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# Oil demand and price elasticity of energy consumption in the GCC countries: A panel cointegration analysis

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This paper examines the cointegrating relationship between oil demand and price elasticity of energy consumption in the Gulf Cooperation Council (GCC) countries during the period 1980-2010. The paper has applied the recently developed panel cointegration techniques, Dynamic Ordinary Least Squares (DOLS) and panel DOLS in a panel of GCC countries. The region is being recognized as the major region of oil production and export in the global economy. In recent times, the region is emerging as a fastest growing oil consuming region globally. This fast increase in the level of oil consumption in the major oil exporting countries raises the energy security implications in the sphere of the growing oil demand in the world economy. This is likely to bring many pitfalls in the form of price distortions and reduced growth rates in and outside the oil export region. The empirical finding reveals a cointegrating relationship among the variables and indicates an income elastic and price inelastic demand for oil in the long-run in the GCC countries. The outcomes of income elastic and price inelastic demand for oil are also consistent in the short-run. The income and price inelastic demand for oil though exists for a full panel of countries but vary across the GCC countries. The result of the Granger Causality test also depicts a unidirectional causality running from income to oil consumption and bidirectional causality running between oil prices and income in the GCC countries. Moreover, the outcomes reveal that demand for oil varies positively with the growth of income and negatively with the price level in the economy.

**JEL Classifications:** C236 Q21, P22, R15, E21, P18

**Keywords:** Oil, GDP, price, panel, cointegration, DOLS, Gulf Cooperation Council

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## Introduction

The economy of Gulf Cooperation Council (GCC) countries is being recognized as the major region of oil production and export in the global economy. In recent years, the region is emerging as a fastest growing oil consuming region at the global level. This may be accorded to the initiation of developmental programmes in the GCC countries which arises due to a sharp rise in the oil prices in the 1970s (Al-Faris, 1997). The unanticipated oil revenue equipped the GCC countries to diversify their economic structure and to optimize their socio-economic development. The oil consumption measured in terms of thousands of barrel per day increased many fold from 491.4 in 1971 to 4070.7 in 2010. The decadal average annual growth rate of oil consumption increased from 46.9 percent during 1980s to 62.4 percent during 1990s and further to 66.6 percent during 2000s (IEA, 2011). This is about 6 percent of the production in 1980 and about 25 percent of the

production in 2010. This rapid growth in oil consumption at 5.3 percent annually is 21 percent faster than its income growth rate of 4.2 percent annually over the last 31 years (OPEC, 2011). The fast increase in the level of oil consumption in the major oil exporting countries raises the energy security concerns in the sphere of growing oil demand in the world economy. This is likely to bring many pitfalls in the form of price distortions and reduced growth rates in and outside the oil export region. The region is also experiencing a decline in the oil exports revenue from 48.6 percent in 2008 to 36.4 percent of GDP in 2010 and any supply deficiencies is likely to raise inflationary tendencies and Balance of Payment (BOP) implications in the GCC countries (IMF, 2012). The prevailing low price of oil in the oil exporting countries induces more consumption and raises a major energy security issues in the world economy. It appears that a decline in the export revenue may tend to increase the price level further and may impose the heavy burden on the economy.

There is an extended volume of literature available on the issue of oil production, pricing policies and export of oil but not any studies have examined the income and price elasticity of energy consumption in the GCC countries in a panel framework. This study seeks to examine the long-run income and price elasticity of energy consumption in a panel of GCC countries by applying the panel cointegration techniques. It has been observed that the panel based cointegration test possesses high power than the tests based on the single series. To this end, this study has applied Pedroni (2004) panel cointegration and Dynamic Ordinary Least Squares (DOLS) proposed by Saikkonen (1992) and Stock and Watson (1993) and panel DOLS advocated by Kao and Chiang (2000) to examine the long-run relationship between oil consumption, income and oil prices in the panel of GCC countries. The remainder of the paper is organized as follows. Second section, discusses the available literature on the issue of income and price elasticity of energy consumption specific to the Middle East countries. Third section outlines the economic growth and oil consumption in the GCC countries. Fourth section, describes the model specification, data and methodology. The last section, sum up the study with important findings and valuable suggestions.

## Review of literature

The available literature on the oil segment grew rapidly after a sudden increase in the oil prices in 1973. There has been a number of studies that empirically examines the oil market and behavior of the OPEC (Griffin, 1985; Dahl and Yucel, 1991; Al-Yousef, 1998; Ramcharan, 2002 and Kaufmann et al., 2006). Most of the literature analyses the oil production, export of oil and price policies in the Middle East countries (Eltony and Haque, 1996; Eltony and Mohammad, 1999; Diabi, 1998). The other studies examine the income and price elasticity of energy consumption in the Middle East countries (Eltony and Mohammad, 1993; Eltony, 1994; Al-Mutairi and Eltony, 1995; Al-Sahlawi, 1988 and Chakravartoy et al. (2000). Rothman et al., 1994; Brenton, 1997; Narayan and Smyth (2007), employ a panel framework to analyze the relationship between income and price elasticity of energy consumption in the Middle East countries.

Al-Mutairi and Eltony (1995) have examined the price and income elasticity of energy demand in Kuwait and found that energy demand is price inelastic in the short-run and income elastic in the long-run. Al-Sahlawi (1997), have studied the demand for petroleum products in Saudi Arabia and found an income elastic and price inelastic demand for energy consumption in the long-run. Al-Faris (1997), in his study on demand for oil products in the GCC countries observed a price inelastic demand in the short-run. Chakravartoy et al. (2000), has analyzed the petroleum demand in OPEC countries for the period 1972-1992. Al-Iriani (2006), observed a unidirectional causality running from income to energy consumption in the case of GCC countries. More recently, Narayan and Smyth (2007), on the relationship between oil demands, income and price elasticity of energy consumption in a panel of Middle East countries found that oil demand is slightly income elastic and highly price inelastic.

The literatures on oil demand in the Middle East countries have generally observed that oil demand is income elastic and price inelastic for their study period. The significance of the study on elasticity of oil demand in the oil exporting countries arises due to the increasing higher level of energy consumption in these countries. This, study will be helpful in the sense that estimated oil and price elasticity of energy demand will enable the policy makers to formulate the suitable policies about the higher level of energy consumption with respect to the prevailing income and price elasticity of energy consumption. The study has applied the recently applied Pedroni (2004) panel cointegration techniques to examine the existence of long-run relationship between the variables in a heterogeneous framework model. The said technique is superior and scientific as compared to the causality test and homogeneous based panel cointegration test.

## Economic growth and oil consumption

The economic development in the GCC countries accelerated during the early 1970s due to a sharp rise in the oil prices. In 1972, crude oil prices increased many fold from \$12.05 per barrel to \$51.23 per barrel in 1974 (\$2010, BP statistics) following the eruption of the Arab-Israel war in October, 1973. The largest oil producing countries Iran, Saudi Arabia, Kuwait, Qatar and UAE benefitted with higher oil revenue (Narayan and Smyth, 2007). The surge in the oil prices benefitted most of the countries in the Middle East and North Africa (MENA) region including the low oil reserve countries Bahrain and resource poor countries Jordan, Palestine and Yemen (Al-Iriani, 2006). This has accorded the oil production in the GCC countries from an average 1636.9 thousands barrel per day in 1971 to 2454.9 thousands of barrel per day in 1979 which is about 10.1 percent in 1971 and 11.4 percent in 1979 of the total production in the Middle East countries.

TABLE 1. GROWTH RATE OF GDP AND OIL CONSUMPTION DURING 1980 - 2010

COUNTRY/REGION	1980-89	1990-99	2000-09	2005	2006	2007	2008	2009	2010
MENA	2.3 (4.7)	4.3 (3.9)	4.3 (4.5)	4.7 (4.7)	5.5 (4.4)	5.9 (3.7)	4.7 (6.2)	3.5 (3.9)	4.3 (5.3)
GCC	1.4 (5.9)	4.5 (5.3)	6.4 (4.9)	7.3 (6.0)	9.3 (3.3)	7.7 (5.3)	8.6 (7.0)	1.3 (5.8)	5.9 (8.5)
Bahrain	3.7 (-2.6)	4.9 (0.7)	6.0 (6.1)	7.9 (10.7)	6.7 (13.7)	8.4 (-0.24)	6.3 (-0.36)	3.1 (3.8)	4.1 (1.3)
Kuwait	-1.0 (4.9)	3.2 (4.6)	5.2 (2.9)	10.4 (8.0)	5.3 (-15.0)	4.5 (6.7)	5.0 (3.3)	-5.2 (-11.2)	3.4 (7.4)
Oman	9.2 (3.3)	5.5 (8.3)	4.6 (7.3)	4.0 (9.6)	5.5 (7.9)	6.7 (9.6)	12.9 (10.7)	1.1 (-0.8)	4.1 (14.8)
Qatar	-0.1 (16.3)	4.7 (2.7)	12.6 (12.3)	7.5 (9.2)	26.2 (13.6)	18.7 (15.9)	17.7 (15.4)	12.0 (-2.2)	16.6 (5.1)
Saudi Arabia	-0.6 (3.9)	3.1 (7.7)	3.4 (5.4)	5.6 (4.6)	3.2 (5.0)	2.0 (4.1)	4.2 (7.1)	0.1 (10.6)	4.1 (7.7)
UAE	-0.5 (25.0)	6.1 (3.5)	6.6 (4.7)	8.6 (8.3)	8.8 (6.1)	6.6 (6.3)	5.3 (6.8)	-3.2 (0.7)	3.2 (12.4)

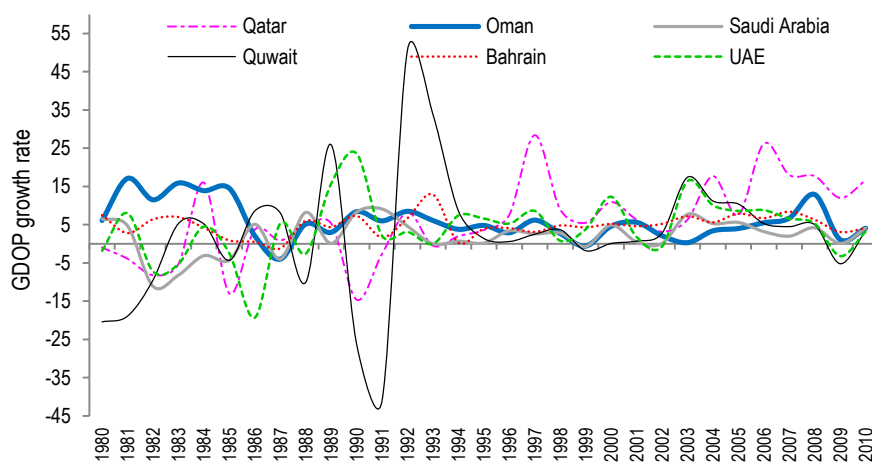
Source: IEA, (online data base) OECD 2011 and World Economic Outlook, 2012. The values in the parenthesis shows annual growth rate of oil consumption.

The increased oil production and oil prices have accelerated the economic growth in the GCC countries during 1970s. Since, then the economic growth in the region is tied with the price of the oil in the world economy. The eruption of the Iranian revolution and subsequently the Iraq-Iran war in 1979 and 1980 has resulted in a loss of oil production and a rise in the crude oil prices from mere \$46.9 per barrel in 1978 to \$86.2 barrel per day

in 1981. The rapid rise in the oil prices in 1973 and 1980 had also resulted in pursuing United States to impose price controls, increasing the oil exploration in non-OPEC countries and to adopt the alternative fuel substitution mechanism. The loss of oil production and declining oil prices have resulted in a loss of export revenue and that affected the high rate of economic growth achieved during 1970s and early 1980s in the Middle East countries (Narayan and Smyth, 2007). This has caused the oil prices to decline from \$86.2 per barrel in 1981 to \$27.5 per barrel in 1988. In 1990, the oil prices jumped to \$39.6 per barrel due to the lower production and uncertainties regarding the Gulf War. The eruption of the Gulf War and the economic slowdown has led to a persistent fall in the oil prices to a low level of \$17.0 per barrel in 1998. This has also resulted in a subsequent decline in the oil production and that also caused oil prices to grow moderately between the period 2001 and 2002. Since 2003, oil prices starts rising and that reached to \$98.5 per barrel in 2008 and \$79.40 per barrel in 2010 due to a global economic slowdown.

Table 1 presents the GDP growth rate and the annual average growth rate of oil consumption in the Middle East countries including the GCC countries during the period 1980-2010. The economic growth in the Middle East countries have decreased from 6.2 percent during 1970s to 2.3 percent during 1980s before growing by 4.3 percent during 1990s and 2000s.

FIGURE 1. GDP GROWTH RATE IN GCC COUNTRIES DURING 1980-2010



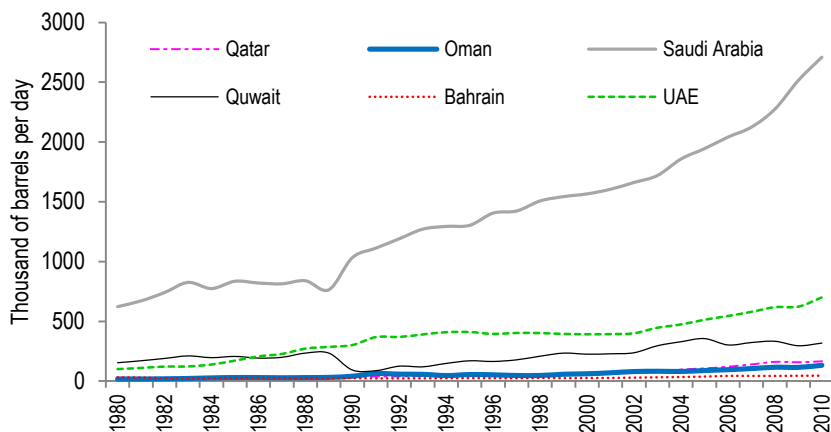
Source: World Economic Outlook, 2012.

Figure 1, depicts that in the GCC countries the real GDP grew from 1.4 percent during 1980s to 4.5 percent during 1990s and further to 6.4 percent during 2000s. In the GCC countries, the economy of Bahrain grew at a high annual growth rate of 6.1 percent, Oman 6.0 percent, Qatar 4.8 percent, UAE 4.0 percent, Kuwait 2.5 percent and Saudi Arabia by 2.0 percent during the period 1980-2010. It can be also observed that the economy of GCC countries grew at an annual growth rate of 6.6 percent during 2000s which is the highest growth rate during the past decades.

The economic development in the region has been accompanied by an increase in the oil consumption in the oil exporting countries (Table.1, Fig.2). The average annual growth rate of oil consumption increased from an average 2848 thousands of barrels per day

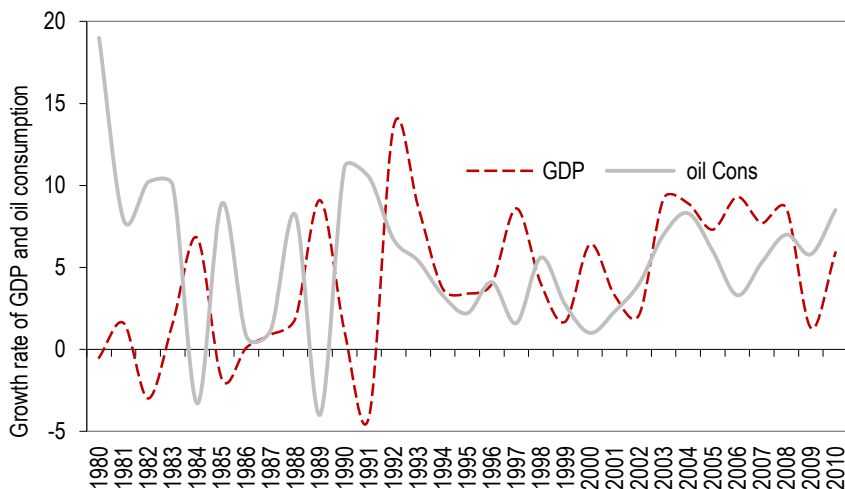
during 1980s to 4187 thousands of barrels per day during 1990s. This has been further increased to 6115 thousands of barrels per day during 2000s in the Middle East countries.

FIGURE 2. OIL CONSUMPTION IN THE GCC COUNTRIES DURING 1980-2010



Source: IEA (online data base), OECD, 2011.

FIGURE 3. GROWTH RATE OF GDP AND ANNUAL GROWTH RATE OF OIL CONSUMPTION IN GCC COUNTRIES DURING 1980-2010



Source: IEA (online data base), OECD, 2011; World Economic Outlook, 2012.

In the GCC countries, the average annual consumption of oil increased from 1226.7 thousands of barrel per day (46.9 percent average annual growth rate) during 1980s to 1967.2 (62.4 percent average annual growth rate) during 1990s and to 2952.3 (66.6 percent average annual growth rate) during 2000s. The oil consumption in the GCC countries grew at an average annual growth rate of 5.5 percent during 1980-2010. The average annual growth rate in oil consumption vary from 11.1 percent in UAE, 10.3 percent in Qatar, 6.7 percent in Oman, 5.6 percent in Saudi Arabia, 4.2 percent in Kuwait and 1.4 percent in Bahrain during the period 1980-2010.

Table 1 & Figure 3, depicts that an increase in the GDP growth rate by 1.4 percent is associated with 5.9 percent annual growth rate in oil consumption in the GCC countries during 1980s. The growth rate of GDP increased from 4.6 percent during 1990s to 6.4 percent during 2000s while oil consumption increased from 5.3 percent to 5.4 percent respectively during the above period. The annual trend shows that an increase in the GDP growth rate by 8.6 percent has been found to be associated with the growth rate of oil consumption by 7.0 percent in the year 2008. In 2010, the GDP growth rate by 5.9 percent has been accompanied by 8.5 percent increase in oil consumption in the GCC countries.

### Model specification

We examine the long-run relationship between oil demand, real GDP growth rate and price of oil in a panel of GCC countries during the period 1980-2010. In the energy literature, it is observed that oil demand is income elastic and price inelastic (Dahl, 1994 and Narayan and Smyth, 2007). The earlier studies had observed that real GDP exerts a significant influence on the oil demand and the relative prices in the economy. Based on the theoretical convention, the relationship between oil demand, real GDP and the price of oil can be expressed as:

$$QP_t = f(YP_t, OP_t)$$

Where,  $QP_t$  indicates the per capita demand for oil,  $YP_t$  indicates the real per capita GDP and  $OP_t$  indicates the price of oil. The empirical model can be formulated in a cross sectional framework as follows:

$$QP_{it} = b_{0i} + b_1 YP_{it} + b_2 OP_{it} + \varepsilon_t$$

Where,  $b_{0i}$  is constant and  $b_1$  and  $b_2$  represents the estimated parameters in the model. The subscript  $i$  is a cross- sectional data representing a panel of countries and  $t$  refers to the time period. The term  $\varepsilon_t$  refers to the random disturbance term and assumed to be normally distributed with zero mean and constant variance. Where, the respective regressors represent their income elasticity  $YP_{it}$  and price elasticity  $OP_{it}$  of oil demand in the model.

### Heterogeneous panel unit root

We start with the investigation of a possibility of panel cointegration by initially examining the presence of a panel unit root in our data set. There are a number of methods of testing the existence of a panel unit root test applied in the recent studies. We employed the Breitung (2000) and Im, Pesaran and Shin (2003) test of a panel unit root. Hlouskova and Wagner (2006), employed the Monte Carlo simulation studies and Narayan and Smyth (2007), have used the Breitung (2000) panel unit root test. Moreover, the test proposes a t-test statistics that follows the standard normal distribution. Im, Pesaran and Shin (2003), provides a separate estimation for each cross-section, allowing separate specification of the parametric values, the residual variance and the number of lag lengths to be chosen (Asteriou and Hall, 2006). Moreover, the test has been found to be equipped with superior test power, with small distortions and also applicable for the small size of the sample (Kao and Chaing, 2000). The said test uses a separate Augmented Dicky-Fuller (ADF) test and can be expressed as:

$$\Delta Y_{it} = \alpha_i + \rho_i Y_{it-1} + \sum_j \delta_j Y_{it-j} + \beta_{it} + \varepsilon_t$$

This test is based on the assumption that  $T$  should be identical across the cross sections. The t-statistics is the average of each separate ADF t-statistics for testing that  $\rho_i = 0$

$\rho_i = 0$  for all cross sections.  $\bar{t} = \frac{1}{N} \sum_{i=1}^N t_{\rho_i}$ . Im, Pesaran and Shin (1997) referred that t-bar has a better performance when  $N$  and  $T$  are small.

### Heterogeneous panel cointegration test

After examining the presence of a panel unit root, the next step is to examine the existence of a long-run cointegration relationship between oil demand, real GDP and price of oil by applying the panel cointegration test proposed by Pedroni (2004). This test allows for a multiple regressors and estimates the residuals from a cointegration regression and provides seven test statistics for the test of cointegration in a heterogeneous panel's framework. The test allows the cointegration vector to vary across the sections in the panel and also allows heterogeneity across the cross-sectional units. The estimated residual from the long-run regression are based on the following form:

$$Y_{it} = \alpha_i + \pi_{it} + \sum_{m=1}^M \beta_{mi} X_{mit} + \mu_{it},$$

$$t = 1 \dots T, i = 1 \dots N; m = 1 \dots M$$

Where,  $T$  represents the time specific observations,  $N$  represents the cross-sectional units and  $M$  represents the number of regressors in the model. The intercept  $\alpha_i$  and  $\pi_i$  slope

coefficients varies across the cross sectional units and  $\mu_{it} = \gamma_i \mu_{it}(t-1) + \varepsilon_{it}$  are the estimated residuals. Pedroni (2004) has used the Monte Carlo simulations to present the critical values for the seven test statistics. The test proposes that null hypothesis of no cointegration will be rejected if the value of the test statistics is greater than the given critical values.

### **Panel long-run relationship**

After establishing the existence of a long-run cointegration relationship, we employ the recently used DOLS advocated by Saikkonen (1992), Stock and Watson (1993) and panel DOLS advocated by Kao and Chiang (2000) to examine the long-run relationship between the variables in the model. The panel DOLS method involves the lags and leads of the regressor which is found to be superior to OLS and Fully Modified Ordinary Least Squares (FMOLS) (Kao and Chiang, 2000).

### **Data**

The data in the study is consistent with the earlier studies and are taken from the International Energy Agency (IEA) data base, OECD 2011, British Petroleum (BP) Statistical Review of World Energy (2012). The data on oil demand per capita expressed in terms of the consumption of thousands of barrel per day are taken from the IEA, data base, OECD 2011 and the data on crude oil prices are taken from the SAMA annual report, 2011. The data on real GDP per capita measured in terms of the US dollars at 2005 prices based on the purchasing power parity (PPP) are taken from the IEA, data base, OECD, 2011, and Penn World Table.

### **Empirical results**

Table 2, presents the results of Breitung (2000) and Pesaran and Shin (2003) of a panel unit root test of the variables QP, YP and OP in the model. The result shows that Breitung t-statistics and Pesaran and Shin ADF-test statistics applied to the QP, YP and OP for the panel of GCC countries indicates a panel unit root.

TABLE 2. PANEL UNIT ROOT TEST RESULT

Variables	Breitung t-test	Pesaran and Shin ADF-test
QP	1.5597 (0.9406)	0.6074(0.7282)
$\Delta$ QP	-8.3361*** (0.0000)	-9.3360*** (0.0000)
YP	2.3718 (0.9911)	0.6954(0.7566)
$\Delta$ YP	-4.7160*** (0.0000)	-11.8374*** (0.0000)
OP	-1.4280 (0.0766)	1.3099(0.9049)
$\Delta$ OP	-7.06979*** (0.0000)	-4.6454*** (0.0000)

Notes: Probability values are in Parenthesis; \*\*\* - denotes statistical significance at 1 percent level.

After establishing the presence of a panel unit root for the variables QP, YP and OP we proceed to test that whether there exist a cointegration relationship between the variables by applying Pedroni (2004) heterogeneous panel cointegration test. The results of the

Pedroni (2004) panel cointegration for the seven panel test statistics are presented in the Table 3.

The outcomes of the test statistics has been compared with Pedroni (1999; 2004) critical values. The observations reveal that the outcomes accept the panel  $v$ -statistics (close to) all the test statistics favors the rejection of null hypothesis of no cointegration. This implies that there exist a cointegration relationship between the oil demand and real per capita GDP and price of oil in a panel of GCC countries. The outcomes of the test are also found to be consistent with the Pedroni (1999) for a panel of non-parametric ( $t$ -statistic) and parametric (ADF-statistics) that the results are more reliable in case of a constant and trend.

TABLE 3. PEDRONI (2004) PANEL COINTEGRATION

VARIABLES	
Panel $v$ –statistics	1.4340(0.0758)
Panel Phillips-Perron type $\rho$ -statistics	-1.8785*** (0.0302)
Panel Phillips-Perron type $t$ –statistics	-2.3072*** (0.0105)
Panel ADF $t$ –statistics	-2.5982*** (0.0047)
Group Phillips-Perron type $\rho$ -statistics	-0.2182*** (0.4136)
Group Phillips-Perron type $t$ -statistics	-0.9943*** (0.1600)
Group ADF $t$ -statistics	

Notes: Critical values are based on the Pedroni (1999; 2004). \* - denotes statistical Significance at 1 percent level.

After establishing the existence of cointegration relationship we may proceed to examine the long-run relationship between income and price elasticity of demand for oil in the GCC countries. The study has applied the DOLS technique to examine the long-run relationship. The estimated outcomes along with panel long-run and short-run relationships have been presented in Table 4.

TABLE 4. LONG-RUN ELASTICITY AND SHORT-RUN ELASTICITY

DOLS LONG-RUN ELASTICITY	YP	OP
Bahrain	0.9440*** (0.0055)	-0.0172(0.8934)
Kuwait	0.3214*** (0.0224)	0.0967 (0.2751)
Oman	0.3208(0.7614)	-0.01572(0.8842)
Qatar	-0.6020*** (0.0001)	<b>0.3798***</b> (0.0001)
Saudi Arabia	0.04286 (0.8173)	0.02812(0.7102)
UAE	-2.8793*** (0.0000)	<b>0.939***</b> (0.0006)
Panel	0.9606*** (0.0123)	-1.4141(-0.7607)
PANEL SHORT-RUN ELASTICITIES		
YP	0.0234 ***	5.8254*
OP	-0.0051***	-3.1999*

Notes: Values in the parenthesis indicates p-values.\*\*\* - shows statistical significance at 1% level of significance and \* represents the t-statistics and shows significant at 1% level of significance.

The estimated outcomes depicts that for a panel of GCC countries income elasticity of oil consumption is positive and significant while price elasticity of energy consumption is negative and statistically insignificant. In other words, the oil demand estimated outcomes depict that oil demand as income elastic and price inelastic in the long-run in the GCC countries. However, the estimated coefficients for the panel of GCC countries vary across the panel of countries.

The estimated outcomes depicts that for a panel of GCC countries the income elasticity of oil demand is positive for Bahrain, Kuwait, Oman and Saudi Arabia. The estimated

outcomes is consistent with Narayan and Smyth, 2007 which states that demand for oil as income elastic in Bahrain, Kuwait, Oman and Saudi Arabia in the long-run. The outcomes indicate an income inelastic demand for oil in Qatar and UAE. The outcomes also reveal a price inelastic demand for oil in a full panel of countries. The results depict that demand for oil as price inelastic in Bahrain and Oman in the long-run. Thus, the results shows that income and price elasticity of oil demand vary across the panel of countries. This may be accorded to the high oil consumption trends in recent times, low price of oil and improved level of income and life patterns of the peoples in these countries.

The study has also conducted the Granger causality test and results are presented in Table 5. Sims, Stock and Watson (1989) and Toda and Phillips (1994), have shown in their studies that if the variables are cointegrated of order I (1) the said test can be applied to show the direction of their causality. The results shows that GDP growth rate does Granger cause demand for oil and demand for oil does not Granger cause GDP growth rate. The results of the study is consistent with the outcomes that unidirectional causality running from GDP growth to energy consumption in GCC countries (Al-Iriani, 2006). The table also shows that GDP growth does not Granger cause demand for oil and oil price does Granger cause GDP growth rate. It can be also observed that oil prices does not Granger cause demand for oil and demand for oil also does not Granger cause price of oil.

TABLE 5. GRANGER CAUSALITY TEST ( $\chi^2$ )

DEPENDENT	QP	YP	OP	$ECM_{t-1}$
QP		5.6393(0.0596)	1.9875(0.3702)	<b>-0.0198 (-2.5517)</b>
YP	0.3065(0.0879)		7.3116(0.0258)	
OP	0.5527(0.0.7585)	11.0042(0.0041)		

Note: Values in the parenthesis shows p-values.

Thus, the outcome depicts that GDP growth rate does Granger cause oil consumption and demonstrates a unidirectional causality running from GDP growth to oil consumption and bidirectional causality running between oil prices and GDP growth in the GCC countries. The result of the study is consistent with the findings of Narayan and Wong (2009).

## Conclusion and suggestions

This paper examines the income and price elasticity of energy consumption in the GCC countries. The study has applied Panel cointegration test, DOLS and Panel DOLS test techniques and found the long-run cointegration relationship between the variables used in the study. The estimated outcomes of the panel cointegration test depicts that oil demand is income elastic and price inelastic in the long-run and in the short-run in the GCC countries. The estimated coefficients depict an income elastic demand for oil in Bahrain, Kuwait, Oman and Saudi Arabia. Moreover, the result shows an income and price elasticity of oil demand vary across the panel of countries. This may be accorded to the high oil consumption trends in recent times, low prices of oil, improved level of income and fast changing life patterns of the peoples in these countries. The outcome of the study is consistent with the economic tendencies that demand for oil does not depends mainly on the income and price of oil but also depends on the relative income, prices, taste and social status across the GCC countries. The result of Granger Causality test indicates a unidirectional causality running from income to oil consumption and bidirectional causality running between oil prices and income in the panel of GCC countries. Thus, the outcome reveals that demand for oil varies positively with the growth

of income and negatively with the price level in the economy. The increasing oil consumption more than the growth rates of income across the countries in the GCC countries is a matter of great concern. These raises a major policy issues for the low oil prices and conservation of the natural resources of the country. The oil conservation policies require adopting the natural gas and atomic energy along with railways means to conserve the oil resources of the country.

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