to the GDP of any country, as it is oil-rich or oil importing country. The following figure 4 shows the trend of oil price and manufacturing output in Saudi Arabia.

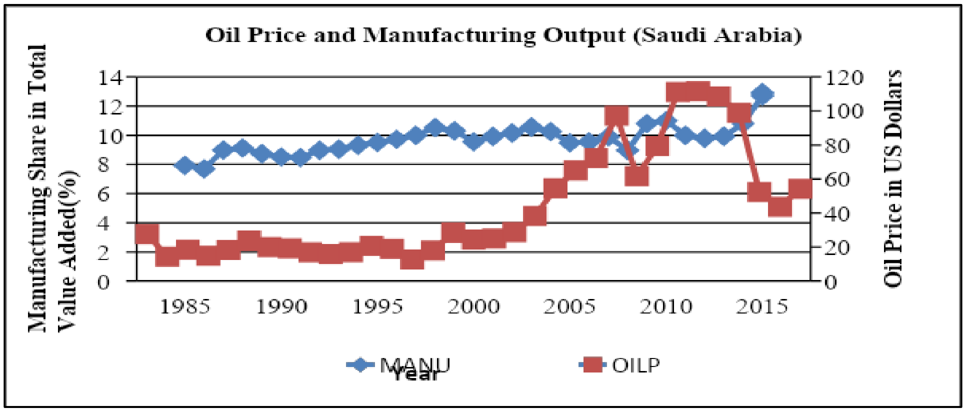

Figure 4: Oil Price and Manufacturing Output in Saudi Arabia

Data Source: SESRIC Data (Author's calculation)

The following figure 5 reflects the oil price trend with the manufacturing sector for the United Arab Emirates. The fluctuation in oil price shows co-movement with manufacturing output in United Arab Emirates.

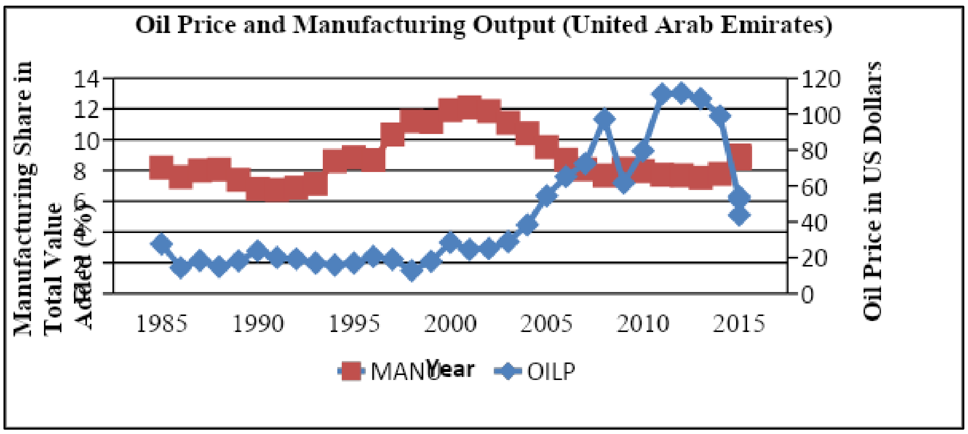

Figure 5: Oil Price and Manufacturing Output in United Arab Emirates

Data Source: SESRIC Data (Author's calculation)

The following figure 6 shows the relation of oil price with manufacturing output in Kuwait from 1985-2017

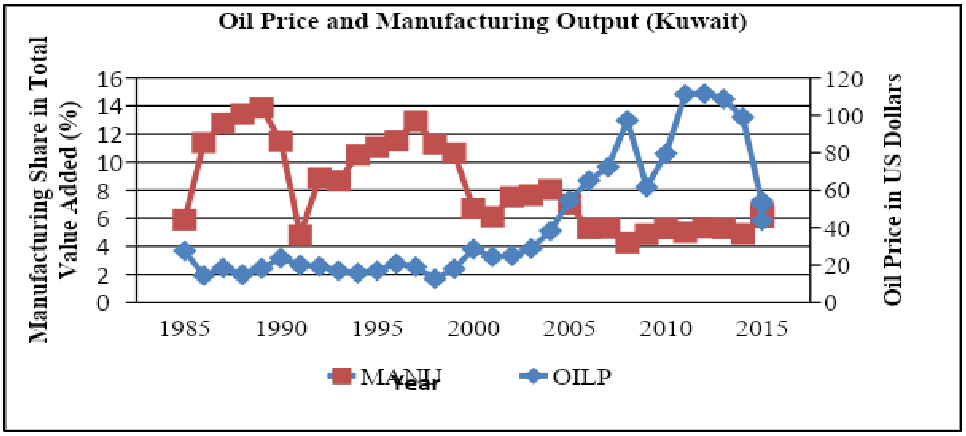

Figure 6: Oil Price and Manufacturing Output in Kuwait

Data Source: SESRIC Data (Author's calculation)

The main objective of the study is to empirically examine the the factors that are most responsible for manufacturing output in oil-exporting economies viz. Saudi Arabia, Kuwait and United Arab Emirates within the framework of Resource Curse and Dutch Disease hypothesis. Previous literature showed different factors like inflation, interest rate, remittance, labor productivity, globalization, urbanization, corruption and trade openness are causing factors of growth in manufacturing output (Judith and Chijindu, 2016; Bass, 2018; Daway-Ducanes, 2019; Amiri et al., 2019). However, these studies include common factors that determine manufacturing output in their analysis while excluding some important factors like oil price, institutional quality, real effective exchange rate and financial development among others which have proved their significant effect in other countries' empirical studies (Law et al., 2013; Puatwoe and Piabuo, 2017; Tams-Alasia et al., 2018).

The study would contribute in the existing literature by checking oil price and manufacturing output relation in different way that is unique. For this, the study applied both linear and nonlinear ARDL estimation to check the nonlinear behavior of oil price on manufacturing output which is rare in literature, especially in Saudi Arabia, Kuwait and United Arab Emirates. The reason behind the selection of these countries because these economies highly depend on oil revenue and major oil exporter in GCC member countries with dominancy of Saudi Arabia that contributed roughly 90% of export earnings, 87% of budget revenues and 42% of the GDP; Kuwait revenue depends on petroleum exports more than 70% of total government revenue; even though United Arab Emirates is more diversified among these countries but still it depends on oil sector that accounts for more than half of budget revenue and exports and a third of real economic output (Javid et al., 2018; The World Fact Book, 2018; Mahmah and Kandil, 2019). This study is usful for policy makers and government official to diversify their economies and concenterate on manufacturing output.

The remainder of the study is composed of different parts. Part two provides review of the literature. Part three elaborates the data and estimated methodology. Part four gives the results and discussion. Finally, conclusion and policy implication of this the study reports in part five.

2. Literature Review

The empirical literature showed the evidence of oil price effect on different macroeconomic variables including manufacturing output, which is symmetric relation (Geiger and Scharler, 2019). For instance, the study of Bjørnland (1998) explored the oil and gas boom effect of manufacturing sector in two energy-producing economies by employing structural VAR method and found a negative effect on manufacturing in UK but the opposite result for Norway. Similarly, the study of Bass (2018) explored oil price influence on the manufacturing output in Russia for the period of 1996-2017 by using VEC framework and found oil price and the manufacturing output cointegrated in the long run. The studies of Ollus and Barisitz (2007) for Russia in favour of deindustrialization and Dutch disease including other factors that driven sectoral changes and Oomes and Kalcheva (2007) concluded with no result of Dutch disease in Russia and Algieri (2011) found adverse effect on the manufacturing sector. Shaari et al (2013) found the impact of oil price on different economic sectors including manufacturing sector by using quarterly data from 2000-2011 in Malaysia. Yasmeen et al., (2019) investigates the effect of oil price fluctuation on real sector growth (manufacturing, transport and communication, electricity and livestock) by employing ARDL method over 1976 to 2017 in Pakistan. The results shows that oil price affect manufacturing, electricity and livestock adversely and positive effect on transportation and communication. The study of Fasanya and Onakoya (2013) explores the relationship of oil price and real output growth in the framework of dyanamic VAR analytical framework over 1970 to 2011 in Nigeria. The results shows that oil price impact output growth only in long run.

However, other literature does not support the symmetric relationship. For example, the study of Mork (1989) reported that indicators were significant and negatively affected when oil price increased, but oil, the variables were insignificant when oil price decrease. Hamilton (2003) also supports this in his studies by showing that the rise in the price of oil found more critical than oil price decrease. Similarly, by using VAR model Guidi (2010), found that inverse and nonlinear association of oil price with manufacturing sector in United Kingdom (UK). Moreover, the study of Balasubramaniam, (2017) explored the oil price and output nexus in Malaysia by employing ARDL and NARDL estimation and concluded nonlinear relation of oil price on manufacturing and industrial output. Farzanegan and Markwardt (2009) revealed that oil shock of positive and negative showed a different effect on industrial production by decreasing imported input price and increase industrial production and decrease industrial production because of high imported input price in Iran, respectively.

Some studies showed the limited or no effect of oil price on manufacturing sector. For example, the study of Mahboub and Ahmed (2017) found no influence of oil price on manufacturing sector in short-run but have effect after 10 quarters through government spending according to impulse response function in Saudi Arabia. Similarly, Aimer (2017) revealed oil price impact on economic sectors in Libya and results concluded oil price increase has no impact on aggregate manufacturing sector but also have negative effect on sectors, agriculture and manufacturing. As the study of Mehrara and Sarem (2009) showed oil price affect the industrial production in Saudi Arabia and Iran as compared to Indonesia because of limited role-play of oil.

Moreover, other factors also affect the industrial output and assumed as important factors like exchange rate, financial development, real exchange rate and institutional quality. The relationship of the real exchange rate with manufacturing output is in two categories in the literature that are positive and negative. In case of increase in real exchange rate that increases competitiveness of exports or tradable sector that would increase the economic growth (Rodrick, 2008). The same findings are in the study of Daway-Ducanes (2019) in finding the relationship with manufacturing output. The study of Judith and Chijindu (2016) also find the exchange rate and manufacturing output positively related to Nigeria. The study of Tams-Alasia et al. (2018) found positive but non-significant association of exchange rate with manufacturing industry output in Nigeria during 1980-2016.

This relationship of finance growth traces in the early twentieth century by the work of Schumpeter (1911) and now policymakers trust that financial development spur productivity by funding investment (Puatwoe and Piabuo, 2017). The recent study, Puatwoe and Piabuo (2017) also find the impact is positive in Cameroon. Galbis (1977) and Fry (1980) revealed that financial development reduces growth by this channel, in response to the imposition of restrictions on the banking system that are high reserve requirements and credit ceiling would adversely affect growth.

Others, Lucas (1988) and Stern (1989) claimed that finance is an overstressed determinant of growth and has no effect on output growth. The study of Bloch and Tang (2003) also find no significant relation of financial development with growth. Moreover, the study of Edame and Okoi (2015) found significant institutional quality in the manufacturing sector over 1999-2013 in Nigeria. Similarly, the study of Bass (2018) found the significant effect of institutional quality on manufacturing sector in Russia. Law et al. (2013) concluded positive effect of financial development after a certain of institutional quality threshold level. The existing literature portrayed the mixed findings of these variables relationship with manufacturing output in different economies that may base on the country's profile, data availability, and estimation method.

3. Methodology

In the below-specified model manufacturing output which is used as a dependent variable. Oil price is used as the main independent variable. Oil price is taken as annual price per barrel of Brent. The expected sign is negative of oil price with manufacturing output. Some other control variables are included in this study like financial development, real effective exchange rate and institutional quality. principal component analysis (PCA) estimation technique is used to obtain institutional quality index (INSQ) made up of eight selected indicators of institutional quality (government stability, corruption, investment profile, military in politics, demographic accountability, Bureaucracy quality, socioeconomic conditions, law and order). The data is sourced from different sources like British Petroleum Statistical Review for oil price; Bruegel Dataset for real effective exchange rate; SESRIC (OIC Database) for manufacturing output; World Development Indicators (WDI) for financial development and International Risk Guide for institutional quality data.

3.1 Model Specification

In this context, Sachs and Warner were the significant contributors that showed the negative relationship of natural resource with economic growth and later named as Resource Curse that is further empirically tested in studies (Sachs and Warner; 1997, 2001). They explained in their theory that resource-rich economies majority exports depend on resource base primary products and due to this, they experienced a slow growth process (Sachs and Warner, 1995). There are different channels that affect economic growth according to resource curse theory and these channels called crowding out channels, that describe crowding out other essential channels of development and ultimately affect (Sachs and Warner, 2001). Other variables like financial development, institutional quality and real effective exchange rate also affect manufacturing output (Edame and Okoi, 2015; Judith and Chijindu, 2016; Bass, 2018; Daway-Ducanes, 2019).

$$y = f(OILP, REER, FD, INSQ) \quad (1)$$

$$LMANU_t = \beta_1 + \beta_2 LOILP_t + \beta_3 LREER_t + \beta_4 LFD_t + \beta_5 INSQ_t + \mu_t \quad (2)$$

The coefficients β_2, β_3, β_4, and β_5 are the elasticities of manufacturing output concerning the oil price, real effective exchange rate, financial development and institutional quality. The study uses ARDL and NARDL (for asymmetric behavior) method to estimate our objective. This methodology is preferable to other traditional estimation methods due to several reasons such as, it can be valid for analization of relationship of variables that are either I(0) or I(1) as well as mixed order; more convenient and gives good results even in small sample size; easy to apply, more flexible and yield consistent estimates (Pesaran & Shin, 1998; Paseran et al., 2001; Duasa, 2007; Faheem et al., 2019).

To estimate the above model, we apply the ARDL bounds approach by using the following specified model:

$$\Delta LMANU_t = \alpha_0 + \sum_{i=1}^{l} a_{1i}\Delta LMANU_{t-1} + \sum_{i=0}^{p} \alpha_{2i}\Delta LOILP_{t-i} + \sum_{i=0}^{q} \alpha_{3i}\Delta LREER_{t-i} + \sum_{i=0}^{r} \alpha_{4i}\Delta LFD_{t-i} + \sum_{i=0}^{s} \alpha_{5i}\Delta INSQ_{t-i} + \\ + \beta_1 LMANU_{t-1} + \beta_2 LOILP_{t-1} + \beta_3 LREER_{t-1} + \beta_4 LFD_{t-1} + \beta_5 INSQ_{t-1} + \mu_t \quad (3)$$

In the above equation, Δ shows the first difference operator of the concerned variable and the deterministic drift parameter is α_0.

The unrestricted error correction model (ECM) estimated as follows:

$$\Delta LMANU_t = \alpha_0 + \sum_{i=1}^{l} a_1 \Delta LMANU_{t-i} + \sum_{i=0}^{p} \alpha_2 \Delta LOILP_{t-i} + \sum_{i=0}^{q} \alpha_3 \Delta LREER_{t-i} + \sum_{i=0}^{r} \alpha_4 \Delta LFD_{t-i} + \sum_{i=0}^{s} \alpha_5 \Delta INSQ_{t-i} + \lambda ECT - 1 + vt_t \quad (4)$$

In the above equation λ shows the speed of adjustment parameter and ECT denotes the residuals from the estimated model.

The next is the nonlinear model specification that is the formulation of asymmetric behavior of oil price in accordance with the nonlinear autoregressive distributed lag model where oil price decomposes into positive and negative parts.

$$LMANU_t = \beta_1 + \beta_2 LOILP_t + \beta_3 X_t + \mu_t \quad (5)$$

$$LMANU_t = \beta_1 + \beta_2^{+} LOILP^{+}{}_t + \beta_2^{-} LOILP_t^{-} + \beta_3 X_t + \mu_t \quad (6)$$

Based on the nonlinear model (Equation (6)), β^{+}_2 shows oil price increase impact on manufacturing output in long run in equation (7), which is expected to be negative. And β^{-}_2 in equation (8) represents the oil price decrease impact.

$$\beta_2^{+} LOILP_t^{+} = \sum_{j=1}^{t} \Delta LOILP_j^{+} = \sum_{j=1}^{t} \max(\Delta LOILP_j, 0) \quad (7)$$

$$\beta_2^{-} LOILP_t^{-} = \sum_{j=1}^{t} \Delta LOILP_j^{-} = \sum_{j=1}^{t} \max(\Delta LOILP_j, 0) \quad (8)$$

Shin, Yu, and Greenwood-Nimmo (2014) introduced NARDL setting with the extension of ARDL as:

$$\Delta LMANU_t = \alpha_0 + \sum_{i=1}^{l} a_{1i} \Delta LMANU_{t-1} + \sum_{i=0}^{p1} \alpha^{+}{}_{2i} \Delta LOILP^{+}{}_{t-i} + \sum_{i=0}^{p2} \alpha^{-}{}_{2i} \Delta LOILP^{-}{}_{t-i} + \sum_{i=0}^{q} \alpha_{3i} \Delta LREER_{t-i} + \sum_{i=0}^{r} \alpha_{4i} \Delta LFD_{t-i} + \sum_{i=0}^{s} \alpha_{5i} \Delta INSQ_{t-i} + \\ + \beta_1 LMANU_{t-1} + \beta_2^{+} LOILP_{t-1}^{+} + \beta^{-}{}_2 LOILP^{-}{}_{t-1} + \beta_3 LREER_{t-1} + \beta_4 LFD_{t-1} + \beta_5 INSQ_{t-1} + \mu_t \quad (9)$$

The long-run and short run asymmetry is measured by β_2^+ and β_2^- , α_2^+ and α_2^- respectively by taking following hypotheses:

H_0: $\beta_2^+ = \beta_2^- = 0$

$$H_0 : \sum_{i=0}^{p1} \alpha^+_{2i} = \sum_{i=0}^{p2} \alpha^-_{2i}$$

for all i=0,….,p

4. Results and Discussion

The descriptive statistics and correlation matrix for oil price and manufacturing output have presented the feature of variables that explained the nature of data mean, maximum value, minimum value and standard deviation of each variable. The mean of annual manufacturing output of three countries viz., Saudi Arabia, Kuwait and United Arab Emirates are 9.879697, 8.068182, 8.801515; while oil price 43.43193, real effective exchange rate 119.0631, 104.8711, 89.42407 and financial development 30.21333, 60.68364, 45.13424, respectively. The maximum value of the annual manufacturing output of three countries viz., Saudi Arabia, Kuwait and United Arab Emirates are 12.93000, 13.87000, 12.11000; while oil price 111.6697, real effective exchange rate 219.4085, 130.2252, 122.1642; financial development 58.11000, 105.1900, 87.60000; institutional quality 1.957962, 2.197349 and 2.378887 respectively. The minimum value of the annual manufacturing output of three countries viz., Saudi Arabia, Kuwait and United Arab Emirates are 7.690000, 4.260000, 6.740000; while oil price 12.71566, real effective exchange rate 93.62908, 89.82112, 60.10357; financial development 14.82000, 17.16000, 22.57000, institutional quality -4.170849, -7.631322 and -4.359648 respectively. The correlation matrix shows the sign and magnitude of each variable depends on the other variable.

4.1. Stationarity Tests

The study analysis starts from the unit root test because it compulsory to know about stationarity and on the behalf of its finding further study may proceed about suitable estimation method. The study used well-known unit root tests i.e, (Augmented Dickey-Fuller (1979) (ADF) and Phillips-Perron (1988) (PP)) tests. In case of Saudi Arabia, unit root results show oil price (OILP), financial development (FD) and institutional quality are stationary also at a level at first difference and all variables become stationary. In case of Kuwait, only some of the variables, in particular oil price (OILP) and manufacturing output (MANU) is stationary also at a level and all variables are stationary at first difference. United Arab Emirates results show manufacturing output (MANU), oil price (OILP), real effective exchange rate and financial development are stationary also at a level and at first difference all variables becomes stationary except manufacturing output.

Table: 1 Unit Root Tests

Variable			**ADF Test**	
In Level I(0)			First Difference I(1)	
Saudi Arabia				
	Intercept	Intercept & trend	Intercept	Intercept & trend
MANU	-1.028	-2.344	-5.421***	-5.334***
OILP	-1.283	-4.262**	-5.136***	-5.075***
REER	-2.267	-2.014	-7.212***	-6.656***
FD	-0.211	-3.358*	-5.004***	-5.047***
INSQ	-4.874***	-1.071	-2.432	-5.982***
Kuwait				
MANU	-2.014	-3.477*	-6.102***	-5.938***
OILP	-1.283	-4.262**	-5.136***	-5.075***
REER	-1.112	-2.545	-4.543***	-4.326***
FD	-1.464	-2.261	-5.506***	-5.901***
INSQ	-2.047	-2.317	-5.936***	-5.879***
United Arab Emirates				
MANU	-3.160**	-3.117	-1.538	-1.505
OILP	-1.283	-4.262**	-5.136***	-5.075***
REER	-0.012	-3.857**	-4.614***	-4.593***
FD	-0.315	-3.287*	-4.315***	-4.308***
INSQ	-1.617	-0.671	-4.437***	-1.734

Table Continues

Variable			**Phillips-Perron Test**	
In Level I(0)			First Difference I(1)	
Saudi Arabia				
	Intercept	Intercept & trend	Intercept	Intercept & trend
MANU	-0.729	-2.409	-5.783***	-5.749***
OILP	-1.336	-2.121	-5.136***	-5.075***
REER	-6.779***	-5.821***	-8.464***	-7.784***
FD	0.682	-2.077	-5.454***	-9.655***
INSQ	-2.043	0.719	-4.355***	-8.865***
Kuwait				
MANU	-2.116	-4.024**	-8.313***	-8.175***
OILP	-1.336	-2.121	-5.136***	-5.075***
REER	-1.432	-3.416*	-4.686***	-4.797***
FD	-1.464	-1.702	-5.510***	-6.252***
INSQ	-1.968	-2.377	-6.786***	-8.123***
United Arab Emirates				
MANU	-1.650	-1.617	-3.644**	-3.619**
OILP	-1.336	-2.121	-5.136***	-5.075***
REER	0.149	-3.794**	-6.911***	-7.633***
FD	0.024	-1.663	-3.411**	-3.541*
INSQ	-1.617	-677	-4.375***	-8.304***

*,**,***Statistical significance at the 10%, 5% and 1% level, respectively.

So, after unit root test results the move towards econometric estimation methods that are ARDL and NARDL (for asymmetric relationship). Because autoregressive distributed lag model (ARDL) may apply under certain conditions if variables are at I(0) or I(I) or mixed order and no any variable be on order I(2) and our results are in same condition which are discussed above.

4.2 ARDL Bound Test

Table 2 shows the output of the bound test of cointegration. The computed values of F-statistic are higher than upper bound and that confirms long-run association between manufacturing output and oil price, real effective exchange rate, financial development and institutional quality exist in case of Saudi Arabia, Kuwait and United Arab Emirates.

Table 2: Results of ARDL Bound Test

	10%	5%	1%
Lowe bound I(0)	2.45	2.86	3.74
Upper bound I(1)	3.52	4.01	5.06
F-Statistics (Saudi Arabia)			4.861
F-Statistics (Kuwait)			3.611
F-Statistics (United Arab Emirates)			3.896

The AIC criteria that assume maximum lags used for lag selection. The following optimal lag orders have chosen the base of this criteria: (ARDL (1, 0, 1, 1, 1)) for Saudi Arabia; (ARDL (3, 0,1,0,1)) for Kuwait and (ARDL (1, 1, 2, 0, 0)) for United Arab Emirates.

4.3 Results of Linear ARDL Model

These results summarize short-run and long-run estimated coefficients in the following Table 3 as well as diagnostic tests like normality, serial correlation, Ramsey reset test and heteroskedasticity. These diagnostic test results are in favour that model cleared from heteroskedasticity problem, well-specified, serial correlation and normally distributed.

Saudi Arabia findings indicate that elasticity of manufacturing output relative to oil prices is significant with a negative sign that implying 1% increase in oil price that decrease 0.116% and 0.099% in the long run and short run respectively. Financial development coefficient is significant. Moreover, the coefficient of the variable institutional quality is insignificant in long-run but significant in the short run.

Kuwait case, the results show that elasticity of manufacturing output in relation oil prices is significant with a negative sign that implying 1% increase in oil price that decreases 0.319% and 0.180% in short-run and the long-run. The coefficients of real effective exchange rate, financial development and institutional quality are also significant. United Arab Emirates case, elasticity of manufacturing output relative to oil price is significant with negative sign showing that 1% increase in oil price that decrease 0.244% and

0.158% in long-run and short-run. The coefficients of financial development and real effective exchange rate are significant with respective signs. The variable institutional quality is insignificant.

The error correction term (ECT) coefficients are equal to -0.850, − 0.565 and -0.411 that are significant with negative signs that insured long term dynamics adjustment of variables in these countries.

Our results are similar to the study of Bass (2018) that explored the influence of oil price on manufacturing output in Russia for the period of 1996-2017 by using VEC framework and found cointegration. Similarly, the studies of Ollus and Barisitz (2007) for Russia and Oomes and Kalcheva (2007) and Algieri (2011) found same relation as our results. However, our results provides the novel relation of oil price and manufacturing output by considering these control variables like real effective exchange rate, financial development and institutional quality that are somehow not included in previous studies to test the resource curse phenomenon. Aditionally, our findings provides the complete picture in these oil exporting countries that are main member of GCC countries.

Table 3: Results of Linear ARDL Estimation and Diagnostic Checks

	Saudi Arabia	**Kuwait**	**United Arab Emirates**
Long-run Estimates			
LOILP	-0.116*** [0.033]	-0.319*** [0.073]	-0.244*** [0.073]
LREER	0.011 [0.171]	-1.332** [0.517]	1.333*** [0.461]
LFD	0.451*** [0.059]	0.287** [0.129]	-0.510*** [0.172]
INSQ	-0.001 [0.003]	-0.014 [0.013]	0.015 [0.014]
CONSTANT	0.498 [0.364]	3.547*** [0.917]	-0.430 [0.774]
Short-run Estimates			
D(MANU(-1))	-----	0.267** [0.117]	------
D(MANU(-2))	-----	0.125 [0.094]	-----
	Table Continues		

D(LOILP)	-0.099*** [0.031]	-0.180** [0.071]	-0.158*** [0.040]
D(LREER)	0.299 [0.229]	-0.753** [0.329]	0.548** [0.211]
D(LFD)	0.169** [0.069]	0.462*** [0.111]	-0.209** [0.077]
D(INSQ)	0.013* [0.007]	0.037*** [0.010]	0.006 [0.009]
D(INSQ(-1))	-----	-----	-0.029*** [0.009]
ECT	-0.850*** [0.159]	-0.565*** [0.154]	-0.411*** [0.086]
Diagnostic Tests			
R^2	0.898	0.932	0.954
Adj. R^2	0.862	0.901	0.937
LM Test	1.059 (0.364)	0.413 (0.668)	1.051 (0.368)
J.B (P-Value)	2.540 (0.281)	0.812 (0.665)	0.995 (0.608)
Hetero Test	0.534 (0.818)	0.431 (0.902)	1.379 (0.259)
Ramsey Reset Test	1.706 (0.205)	0.865 (0.398)	1.057 (0.303)

*, **, and *** represents probabilities at 10%, 5% and 1% significance; the values in [] are standard error; the values in () are p-values.

However, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) introduced by Brown et al. (1975) show the stability of estimated coefficients and our estimation results for Saudi Arabia, Kuwait and United Arab Emirates are presented in Figs. 7, 8, 9, 10, 11,and 12, respectively.

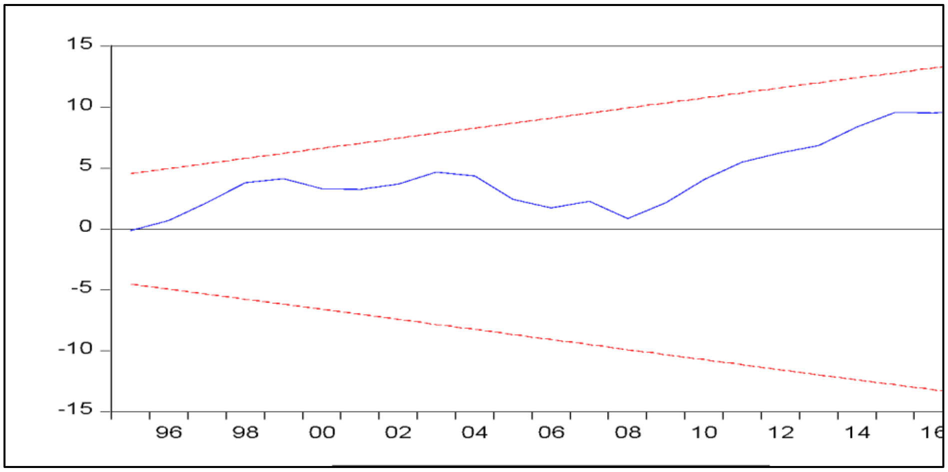

Figure 7: ARDL CUSUM (Saudi Arabia)

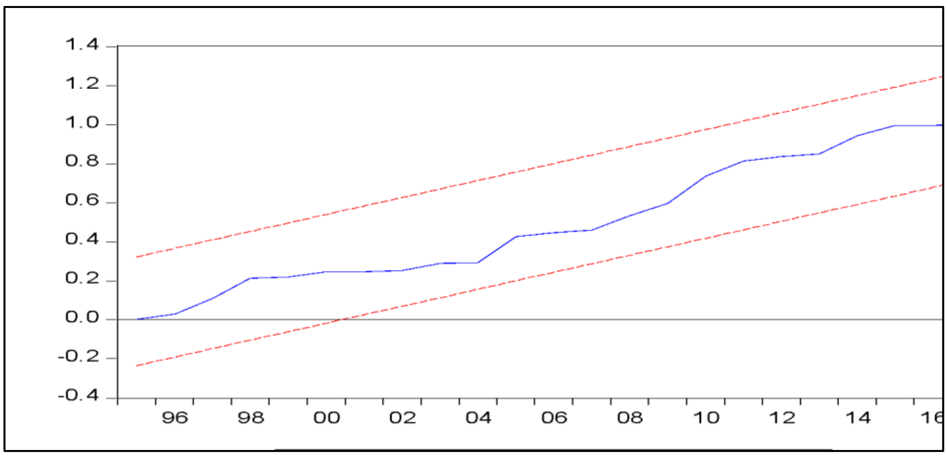

Figure 8: ARDL CUSUMQ (Saudi Arabia)

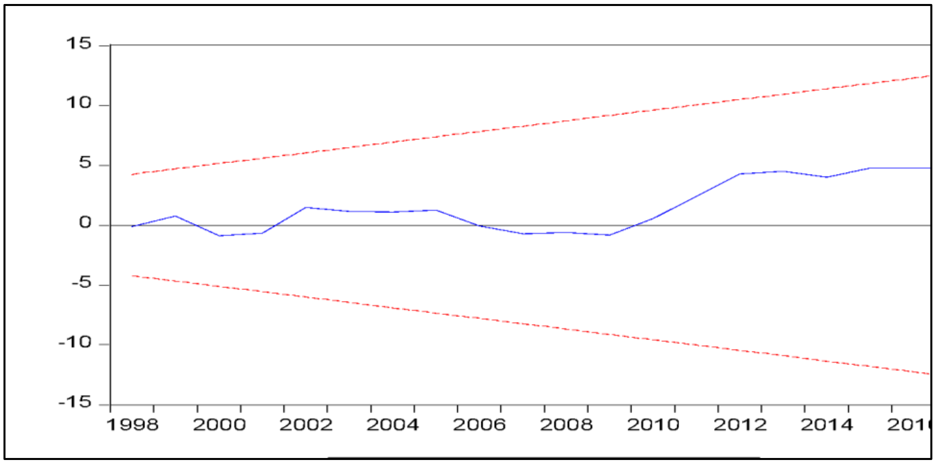

Figure 9: ARDL CUSUM (Kuwait)

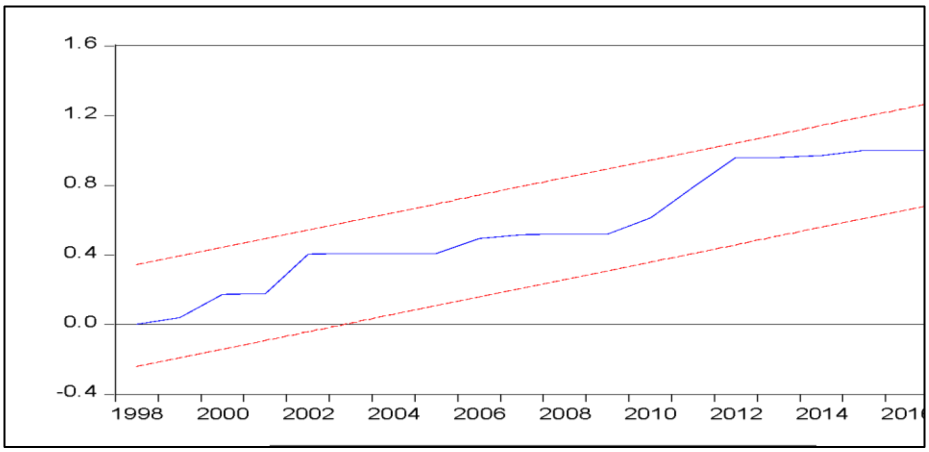

Figure 10: ARDL CUSUMQ (Kuwait)

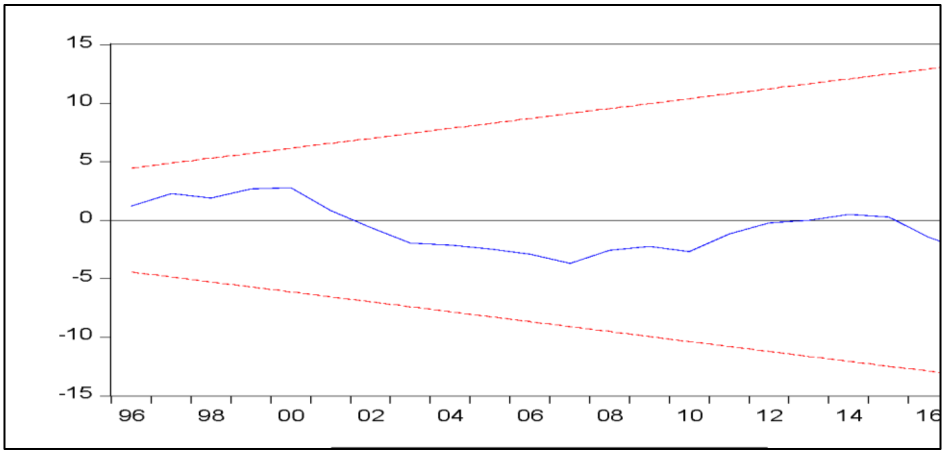

Figure 11: ARDL CUSUM (United Arab Emirates)

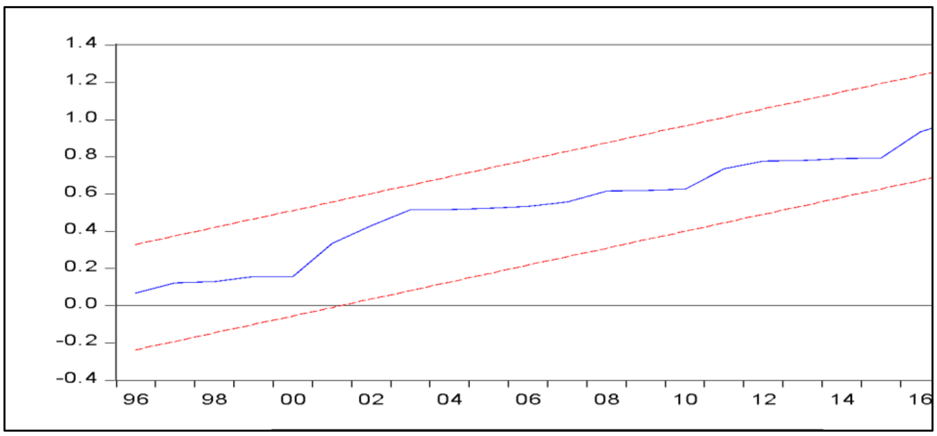

Figure 12: ARDL CUSUMQ (United Arab Emirates)

4.4 Results of Nonlinear ARDL Model

The study follows the same first steps bound test for checking the variables nonlinear long-term association. The bound tests results reported in Table 4. The calculated values of F-statistics are higher than upper bound that suggest nonlinear cointegration between manufacturing output, oil price, financial development, real effective exchange rate and institutional quality.

Table 4: Results of NARDL Bound Test for Cointegration

	10%	5%	1%
Lowe bound I(0)	2.26	2.62	3.41
Upper bound I(1)	3.35	3.79	4.68
F-Statistics (Saudi Arabia)			3.931
F-Statistics (Kuwait)			6.123
F-Statistics (United Arab Emirates)			3.451

AIC criteria that assume maximum lags used as lags selection. The following optimal lag orders have chosen the base of this criteria: (ARDL (2, 0, 0, 1, 0, 1)) for Saudi Arabia; (ARDL (4, 2,1,1, 2, 2)) for Kuwait and (ARDL (1, 0, 1, 2, 0, 2)) for United Arab Emirates.

Table 5 shows the short run and long run estimates and also diagnostic test results that indicate no problem of serial correlation, heteroskedasticity, well-specified and normally distributed. In case of Saudi Arabia, the nonlinear results suggest that a 1% increase price of oil decreases the manufacturing output by 0.078%, 0.099% and a 1% decrease in the price of oil increase manufacturing output by 0.202%, 0.258 in the long run and short run, respectively. The other control variables like financial development are significant in the long run while real effective exchange rate and institutional quality are not significant.

The oil price significantly impact manufacturing output, an oil price increase of 1% that decrease manufacturing output by 0.448%, 0.744% and 1% decrease in the price of oil that increases manufacturing output by 0.453% only in long run in Kuwait. The other control variable like financial development, institutional quality and real effective exchange rates are significant.

In the case of United Arab Emirates oil price fluctuations influence manufacturing output significantly, an oil price increase of 1% results manufacturing output decrease of 0.266%, 0.109% in long-run and short-run. While negative oil price changes influence manufacturing output significantly in short-run only. The coefficient of real effective exchange rate and financial development significantly affects while institutional quality is insignificant.

The error correction term (ECT) coefficients are equal to -1.273 for Saudi Arabia, -1.457 for Kuwait and -0.414 for the United Arab Emirates that are negative and significant. The error correction term shows the existence of cointegration and convergence (Baek and Kwon, 2019).

These findings are similar to the study of Balasubramaniam, (2017) and Mordi and Adebiyi (2010) analyzed the oil price and output nexus in Malaysia. However, our results are somehow novel for these economies that explains the nonlinear behavior of oil price with manufacturing out by including real effective exchange rate, financial development and institutional quality as controlled variables to test resource curse hypothesis.

Table 5: Results of Nonlinear ARDL

	Saudi Arabia	**Kuwait**	**United Arab Emirates**
Long-run Estimates			
LOILP_POS	-0.078*** [0.019]	-0.448*** [0.044]	-0.266** [0.103]
LOILP_NEG	-0.202*** [0.032]	-0.453** [0.153]	-0.096 [0.127]
LREER	0.031 [0.104]	-0.997 [0.677]	1.769*** [0.572]
LFD	0.141** [0.054]	0.212*** [0.064]	-0.384 [0.266]
INSQ	0.001 [0.002]	0.019** [0.008]	0.016 [0.014]
Constant	0.637** [0.226]	2.606* [1.233]	-1.715 [1.096]
Short-run Estimates			
D(LMANU(-1))	0.215* [0.108]	0.658** [0.240]	-------
D(LMANU(-2))	-------	0.544*** [0.154]	-------
D(LMANU(-3))	-------	0.377** [0.126]	-------

D(OILP_POS)	-0.099*** [0.025]	-0.744*** [0.229]	-0.109** [0.040]
D(OILP_POS(-1))	--------	-0.745** [0.250]	-------
D(OILP_NEG)	-0.258*** [0.049]	-0.049 [0.149]	-0.215** [0.083]
D(REER)	0.039 [0.132]	1.931* [1.037]	0.732*** [0.237]
D(LFD)	0.013 [0.065]	0.290** [0.125]	-0.308* [0.152]
D(LFD(-1))	------	-0.692*** [0.218]	-0.069 [0.119]
D(INSQ)	0.007 [0.005]	0.013 [0.014]	0.014 [0.010]
D(INSQ(-1))	-------	-0.017 [0.013]	-0.028*** [0.009]
ECT	-1.273*** [0.145]	-1.457*** [0.292]	-0.414*** [0.077]
Diagnostic Tests			
R^2	0.949	0.978	0.962
Adj. R^2	0.927	0.944	0.941
LM Test	1.002 (0.386)	1.172 (0.353)	0.057 (0.945)
J.B Test	0.029 (0.985)	1.402 (0.496)	0.244 (0.885)
Hetero Test	0.962 (0.497)	0.497 (0.906)	0.777 (0.659)
Ramsey Reset Test	0.636 (0.434)	0.719 (0.489)	0.843 (0.371)
W_{LR} W_{SR}	51.688 (0.000) 0.147 (0.400)	2.148(0.157) 0.481(0.626)	0.158 (0.695) 0.023 (0.881)

*, **, and *** represents probabilities at 10%, 5% and 1% significance, respectively; the values in [] are standard error; the values in () are p-values. W_{LR}, W_{SR} : Wald test for symmetry.

The results of the CUSUM and CUSUMQ are presented by Figs. 13, 14, 15, 16, 17, and 18.

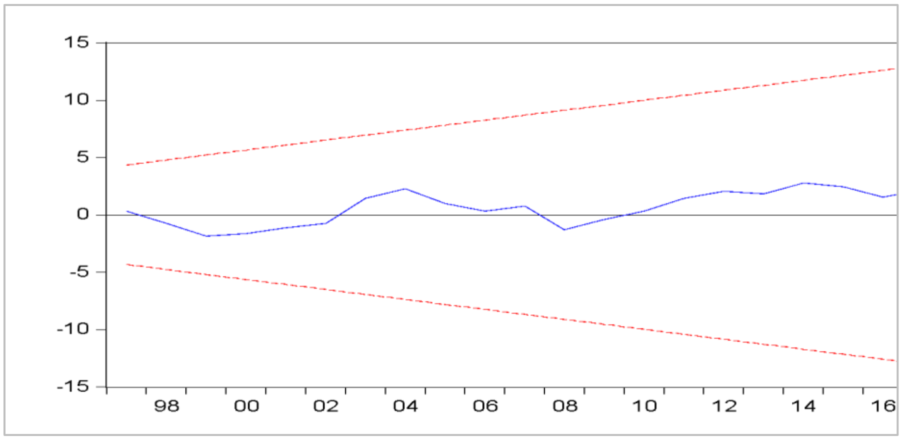

Figure 13: NARDL CUSUM (Saudi Arabia)

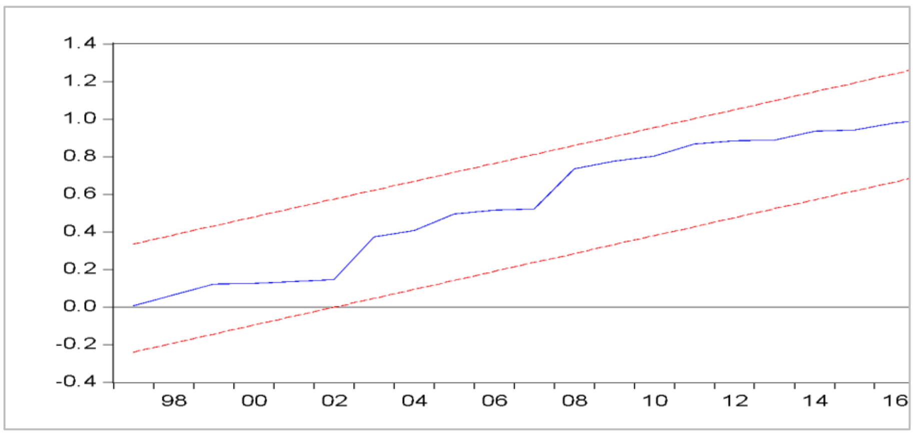

Figure 14: NARDL CUSUMQ (Saudi Arabia)

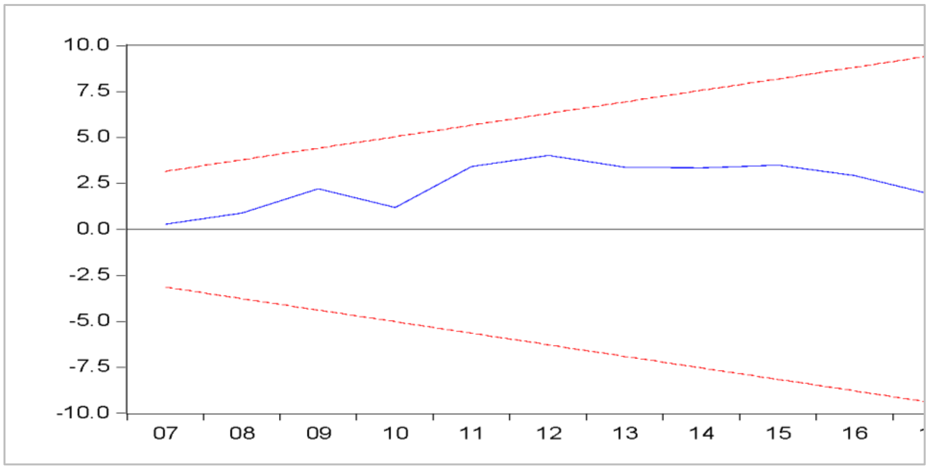

Figure 15: NARDL CUSUM (Kuwait)

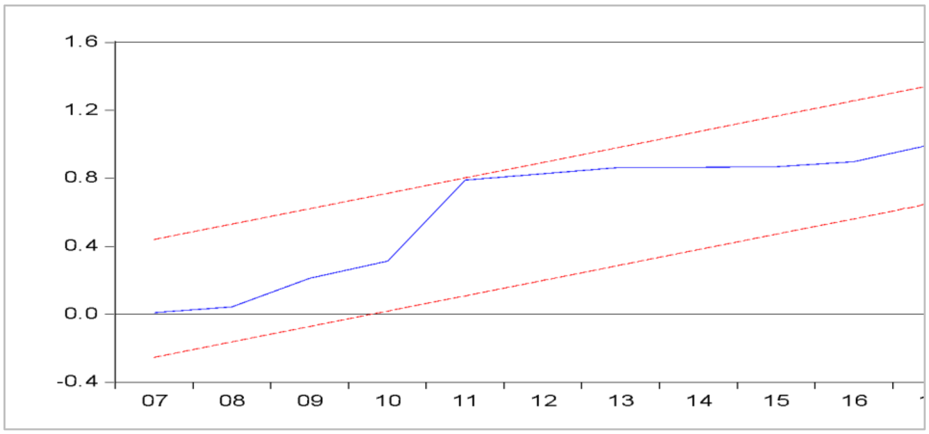

Figure 16: NARDL CUSUMQ (Kuwait)

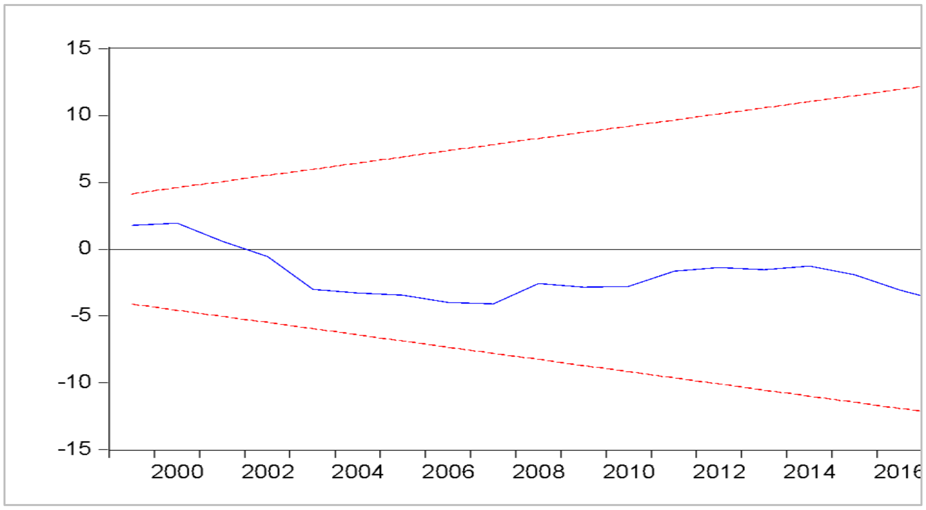

Figure 17: NARDL CUSUM (United Arab Emirates)

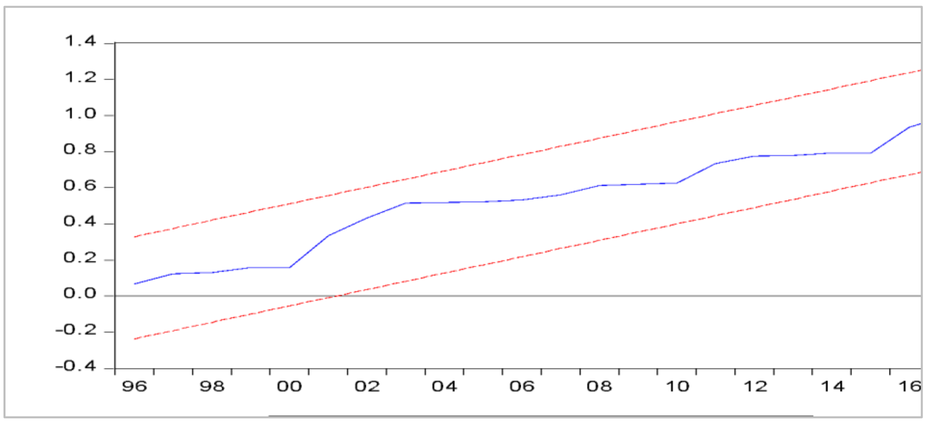

Figure 18: NARDL CUSUMQ (United Arab Emirates)

The results regarding asymmetry confirmation, findings are in support that a linear model for manufacturing output in Saudi Arabia would be probably misspecified. However, Kuwait and United Arab Emirates case, the result is not in support of asymmetry.

Moreover, the following dynamic multiplier graphs show the asymmetric behavior of oil price. The dotted red lines that represent the lower and upper band for asymmetry show the 95% confidence interval. In the following figures of multiplier graph, on the horizontal axis years and vertical axis magnitude of the effect presented to long-run relationship equilibrium achievement.

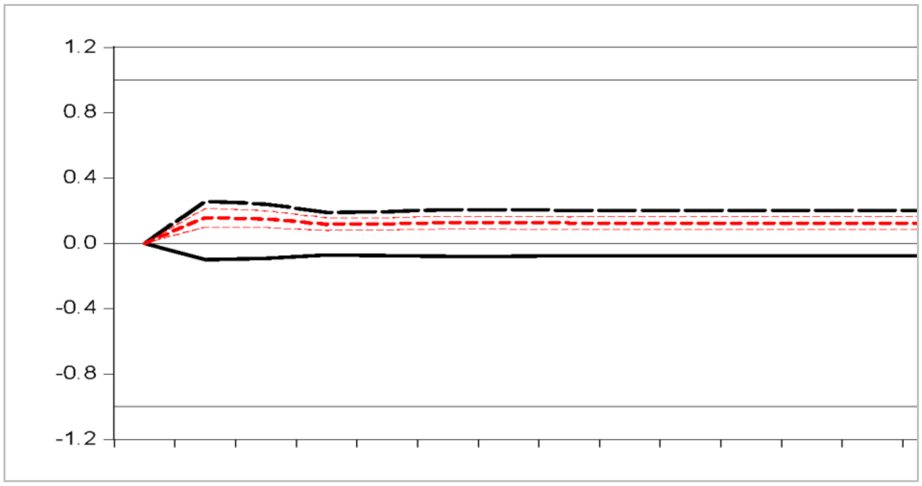

Figure19: Dynamic Multiplier Graph (Saudi Arabia)

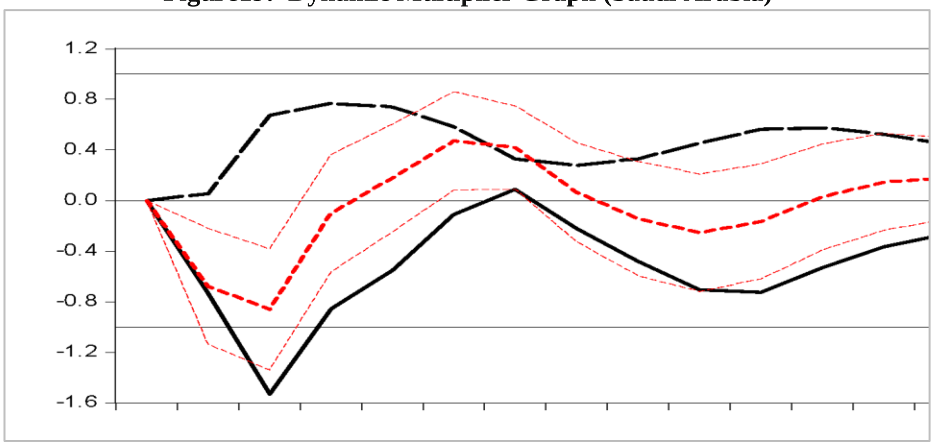

Figure 20: Dynamic Multiplier Graph (Kuwait)

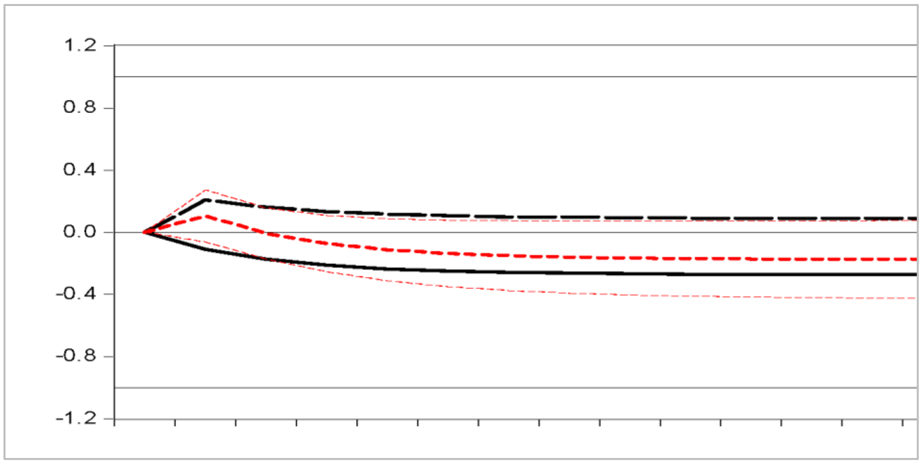

Figure 21: Dynamic Multiplier Graph (United Arab Emirates)

Furthermore, variables causal relationship confirmation, this study employed the Granger causality test and findings are reported in table 6 (Appendices). The results show one-way causality runs from oil price to manufacturing output in the case of Saudi Arabia and Kuwait except for United Arab Emirates.

5. Concluding Remarks and Policy Implications

This paper explores the complex relationship of oil price and manufacturing output from 1985 to 2017, using the linear and nonlinear ARDL Model. The results show that elasticity of manufacturing output relation to oil price is significant with a negative expression in Saudi Arabia, Kuwait and United arab Emirates. However, the detection of asymmetric behavior of oil price in linear ARDL model is an insufficient capability and this study further estimates non-linear model. In Saudi Arabia and Kuwait, the nonlinear findings revealed that increase in the price of oil decreases the manufacturing output and decrease in the price of oil that increases manufacturing output. But the case of United Arab Emirates is little bit different, oil price fluctuations affected significantly manufacturing output, an oil price increase results in manufacturing output decrease and negative oil price changes significantly affect manufacturing output in only in short-run. The study also applied the Granger causality test and results show one-way causality from oil price to manufacturing output only in Saudi Arabia and Kuwait. The results are different due to dependency difference on oil. United Arab Emirates is in the phase of diversification and tries to reduce their dependence on oil extraction and exports. These results are helpful for those countries that are depending on oil extraction and its exports and helpful in understanding the dynamic relation of oil price with manufacturing output.

However, the contribution of this study is as follows: this study uses both ARDL and NARDL methods at a time to show the oil-manufacturing output relationship and test the Resource curse hypothesis. This study is also useful for policymakers and government officials of oil exporting countries to understand the complex relation of both variables and make policies for diversification. Against this backdrop, this study is limited to this constraint due to data availability and it helps only those oil exporting countries that have similar conditions like Saudi Arabia, Kuwait and United Arab Emirates.

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APPENDICES

6: Results of Granger Causality

Dependent Variable	**Independent Variable**					
Case of Saudi Arabia						
	LOILP	**LMANU**	**LREER**	**LFD**	**INSQ**	**Direction of Causality**
LOILP		1.481	1.511	2.639*	2.511	LFD→LOILP
LMANU	4.637***		0.22953	2.738*	0.423	LOILP→LMANU LFD→LMANU
LREER	0.468	0.078		0.585	1.816	
LFD	3.778**	0.027	1.593		2.693	LOILP→LFD
INSQ	1.279	0.853	0.285	3.919**		LFD→INSQ
Case of Kuwait						
	LOILP	LMANU	LREER	LFD	INSQ	Direction of Causality
LOILP		0.420	1.356	0.584	2.369	
LMANU	13.749***		0.259	1.879	2.083	LOILP→LMANU
LREER	7.837***	0.313		0.324	3.358*	LOILP→LREER INSQ→LREER
LFD	1.697	0.819	2.345		11.286***	INSQ→LFD
INSQ	0.010	5.802**	0.391	8.623***		LMANU→INSQ LFD→INSQ
Case of United Arab Emirates						
	LOILP	LMANU	LREER	LFD	INSQ	Direction of Causality
LOILP		4.887***	2.033	2.363*	1.656	LMANU→LOILP LFD→LOILP
LMANU	0.433		1.528	0.232	2.311	
LREER	0.643	0.083		0.643	10.803***	INSQ→LREER
LFD	6.764***	3.629**	0.956		1.222	LOILP→LFD LMANU→LFD
INSQ	1.868	1.374	0.858	2.179		

Note: *, ** and *** represent probabilities at 10%, 5% and 1% significance, respectively