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The Long Run Effects of Oil Prices on Economic Growth: The case of Saudi Arabia

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ABSTRACT

This paper studies the long run effects of oil price growth rates (OS) on the economic growth of the Kingdom of Saudi Arabia (KSA). The empirical results of an autoregressive distributed lag model find a strong positive direct impact of OS on the gross domestic product (GDP) growth rates of KSA during the period 1995Q4-2015Q4. Despite the fact that China is the most important trading partner of KSA, OS doesn't affect indirectly Saudi GDP growth rates. OS weakens the positive long run effect exercised on the GDP growth rates of KSA via trading with Japan. Although trading with South Korea and UK have negative significant effects on the Saudi GDP growth rates, OS has no possible indirect effect via trading with UK. But, it has a positive effect on the weighted GDP growth rates of S. Korea via trading with KSA. Trading with USA, India, Canada, France and Germany have no significant impacts on Saudi economy.

Keywords: Saudi Arabia, Economic Growth, Oil Price Effect, Autoregressive Distributed Lags Model
JEL Classifications: O53, O40, C23

1. INTRODUCTION

The Kingdom of Saudi Arabia (KSA) is an oil based economy. It is the first oil exporter in the world and the second largest oil producer in the world[1], where oil represents more than 90% of its exportations and 70% of annual government revenues. Oil participates in 45% of Saudi Arabia gross domestic product (GDP)[2]. Although several previous studies found a strong positive direct impact of oil prices on the GDP growth rates of KSA, few papers have been carried out to study the indirect effect of high oil prices effect on economic growth in the KSA through trading partners. Among these few previous studies a paper published by Aslanoglu and Deniz (2013). They focused in studying the indirect effect in a sample of countries contained the KSA. They tried to answer the following question: Is there a mechanism for the transmission from East Asian economies (China and India) to The Middle East economies through oil prices? The study found that a high economic growth in these two Asian countries will have a positive impact on the oil exporter's countries such as the KSA.

Hesary et al. (2013) studied the impact of oil shocks on the second and third largest exporters of crude oil (Russia and Iran respectively), excluding unfortunately from their survey the largest oil exporter due to the lack of data: "Saudi Arabia is the largest oil exporter but some statistics for this country were not available; this is why we selected Iran and Russia" Hesary et al. (2013. p. 573). In this regard, it is to be mentioned that collecting quarterly data especially for the Saudi real GDP consumed a lot of time. After long research, I found them available on the site of OCED for the G20.

Saudi Arabia will be the axis of my research and not only one among others in a sample of countries. The importance of this study is to deal with all the countries associated and linked with Saudi Arabia by a strong commercial ties. They will be added to the model in order to investigate the indirect effect of oil price on the Saudi economy. This means that Saudi economic growth rates in the model doesn't only depend on the changes of oil prices but also on the GDP growth rates of the other countries via bilateral trade matrix.

1 The International Energy Agency (IAE), World Energy Outlook 2015.
2 The source of these data: http://www.indexmundi.com/saudi_arabia/economy_overview.html.

An autoregressive distributed lag (ARDL) model is employed in order to investigate the direct and indirect long run effects of oil prices on economic growth represented by the GDP growth rates. The direct long run impact of oil price on the GDP growth rates can be examined directly through the estimated long run parameters, while the indirect effect is passing through trading partners. Therefore, oil price shock affects indirectly the GDP growth rates of Saudi Arabia through the weighted GDP growth rates of its trading partners represented as independent variables in the Saudi Arabia auto regressive model. Thus, if a direct long run relationship is found between the weighted GDP growth rates of Saudi Arabian trading partners and the GDP growth rates of KSA, and if oil price shock has a direct long run effect (positive or negative) on the weighted GDP growth rates of KSA trading partners, par consequence, oil price will have an indirect effect on the GDP growth rates of KSA. This is a spillover effect or a secondary effect that follows from a primary effect.

This study is organized in six sections. It is structured as follows. Section 2 reviews briefly the theoretical framework of the effect of oil price shock on economic growth from demand side and supply side. It reviews the latest empirical studies that investigated the direct and indirect relationship between oil price shock and economic growth. In section 3, Saudi Arabia main economic indicators for the period (1990-2015) are presented in order to give the reader a good background of Saudi Arabian economy and to show at what point oil has played a major role as a motor of the economy. In addition, the trading shares of the five main commercial partners of Saudi Arabia (China, USA, Japan, South Korea and India) are presented in order to show their evolution over time. The ARDL model, the econometric method of estimation and the dependent and independent variables are presented and described in section 4. This is followed by the results and interpretation in section 5 and the conclusion in section 6.

2. THEORETICAL AND EMPIRICAL REVIEW

2.1. Theoretical Background

In an opened economy, the total production (GDP) at the equilibrium point is:

(X-M+G+C+I=Y)

Where:

C: Consumption,

I: Investment,

G: Government expenditure,

X-M: Net exportation.

Production is the main determinant of economic growth. While labor, capital, land and entrepreneurship are known as the primary inputs of production, petroleum derivatives are one of the most important intermediate inputs in the production process because without energy resources there is no production. The theory of economic growth implies that a high rise of oil prices may lead to a contractionary supply shock which lowers the production of firms accompanied with an augmentation in general prices (Stagflation).

It is important to be mentioned that the effects of oil prices changes are not symmetric among countries as they depends on the category to which each country belongs (net exporting or net importing countries). In general, oil price increases have positive direct effects in oil exporting countries and negative direct effects in oil importing countries. In fact, an increase of oil price has two macroeconomic major sides' effects: Demand effect and supply effect. Oil is the only commodity that has an impact on all the components of aggregate demand as it is well explained by Ghalayini (2011): "Oil prices changes entail demand-side effects on consumption and investment. Consumption is affected indirectly through its positive relation with disposal income. Moreover, oil prices have an adverse impact on investment by increasing firms' costs" Ghalayini (2011. p. 128). Increasing firms' costs lead to decreasing the profitability which lowers the new investments. On the other side, high oil price in oil importing countries lower disposal income which decreases consumption.

In the oil exporting countries like Saudi Arabia, oil price is an important determinant of government expenditure (G); especially oil represents 70% of Saudi government revenues. Thus, a decline in oil price leads to reduce government expenditure on the projects which lowers GDP growth by reducing the aggregate demand.

The external sector which is represented by the net exportation is directly and indirectly influenced by changes in oil prices. The indirect impact of high oil prices affects the economic growth in oil exporting countries through the commercial transactions because oil accounts for an important share of GDP. Berument et al. (2010) mentioned that high oil prices enhance economic growth through higher export earnings and create the terms of trade effect. As a result, wealth will be transferred from oil importing countries to oil exporting countries, leading to greater purchasing of power for economic agents of oil exporting countries. For example, KSA is an important trade partner of China. The rise in oil prices is expected to have a positive impact on the economic growth in KSA (direct effect), while adversely affect the economic growth in China (direct effect). In contrast, the rise in national income in Saudi Arabia as a result of the direct impact of higher oil prices lead to increase demand for Chinese goods (increase imports from China), which indirectly positively affect the economic growth in China. However, a significant rise in oil prices may have a negative indirect impact on Saudi Arabia (shock via trade); as rising energy costs increase the production cost of Chinese goods, leading to a contractionary supply shock, which lowers China's demand for Saudi oil (one of the most important exports of Saudi Arabia). Therefore, as it is mentioned by Oriakhi and Osaze (2013), oil price changes whatever the nature (either a rise or a fall) can both benefit and hurt the economy at the same time by direct and indirect effects. In few words, Hesary et al. (2013) indicated that: "A positive indirect effect due to an increase in the revenue of oil exporting countries allowing oil importing countries to export more goods to these countries, decreasing their net loss" Hesary et al. (2013. p. 572).

The empirical study of Abeysinghe (2001) showed that GDP growth of Singapore (a net oil importer) was negatively affected by high oil prices, while the indirect effect was positive due to the increase of exports to Singapore's main commercial partners: Indonesia and Malaysia (two oil net exporter).

The earlier studies concerning the relationship between oil prices and economic growth used linear models of symmetric effects relationship theory (Rasche and Tatom, 1981; Hamilton, 1983; Tatom, 1989). While from the mid-1980s, non-linear models of asymmetric effects have been more employed to study the relationship between oil price changes and economic growth. By testing the stability of coefficients before and after the decline of oil prices in the end of 1985, Mork (1989) found a strong negative effect of oil price increases on the US real GNP growth and a weak insignificant positive effect of oil price decreases. This asymmetric effects can be explained by Balke et al. (1998) who found that gasoline prices rise more quickly when oil prices are increasing than they fall when oil prices are decreasing. Ghalayini (2011) noticed that oil price changes don't have the same effects among different countries because the ratio of energy imports to GDP differ from country to another. By using multivariate correlations between GDP and oil price increases and decreases, Mork et al. (1994) found that the correlation patterns are not the same for price increases and decreases among different countries. The magnitude and the direction of the effects of oil price shocks depend on whether the country is a net exporter or importer of oil. Moreover, the effects of oil prices changes aren't symmetric concerning the same country. Kilian and Vigfusson (2011) concluded that the negative effect of an unexpected increase in real price of oil on real GDP was larger than the positive response of real GDP to unexpected decrease of the same magnitude in real price of oil.

In addition of all what have been mentioned above, an increase of oil price has a positive relationship with inflation. The study of Aleisa and Dibooglu (2002) showed that, while world inflation is affected by Saudi oil policy, the rise of world good prices affect the inflation in Saudi Arabia by imported goods.

Oil price is the main source of output fluctuations in Saudi Arabia, implying that it is vulnerable to external shocks (Mehrara and Oskoui, 2007). In oil producing countries (exporting countries such as KSA and non-exporting ones like USA) higher oil prices makes the investment in oil sector more profitable, this rises the value of oil production which is a part of GDP (Y). In KSA, an increase of oil price rises the nominal production rather than rising the real production which is constant as it is determined by the quota of OPEC. While in USA which isn't a member of any oil cartel, the production of oil itself depends in the feasibility of investment in oil sector. When oil prices reached 140$ per barrel in 2007, many American energy companies increased the number of oil rigs. Recently, when oil prices have started slowing down to reach 40 $ per barrel, this led American oil companies to reduce the number of operating oil rigs. On the other hand, in oil importing countries, the impact of an increase of oil price on the output, pass via an augmentation of production costs which lowers the production of firms.

2.2. Empirical Studies Review

The empirical studies concerning the impact of oil price on economic growth are going to be presented as: Studies focus only on direct effect and those investigated the direct and indirect effects.

2.2.1. Direct effect studies

One of the questions that Dibooğlu and Aleisa (2004) tried to answer in their study was: To what extent Saudi Arabia influences and is influenced by real oil price? They used a simple macroeconomic model tailored to the Saudi Arabian economy and a SVAR. They used quarterly data from1980 to 2000. The three major findings are:

1. In the long run, the variance decomposition of output indicates that 35% of the forecast error variance of output is due to terms of trade balance shocks. Saudi Arabia oil policy should minimize fluctuations in oil prices because terms of trade shock are generated by nominal oil price changes. This corresponds to the results of Spatafora and Warner (1995) who concluded that positive terms of trade shocks affect positively the investment and GDP in the long run in oil exporting countries.
2. In the long run, government expenditures are influenced by oil price changes.
3. Real oil price shocks drive the price level and real exchange rates in the long term.

Jiménez-Rodríguez and Sánchez (2005) studied over the period (1972:Q3-2001:Q4) the relationship between oil prices and GDP growth of G-7 countries, Norway and the euro area as a whole. Only Norway and UK are net oil exporters while the others are oil net importers. The results which were obtained from VAR indicated that an increase of oil prices has a negative effect on GDP growth in oil importing countries and UK using both linear and non-linear models. Norwegian GDP growth is positively affected by oil price increases. In general, they concluded that oil price increases have an impact on economic growth of a larger magnitude than that of oil price decreases.

Ito (2010) examined the effect of oil price changes on GDP growth and the exchange rate in Russia over the period (1994-2009). He used a VAR model. The results found that 1% increase or decrease in oil prices contributes to a 0.46% of GDP growth or (decline). He concluded that Russian economy is highly vulnerable to oil price volatility because in the short run exchange rate and inflation rate increase and decrease following the changes of oil prices.

Berument et al. (2010) used annual data from 1952 to 2005 in order to study the effect of oil price volatility on economic growth of 16 countries in MENA region and employed a SVAR model in order to capture the dynamics of world oil price shocks on output growth. Two other variables are included in the VAR model (exchange rate and Inflation). Their results showed that: "One standard deviation shock in oil prices has a statistically significant and positive effect on the growth of the mostly net oil-exporting economies: Algeria, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Syria, and UAE. Oil price shocks do not appear to impose statistically significant effects on the economies of the other countries: Bahrain, Djibouti, Egypt, Israel, Jordan, Morocco and Tunisia" Berument et al. (2010. p. 172).

Oriakhi and Osaze (2013) used quarterly data over the period (1970-2010) in order to study the relationship between oil price volatility and economic growth in Nigeria by employing an unrestricted VAR model. Their empirical results indicated that oil price volatility exercises its impact on real GDP via government expenditure and exchange rate.

2.2.2. Direct and indirect effect studies

Abeysinghe (2001) divided the effect of oil price shocks into two sub-effects: The direct effect received from an increase of oil price and the indirect effect which works through an economy's trading partners. Abeysinghe employed a multi-equation framework: Using a structural VARX model and using a reduced form bilateral export functions in order to estimate the direct and indirect effects of oil prices during the period (1982Q1-2000Q2) on the GDP growth of 10 Asian economies, USA and the Rest of OECD. To find the main trading partners Abeysinghe used 12 quarter moving averages of export shares, so that they change slowly over time. His results showed that:

Although Indonesia and Malaysia (net oil exporters) benefit from a positive direct effect of high oil prices, they are negatively affected by their trading partner (Singapore) which is a net oil importing country. The direct effect of high oil prices affects negatively the GDP growth of Singapore, while the indirect effect is slightly positive due to the increase of exports to Indonesia and Malaysia. For the rest of countries in the study (which are net oil importers) there is a negative direct and indirect effect. The study shows that the transmission effect of oil price on growth doesn't have an important effect for a large economy like the USA. It plays a critical role in small open economies.

Abeysinghe and Forbes (2005) developed a structural VAR model to estimate how a shock to a one country affects directly the output in other country through bilateral trade linkages and indirectly the output in other third countries via out-put-multiplier. The results concerning the Asian crisis on 11 Asian countries, the US and the rest of the OECD show that: Output-multiplier effects are large and capture an important transmission mechanism that is overlooked in models using only a bilateral-trade matrix. The predicted impact of a shock working directly through export flows can be different than the predicted impact of a shock working through multiplier effects on output growth and trade linkages in the full sample. Table 4 also shows several noteworthy patterns. First, and not surprisingly, shocks to the larger economies have the greatest multiplier effects on other countries. For most countries, the ROECD, the USA, and/or Japan are at the top of the "ranked by multiplier" column. Secondly, shocks to a country's most important bilateral-trade partners can be relatively less important than shocks to other countries when the full multiplier effects are considered. For example, Hong Kong is China's largest trading partner (and vice versa) and Singapore is Malaysia's largest trading partner (and vice versa). According to the multiplier effects, however, a one-unit shock to any of these countries would have less impact on their main trading partner than a one-unit shock to the ROECD or US. Direct trade flows from Taiwan to China are small (with China at the bottom of Taiwan's list of export markets), but the multiplier effect of a shock to China on Taiwan's GDP growth is predicted to be much larger. This captures the fact that a large share of Taiwan's exports go to Hong Kong and are then re-exported to China Abeysinghe and Forbes (2005. p. 369, 372).

Korhonen and Ledyaeva (2010) focused on studying the direct and indirect effect of oil price shocks on Russia and its main trading partners (1994-2005) by using reduced form bilateral export functions developed by Abeysingh and Forbes, 2001; 2005. The authors found that Russia as a net oil exporter benefits from high oil price. A 50% increase in oil price in the current quarter leads to an increase of 6.8% and 6% in cumulative GDP after 4 and 12 quarters, respectively. On opposite side, the indirect effects of positive oil price shock from Russia to its trading partners are mostly positive except surprisingly for Germany which gets the largest negative indirect effect from Russia. There is in general a negative indirect effect from Russia's trading partners to Russia. The largest negative indirect effect is from USA, while the largest indirect positive ones are from China and Netherlands. It must be mentioned that the direct effect for Russia is positive and very large but the indirect effect as a final outcome from all countries is negative and small.

Hesary et al. (2013), examined the direct and indirect effect of oil price shock on the GDPs of the second and the third largest oil exporters in the world (Russia and Iran). To examine the indirect effect, the authors included 17 countries that are the main trade partners of Russia and Iran. As Korhonen and Ledyaeva (2010), the authors used the same frame work developed by Abeysingh (1998; 2000) and Abeysingh and Forbes (2005). Quarterly data from (1990Q1 to 2011Q4) were used to estimate their model. All the series were found stationary by using two stationary tests (ADF test and KPSS test). According to their results they concluded that: "Among the 19 countries, three are net oil exporters, Iran, Russia and Canada. As expected we found that the direct effect of a positive oil shock on the GDPs of Iran and Russia is positive, while in contrast with Korhonen and Ledyaeva (2010) for Russia and Iran the indirect effect is also positive and the net effect is always positive and larger than the direct effect. However, the magnitude of these effects varied. For Canada the direct effect is negative but the indirect effect is positive. The reason for these findings in Canada is that oil exports account for a small portion of its GDP and the impact of oil shocks on its economy is more like that of an oil importer. This means a negative direct effect and a positive indirect effect, because Canada is more involved in exporting final commodities than crude oil, just like most of the oil importers in our survey" Hesary et al. (2013. p. 589).

Aslanoglu and Deniz (2013), tries to know if there is a transmission mechanism of growth from China and India to Middle East economies by employing Pesaran et al. (2001) bounds test as it allows for using non-stationary and stationary series at the same time covering the period between 1986 and 2011. The results indicate that high economic growth in these two countries (China and India) would have a positive impact on the economies of oil-exporting countries in the sample. Saudi Arabia, UAE, Iran and Kuwait have a positive significant relationship between oil price and GDP levels.

3. ECONOMIC BACKGROUND OF SAUDI ARABIA

Oil reserves are the main force of Saudi Arabia economy. Oil participates in 45% of Saudi Arabia GDP. Only about 40% of

Table 1: The participation of oil sector in saudi economy (2000-2015) in (US $)

Years	Oil sector US	In percentage of GDP	Other sectors participation
2000	77110544675	0.409200705	0.590799295
2001	67604042074	0.369396234	0.630603766
2002	69718198197	0.369757383	0.630242617
2003	87525086770	0.407903922	0.592096078
2004	1.11129E+11	0.429496952	0.570503048
2005	1.62771E+11	0.495559079	0.504440921
2006	1.89925E+11	0.503913691	0.496086309
2007	2.07913E+11	0.499832681	0.500167319
2008	2.85757E+11	0.549748187	0.450251813
2009	1.7407E+11	0.405665011	0.594334989
2010	2.35152E+11	0.446368617	0.553631383
2011	3.40378E+11	0.508400725	0.491599275
2012	3.67087E+11	0.500148605	0.499851395
2013	3.53027E+11	0.474285097	0.525714903
2014	3.34497E+11	0.434378548	0.565621452
2015	1.79662E+11	0.2745991716	0.725008284

Source: Central Department of Statistics and Information, Ministry of Economy and Planning, KSA

Table 2.1: The main economic indicators in the KSA for the period (1990-2015) in (U.S $)

Years	GDP at current prices	GDP growth rate at current prices (%)	GDP per capita at current prices	GDP per capita (constant2010)	GDP per capita growth rate (constant2010) (%)	Inflationrate (CPI,annual%)	Unemployment rate (% of total labor force)
1990	1.16778E+11	−3.04475	7137.392242	18002.73873	11.16565997	2.077	NA
1991	1.31336E+11	12.46621232	7775.701542	20040.4957	11.31914987	4.861	6.599
1992	1.36304E+11	3.782837555	7834.236208	20226.85422	0.929909714	−0.077	6
1993	1.32151E+11	−3.046669762	7386.668213	19413.78293	−4.019761453	1.056	5.900
1994	1.34327E+11	1.646369924	7310.950345	19041.0584	−1.919896472	0.564	4.900
1995	1.42458E+11	6.052817286	7555.965332	18648.85687	−2.059767496	4.868	5.400
1996	1.57743E+11	10.72981646	8159.980674	18744.78051	0.514367437	1.222	6
1997	1.64994E+11	4.596545397	8328.970985	18588.30435	−0.834771943	0.057	6.199
1998	1.45773E+11	−11.64955996	7180.15044	18763.58593	0.942967039	−0.357	6.400
1999	1.60957E+11	10.41639227	7728.676388	17690.91757	−5.716755656	−1.348	4.300
2000	1.88442E+11	17.07585791	8808.875367	18263.23008	3.235064046	−1.125	4.599
2001	1.83012E+11	−2.881312999	8315.739302	17585.39045	−3.711499142	−1.113	4.599
2002	1.88551E+11	3.026536655	8317.908575	16619.43466	−5.492944829	0.230	5.199
2003	2.14573E+11	13.80081378	9186.310388	17954.94979	8.035863807	0.587	5.900
2004	2.58742E+11	20.58477744	10756.01622	18822.73004	4.833097602	0.330	5.900
2005	3.2846E+11	26.94477105	13273.6535	19309.31207	2.585076792	0.699	5.900
2006	3.769E+11	14.74778739	14826.9167	19304.55023	−0.024660827	2.207	6.300
2007	4.15965E+11	10.36464906	15947.40579	19136.15923	−0.872286563	4.169	5.699
2008	5.19797E+11	24.96181475	19436.85716	19792.72038	3.430997525	9.869	5.099
2009	4.29098E+11	−17.44892107	15655.08337	18861.11	−4.706833456	5.067	5.400
2010	5.26811E+11	22.77186805	18753.98123	19259.58726	2.112692511	5.343	5.400
2011	6.69507E+11	27.08657822	23256.09561	20575.49795	6.832496856	5.824	5.800
2012	7.33956E+11	9.626351742	24883.18971	21056.34715	2.336999074	2.886	5.599
2013	7.44336E+11	1.414254229	24646.02087	21005.01212	−0.24379834	3.506	5.570
2014	7.46249E+11	0.25698081	24160.95854	21183.46489	0.849572305	2.671	5.719
2015	6.5427E+11	−12.31894	20732.8617	21507.95569	1.531811756	2.184	5.590

Source: World Bank dataset 2015 available online at the official website: http://data.worldbank.org/indicator

GDP comes from the private sector. During the period (2003-2014), the economic growth rates of the KSA were the highest recorded in the past 30 years; due to a continuous high prices of oil which reached its peak level of 147.27$ a barrel on 11th July 2008[3]. As it is mentioned by Alturki (2013): "Positive growth is supported in KSA by: (i) High government spending, (ii) robust domestic consumption, and (iii) supportive credit to private sector. High oil revenues levels will boost business and investor confidence, but major risk to this scenario is a global growth meltdown that bring a sustainable decline in oil prices" Alturki (2013. p. 4). Although, the economy is suffering now from the collapse of oil price, the government expenditure is still strong by tapping into foreign reserves worth 763 $billion[4]. Despite this big amount of international reserves, the economy in 2016 seems to be negatively suffered from the cut of government spending and the rise of local fuel prices in order to reduce a record budget deficit for the year 2015 ($98 billion) which represents 15% of

3 http://www.gulfbase.com/Gcc/Index/1

4 The Financial Times, January 11, 2015: http://www.ft.com/intl/cms/s/0/dbdf2806-99a0-11e4-a3d7-00144feabdc0.html#axzz403dUpXBG

Table 2.2: The main economic indicators in Saudi Arabia for the period (1990 2015)

Years	Gross domestic savings (% of GDP)	Gross capital formation (% of GDP)*	Deficit -surplus in government budget	Fiscal account (% of GDP)***	Balance of trade (X-M) (US $)	Balance of trade (% of GDP)	Foreign direct investment, net inflows (% of GDP)	International reserves (US $)
1990	24.09577	15.068803	−6670000000	−5.711	10541522352	9.03	1.59391	11667678407
1991	21.37528	19.444834	**	**	2535380507	1.93	0.12183	11673287265
1992	25.660239	22.520711	−8530000000	−6.495	4279305741	3.14	−0.05791	5934996250
1993	25.496103	24.591893	−7410000000	−5.607	1194926569	0.91	1.03457	7428118920
1994	27.834928	19.854290	−10670000000	−7.943	10720160214	7.98	0.26006	7377503935
1995	29.484502	19.790666	−4000000000	−2.807	13809612817	9.69	−1.31595	8621627293
1996	31.566590	18.096718	−4930000000	−3.125	21247797063	13.47	−0.71475	14320646884
1997	31.506452	18.300151	−1600000000	−0.97	21789586115	13.2	1.842170	14876421461
1998	25.617582	22.419363	−12027000000	−8.250	4662133333	3.2	2.938454	14220177941
1999	32.684160	21.143029	−11700000000	−7.269	18576266667	11.54	−0.48394	16996929845
2000	37.461880	18.711623	6065000000	3.218	35333333333	18.75	−0.99822	19585485092
2001	34.686199	18.882814	−7195000000	−3.931	28922133333	15.8	0.01073	17595731795
2002	37.075694	19.674090	−5466.666667	−2.899	32810933333	17.4	−0.32571	20610443224
2003	41.82201	19.818976	9600000000	4.447	47212533333	22.00	−0.27334	22619992107
2004	46.752442	19.864616	28558000000	11.04	69570133333	26.89	-0.12921	27290850153
2005	52.322243	20.174833	58096000000	17.69	1.05591E+11	32.15	3.68592	1.55029E+11
2006	51.934372	22.215161	74763000000	19.84	1.12012E+11	29.72	4.86007	2.26035E+11
2007	51.484417	26.472854	47081000000	11.32	1.04039E+11	25.01	5.84997	3.05455E+11
2008	55.416167	27.295794	1.54913E+11	29.80	1.46169E+11	28.12	7.59063	4.42249E+11
2009	41.034182	31.715282	−23101000000	−5.383	39987200000	9.32	8.49635	4.09694E+11
2010	47.376999	30.743294	23395000000	4.44	87628266667	16.63	5.54899	4.44722E+11
2011	53.405572	26.781909	77625000000	11.59	1.78247E+11	26.62	2.43587	5.40677E+11
2012	51.4381975	26.3394632	99758000000	13.59	1.84214E+11	25.1	1.65982	6.56464E+11
2013	47.4338641	26.2413843	54993330000	7.388	1.57743E+11	21.19	1.19095	7.25292E+11
2014	41.0736441	27.7860602	−11733000000	−1.572	99158400000	13.29	1.07361	7.3192E+11
2015	29.7	35.1274824	−97900000000	−14.963	−3554421689	−0.54	1.244	6.1598E+11

Table 2.1 and 2.2 are elaborated by the author based on the data collected from: World Bank Dataset 2015 available online at the official website: http://data.worldbank.org except Deficit or Surplus in Government Budget, the source is Ministry of Finance. *Gross capital formation (Formerly gross domestic investment) consists of layouts on fixed assets plus net changes in inventories. Fixed assets include land improvements, machinery and equipment purchases, the construction of roads, railways, schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales. **Saudi Budget was not announced in this year due to the Gulf war. ***Calculated by the author by dividing deficit or Surplus in Government Budget by GDP at Current Prices

Table 3: The five main commercial partners of Saudi Arabia in 2005 (in billions of US $)

Trade partner	Trade (X+M)	Share in SA trade %	Exportsto (US $)	Share in total exports %	Imports from (US $)	Share intotal imports%	Net balance (US $)
USA	36.719	15.297	27.932	15.469	8.787	14.777	19.145
Japan	33.513	13.962	28.155	15.592	5.358	9.010	22.797
South Korea	17.468	7.277	15.298	8.472	2.170	3.649	13.128
China	15.211	6.337	10.805	5.984	4.406	7.410	6.399
India	12.566	5.236	10.730	5.942	1.836	3.088	8.894
Rest of the world	124.557	51.891	87.652	48.541	36.906	62.066	50.746
Total	240.0344	100%	180.572	100%	59.463	100%	121.109

This table is elaborated by the author. The shares are calculated by the author based on the data collected from Central Department of Statistics and Information, Ministry of Economy and Planning, KSA

GDP. The deficit for the year 2016 is $83 billion representing 13% of GDP[5]. The following table represents the share of Saudi oil sector in the GDP over the last 16 years. It is obvious that oil sector dominates Saudi economy with an average 44.2% of GDP over the period (2000-2015). The lowest percentage was in the year 2015 where oil participation in the economy represented only 27.5% as a response of oil price fall. This situation has led to a historical deficit in the government budget representing 14.96% of GDP (Table 2.2). Table 2.1 and 2.2 give a clear picture of the most important economic indicators over the period (1990-2015).

5 Public Finance Statistics List / Saudi Arabian Monetary Authority:http://www.sama.gov.sa/en-US/EconomicReports/Pages/YearlyStatistics.aspx

The average GDP growth rate at current prices over the period (1990-2015) is 7.38%. The GDP per capita at constant prices grew by 19.4% between 1990 and 2015. In general for this period, the balance trade has always been surplus due to the large quantities of exported oil.

Tables 3-6 show the evolution of the five main commercial partners of Saudi Arabia in the years 2005, 2010, 2014 and 2015 respectively, classified descending. Since 2014, China has become the most important commercial partner of KSA with a share of 12.8% in Saudi Arabia total trade, advancing in 5 years (2010-2014) the USA and Japan. On the other hand, India has kept its

Table 4: The five main commercial partners of Saudi Arabia in 2010 (in billions of US $)

Trade partner	Trade (X+M)	Share in SA trade %	Exports to (US $)	Share in total exports %	Imports from (US $)	Share in total imports%	Net balance (US $)
USA	47.313	13.216	33.247	13.238	14.066	13.163	19.181
Japan	44.158	12.334	36.169	14.402	7.989	7.476	28.18
China	42.417	11.848	29.923	11.915	12.494	11.692	17.429
South Korea	29.392	8.210	24.648	9.814	4.744	4.439	19.904
India	23.202	6.481	19.171	7.633	4.031	3.772	14.14
Rest of the world	171.524	47.911	107.985	42.99	63.539	59.458	44.446
Total	358.006	100%	251.143	100%	106.863	100%	143.28

This table is elaborated by the author. The shares are calculated by the author based on the data collected from Central Department of Statistics and Information, Ministry of Economy and Planning, KSA

Table 5: The five main commercial partners of Saudi Arabia in 2014 (billions of US $)

Trade partner	Trade (X+M)	Share in SA trade %	Exports to (in US $)	Share in total exports %	Imports from (in US $)	Share in total imports%	Net balance (in US $)
China	66.081	12.800	42.848	12.514	23.233	13.363	19.615
USA	65.918	12.768	43.323	12.653	22.595	12.996	20.728
Japan	51.767	10.027	41.819	12.213	9.948	5.722	31.871
South Korea	41.572	8.052	32.949	9.623	8.623	4.959	24.326
India	36.623	7.094	30.354	8.865	6.269	3.606	24.085
Rest of the world	254.306	49.259	151.107	44.132	103.199	59.354	47.908
Total	516.267	100%	342.400	100%	173.867	100%	168.533

This table is elaborated by the author. The shares are calculated by the author based on the data collected from Central Department of Statistics and Information, Ministry of Economy and Planning, KSA

Table 6: The five main commercial partners of Saudi Arabia in 2015 (billions of US $)

Trade partner	Trade (X+M)	Share in SA trade %	Exports to (US $)	Share in total exports %	Imports from (US $)	Share in total imports%	Net balance (US $)
China	49.191	13.006	24.552	12.062	24.639	14.105	−0.087
USA	45.387	12.000	21.473	10.549	23.914	13.690	−2.441
Japan	31.457	8.316	21.515	10.569	9.942	5.691	11.573
South Korea	27.559	7.286	17.626	8.659	9.933	5.686	7.693
India	25.223	6.669	19.214	9.439	6.009	3.440	13.205
Rest of the world	199.410	52.723	99.170	48.722	100.238	57.385	−1.068
Total	378.227	100%	203.550	100%	174.675	100%	28.875

This table is elaborated by the author. The shares are calculated by the author based on the data collected from Central Department of Statistics and Information, Ministry of Economy and Planning, KSA

fifth position over the last 16 years. We can remark that the total volume of Saudi trade (X+M) has been declined in the year 2015. The data collected from the world bank show a deficit of 3.554 billion $ in the balance trade in the year 2015 (Table 2.2), while the data collected from Saudi Ministry of Economy and Planning reveal a surplus of 28.874 Billion $ in the year 2015 comparing to a surplus of 168.599 billion $ in the year 2014. This is due to the decline of oil prices which reached its lowest level in December 2015 (38.01 $ a Brent barrel)[6]. In fact, it has deteriorated all the main economic indicators in KSA.

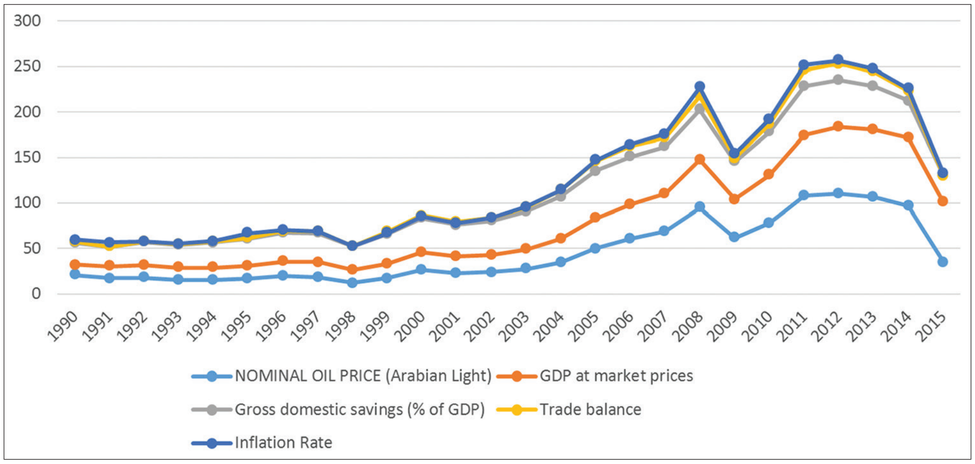
The whole picture can't be completed without oil prices and their evolution over time in order to understand the evolution of the main economic indicators in the KSA. It is obvious from Figure 1 that the main economic indicators in KSA follow oil prices in the same direction which is represented by the light blue line in the bottom of this figure. Curves which represent GDP at market prices, inflation rates, gross domestic saving (% of GDP), trade balance and oil prices overlap over time so much to the point of barely distinguishable. They appear as one curve not five separated. This shows at which point the dependence of Saudi Arabian economy on oil. Table 7 gives the nominal and real prices of oil brut.

4. EMPIRICAL MODEL AND METHODOLOGY

An ARDL model will be employed in order to examine the direct and indirect effect of oil price on economic growth in KSA using quarterly data for the period (1995-2015). As we are going to see in the next section, many variables in our survey are found to be stationary from I(0) and few other are stationary from I(1), therefore an ARDL model developed by Pesaran et al. (2001) is an appropriate method. It allows for using non-stationary and stationary series at the same time in order to estimate the parameters of models which contain lags of dependent variable and lags of independent variables. It is a useful approach to detect the existence of a long run relationship between dependent variable

6 Source: Europe Brent Spot Price: U.S Energy Information Administration (EIA).
http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RBRTE&f=M

Figure 1: The evolution of economic indicators in the KSA (1990-2015)



This Figure 1 is elaborated by the author based on some data given in Tables 1 and 6. In order to make the comparison possible, GDP at market prices and trade balance were divided by 10000000000.

Table 7: Nominal and real oil prices (1990-2015) in US. $ Per Barrel (period average)

Years	Nominal oil price			Real oil price*		
	Arabian light	North Sea (Brent)	OPEC basket	Arabian light	North Sea (Brent)	OPEC basket
1990	20.82	23.99	22.26	28.40	32.73	30.36
1991	17.43	19.99	18.62	23.50	26.95	25.10
1992	17.94	19.33	18.44	22.64	24.40	23.27
1993	15.68	17.00	16.33	20.52	22.24	21.36
1994	15.39	15.80	15.53	19.31	19.82	19.48
1995	16.73	17.01	16.86	19.24	19.56	19.39
1996	19.91	20.70	20.29	23.07	23.99	23.52
1997	18.71	19.06	18.68	23.04	23.47	22.99
1998	12.20	12.71	12.28	15.08	15.71	15.18
1999	17.45	17.91	17.48	21.60	22.17	21.63
2000	26.81	28.44	27.60	35.64	37.81	36.69
2001	23.06	24.46	23.12	31.14	33.04	31.23
2002	24.32	25.03	24.36	31.27	32.18	31.32
2003	27.69	28.81	28.10	30.92	32.17	31.37
2004	34.53	38.23	36.05	35.14	38.91	36.68
2005	50.21	54.37	50.64	50.21	54.37	50.64
2006	61.10	65.14	61.08	59.94	63.90	59.92
2007	68.75	72.55	69.08	62.59	66.05	62.89
2008	95.16	97.37	94.45	80.38	82.25	79.78
2009	61.38	61.68	61.06	53.89	54.16	53.61
2010	77.82	79.60	77.45	68.60	70.17	68.27
2011	107.82	111.36	107.46	88.79	91.70	88.50
2012	110.22	111.62	109.45	93.06	94.24	92.40
2013	106.53	108.62	105.87	88.95	90.70	88.40
2014	97.18	99.08	96.29	80.34	81.91	79.60
2015	49.85	52.41	49.49	46.47	48.86	46.13

This Table 7 was elaborated by Saudi Arabian Monetary Authority, Annual Report 2015. It was directly copied from Oil Statistics Section. http://www.sama.gov.sa/en-US/EconomicReports/AnnualReport/Fifty%20 Second%20Annual%20Report.pdf. *Real prices have been calculated by using the OPEC Basket Deflator (Base Year 2005)

and the independent variables. There are many advantages to estimate the parameters of the model by an ARDL method.

There is a high probability of no serial correlation if the lags are suggested automatically by Akaike info criterion or Schwarz Bayesian criterion. When the automatic selection is chosen, Eviews9 has the capacity to select the most fitted model over several number of models evaluated and which is consist of the optimal number of lags for each variable with the low AIC criterion and the highest adjusted R squared criterion. In addition, ARDL provides direct estimation of the error term (co-integrating coefficient) at short run and long run term. So it allows to test if there is a long run relationship between variables: Y represents the GDP growth rates and X represents foreign variables and oil price shock variable. Only one long run relationship is assumed between independent variables X and dependent variable y. If it exists, one can conclude that foreign variable - which is already influenced positively or negatively by oil price shock- will have a long run effect on the GDP growth rates of its trading partner country.

This study contains six countries: KSA and its five main commercial partners. Abeysinghe (2001) and Korhonen and Ledyaeva (2010) introduced in their models more countries because they were considered as the major commercial partners of some other countries in their surveys. In the Saudi case, four countries will be added to the model as they are the major trading partners of China, USA, Japan and South Korea. These four countries are Germany, France, UK (the main members in the EU) and Canada which is a major trading partner of the USA. However, they are also very important trading partners of Saudi Arabia itself. It is to be mentioned here that R^2 was (0.487) and the adjusted R^2 was (0.359) using the model with only the five first main trading partners of Saudi Arabia, while R^2 and adjusted R^2 have become (0.872) and (0.686) respectively employing the nine trading countries. Therefore, an ARDL representation of Saudi Arabia (01)[7] can be formulated as following:

$$
\begin{aligned}
& d(y_{1t}) = \propto_0 + \sum_{i=1}^{p}\alpha_{1,i} d(y_{1,t-i}) + \sum_{i=o}^{q}\alpha_{2,i} d\left(W_{1,2}.y_{2,t-i}\right) \\
& + \sum_{i=o}^{m}\alpha_{3,i} d(W_{1,3}.y_{3,t-i}) + \sum_{i=o}^{n}\alpha_{4,i} d(W_{1,4}.y_{4,t-i}) + \ldots\ldots + \\
& \sum_{i=o}^{s}\alpha_{10,i} d(W_{1,10}.y_{10,t-i}) + \sum_{i=0}^{R}\alpha_{11,i} d(OS_{t-i}) + \lambda_1 y_{1,t-1} \\
& + \lambda_2 W_{1,2}.y_{2,t-1} + \lambda_3 W_{1,3}.y_{3,t-1} + \text{»}_4 W_{1,4}.y_{4,t-1} + \ldots \\
& + \lambda_{10} W_{1,10}.y_{10,t-1} + \lambda_{11} OS_{t-1} + \varepsilon_{1t}
\end{aligned}
$$

An ARDL representation of China (02) can be presented as following:

$$
\begin{aligned}
& d(y_{2t}) = \beta_0 + \sum_{i=1}^{p}{}^{2}{}_{1,i} d(y_{2,t-i}) + \sum_{i=o}^{q}{}^{2}{}_{2,i} d\left(W_{2,1}.y_{1,t-i}\right) + \sum_{i=o}^{m}{}^{2}{}_{3,i} \\
& d(W_{2,3}.y_{3,t-i}) + \sum_{i=o}^{n}{}^{2}{}_{4,i} d(W_{2,4}.y_{4,t-i}) + \ldots\ldots + \sum_{i=o}^{s}\beta_{10,i} \\
& d(W_{2,10}.y_{10,t-i}) + \sum_{i=0}^{R}{}^{2}{}_{11,i} d(OS_{t-i}) + \lambda_1 y_{2,t-1} + \lambda_2 W_{2,1}.y_{1,t-1} \\
& + \lambda_3 W_{2,3}.y_{3,t-1} + \lambda_4 W_{2,4}.y_{4,t-1} + \ldots + \alpha_{10} W_{2,10}.y_{10,t-1} + \lambda_{11} OS_{t-1} + \varepsilon_{2t}
\end{aligned}
\tag{1}
$$

An ARDL representation of UK (10) can be presented as following:

$$
\begin{aligned}
& d(y_{10t}) = \gamma_0 + \sum_{i=1}^{p}\gamma_{1,i} d(y_{10,t-i}) + \sum_{i=o}^{q}\gamma_{2,i} d\left(W_{10,1}.y_{1,t-i}\right) + \sum_{i=o}^{m}\gamma_{3,i} d \\
& (W_{10,2}.y_{2,t-i}) + \sum_{i=o}^{n}\gamma_{4,i} d(W_{10,3}.y_{3,t-i}) + \ldots\ldots + \sum_{i=o}^{s}\gamma_{10,i} d(W_{10,9}.y_{9,t-i}) \\
& + \sum_{i=0}^{R}\gamma_{11,i} d(OS_{t-i}) + \lambda_1 y_{10,t-1} + \lambda_2 W_{10,2}.y_{2,t-1} + \lambda_3 \\
& W_{10,3}.y_{3,t-1} + \lambda_4 W_{10,4}.y_{4,t-1} + \ldots + \lambda_{10} W_{10,9}.y_{9,t-1} + \lambda_{11} OS_{t-1} + \varepsilon_{10t}
\end{aligned}
$$

Where:

α_0, β_0, …γ_0 are the constants of each single ARDL model.

d: Denotes the first difference.

T = Max (p,q,m,n,s,r),……, T where:

(p,q,m,n,s,r): Are the optimal lag orders (possibly different across regressors), obtained by using 4 maximum automatic selected lags by minimizing a model selection criterion. If the model uses 4 fixed lags then (p = q = m = n = s = r = 4).

ε the white noise errors.

$y_{i,t}$ (i=1,…, 10) is the real GDP growth rate of country at time t:

y_{1t}: Is GDP growth rate of the first country (KSA).

$y_{1,t-i}$: Is the lag of GDP growth rate of KSA.

$Y_{2,t-i}$: Is the lag of GDP growth of China.

$y_{3,t-i}$: Is the lag of GDP growth of USA.

$y_{10,t-i}$: Is the lag of GDP growth of UK.

$W_{i,j}$: Is the share of exports of country i to country j (in country i's total exports)

$W_{1,2}$: Is the share of Saudi Arabia exports to China (in KSA's total exports).

$W_{1,3}$: Is the share of Saudi Arabia exports to USA (in KSA's total exports).

$W_{1,10}$: Is the share of Saudi Arabia exports to UK (in KSA's total exports).

$\sum_{i=0}^{q}(W_{1,2}.y_{2,t-i})$, $\sum_{i=0}^{m}(W_{1,3}.y_{3,t-i})$,…, $\sum_{i=0}^{S}(W_{1,10}.y_{10,t-i})$: The weighted GDP growth rates of partners resulted from the sum of multiplying the export shares of KSA to its nine commercial partners by each partner's GDP in our survey using Hadamard product of two matrices[8].

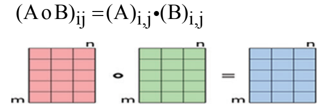
$\sum_{i=0}^{q}(W_{2,1}.y_{2,t-i})$, $\sum_{i=0}^{m}(W_{2,3}.y_{3,t-i})$,…, $\sum_{i=0}^{S}(W_{2,10}.y_{10,t-i})$: The weighted GDP growth rates of partners resulted from the sum of multiplying the export shares of China to the nine commercial partners by each partner's GDP in our survey using Hadamard product.

$\sum_{i=0}^{q}(W_{10,1}.y_{1,t-i})$, $\sum_{i=0}^{m}(W_{10,2}.y_{2,t-i})$,…, $\sum_{i=0}^{S}(W_{10,9}.y_{9,t-i})$: The weighted GDP growth rate of partners resulted from the sum of multiplying the export shares of UK to the nine commercial partners by each partner's GDP in our survey using Hadamard product.

7 Saudi Arabia ARDL model is given number (01), China (02), USA (03), Japan (04), South Korea (05), India (06), Canada (07), France (08), Germany (09) and UK (10).

8 The Hadamard product operates on identically-shaped matrices and produces a third matrix of the same dimensions. For two matrices, A,B, of the same dimension, m×n the Hadamard product, AB, is a matrix, of the same dimension as the operands, with elements given by

$$(A \circ B)_{ij} = (A)_{i,j} \bullet (B)_{i,j}$$



Source: Wikipedia

$OS_{i,t}$ is a measure of oil price shock[9] to country i.

To measure the oil price shock to country i in time t ($OS_{i,t}$) several methods were applied by previous studies. As the impact of oil chock could be different in countries other than USA because of changes in bilateral exchange rate, Abeysinghe (2001) converted the oil price to domestic currencies and then deflated it by each country's CPI. He defined real oil price as $o_i = \Delta\ln (O.E_i|P_i)$, where O is oil price in \$US, E_i is the exchange rate of country i against the \$US and P is the CPI of country i. It is to be mentioned here that this proxy is poor concerning the relative price because of the direct dependence of Consumer price index (P) on oil prices (O).

Korhonen and Ledyaeva (2010) defined real oil price as the ratio of the simple average of three crude oil price measures: (Petroleum West Texas Intermediate, Petroleum UK Brent and Petroleum Dubai) in \$US per barrel to the US GDP deflator, since oil prices are denominated in US dollars. As a robustness check they also used two other measures: The nominal oil price deflated by US producer price index and the oil prices converted to domestic currencies and deflated by each country's CPI. They retained the results of the first measure because they didn't find any significance differences in the results using the two other measures.

Oil price shock was referred to oil price growth rates by Hesary et al. (2013). They used a simple log- difference of real oil price $\Delta\ln O_{it}$. They defined it as the ratio of the simple average of two main crude oil price measures: Brent and Dubai in \$US per barrel to the US GDP deflator. They also used the nominal oil price deflated by US producer price index but as the results were similar they retained US GDP deflator.

To measure oil price growth rate, this study will use a simple log- difference of real oil price $\Delta\ln O_{it}$ calculated as the simple average of two main crude oil price measures: Brent and Dubai in \$US per barrel to the US GDP deflator (2010=100). Available quarterly data for all countries from 1995Q4 to 2015Q4 will be used.

In the right-hand side there are two parts concerning the first country (KSA):

First part corresponds to the short-run relationship:

$$\sum_{i=1}^{p}\alpha_{1,i}d(y_{1,t-i})+\sum_{i=o}^{q}\alpha_{2,i}d\left(W_{1,2}.y_{2,t-i}\right)+\sum_{i=o}^{m}\alpha_{3,i}d(W_{1,3}.y_{3,t-i})$$
$$+\sum_{i=o}^{n}\alpha_{4,i}d(W_{1,4}.y_{4,t-i})+\ldots\ldots+\sum_{i=o}^{s}\alpha_{10,i}d(W_{1,10}.y_{10,t-i})$$
$$+\sum_{i=0}^{R}\alpha_{11,i}d(OS_{t-i})$$

Where:

$\alpha_{1,i}$, $\alpha_{2,i}$, $\alpha_{3,i}$, $\ldots\alpha_{11,i}$ are the parameters estimated representing the error correction dynamics.

The second important part corresponds to the long-run relationship:

$\lambda_1\ y_{1,t-1}+\lambda_2 W_{1,2}.y_{2,t-1}+\lambda_3 W_{1,3}.y_{3,t-1}\ +\lambda_4\ W_{1,4}.y_{4,t-1}\ +\ldots+\lambda_{10}\ W_{1,10}.y_{10,t-1}+\lambda_{11}OS_{t-i}$

Where:

λ_1: Coefficient of error correction.

$\lambda_2, \lambda_4\, \lambda_5 \lambda_5 \ldots\ \lambda_{11}$ are the estimators of independent variables in the co-integration model denoting the long run relationship.

In order to examine the existence of a long run relationship (test of cointegration between variables of the model), the hypotheses are formulated as following:

The null hypothesis of no cointegration among the variables:

H_0: $\lambda_1 = \lambda_2 = \lambda_4 = \lambda_5 = \lambda_5 = \ldots = \lambda_{11} = 0$

The alternative hypothesis of cointegration among the variables:

H_0: $\lambda_1 \neq \lambda_2 \neq \lambda_4 \neq \lambda_5 \neq \lambda_5 \neq \ldots = \lambda_{11} \neq 0$

According to bounding test of Pesaran et al. (2001) if F statistic is more than F tabulated or exceeds the upper bound of the critical value then we can say there is a long run relationship between variables that takes the following formula concerning KSA.

$$y_{1t} = \propto_0 + \sum_{i=1}^{p}\alpha_{1,i}y_{1,t-i} + \sum_{i=o}^{q}\alpha_{2,i}\left(W_{1,2}.y_{2,t-i}\right) + \sum_{i=o}^{m}\alpha_{3,i}(W_{1,3}.y_{3,t-i})$$
$$+\sum_{i=o}^{n}\alpha_{4,i}(W_{1,4}.y_{4,t-i})+\ldots\ldots+\sum_{i=o}^{s}\alpha_{10,i}(W_{1,10}.y_{10,t-i})$$
$$+\sum_{i=0}^{R}\alpha_{11,i}(OS_{t-i})+v_{1t}$$

And so on for the 9 other countries (trading partners of KSA).

It is to be mentioned that $\lambda_1, \lambda_2, \lambda_4, \lambda_5,\ldots, \lambda_{11}$ are used to calculate the parameters of the model at long run. Let us for simplifying suppose we have only one trading partner (China), so two independent variables concerning KSA: ($W_{1,2}.y_{2,t}$ and OS_{t-i}). Thus, the long run relationship between variables is:

$y_{1t} = a+b\ W_{1,2}.y_{2,t}+c\ OS_t+v_{1t}$

$y_{1t} = \alpha_0+\alpha_2\ W_{1,2}.y_{2,1}+\alpha_{11}.OS_t+v_{1t}$

Where:

b represented by $\alpha_2 = \dfrac{-\lambda_2}{|\lambda_1|}$, c represented by $\alpha_{11} = \dfrac{-\lambda_{11}}{|\lambda_1|}$ and the constant $a = \alpha_0 = \dfrac{-\alpha_0}{|\lambda_1|}$

Therefore, the long–run estimated cointegration equation for KSA:

$$y_{1t} = \frac{-\alpha}{|\lambda_1|}+\frac{-\lambda_2}{|\lambda_1|}W_{1,2}.y_{2,t}+\frac{-\lambda}{|-\lambda_1|}OS+v_{1t}$$

9 "An oil price shock is created by a rise in oil prices. These increases in oil price may occur slowly and gradually or abruptly and unexpectedly" Hesary et al. (2013. p. 576).

According to ARDL method there is one long run relationship assumed between independent variables and dependent variable in each single equation. After obtaining the long run relationship (the cointegration model), the ECM is estimated in order to capture short-run dynamics. Thus, the error correction model for cointegrated variables concerning KSA (01) can be presented as follows:

$$d(y_{1t}) = \propto_0 + \sum_{i=1}^{p}\alpha_{1,i}d(y_{1,t-i}) + \sum_{i=o}^{q}\alpha_{2,i}d\left(W_{1,2}.y_{2,t-i}\right) + \sum_{i=o}^{m}\alpha_{3,i}d(W_{1,3}.y_{3,t-i}) + \sum_{i=o}^{n}\alpha_{4,i}d(W_{1,4}.y_{4,t-i}) + \ldots\ldots + \sum_{i=o}^{s}\alpha_{10,i}d(W_{1,10}.y_{10,t-i}) + \sum_{i=0}^{R}\alpha_{11,i}d(OS_{t-i}) + \lambda ECT_{t-1} + e_{1t}$$

The error correction model for cointegrated variables concerning China (equation 2) is:

$$d(y_{2t}) = \beta_0 + \sum_{i=1}^{p}\beta_{1,i}d(y_{2,t-i}) + \sum_{i=o}^{q}\beta_{2,i}d\left(W_{2,1}.y_{1,t-i}\right) + \sum_{i=o}^{m}\beta_{3,i} d(W_{2,3}.y_{3,t-i}) + \sum_{i=o}^{n}\beta_{4,i}d(W_{2,4}.y_{4,t-i}) + \ldots\ldots + \sum_{i=o}^{s}\beta_{10,i} d(W_{2,10}.y_{10,t-k}) + \sum_{i=0}^{R}\beta_{11,i}d(OS_{t-i}) + \lambda ECT_{t-1} + e_{2t}$$

The error correction model for cointegrated variables concerning UK (equation 10) is:

$$d(y_{10t}) = \gamma_0 + \sum_{i=1}^{p}\gamma_{1,i}d(y_{10,t-i}) + \sum_{i=o}^{q}\gamma_{2,i}d\left(W_{10,1}.y_{1,t-i}\right) + \sum_{i=o}^{m}\gamma_{3,i}d (W_{10,2}.y_{2,t-i} + \ldots\ldots + \sum_{i=o}^{s}\gamma_{10,i}d(W_{10,9}.y_{9,t-i}) + \sum_{i=0}^{R}\gamma_{11,i}d (OS_{t-i}) + \lambda ECT_{t-1} + e_{10t}$$

Where:

ECT: Error correction term. It is OLS residuals obtained from long run estimated cointegration model.

λ: The speed of adjustment indicating how quickly variables parameters return back to equilibrium at long term (λ is expected to be negative and significant). It is ideal if it lies between 0 and −1. The more it is near to −1 stronger the equilibrium is but it's significant is must.

To confirm the existence of a long run relationship one must look at λ. If it is negative and significant, then there is a long run relationship between the variables.

The error correction term ECT_{t-1} is the most important component in the error correction model for cointegrated variables. For this reason Table 12 presents the estimated long run parameters and at the bottom of the table it reports the coefficients associated to the ECT_{t-1} for all countries that have a long run relationship among variables. In addition, four diagnostic tests are presented for each single long run estimated coefficients model. Diagnostic tests include: (Heteroscedasticity test, autocorrelation test, normality test and Ramsey test. Stability tests using cumulative sum (CUSUM) of recursive residuals and CUSUM of squared residuals are presented in Figure 2 for all the cointegrated countries.

λ in (01) is different from λ in (02) and different from λ in (03),≠ ………≠ λ in (10).

5. TESTS AND RESULTS

Before using the ARDL method to detect the existence of long term relationship between GDP growth rates, oil price variable and foreign variables through the co-integration equation, some important preliminary tests will be done: Tests of stationarity, optimal model lags for each single country and bound tests for cointegartion.

The short run estimated parameters of the lagged 1st differenced variables in the ARDL model will not be presented due to the fact that not much interpretation can be related to them. They show the dynamic adjustment of variables. If they are significant they show a significant effect on the dependent variable in short run. However, the short run oil price parameters D(OS) are going to be displayed in Table 15. Of course, the ECT coefficient (ʎ) is going to be reported in Table 12 in order to measure the speed of adjustment that adjusts the disequilibrium in short-term towards long-term equilibrium.

5.1. Unit Root Tests

Kwiatkowski-Phillips-Schmidt-Shin test (1992)[10], Augmented Duckey-Fuller test and Phillips- Perron[11] test show that all the series in the survey are integrated of order I(0) (model with constant) and (model with constant and trend) except: (W1,8. y8), (W1,9. y9) and (W4,2. y2) which are integrated of order I(1)[12]. Tables 8.1 and 8.2 give the results for all series concerning model with constant and model with constant and trend.

The appropriate econometric method to apply depends on the statistical properties of the data in use. Spurious regression can be the result of applying OLS method in the case of non-stationary variables. Autocorrelation is highly expected at least for eq01 where two variables are stationary from first difference ([W1,8. y8], [W1,9. y9]). Residuals are likely to be positively correlated. This can lead to overestimate t and F statistics as a result of underestimation the standard errors of the regression. To address this problem in an AR model, a cointegration model

10 A major disadvantage for the KPSS test is that it has a high rate of Type I errors (it tends to reject the null hypothesis too often). If attempts are made to control these errors (by having larger P-values), then that negatively impacts the test's power. One way to deal with the potential for high Type I errors is to combine the KPSS with an ADF test. If the result from both tests suggests that the time series in stationary, then it probably is. Source: http://www.statisticshowto.com/kpss-test/.

11 This test will be a reference in case that ADF test indicates the stationarity of the series, while KPSS test indicates the non-stationarity. If 2 out of 3 indicate the stationarity then we consider the series stationary.

12 Null hypothesis: D(W1,8. y8), D(W1,9. y9) and D (W4,2. y2) has a unit root. It is rejected because: T-statistics are: −19.128 (0.0001), −4.513 (0.0030) and −6.183 (0.0000) respectively.

Table 8.1: Unit root tests (model with constant and linear trend)

The null hypothesis for ADF and PP tests: The data is not stationary							
The null hypothesis for KPSS test: The data is stationary							
Variable	ADF	KPSS	PP	Variable	ADF	KPSS	PP
Saud_y1s	−7.860201**	0.122885*	−8.503270**	OS	−7.914163**	0.096953**	−7.860532**
Chin_y2c	−3.683664 *	0.092108**	−3.664468*	OS+	−8.094282**	0.167294*	−8.094282**
USA_y3u	−6.136791**	0.118755*	−6.191196**	OS−	−8.414407**	0.109114**	−8.406176**
Jap_y4j	−4.223111**	0.120679*	−8.762779**				
Kor_y5k	−6.184755**	0.091521**	−39.24236**				
Ind-y6I	−9.412028**	0.141218*	−9.762674**				
Can_y7c	−7.299079**	0.146783*	−7.241460**				
Fra_y8f	−9.099183**	0.095020**	−9.101807**				
Deut_y9g	−8.229751**	0.182697	−8.214031**				
UK_y10	−7.888809**	0.048570**	−7.835748**				
W1,2. y2	−11.43932**	0.500000	−11.72483**	W2,1. y1	−3.591350*	0.149030*	−13.47055**
W1,3. y3	−6.200189**	0.047226**	−6.156109**	W2,3. y3	−3.987330*	0.084980**	−26.74136**
W1,4. y4	−6.154321**	0.034170**	−6.119003**	W2,4. y4	−3.274713	0.138514*	−10.89719**
W1,5. y5	−6.247967**	0.059790**	−6.245455**	W2,5. y5	−4.193140**	0.500000	−12.61421**
W1,6. y6	−3.590520*	0.424196	−11.25729**	W2,6. y6	−9.693109**	0.242043	−9.660973**
W1,7. y7	−6.125916**	0.039682**	−4.239775**	W2,7. y7	−4.343109**	0.125402*	−15.43719**
W1,8. y8	−2.259925	0.136128*	−12.51869**	W2,8. y8	−9.385815**	0.146474*	−9.348880**
W1,9. y9	−1.418248	0.500000	−11.62818**	W2,9. y9	−8.626180**	0.500000	−21.07058**
W1,10. y10	−4.342531**	0.210930	−14.24568**	W2,10. y10	−4.024865*	0.338766	−14.09145**
W3,1. y1	−9.819579**	0.097754**	−15.73408**	W4,1. y1	−5.217711**	0.464016	−24.00350**
W3,2. y2	−4.753727**	0.117718*	−14.95968**	W4,2. y2	−3.251078	0.160492	−20.04338**
W3,4. y4	−9.639137**	0.085669**	−9.639137**	W4,3. y3	−3.743208*	0.159735*	−6.674133**
W3,5. y5	−8.864412**	0.044318**	−8.864827**	W4,5. y5	−4.565935**	0.085377**	−8.913380**
W3,6. y6	−4.083222*	0.133201*	−10.07635**	W4,6. y6	−10.02717**	0.148819*	−9.991742**
W3,7. y7	−3.583824*	0.107330**	−12.00425**	W4,7. y7	−4.308979**	0.168119*	−15.46726**
W3,8. y8	−8.272160**	0.201750	−25.67429**	W4,8. y8	−9.060339**	0.051488**	−9.281565**
W3,9. y9	−10.20315**	0.135677*	−10.28542**	W4,9. y9	−7.151345**	0.044077**	−7.240198**
W3,10. y10	−9.872757**	0.500000	−14.09145**	W4,10. y10	−11.37282**	0.186953*	−16.24446**
W5,1. y1	−9.523399**	0.062267**	−9.806424**	W6,1. y1	−8.210464**	0.100502**	−10.43972**
W5,2. y2	−11.75594**	0.038901**	−11.86288**	W6,2. y2	−8.669260**	0.093112**	−26.32343**
W5,3. y3	−9.564458**	0.133696*	−9.544157**	W6,3. y3	−4.153062**	0.192424	−9.324665**
W5,4. y4	−7.034026**	0.043323**	−7.000133**	W6,4. y4	−14.41925**	0.109886**	−14.41925**
W5,6. y6	−9.247382**	0.075348**	−9.420007**	W6,5. y5	−10.52566**	0.128749*	−11.07779**
W5,7. y7	−9.489090**	0.09683**	−40.49117**	W6,7. y7	−11.43573**	0.298571	−11.51160**
W5,8. y8	−6.335614**	0.236794	−13.41263**	W6,8. y8	−9.340637**	0.151212*	−17.23114**
W5,9. y9	−15.40159**	0.500000	−24.53686**	W6,9. y9	−9.764141**	0.161671*	−9.842413**
W5,10. y10	−10.99886**	0.186953	−10.98317**	W6,10. y10	−14.70042**	0.097521**	−15.68997**
W7,1. y1	−7.547376**	0.440522	−25.64210**	W8,1. y1	−12.48137**	0.058221**	−13.07844**
W7,2. y2	−10.97763**	0.093626**	−18.94009**	W8,2. y2	−13.69057**	0.068198**	−13.94886**
W7,3. y3	−8.203519**	0.255792	−8.193942**	W8,3. y3	−3.836565*	0.135206*	−6.477521**
W7,4. y4	−10.09909**	0.123648*	−10.10470**	W8,4. y4	−3.653862*	0.224658	−13.41299**
W7,5. y5	−11.43173**	0.137632*	−11.63237**	W8,5. y5	−8.538564**	0.154494*	−27.93509**
W7,6. y6	−10.76698**	0.196327	−15.56021**	W8,6. y6	−9.448317**	0.148928*	−12.07329**
W7,8. y8	−11.92999**	0.143787*	−12.96805**	W8,7. y7	−5.413684**	0.105277*	−5.334527**
W7,9. y9	−11.92999**	0.500000	−21.17508**	W8,9. y9	−12.15026**	0.130451*	−5.334527**
W7,10. y10	−11.28009**	0.100948**	−11.50109**	W8,10. y10	−9.915198**	0.187163	−10.11340**
W9,1. y1	−8.690646**	0.159423	−16.76792**	W10,1. y1	−11.63313**	0.060600**	−11.64994**
W9,2. y2	−6.671270**	0.107869**	−12.13682**	W10,2. y2	−8.946267**	0.156213	−20.28697**
W9,3. y3	−10.72853**	0.246257	−10.58296**	W10,3. y3	−8.605260**	0.140588*	−10.58169**
W9,4. y4	−7.151345**	0.044077**	−7.240198**	W10,4. y4	−11.58020**	0.107784**	−11.90775**
W9,5. y5	−7.392245**	0.068877**	−7.271084**	W10,5. y5	−10.59931**	0.121166*	−13.36816**
W9,6. y6	−10.67021**	0.172467	−10.54166**	W10,6. y6	−11.45751**	0.101171**	−11.87048**
W9,7. y7	−11.86799**	0.119735*	−11.99900**	W10,7. y7	−12.68616**	0.077065**	−15.57262**
W9,8. y8	−9.183579**	0.083947**	−9.295518**	W10,8. y8	−8.875282**	0.155186	−12.31424**
W9,10. y10	−6.776613**	0.187163	−11.45216**	W10,9. y9	−9.826945**	0.134585*	−9.790862**

**Significant at 1%, *significant at 5%, ADF- Fischer Chi-square and PP- Fischer Chi-square are left hand side rejection area. Kwiatkowski-Phillips-Schmidt-Shin test is one-sided LM statistics test. If the LM statistic is greater than the critical value for a model with constant and trend (0.119 for alpha level of 10%, 0.146 for 5% and 0.216 for 1% significance levels), then the null hypothesis is rejected; the series is not stationary

Table 8.2: Unit root tests (model with constant)

The null hypothesis for ADF and PP tests: The data is not stationary							
The null hypothesis for KPSS test: The data is stationary							
Variable	**ADF**	**KPSS**	**PP**	**Variable**	**ADF**	**KPSS**	**PP**
Saud_y1s	−7.784618**	0.231890**	−8.502466**	OS	−7.849165**	0.192604 **	−7.804538**
Chin_y2c	−3.765541*	0.179383**	−3.746661*	OS+	−8.147814**	0.167294**	−8.147814**
USA_y3u	−5.587501**	0.486461	−5.585205**	OS−	−7.940773**	0.572336	−7.945704**
Jap_y4j	−4.215245**	0.119363**	−8.804109**				
Kor_y5k	−5.620009**	0.098777**	−34.29186**				
Ind-y6I	−9.466061**	0.150066**	−9.826730**				
Can_y7c	−7.299079**	0.345463*	−7.114736**				
Fra_y8f	−9.047274**	0.174364**	−9.059129**				
Deut_y9g	−8.262404**	0.205754**	−8.247978**				
UK_y10	−7.837558**	0.148114**	−7.786021**				
W1,2. y2	−11.10922**	0.299265**	−10.95839**	W2,1. y1	−3.653078*	0.164370**	−13.63922**
W1,3. y3	−5.448731**	0.555180	−5.455888**	W2,3. y3	−3.167453*	0.343860*	−12.45675**
W1,4. y4	−6.190496**	0.045031**	−6.155100**	W2,4. y4	−3.091920*	0.196256**	−10.63869**
W1,5. y5	−6.218753**	0.135819**	−6.217859**	W2,5. y5	−4.180729**	0.464134*	−12.50289**
W1,6. y6	−3.300239*	0.298663**	−10.82477**	W2,6. y6	−9.596309**	0.347628*	−9.560022**
W1,7. y7	−5.915266**	0.193374**	−4.254365**	W2,7. y7	−3.229410*	0.311029**	−10.51253**
W1,8. y8	−0.755174	0.576892	−11.30127**	W2,8. y8	−8.941777**	0.367895*	−9.001691**
W1,9. y9	0.263759	0.475037	−9.236729**	W2,9. y9	−8.049011**	0.363926*	−12.62092**
W1,10. y10	−3.937117**	0.302359**	−10.32867**	W2,10. y10	−3.478007*	0.304446**	−10.10964**
W3,1. y1	−5.094910**	0.111117**	−15.31319**	W4,1. y1	−9.343986**	0.464223*	−24.11607**
W3,2. y2	−4.646340**	0.118201**	−14.46219**	W4,2. y2	−3.251078	0.168163**	−20.22293**
W3,4. y4	−9.697732**	0.089708**	−9.697732**	W4,3. y3	−3.182808*	0.690156	−5.207443**
W3,5. y5	−8.924719**	0.043379**	−8.925606**	W4,5. y5	−4.595627**	0.089765**	−8.963160**
W3,6. y6	−4.112384**	0.137521**	−10.14288**	W4,6. y6	−10.08639**	0.199841**	−10.04926**
W3,7. y7	−3.026012*	0.317996**	−10.27629**	W4,7. y7	−4.176739**	0.332997**	−12.45316**
W3,8. y8	−8.913408**	0.500000	−12.00162**	W4,8. y8	−9.060339**	0.126290**	−9.095923**
W3,9. y9	−10.25088**	0.152856**	−10.29842**	W4,9. y9	−7.012692**	0.111903**	−7.153094**
W3,10. y10	−9.897280**	0.295019**	−12.44695**	W4,10. y10	−11.42676**	0.500000*	−15.55320**
W5,1. y1	−9.492938**	0.201638**	−9.614831**	W6,1. y1	−8.244220**	0.104474**	−10.41558**
W5,2. y2	−11.75713**	0.083230**	−11.75713**	W6,2. y2	−4.716739**	0.186559**	−22.16263**
W5,3. y3	−9.625919**	0.134372**	−9.603919**	W6,3. y3	−4.149269**	0.192634**	−9.378856**
W5,4. y4	−7.034026**	0.085976**	−7.027853**	W6,4. y4	−14.32068**	0.224474**	−14.55969**
W5,6. y6	−9.287788**	0.092475**	−9.458012**	W6,5. y5	−10.56105**	0.132807**	−11.04837**
W5,7. y7	−9.009911**	0.197107**	−22.41381**	W6,7. y7	−11.43126**	0.216906**	−11.51057**
W5,8. y8	−6.390254**	0.235453**	−13.40113**	W6,8. y8	−9.357999**	0.209084**	−17.02992**
W5,9. y9	−15.50087**	0.500000	−23.02903**	W6,9. y9	−9.819364**	0.161711**	−9.907669**
W5,10. y10	−10.92803**	0.310037**	−10.92803**	W6,10. y10	−14.78921**	0.113742**	−15.78509**
W7,1. y1	−7.659432**	0.500000	−27.02489**	W8,1. y1	−12.46575**	0.226697**	−12.81765**
W7,2. y2	−10.42885**	0.620148	−12.01677**	W8,2. y2	−13.76977**	0.107819**	−14.01510**
W7,3. y3	−7.848665**	0.616912*	−7.842367**	W8,3. y3	−3.437526*	0.586406	−5.618744**
W7,4. y4	−10.17103**	0.150082**	−10.17685**	W8,4. y4	−3.679378**	0.224487**	−13.50793**
W7,5. y5	−11.45266**	0.184082**	−11.59648**	W8,5. y5	−8.402665**	0.311016**	−21.93273**
W7,6. y6	−10.77963**	0.329430**	−13.22826**	W8,6. y6	−9.509368**	0.150238**	−12.17315**
W7,8. y8	−12.00742**	0.143694**	−13.03700**	W8,7. y7	−4.614008**	0.607651	−4.585492**
W7,9. y9	−11.62818**	0.500000	−20.44851**	W8,9. y9	−12.23005**	0.132475**	−12.48772**
W7,10. y10	−11.35721**	0.100903**	−11.58525**	W8,10. y10	−9.873175**	0.195068**	−10.00824**
W9,1. y1	−8.455655**	0.276655**	−13.34707**	W10,1. y1	−11.66504**	0.113334**	−11.64834**
W9,2. y2	−6.647203**	0.152406**	−11.43774**	W10,2. y2	−8.684491**	0.419510*	−13.96422**
W9,3. y3	−10.77399**	0.257853**	−10.62497**	W10,3. y3	−8.653032**	0.177518**	−10.60095**
W9,4. y4	−7.012692**	0.111903**	−7.153094**	W10,4. y4	−11.65457**	0.119251**	−11.99046**
W9,5. y5	−7.321986**	0.161943**	−10.56966**	W10,5. y5	−10.51979**	0.297654**	−11.55529**
W9,6. y6	−10.70610**	0.206446**	−11.93903**	W10,6. y6	−11.53010**	0.105937**	−11.74851**
W9,7. y7	−11.86929**	0.190702**	−9.181664**	W10,7. y7	−12.71477**	0.153062**	−14.62818**
W9,8. y8	−9.145735**	0.169545**	−11.46529**	W10,8. y8	−8.862870**	0.207881**	−9.743980**
W9,10. y10	−6.768066**	0.221123**	−11.46529**	W10,9. y9	−9.884569**	0.137477**	−9.846018**

**Significant at 1%, *significant at 5%. ADF- Fischer Chi-square and PP- Fischer Chi-square are left hand side rejection area. Kwiatkowski-Phillips-Schmidt-Shin test critical value for a model with constant is (0.347 for alpha level of 10%, 0.463 for 5% and 0.739 for 1% significance levels). If the LM statistic is greater than the critical value then the null hypothesis is rejected; the series is not stationary by applying ARDL can be used. We can read in a recent study of Nkoro and Uko (2016) published in journal of statistical and econometric methods: "ARDL cointegration technique is adopted irrespective of whether the underlying variables are I(0), I(1) or a combination of both, and cannot be applied when the underlying variables are integrated of order I(2). However, to avoid crashing of the ARDL technique and, effort in futility, it is advisable to tests for unit roots since variables that are integration of order I(2) leads to the crashing of the technique" Nkoro and Uko (2016. p. 86).

The results in Tables 8.1 and 8.2 indicate that there isn't any variable integrated from second difference.

5.2. Optimal Model Lags

The results will be presented using 4 maximum automatic selected lags concerning all countries. But before proceeding, an ARDL model have been launched for Saudi Arabia by choosing: 2 fixed lags model, 3 fixed lags model, 4 fixed lags model. Eviews9 is let to choose automatically the optimum number of lags for the fourth model with 4 maximum lags for the dependent variable Y1S and the independent dynamic regressors: W1_2___Y2, W1_3___Y3, W1_4___Y4, W1_5___Y5, W1_6___Y6, W1_7___Y7, W1_8___Y8, W1_9___Y9, W1_10___Y10 and OS.

Table 9 gives a clear idea about the choice of the optimal model concerning KSA (01). Four fixed selected model is better than 2

Table 9: Optimal model lags for Saudi Arabia (1995Q4-2015Q4)

Dependent variable: y1s Method: ARDL Model selection method: AIC				
Lags	**Selected model: ARDL (2, 2, 2, 2, 2, 2, 2, 2, 2,2, 2)**	**3 (fixed) selected model: ARDL (3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3)**	**4 (fixed) selected model: ARDL (4, 4, 4, 4, 4, 4, 4, 4, 4, 4)**	**Automatic (4 max) selected model: ARDL (4, 4, 4, 4, 1, 2, 3, 3, 3, 4, 2)**
AIC	0.493	0.285	−0.239	−0.381
R^2	0.573		0.892	0.870471
Adjust R^2	0.258	0.397	0.5859	0.686623
S.E. of regression	0.2666	0.241	0.201	0.173164
Sum squared residual	3.05	1.80	0.771	0.929564
Log likelihood	14.256	33.27	63.86	59.50405
(F−statistic)	1.809* (0.0348)	2.137* (0.0147)	2.91** (0.006)	4.734** (0.0000)
Durbin-Watson stat	1.95	1.786	2.122	2.147

This table is elaborated by the author based on the results obtained by Eviews 9. AIC: Akaike info criterion

Table 10: Optimal model lags for equation 2, equation 3,……., equation 10

Dependent variable: y2c, y3u, y4j, y5k, y6i, y7ca, y8f, y9g and y10uk							
Selected model	**AIC**	**R^2**	**Adjusted R^2**	**Sum squared residual**	**Mean dependent variable**	**F-statistic**	**Durbin-Watson stat**
ARDL for China (2, 4, 3, 0, 3, 4, 0, 0, 0, 4, 3)	−2.58272	0.789268	0.605552	0.130620	0.174961	4.445140** (0.000006)	2.051232
ARDL for USA (2, 4, 4, 1, 0, 0, 0, 2, 1, 0, 0)	−3.09366	0.696379	0.553498	0.099947	0.059480	4.873855** (0.000001)	2.026833
ARDL for Japan (3, 3, 4, 4, 0, 3, 0, 0, 0, 4)	1.805049	0.710820	0.451300	10.22321	0.023101	2.738975** (0.001303)	1.871503
ARDL for Korea (4, 0, 0, 0, 2, 1, 1, 0, 4, 0, 4)	−1.315408	0.968932	0.952446	0.586796	0.081506	58.77575** (0.000000)	1.694018
ARDL for India (3, 0, 0, 4, 0, 2, 3, 0, 4, 1, 1)	4.432852	0.602770	0.360978	159.9341	0.501332	2.492927** (0.002904)	2.044563
ARDL for Cana (4, 0, 2, 4, 2, 1, 0, 1, 3, 1, 2)	0.952003	0.813530	0.689217	5.099131	0.087879	6.544189** (0.000000)	1.519627
ARDL for France (4, 3, 1, 0, 3, 0, 1, 4, 1, 0, 2)	2.487342	0.809941	0.690122	24.30604	−0.002515	6.759676** (0.00000)	1.951827
ARDL for Deu (4, 0, 4, 4, 2, 4, 4, 2, 4, 3, 4)	1.242611	0.899804	0.738774	4.329949	0.077274	5.587806** (0.000004)	2.112728
ARDL for UK (4, 4, 4, 4, 4, 4, 1, 4, 4, 0, 4)	1.890905	0.795099	0.451157	8.336166	0.066249	2.311725* (0.010058)	1.997707

This table is elaborated by the author based on the results obtained by Eviews 9. **Significant at 1%, *significant at 5%

fixed lags and better than 3 fixed lags based on AIC. However, the optimal model is the one selected automatically by Eviews9 over 39062500 evaluated models based on AIC adjusted R squared and F-statistic. Therefore, I will opt for automatic selection by fixing the maximum number of lags at 4 lags for dependent variables and regressors. The last column in Table 9 shows the relative goodness of the estimated model through the high R^2 (0.87) and the relative high adjusted R^2 (0.69). It indicates that the model explains 69% of the variation in Saudi GDP growth rates. The results also indicates that the relation between the dependent variable and the independent variables are not spurious because F-statistic is significant at 1% level. Of course there are many other important tests such as the test of autocorrelation between residuals, heteroscedasticity and the stability of the estimated parameters will be done later after the test of cointegration.

Table 10 gives the optimal model lags and their primarily statistical results for the nine trading partners of Saudi Arabia. In general, their R^2 and adjusted R^2 are relatively high with significant F-statistics at 1% level.

5.3. ARDL Bound Tests for Cointegartion and the Long Run Estimated Parameters

If F-statistic is above the upper bound, the null hypothesis of no long run relationship is rejected. If F-statistic is below the lower bound, the null hypothesis of no cointegration can't be rejected. If F-statistic falls between the bounds, the test is inconclusive. The next table show critical values for lower bounds and upper bounds at 1% and 5% significant level respectively.

The results in Table 11 indicates the rejection of the null hypothesis of no level relationship among the variables in the ARDL models concerning KSA, S. Korea, India, Canada, France and Germany at 5% of significance level. Therefore, there are long-run equilibrium relationships between the set of I(0) and I(1) variables. There are long run relationships between GDP growth rates, oil price shock and the weighted GDP growth. USA and UK don't have a

Table 11: Test for the existence of a level relationship among variables in the ARDL models

Null hypothesis: No long run relationship exists		
Country	**F-statistics**	**Model**
Saudi Arabia equation 1	4.109691**	Constant
China equation 2	2.563343	Constant
USA equation 3	1.578237	Constant
Japan equation 4	2.477453	Constant
South Korea equation 5	3.737828*	Constant
India equation 6	4.473694**	Constant
Canada equation 7	6.211573**	Constant
France equation 8	4.808766**	Constant
Germany equation 9	3.781914*	Constant
UK equation 10	0.902751	Constant

Probabilities are between parentheses: **Significant at 1%, *significant at 5%

Model with constant, for k=10			
Lower bound 1% critical value	**Upper bound 1% critical value**	**Lower bound 5% critical value**	**Upper bound 5% critical value**
2.54	3.86	2.06	3.24

cointegration among their variables because F-ststistics (0.902) for USA and (1.578) for UK are below the lower bounds at 1% and 5% critical values. Table 11 shows that F-statistics for China and Japan fall between the two bounds at 5% level, so the test is inconclusive. To decide in this case if there is a possible cointegartion among the variables, we have to look at the significance of the error term coefficient. Table 12 indicates that λ for china (02) and Japan (04) are −0.727670** and −0.844** with t-statistics −5.784 and −3.010 respectively. The coefficients are negative and very significant. Therefore, we can say there are possible long run relationships among variables for these two countries. However, to examine the marginal effects of oil price shock on the GDP growth rates of these two countries, we have to look at t-statistic and its probability associated to the parameters of oil price variable in the long run equations. Equation 02 and eq04 in Table 12 indicate that the coefficient of oil price growth rates is negative and significant at only 10% level for China, while it is insignificant for Japan revealing no effect of oil price shock on the GDP growth rates of China and Japan at long term. It is to be mentioned that at short run there is a negative significant direct effect of oil price on the GDP growth rates of China (at 5% significant level) (Table 15).

As expected, λ for KSA is approximately (−1) with a very large t – statistic (−5.42) confirming the existence of a long run relationship among variables (Table 12 equation 01). Thus, real oil price growth rate has a strong long run direct positive impact on the real GDP growth in Saudi Arabia and a significant positive short run direct effect (Table 15). It is to be mentioned that oil price variable (OS) has also a positive significant coefficient in Canada which is a net oil exporter country (Table 12 equation 7). There is a positive effect of real oil price growth rates on the GDP growth rates of Canada at long term.

Trading with China (W1_2___Y2) and Japan (W1_4___Y4) are found to have a positive influence on GDP growth rates of KSA (at 5% level), while trading with France (W1_8___Y8) has a positive effect (at only 10% level) (Table 13). This indicates that the share of Saudi Arabia's exports to China in the GDP of China (the weighted GDP growth rates of China via trading with KSA W1_4___Y4) and the share of Saudi Arabia's exports to Japan in GDP of Japan (the weighted GDP growth rates of Japan via trading with KSA W1_2___Y2) have significant positive long run impacts on GDP growth rates of Saudi Arabia. On the other hand, trading with KSA don't have any impact on GDP growth rates at long term in these two countries (The Long Run Coefficients[13] in China and Japan ARDL models are: W2_1___Y1 = 0.046750 and W4_1___Y1 = −0.888040 with t−statistics equal 0.158525(0.8748) and −0.384770 (0.702) respectively).

OS is regressed on the weighted GDP growth rates of Saudi Arabia with these two partners. The results in Table 14 confirm no long run significant correlation between the real oil price growth rates (OS) and China's exports to Saudi Arabia in GDP of KSA (the weighted GDP growth rates of KSA via trading with China (W2_1___Y1). In contrary, there is a positive long run effect of oil price shock on the weighted GDP growth rates of Japan via trading with Saudi Arabia W1_4__Y4 and a negative significant long run

13 They are not reported in Tables.

Table 12: Estimated long run parameters (ARDL models: 01, 02, 04, 05, 06, 07, 08 and 09) for the period (1996Q1-2015Q4)

			Diagnostic tests			
			A: Heteroscedasticity, B: Autocorrelation, C: Normality, D: Stability			
Country	ECT_{t-1} t-statistic ( )	OS t-statistic ( )	Observed* R^2 Prob. Chi-square ( )	Observed* R^2 Prob. Chi-square ( )	Jarque-Bera Prob. ( )	F-statistic Prob. ( )
KSA 01	−1.093787** (−5.4190)	4.929348** (3.5439)	41.42197 (0.5827)	6.730055 (0.1509)	4.489 (0.105)	28.24027**
China 02	−0.7276** (−5.784509)	−1.147871 (−1.916803)	27.48097 (0.7383)	2.944994 (0.5671)	3.947 (0.189)	0.007106 (0.9332)
Japan 04	−0.8445** (−3.01024)	3.578015 (0.788129)	39.15006 (0.2889)	7.054137 (0.1331)	0.452 (0.797)	0.932596 (0.3403)
S. Korea 05	−1.1397** (−4.08690)	1.423512* (2.155635)	28.10019 (0.3535)	10.37682 (0.0345)	0.696 (0.705)	2.236487 (0.1413)
India 06	−1.2569** (−5.34834)	10.434226 (1.182062)	28.80756 (0.4223)	4.938887 (0.2936)	39.037 (0.0000)	3.8567795 (0.0557)
Canada 07	−1.1011** (−6.51899)	6.323044** (3.206033)	39.28036 (0.1196)	(6.444779 (0.1683))	1.890 (0.3885)	0.220252 (0.6412)
France 08	−0.9688** (−3.80404)	−7.914761 (−1.212540)	37.29904 (0.1387)	10.47227 (0.0332)	30.078 (0.0000)	1.653516 (0.2051)
Germany 09	−1.4643** (−5.42963)	−3.294332 (−1.070738)	43.94404 (0.5166)	3.611151 (0.4612)	1.525 (0.466)	10.07121**

**Significant at 1%, *significant at 5%, A: Breusch−Pagan-Godfrey test regresses the squared residuals on the original regressors. H_0: No heteroscedasticity, B: Lagrange multiplier test of residual serial correlation. H_0: No autocorrelation between residuals. C: Jarque-Bera value based on a test of Skewness and Kurtosis of residuals. H_0: Normal distribution of residuals. D: Ramsey RESET test, H0: The model is correctly specified

Table 13: Long run coefficients (Saudi Arabia)

Dependent variable: y1S				
Included observations: 76				
Variable	Coefficient	Standard error	t-statistic	P
W1_2___Y2	0.312319*	0.119852	2.605882	0.0140
W1_3___Y3	0.419517	0.647390	0.648013	0.5217
W1_4___Y4	0.872548**	0.309100	2.822866	0.0082
W1_5___Y5	−0.654317*	0.248002	−2.638357	0.0129
W1_6___Y6	0.060902	0.062904	0.968174	0.3405
W1_7___Y7	−14.803546	12.166356	−1.216761	0.2329
W1_8___Y8	0.235232	0.123600	1.903180	0.0663
W1_9___Y9	−0.145548	0.077682	−1.873623	0.0704
W1_10___Y10	−0.24806**	0.082669	−3.000660	0.0053
OS	4.929348**	1.390916	3.543959	0.0013
C	0.224850**	0.070049	3.209884	0.0031
CointEq(−1)	−1.093787	0.201842	−5.419038	0.0000

*Significant at 5%

effect of oil price shock on the share of the weighted GDP growth rates of Saudi Arabia as a share of Japanese total exportations to KSA (W4_1__Y1) (Table 14). This negative effect weakens the positive effect exercised at long term on GDP growth rates of KSA via trading with Japan. Although oil price shock lowers Japanese exports to KSA, it doesn't have any significant influence on the GDP growth rates of Japan (Table 12 equation 4 Japan).

Negative significant effects on the GDP growth rates of KSA at long term were found via trading with S. Korea W1_5___Y5 and UK W1_10___Y10 (at 5% level) (Table 13). Based on the fact of no possible cointegration among the variables in equation 10 (Table 11) and as oil price shock (OS) has no long run effect on the weighted GDP growth rates of UK via trading with KSA (W1_10___Y10) (Table 14), so this indicates that oil price shock has no possible indirect long run effect on Saudi economy via trading with UK. In contrary, OS has a positive long run effect on the weighted GDP growth rates of S. Korea with Saudi Arabia (W1_5___Y5) (Table 14).

Very interesting, there isn't any significant influence on the GDP growth rates of KSA coming from trading with USA (W1_3___Y3) as well as Canada (W1_7___Y7) the main trading partner of USA (Table 13). This can be explained by the fact that USA has lowered its dependence on the Saudi oil by diversifying its imports of oil from Canada, Venezuela and Mexico. In this regard, Saudi oil exportation to the USA as a share of the total USA oil importation has dropped over the last 30 years to represent only 11% of the total oil crude importation of USA in the year 2016[14]. In addition, there is no cointegration between variables in eq03 indicating no long run relationship was found between oil price shock and GDP growth rates of USA. Par consequence, oil price shock has no real indirect effect on the long run GDP growth rates of Saudi Arabia via its trading with USA.

5.4. Test of Heteroscedasticity

Breusch-Pagan-Godfrey test in Table 12 indicate that the null hypothesis of homoscedasticity can't be rejected for all the lagged models. White test[15] confirms the results obtained by Breusch- Pagan-Godfrey test. This means that we can trust the standard errors. T-statistics are asymptotically standard normal distributed and therefore also the P values.

5.5. Normality test of Residuals

It is an important test because the rejection of the null hypothesis invalidates the test statistics. Jarque Bera statistics[16] show the normality distribution of residuals for all the countries except for India eq06 and France eq08 Table 12. However, as per Central Limit Theorem, normality issue if it exists can be ignored because the sample size is larger than 30.

5.6. Autocorrelation Test

Normally, Durbin Watson test is used to check the presence of autocorrelation between residuals. But DW test isn't appropriate for large sample size and it is only useful for first order correlation. Therefore, it is not appropriate for serial correlation since there is a

14 Source: https://www.eia.gov/energyexplained/index.cfm?page=oil_imports
15 The results of this test have not been reported in Table 12 because they are similar to those given by Breusch- Pagan-Godfrey test. White test regresses the squared residuals on the squared original regressors, while Breusch- Pagan-Godfrey test regresses the squared residuals on the original regressors, http://www.eviews.com/help/helpintro.html#page/content/testing-Residual_Diagnostics.html
16 The Jarque–Bera test is a goodness-of-fit test of whether sample data have the skewness and kurtosis matching a normal distribution. https://en.wikipedia.org/wiki/Jarque%E2%80%93Bera_test.

Table 14: ARDL Long run form between the weighted GDP growth rates of Saudi Arabia and the weighted GDP growth rates concerning some of its commercial partners and oil price shock (OS) over the period (1996Q1-2015Q4)

Dependent variable	OS	Standard error	t-statistic Prob. ( )	ARDL bounds test F-statistic	ECT_{t-1} Prob. ( )
W1_2___Y2 KSA 01	−5.852818	3.766977	−1.553717 (0.1248)	9.753876**	−1.081699** (0.0005)
W2_1___Y1 China 02	0.483908	0.564044	0.857925 (0.3940)	7.383703*	−1.140577** (0.0007)
W1_4___Y4 KSA 01	3.242722**	0.927599	3.495822 (0.0008)	28.24027**	−0.727229** (0.0000)
W4_1__Y1 Japan 04	−0.697176**	0.240945	−2.893505 (0.0051)	11.84850	−1.6506** (0.0000)
W1_5___Y5 KSA 01	2.708592**	0.460313	5.884239 (0.0000)	32.57338**	−1.0382** (0.0000)
W1_10___Y10 KSA	−3.620241	3.816126	−0.948669 (0.3461)	8.398527**	−1.0794** (0.0005)

**Significant at 1%, *significant at 5%

Lower bound 1% critical value	Upper bound 1% critical value	Lower bound 5% critical value	Upper bound 5% critical value
6.84	7.84	4.94	5.73

Table 15: Short-run oil price parameters (cointegrating form: 01, 02, 04, 05, 06, 07, 08 and 09)

Dependent variables	Included observations	D (OS)	t-statistic Prob. ( )	R^2	Adjust R^2	F-statistic Prob. ( )	D-W stat.
Y1S	76	3.126506**	4.548960 (0.0001)	0.870471	0.686623	4.445140** (0.000006)	2.147795
Y2C	74	−0.524291*	−2.444871 (0.0190)	0.785741	0.608977	4.445140** (0.000006)	2.051232
Y4J	75	−3.827669	−1.701543 (0.0968)	0.710820	0.451300	2.738975** (0.001303)	1.871503
Y5K	76	1.62502**	4.704586 (0.0000)	0.968932	0.952446	58.77575** (0.000000)	1.694018
Y6I	75	−3.695683	−0.548929 (0.5857)	0.602770	0.360978	2.492927** (0.002904)	2.044563
Y7Ca	76	5.04633**	4.509181 (0.0000)	0.813530	0.689217	6.544189** (0.000000)	1.519627
Y8F	76	1.541360	0.572385 (0.5698)	0.809941	0.690122	6.759676** (0.00000)	1.951827
Y9G	74	3.428109	1.542409 (0.1342)	0.899804	0.738774	5.587806** (0.000004)	2.112728

**Significant at 1%, *significant at 5%

Table 16: Saudi Arabia ARDL long run form using annual data for the period (1980-2016)

Dependent variable: Y1S							
Included observations: 30 after adjustments							
Sample (adjusted): 1984 2015							
Number of models evaluated: 1024							
Selected model: ARDL (1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1)							
AIC	R^2	Adjust R^2	Sum squared residual	S.E of regression	Mean dependent variable	F-statistic	Durbin-Watson stat
−2.985135	0.938235	0.872059	0.030547	0.046711	0.174961	14.17774** (0.000000)	2.251612

lagged dependent variable on the right-hand side of the equations. As it is mentioned by Allen and Fildes (2001): With lagged dependent variables, the standard D-W statistic is biased towards two, so that a finding of no autocorrelation is a strong result while a finding of autocorrelation requires further testing. A preferred test when lagged dependent variables are present and one that also tests for higher orders of autocorrelation is the Breusch-Godfrey Lagrange Multiplier test[17] developed from Durbin=s alternative procedure@ (Breusch, 1978; Godfrey, 1978; Allen and Fildes, 2001. p. 19). The Breusch-Godfrey Lagrange Multiplier test in Table 12 column (5) indicate that the null hypothesis can't be rejected, suggesting that the residuals aren't serially correlated in KSA model (01).

5.7. Parameters Stability Tests

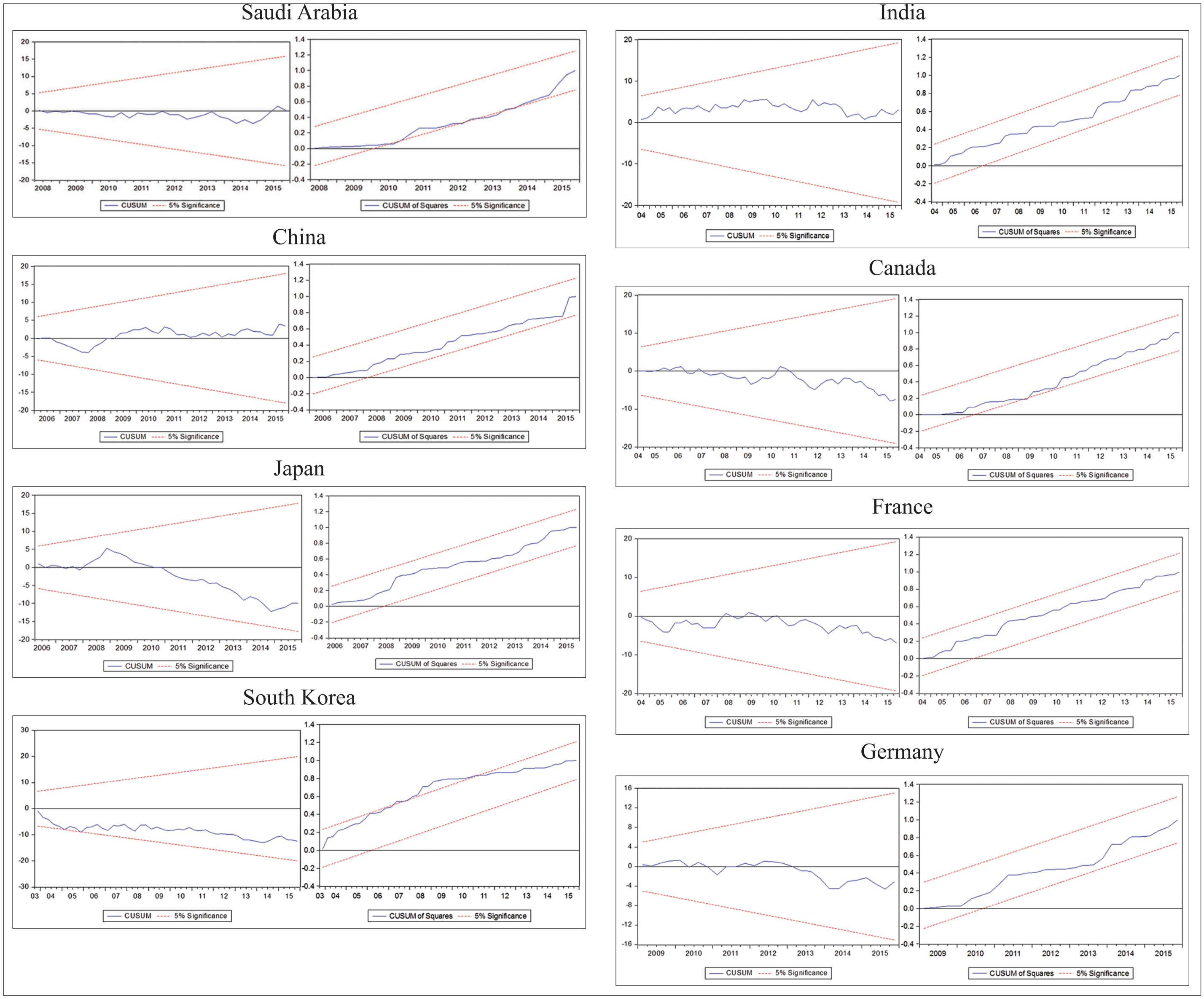
Stability tests using Cumulative sum (CUSUM) of Recursive Residuals helps to show if coefficients of the OLS regression are changing systematically, while the CUSUM of squared residuals helps to show if coefficients of the regression are changing suddenly (Bhatti et al., 2006).

5.7.1. Cumulative sum (CUSUM) of recursive residuals

In general this test indicates the stability of our model. The coefficients of the regression are not changing systematically because the plot of the first equation of Saudi Arabia represented by the blue line as well as for its nine trading countries are within the 5% significance interval except the plot of Germany exceeds the 5% critical bounds (Figure 2 left side plots).

17 It tests for the presence of serial correlation that has not been included in a proposed model structure and which, if present, would mean that incorrect conclusions would be drawn from other tests. Serial correlation is the relationship between a given variable and itself over various time intervals. https://en.wikipedia.org/wiki/Breusch%E2%80%93Godfrey_test.

Figure 2: Plot of cumulative sum of recursive residuals and plot of cumulative sum of squared residuals. Null hypothesis: Parameters are stable



5.7.2. Cumulative sum (CUSUM) of squared residuals

The plot of CUSUM of squared residuals concerning the first equation of Saudi Arabia exceeds the 5% critical bounds of parameter stability, indicating that coefficients of OLS regression are changing suddenly. Thus, based on the results obtained for Saudi Arabia and South Korea there are no stability of the estimated coefficients by OLS (Figure 2 right side plots).

5.8. Ramsey Reset Test

This test examines the null hypothesis of no problem of function misspecification. If H_0 is rejected, there will be some problems with the original model caused may be by autocorrelation or heteroscedasticity or functional form misspecification.

The results of this test (Table 12 last column) indicate the acceptance of the null hypothesis for all countries except for Saudi Arabia and Germany. The diagnostic tests in Table 12 show the absence of problem of heteroscedasticity and autocorrelation between residuals concerning Saudi Arabia and Germany. It is to be noted that public expenditure is the motor of the economy in KSA. As it is mentioned by Alturki (2013) positive growth in KSA is supported by high government spending. Omitting this important variable is considered as model misspecification. If quarterly public expenditure indicator had been added to Saudi Arabia ARDL model the null hypothesis would not have been rejected. It is to be mentioned that since May 2017, Saudi Ministry of Finance has presented -for the first time in its history- the first quarter data of its budget[18]. Before, only annual data were available concerning the public expenditure. For this reason, I couldn’t add it to the right hand side variables. This is also the main reason why Hesary et al. (2013) excluded Saudi Arabia from their sample of study: “Saudi Arabia is the largest oil exporter but some statistics for this country were not

18 Sources: http://english.alarabiya.net/en/business/economy/2017/05/11/Saudi-finance-minister-reviews-Q1-budget-performance-report.html. https://arabic.cnn.com/business/2017/05/11/saudi-budget-first-quarter-results.

Figure 3: Plot of cumulative sum of recursive residuals and plot of cumulative sum of squared residuals after adding GOEXP (using annual data) Saudi Arabia. Null hypothesis: Parameters are stable

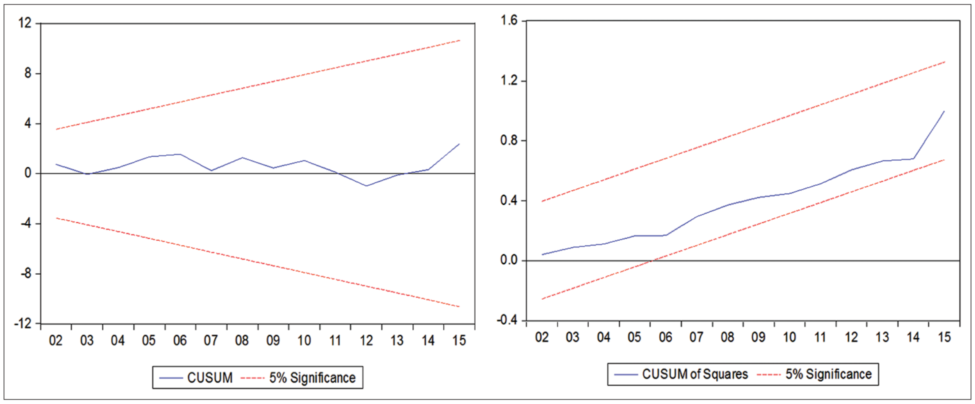
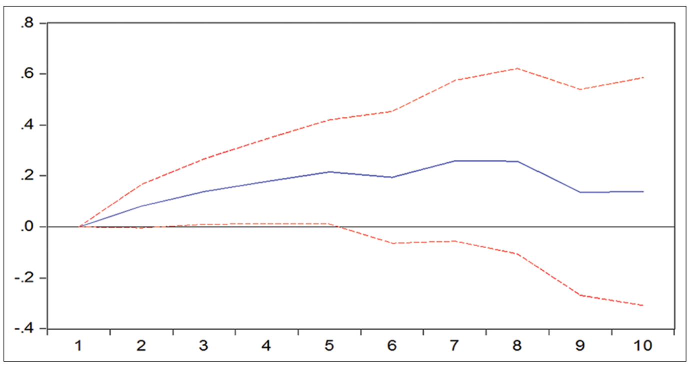


Figure 4: Impulse response of one standard deviation of oil price shock in Saudi Arabia (quarterly data)



available; this is why we selected Iran and Russia" Hesary et al. (2013. p. 573). I am going now to run the ARDL model for Saudi Arabia using annual data for the period (1980-2016) instead of quarterly data. The logarithm of Saudi government expenditure has been added to the independent variables[19]. Let us now look in Table 16 at F- statistic concerning Ramsey Reset test which is 3.298 with probability significance level (0.0925). So, the null hypothesis of no problem of function misspecification can't be rejected. Thus, the model is correct. Furthermore, the results in Table 16 show that R^2 has become 0.938 instead of 0.87 (Fifth column in Table 9) and adjusted has become 0.872 instead of 0.686 reflecting the importance of public expenditure in the Saudi economy. The coefficient of ECT equals −0.706 with a strong significant level, confirming the existence of a long run relationship among variables (Table 16: Appendix). This implies that 70% of any movements into disequilibrium are corrected for within one period. Real oil price growth rates (OS) and government expenditure (GOEXP) have strong positive statistical direct impact on the growth of GDP in Saudi Arabia at long term at 1% significant level (Table 16: Appendix). In addition, the plot of CUSUM of Squared Residuals doesn't exceed the 5% critical bounds of parameter stability, indicating the stability of the estimated coefficients by OLS over time (Figure 3 right side plot).

It is to be mentioned that using annual data instead of quarterly data reduces the sample size. Par consequence, it results in a reduced number of lags. When I tried to use three or even two fixed lags for the dependent variables and regressors, Eviews9 couldn't execute the order due to insufficient number of observations. It was regressed using one lag. The main reason why annual data are used is to show that the results for Saudi Arabia can be accepted despite the undesirable results given by Ramsey Reset test using quarterly data. It is a problem of not adding an important variable to the function due to the lack of quarterly data rather than it is a functional form problem.

5.9. The Impulse Response of One S.D of Oil Price Shock

An increase in oil price in the current quarter could reach an accumulative peak of 26% of GDP growth rates in the seventh quarter before starting losing momentum until the tenth quarter stabilizing at 14% (Figure 4). Therefore, Saudi Arabia gains from a positive oil price shock in short and long run.

6. CONCLUSION

The descriptive statistics show that oil sector dominates Saudi economy. They show that the improvement of GDP growth rates, trade balance, public budget, gross domestic saving, international reserves and foreign direct investment are directly related to positive oil prices evolution. The main economic indicators in KSA follow oil prices in the same direction. The slowdown of oil prices since 2014 has deteriorated the main economic indicators. The empirical results indicate that oil price is a major determinant of Saudi government expenditure which in turn determines GDP. For this reason, Saudi Arabia vision (2020-2030) aims at diversifying its economy in order to lower the dependence on oil sector. This needs to apply a vast program of structural reforms.

This study has tried to investigate over the period (1995Q4-2015Q4), the direct and indirect long run relationship between oil price and GDP growth rates of Saudi Arabia using an ARDL method to cointegration analysis. The study contains ten countries: KSA and

19 The source of annual data concerning: Exports are from IMF Data/ Direction of Trade Statistics (DOTS). Saudi Government total expenditures are from Public Finance Statistics List / Saudi Arabian Monetary Authority. The GDP at current and constant US dollars are from World Bank Data base. Annual oil prices are from Saudi Arabian Monetary Authority, Annual Report 2015/ oil statistics section.

nine of its main commercial partners in order to detect the indirect effect of oil price on the Saudi growth through trading partners.

The results of unit root tests indicate that all the variables are stationary from level except three variables are stationary from first difference. The ARDL bound tests and the cointegration results confirm the existence of long run relationship between GDP growth rates, oil price shock and the weighted GDP growth rates of trading partners concerning KSA, China, Japan, S. Korea, India, Canada, France and Germany.

The empirical results show clearly that oil price growth rate influences positively the economic growth in the KSA at long run as well as at short run (a direct effect). This result is in accordance with the theory for net oil exporting countries and in accordance with many previous empirical studies mentioned in section 2.

The indirect effects differ among Saudi Arabia trading countries. The descriptive statistics indicate that since 2014, China has become the most important trading partner of Saudi Arabia. While trading with China and Japan have positive significant long run impacts on GDP growth rates of Saudi Arabia, trading with KSA don't have any impact on GDP growth rates at long term in these two countries. This empirical result confirms the conclusion obtained by Aslanoglu and Deniz (2013), who found that high economic growth in China would have a positive impact on the following oil-exporting countries: (Saudi Arabia, UAE, Iran and Kuwait). Despite this finding, oil price doesn't affect indirectly the economic growth of Saudi Arabia via trading with China at long run because oil price has found not to have a long run effect on the weighted growth rates of China via trading with KSA, nor on the weighted growth rate of KSA via trading with China. This result is in contradiction with the theory supposes that a significant rise in oil prices may have a negative indirect impact on Saudi Arabia (Shock via Trade), where rising energy costs increases the production cost of Chinese goods, leading to a contractionary shock offer, which in turn will lead to a decline in China's demand for Saudi oil and a decline in the Saudi demand for Chinese products that have become more expensive. This might be explained by the inelasticity of Saudi demand for Chinese goods and the inelasticity of china's demand for oil.

Oil price shock has found to weaken the positive long run effect exercised on GDP growth rates of KSA via trading with Japan, through the significant negative effect of oil price on the weighted GDP of Japan with KSA.

Although, trading with S. Korea and UK has negative significant long run effect on Saudi GDP growth rates, oil price has no possible indirect long run effect on Saudi economy via trading with UK. But, it has a positive long run effect on the weighted GDP growth rates of S. Korea with Saudi Arabia.

Trading with USA, India, Canada, France and Germany have no significant impacts on the long run GDP growth rates of Saudi Arabia. The results show that oil price shock has no real indirect effect on the GDP growth rates of Saudi Arabia via its trading with its third large trading partner USA. Saudi oil exportation to the USA has dropped over years to represent only 11% of the total oil crude importation of USA in the year 2016.

In general, these results might go with the results obtained by Abeysinghe (2001) and Abeysinghe and Forbes (2005) concluded that transmission effect of oil price on growth doesn't have an important effect on large economies like China and USA. It only plays a critical role in small open economies.

Finally, this study can't be completed before studying the indirect effect by using another method. My next paper will use (2SLS method) for simultaneous equations that link up the GDP growth rates of different nations through a trade matrix in order to investigate the transmission effect of oil price on economic growth of KSA via its trading partners. It will use the framework developed by Abeysinghe and Forbes (2005) and Abeysinghe (2001) depending on the framework of Hamilton (2000).

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APPENDIX OF TABLE 16

Long run coefficients using annual data (Saudi Arabia)				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
W1_2___Y2	0.000497	0.000411	1.208269	0.2470
W1_3___Y3	−0.006669	0.005955	−1.119909	0.2816
W1_4___Y4	−0.004677	0.002786	−1.678806	0.1154
W1_5___Y5	0.001933	0.001773	1.090434	0.2939
W1_6___Y6	0.006430	0.003720	1.728680	0.1058
W1_7___Y7	0.006381	0.004566	1.397515	0.1840
W1_8___Y8	−0.004352	0.004954	−0.878434	0.3945
W1_9___Y9	0.006620	0.005334	1.240993	0.2350
OS	0.968614	0.249966	3.874986	0.0017
GOEXP	0.219249	0.072306	3.032218	0.0090
C	−5.536476	1.821944	−3.038774	0.0088
CointEq(−1)	−0.706258	0.119906	−5.890115	0.0000
Diagnostic tests				
Tests				
A: Heteroscedasticity test: Breusch Pagan Godfrey test				
F-statistic	0.447108	Prob. F (15,14)		0.9331
Observed * R^2	9.716631	Prob. Chi-square (15)		0.8372
B: Breusch-Godfrey serial correlation LM test				
F-statistic	0.443396	Prob. F (2,12)		0.6520
Observed * R^2	2.064423	Prob. Chi-square (2)		0.3562
C: Normality test				
	Jarque-Bera	**P**		
	1.536	0.463		
D: Ramsey RESET test				
	Value	**df**		**P**
t-statistic	1.816081	13		0.0925
F-statistic	3.298150	(1, 13)		0.0925

W1_10___Y10 has been removed because it is stationary from second difference, while the rest of variables are integrated from level or first difference