Impact of Oil Price and Shocks on Economic Growth of Pakistan: Multivariate Analysis

By

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Registration No. 07/M.Phil-ETS/PIDE/2011

A Dissertation Submitted to the Pakistan Institute of Development Economics, Islamabad, in partial fulfillment of the requirements of the Degree of Master of Philosophy in Econometrics

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December, 2013

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Dedicated to My Beloved PARENTS and GRAND PARENTS

My Trust, **My Inspiration**, **My World**.

ACKNOWLEDGEMENT

All commend to ***ALLAH*** whose blessing and magnificence prosper my thoughts, and flourished my aims by giving me brilliant teachers, supporting parents, exceptional friends and for giving me potential to completing this thesis. I would like to stat here my supreme gratitude to the people who have assisted and supported me during my research.

Special thanks goes to my supervisor, ***Dr. Abdul Qayyum***, Joint Director of Pakistan Institute of Development Economic Islamabad, for his supervision and regular support. His extensive knowledge and rational way of judgment have been of great worth for me. His detailed analysis and rigorous assessment enhanced not only the quality of this dissertation, but also complete understanding of my thesis. I am thankful to his ever encouraging guidance, keen attention, his precious assistance through beneficial remarks and suggestions during the research works have contribute to the accomplishment of this study.

A special thank of mine goes to my ***Friends*** who helped me in completing the thesis and they exchanged their interesting ideas, thoughts and made this thesis easy and accurate. Their association with their faithfulness has prompted and encouraged my intellectual to maturity which is required for this work and wish to continue our healthy friendship in the future.

Before I finish, my warmth gratitude goes to my beloved ***Parents*** for their never-ending love, prayers and back-up, for their marvelous assistance and support both morally and financially towards the finishing of this study. To those who indirectly supported in this thesis, your concern means a lot to me. Thank you very much to all of you.

SIDRA NAZIR

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ABSTRACT

Oil is becoming the most prominent indicator of economic growth in Pakistan with increase of its demand. Also oil prices are doing their main contribution to impact the GDP of Pakistan including different shock dummies in data. In this study, Cobb-Douglas production function has used to construct four models by introducing total oil consumption and its three major sectors (Transport, Power and Industrial sector oil consumption) and Pakistan's oil price variable to investigate the impact on GDP. ADF (1979), Johansen Maximum Likelihood method of cointegration (1988) and Granger causality test by applying restriction on dynamic model are used to test the order of integration, Long run and short run dynamics and causal relationship between variable using annual data since 1972-2011 in context of Pakistan. Through examining the results the long run and dynamic relationship has detected for all the variables except total, industrial oil consumption and oil price variables for model has no short run impact on GDP. Oil prices impacting real GDP negatively in long run but positively in short run (Rasmussen and Roitman, 2011). There is evidence of causality between Oil consumption (including sectors) and economic growth.

Chapter 1

INTRODUCTION

Since 2010 oil demand has increased rapidly in all over the world because of world oil price has driving down (Kitasei and Narotzky, 2011). The existing literature has suggested the many possible impacts of oil shocks on the economic growth (Brown and Yucel, 2002). Increase in the oil price cause to increase in the production cost, import bills and price of petroleum products, so the decline in the productivity due to increasing cost of input (oil) cause decline in the consumption level, investment and consequently in economic growth (Loungani, 1986). So oil price shocks limit the oil consumption which can be lead to lessen the economic growth. Consumption of energy plays vital role in enhancing the growth of economy (Hou, 2009). Oil consumption plays crucial role in every sector of economy i.e. transport, power sector and industrial sector (Zaman et al, 2011). There is difference in results of causal relationship related to energy-growth model of developed and developing country like Pakistan. Developed countries show more intensity toward energy consumption (Chontanawat, 2008). Many studies have been done on causality issue of energy and economic growth. But still there is dilemma to conclude the reliable results.

Majority of studies are available related to oil prices, its consumption and its impact on the economic growth for developed countries (Hamilton, 1983, Hooker, 1996). But recently there are lots of studies are available on the context of oil prices, its consumption and its impact on the economic growth Malik (2008), Khan and

Qayyum (2007), Akram (2011), Zahid (2008), Kraft and Kraft (1978), Bekhet and Yusop (2009), Chang and Lai (1997), Asafu-Adjaye (2000), Rufael (2004), Lee and Chang (2005), Siddiqui (2004), Chontanawat (2008), Hou (2009), Bhusal (2010), Pradhan (2010). All these studies concluded diverse results regarding energy (oil) consumption and growth. These all studies have not given the satisfactory conclusion that which are specific determinants that impacts the relationship between consumption and growth of the economy. But by examining the all studies mentioned above it can be said that difference of result is due to use of different source of data, time span and econometrics techniques these are different for different countries, so results could be inconsistent.

The country like Pakistan whose major imports comprises on oil and oil products and Pakistan is depending heavily on the oil as input in industrial, transport and electricity sector. As many developing countries generate electricity from cheap sources like water, wind etc, but in Pakistan oil is the major source to produce electricity that is costly input. In Pakistan at my best knowledge only two studies are found that estimates relationship between use of oil and economic growth specifically, i.e. Qazi and Riaz (2008) and Zaman et al (2011). In these studies three stage Granger causality test and ECM approach has been used to test causality respectively and Johansen cointegration test for cointegration analysis. In these studies oil prices or oil price shock variable has denied, as its very important factor to effect the economic growth. In Pakistan recent studies related to oil price shocks and macroeconomic variables are Ahmed (2013), Jawad (2013) and Kiani (2011).

1.1. Objectives of Study

- The core objective is to analyze the results of oil prices and oil price shocks on economic growth. We also investigate impact of other shocks on economic growth of Pakistan
- The other objective of the study is to investigate the impact of oil consumption (aggregate as well as sectoral level) on economic growth of Pakistan by using cointegration analysis and dynamic Error Correction Model.

1.2. Hypotheses

Following are null hypothesis which are going to be tested in this study.

- There is no significant impact of total oil consumption on economic growth.

  $\mathbf{H_o^1}$**:** TOC = 0
- There is no significant impact of transport oil consumption on economic growth.

  $\mathbf{H_o^2}$**:** TRANP = 0
- There is no significant impact of industrial oil consumption on economic growth.

  $\mathbf{H_o^3}$**:** IND = 0
- There is no significant impact of power generation oil consumption on economic growth.

  $\mathbf{H_o^4}$**:** PWG = 0
- There is no significant impact of oil price on economic growth.

H_o^5: P = 0

- There is no significant impact of oil price shocks on economic growth.

  H_o^6: $D_i = 0$

- The series is non-stationary.

  H_o^7: $\varphi = 0$

- There is exist cointegrating relationship between variables.

  H_o^8: $\pi = r$

1.3. Methodology

Following the studies of Kraft and Kraft (1978), Khan and Qayyum (2007), Lee (2005) Bekhet (2009), Ahmed (2013) and Saibu (2011) we specified the energy-growth model and estimated by using annual data from 1972 to 2011. Augmented Dickey Fuller test (1979) of unit root will be used to test the presence of unit root in the variables. Johansen Maximum Likelihood Method of cointegration (1988) will be applied to test the long run and short run dynamic association among the variables and restriction on dynamic model will applied to test the causality between oil consumption (including three sectors), oil prices and economic growth of Pakistan.

1.4. Organization of Study

The organization of thesis is as follows: the chapter 2 explains the oil sector of Pakistan, chapter 3 describes literature review of previous studies internationally and nationally, chapter 4 illustrates the methodology which includes sources of data and explanation of Augmented Dickey Fuller test, Johansen cointegration by Maximum Likelihood Method Chapter 5 explains the results and discussion of the analysis. Finally chapter 6 demonstrates the conclusions of the study.

Chapter 2

SALIENT FEATURES OF OIL IN PAKISTAN

2.1. Introduction

Pakistan has to need a continued long term economic growth of 7 percent to increase its general living standards and meaning full economic development. But it is observed that Pakistan's economy hardly ever grow more then 5 percent since its independence. The economic growth of Pakistan has declined since 2008 and viewed at 2.6 percent. The expected growth in 2012 is around 3 percent which is low then the targeted growth 4.2 percent and meanwhile the continental Asia is expected to grow more then 7.5 percent in that year. Slow macroeconomic fundamentals have been the main factors of low economic growth.

In this chapter followings points will be discussed:

- **i-** Oil price shocks
- **ii-** Oil Consumption and Economic Growth
- **iii-** Oil Prices and Economic Growth
- **iv-** Oil Companies of Pakistan
- **v-** Concluding Remarks

2.2. Oil Price Shocks

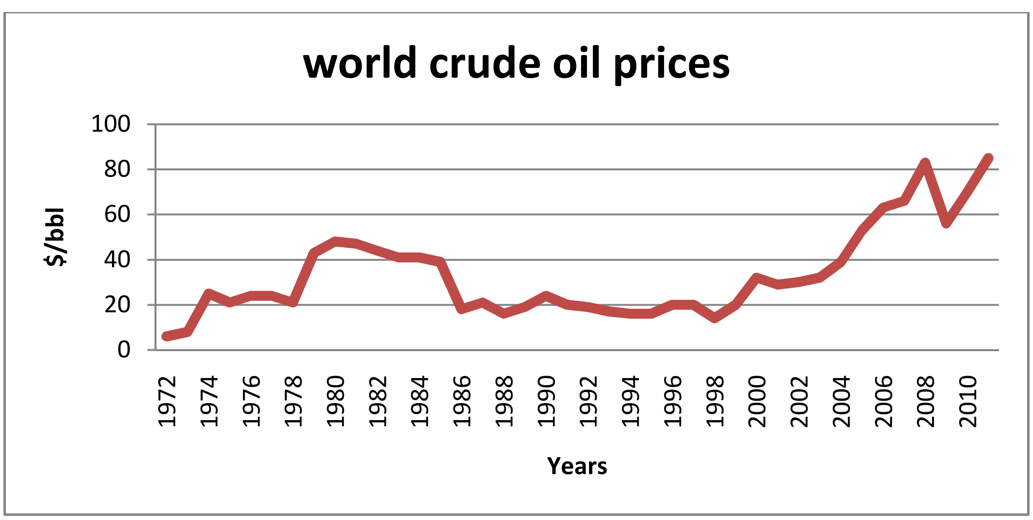
The world economy has suffered badly due to oil shocks since 1973. There are five main oil shocks in the world which affected the whole universe. Oil shocks can be defined as the oil prices increases enough to effect recession or slow down the economy. Followings are the reasons of oil shocks in the world and can be sween through figure 2.1:

i. **1973-1974:** oil shock occur due to oil embargo of US, due to Arab-Israel war oil supply cut down so prices of oil increases from the 4.15 $ in 1973 to 9.47$ in 1974.

ii. **1978-1979:** Iranian revolution.

iii. **1980-1981:** due to Iraq-Iran war, there is decrease in the oil production so prices increases from 12.46$ in 1978 to 35.24$ in 1981.

Figure 2.1: World Crude Oil Prices



Source: World Bank Data Indicator

iv. **1990-1991:** invasion of Kuwait by Iraq.

v. **1999-2000:** there was big shock to oil prices, prices increases about 20$ per barrel.

vi. **2003-2004:** tension in Middle East and emergence of new super power, increased oil demand of China.

It is observed that oil prices in its market place went down but meanwhile, in the context of Saudi its income went upward due to oil extraction and domestic low price. OPEC had set an oil price at 18 dollar per container in December, 1986 but that price was not continued for a long period and decreased in the start of 1987. After that Iraqi and Kuwait war pay an important role to increased oil prices due to instability of oil supply in 1990. But after Gulf war (Kuwait and Iraqi war) the oil price was noticed a considerable decreased till 1994 and reached at the same price which was in 1973. Later then in 1998, the price increased and goes toward revival due to reduced oil supply by OPEC and maintained at the level of 1.72 million containers in April, 1999. In 1982 to 1985, Oil producing and exporting countries (OPEC) has try to allocate a quota among its member countries to maintained the oil supply in the world but they are failed due to not serious action by its members and specially Saudi Arabia, which decreased its oil supply because of decline in oil prices. In the mid 1986, they tried to correlate the oil prices with blemish oil market to maintain the oil prices less the 10 dollar per container (Afia, 2007).

These all shocks have great impact on the GDP of oil importing country, like Pakistan. Other then these external shocks Pakistan oil prices are also affected by the internal shocks due to different natural and political disasters in the country. Like, in 2004

Pakistan GDP was at high level that was due stable economy, the earth quack of 2005 in northern areas of Pakistan influence the great threat to the whole economy and caused inflation in all sectors. Flood of 2011 also ruined the overall structure of the economy. All these miss happenings causes to increase in the import prices and shortage of recourses because to increase oil prices that is the main input in different sector of economy.

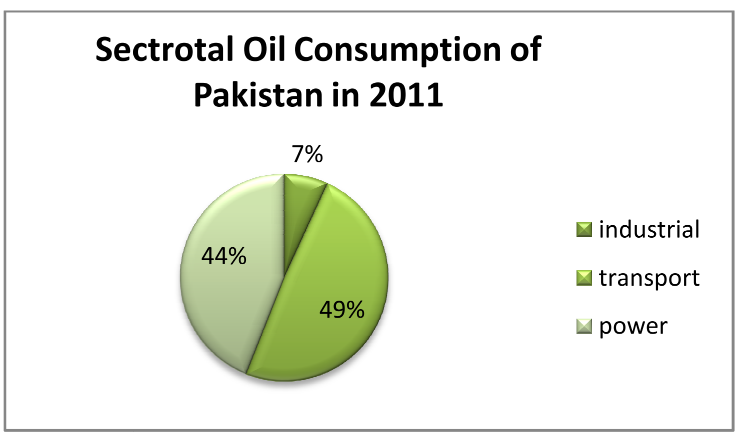
2.3. Oil Consumption and Economic Growth

Later than the oil calamity in 1973, many outstanding findings were made together by the private sector and OGDCL. Oil industry of the country has organized and synchronized by the petroleum ministry and natural recourses during 1977. In Pakistan three major sector of oil consumption are transport, power generation sector and industrial sector. In 1980s Pakistan economy was growing with the increase in energy demand. If we look at the figure 2.4 of oil consumption of Pakistan, it can be seen that, in 1980 to 1990 especially oil consumption has increased, as there was 6% increase in its import per annum. In 1996 energy consumption has increased as in previous year. Pakistan's biggest consumption is gas after that oil is 2^{nd} major energy component. Total energy consumption decreased from 48 % to 29% in 2006-07. So oil consumption in 2000 to 2005 shows drastic negative trend and decreased 3.4 %. During 2005-06 almost 8.4 million tons crude oil is imported. But in 2003-04 it was higher in amount then in 20005-06 that was 16 million tons.

As Pakistan's major import is petroleum or petroleum product from which major part is consumed by transport sector of Pakistan. In 2005-06 55% of total oil consumption is consumption by transport sector and 29% and 12% by power and industrial sector respectively. In 2008-09 the overall condition of energy consumption was very sever due to high oil prices. That affects Pakistan's macroeconomic and cause inflation, current account deficit, decreasing the purchasing power of poor as well as riches. In 2008-09 the oil consumption was 29% of total energy consumption.

In march 2011 oil consumption increase 21% monthly and 2% annually to reach at 1.7% million tons. It is consequence of the high sale of furnace oil (FO) and motor-oil (petrol). But overall consumption decreases by 2.9% from 14.8 million tons in 2010 and reaches at 14.3 million tons in 2011. In 2011 transport sector, petrol surged 18.1 % due to shortage of gas. Petrol consumption increases 34% due to load shading of gas sector and gas sector curtailment. In 2011 the percentage of sectoral oil consumption is given below in the figure 2.2.

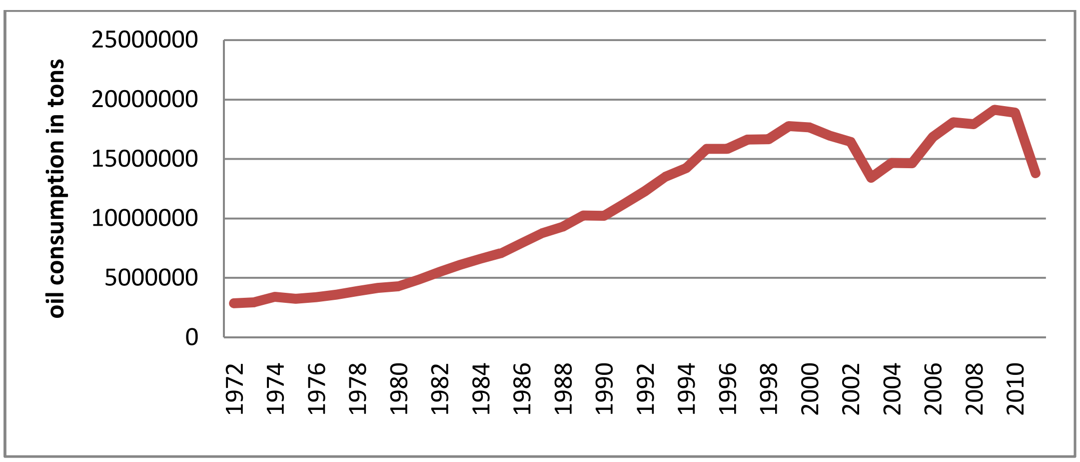
Figure 2.2: Sectoral Oil Consumption



Source: Data taken from Pakistan energy year book by Hydrocarbon Development Institute of Pakistan.

There was increase in the consumption of FO and high speed diesel (HSD) due to increase of power sector needs. But still this sale was less than in 2010. Power sector petroleum consumption decreases 5.7% in 2011. Oil consumption reaches at 8.4 million tons including industrial sector consumption. In November 2011 oil consumption has increased 11%. The average crude oil production in 2011-12 is 66032 barrel per day. In 2011-12 there was almost 24.4% growth in the industrial sector of Pakistan and 3.5% growth in transport sector. Despite all energy shortfall Pakistan oil consumption decreases 3% in 2012 to 19.1 million tons against 19.7 million tons in 2011. This is 2nd consecutive year in which oil consumption has decreases. This is because due to decrease in FO sale, which comprises of 45% of total oil consumption of Pakistan. In this year consumption of oil in power generation sector has declines from 7 to 8.4 million tons. It's because of circular debt (see appendix), cash problems and shortage of electricity and gas supplies increases due to its cheapness.

Figure 2.3: Total Oil Consumption of Pakistan: Tons (1972-2011)



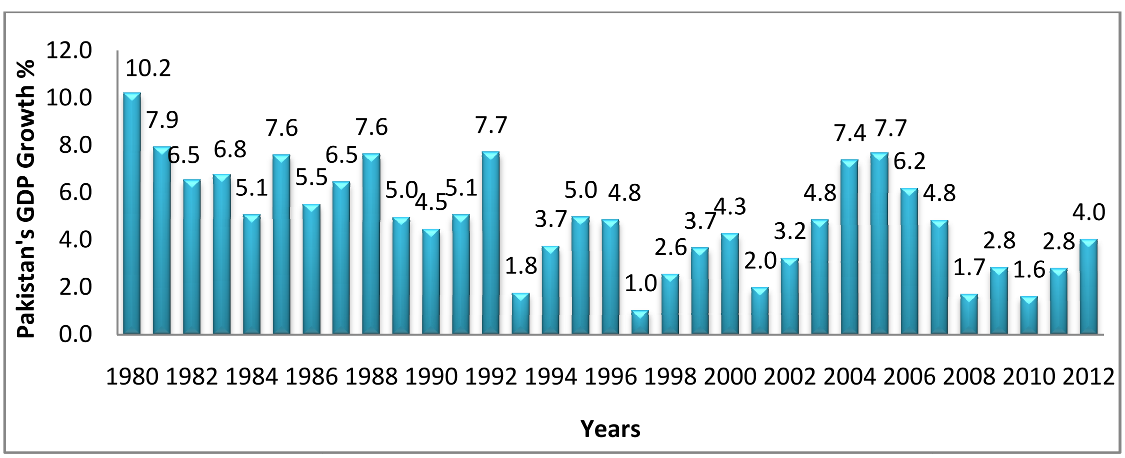
Source: Data taken from Pakistan energy year book by Hydrocarbon Development Institute of Pakistan.

If we examine the transport sector of Pakistan, the sale of petrol increased in 2012 due to CNG curtailment, consumption of petrol increases 14% in 2012 from 12% in 2011, as it was 8% in 2008. If we compare the last year oil consumption with this year, it has decreased due to cut down of NATO supply which causes circular debt to increase. In 2011-2012 total sale of oil is 17.8 million tons as it was 17.9 million tons in 2010-2011. These all trends of oil consumption in Pakistan can be examined through the figure 2.3.

2.4. Oil Prices and Economic Growth

Pakistan petroleum demand is 16 million tons per annum, from which only 18% recovered by local recourses and 82% from imports. Pakistan imports contribute major part of petroleum and petroleum products. Due to world oil prices increase has great impact on Pakistan economy; i.e. increase in the inflation, as in 2012 there was almost 8% increase in the inflation due to oil prices, also increase in import bill, current account deficit, cause circular debt to increase.

Figure 2.4: GDP Growth Rate of Pakistan



Source: Economic Survey of Pakistan (Various Editions)

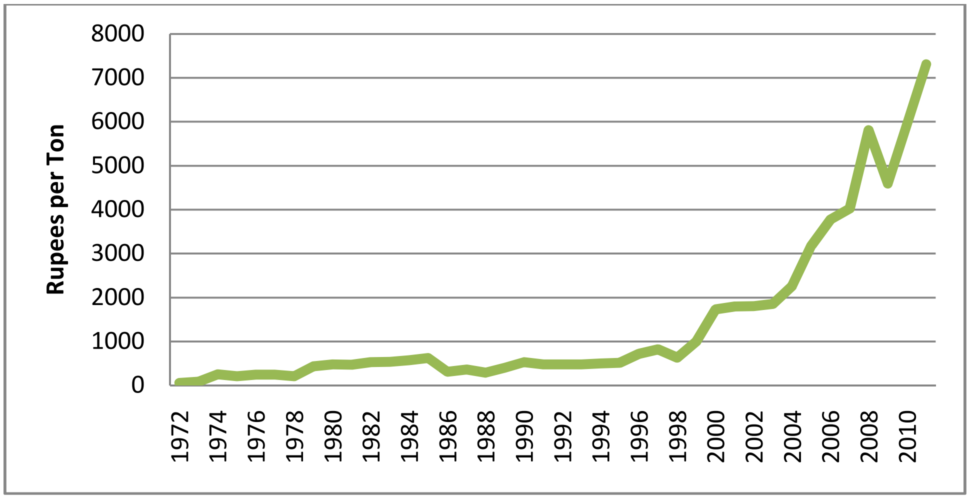
2.4.1. Comparison between Pakistan and World Oil Prices

The problem of Circular debt is due to not paid bills by Pakistan Electric Power Company (PEPCO) particularly Oil and Gas corporations, Independent Power Producers (IPPs) and Water and Power Development Authority (WAPDA). By examining the figures 2.1 and 2.5, in 1990 to 1995 Pakistan oil prices are equivalent to world oil prices. But by examine the year 2003 the international oil prices increases with respect to Pakistan oil prices. But from 2004 to date Pakistan oil prices shows trend as world oil prices showed. Since 2003 world oil prices shown increasing trend. In 2005 because of increase in petroleum prices GDP growth slows down about 7%. International petroleum requirement has improved at the rate of 1.3 %, so most of Asian countries started production of own resources. Pakistan real GDP grew at higher rate of 8.4 % in 2004-05 as given in figure 2.4, due to energy consumption increase it accelerates the economic growth. In 2007-08 high oil prices in the world market cause the decline in the exports that cause to reach the current account deficit at 8.4% of GDP, which was at 1.8% GDP in 2003-04. Before 2007-08 the GDP has increased due to oil consumption increase with the high oil prices. In 201, the world oil prices have increased up to 47% and Pakistan oil prices showed increase of 28%. In May 2011 the world oil price was recorded 115 US $/bbl as compared to previous year 2010 it was 83 US $/bbl, so world oil prices showed increase of almost 39%. Due to increase in world oil prices cause decrease in the oil consumption of Pakistan because Pakistan's oil prices also goes up to 28% in 2011.

2.4.2. Oil Prices and GDP

Pakistan GDP growth in 2009 was 1.7% but in last five years GDP growth has increases from 3.1% in 2010 to 3.7% in 2012 and expected to reach at 4.3% in 2013. But in comparison with other south Asian countries Pakistan GDP showing less growth, it's due to Pakistan economy is very closely related to world, having external exposure and heavy import of oil products. Oil prices increase effects the macroeconomic factors of Pakistan like; investment, consumption, BOP and unemployment. In 2011-12 the oil import bill reached at 11.14$ billion, there is increase of 38% as compared with 4.8$ billion in last year 2010-11. Trade deficit also increases in 2011-12 then previous year due to heavy imports. In economic survey of Pakistan (2011-12) it is claimed that Pakistan's economy showed better growth then other developing economies and GDP remained at its high growth of 3.7% (higher in last three years). But in 2011-12 Pakistan's current account balance is affected due to increase of oil prices as it can be seen in the figure 2.5. Oil prices have also great impact on CPI of Pakistan. That causes the increase in prices of electricity and gas. As we know that Pakistan is oil deficit country and due to increase in import bill, Pakistan has facing increase in circular debt in recent years. Circular debt is because of low refinery utilization, constraint in oil margins, and capability of imports and delay of projects. So there is need to reduce and finally cut down the subsidies to energy sector by government to stop the further increase in circular debt. So, the question is if oil consumption decreased (by 3% in 2011-12), why shouldn't GDP decreased (as it is 3.7 % in 2012, higher in last three years). So how can we say that oil consumption affects helps in boosting the economic growth? There is need to add oil prices factor in our analysis.

Figure 2.5: Real Oil Price of Pakistan



Source: Monthly statistical bulletins of Pakistan.

2.4.3. Pakistan Oil Pricing Formula Given By OGRA

The oil price formula can be calculated by adding up the ex-refinery/import price, inland freight equalization (IFEM), OMC's distribution margins, and dealer's commission. So finally the Ex-Depot sale price will equal to 16% GST of subtotal of these factors plus subtotal of these factors.

2.5. Pakistan Oil Refineries

i) Pakistan Refinery Limited: It is located at Rawalpindi & was incorporated in 1960 as public limited company. It is busy in production and sale of petroleum products.

ii) Pakistan-Arab Refinery (PARCO): It is the one of largest energy company of business sector of Pakistan, with an asset of one hundred and forty one billion. It has mutual business enterprise with Pakistan and Abu Dubai. It is incorporated in 1974. Its revenue reached at Rs.250 billion in 2012.

iii) National Refinery (NRL): It is petroleum refinery that is engaged in manufacturing in asphalt, fuel products and lubes for domestic consumption and exports. It is second largest refinery of crude oil in Pakistan and only lube oil refinery. It is incorporated in 1963. Company's major purchases are made with the history of no default for Saudi Arabia in 2011.

iv) Attock Refinery: It is pioneer crude oil refinery in the country started in 1900s which is located at Rawalpindi. It was incorporated in private limited in 1978.

v) Indus Oil Refinery Limited: (not yet operational)

vi) Khalifa Coastal Refinery: (not yet operational)

vii) Trans Asia Refinery: (not yet operational)

2.6. Concluding Remarks

According to above discussion we can say Pakistan has vast reserves of oil at different areas, but there no proper management to explore them the process them in order to use it. The oil available in Pakistan is not enough to fulfill its demand. So country has to trade in great percentage of oil and oil goods from outside the country.

So there is need of foreign reserve to buy costly oil. That creates many problems related short fall of reserves and ultimately the problem of circular debt that has badly impact on Pakistan economy. Also oil sector has face problem related to oil prices that changes very frequently, so in recent years many users of oil has shifted to word other energy substitutes. Finally, from this chapter, we can make following conclusions on the basis of 2011:

i. In 2011there was total 75.5 million barrel crud oil was supplied in the county out of which 68.1% was imported.

ii. Total Oil consumption shares in total energy consumption in 2010-11 were 29%.

iii. The consumption of oil has showed decline since 2001-02 but in 2011 it showed little bit of positive figure about 1.1%. The consumption is shifted toward the other energy products from oil due to volatility in the prices of oil.

iv. Industrial sector consumption showed positive growth toward oil consumption but transport sector shows decline as it is major consumer of the oil.

v. The total production was estimated in 2011 by the oil companies of Pakistan was 1758.22 (bbl/d).

vi. Finally, the overall sail of oil has decline about 1% in 2011 as compared to previous year due to the main reason of circular debt when NATO cutoff supply in 2011.

Chapter3

LITERATURE REVIEW

3.1. Introduction

The purpose of this chapter is to review relevant literature associated to energy-growth nexus and oil price shocks.

This chapter is divided into three sub-sections.

Sub-section 3.2 reviews evidence from international studies, sub-section 3.3 reviews literature on oil consumption and growth with reference to Pakistan and finally, sub-section 3.4 reviews the studied on oil prices and macroeconomic variables.

3.2. Evidence from International Studies

Many studies can be found that have targeted the relationship between energy and growth. But still no satisfactory answer has concluded. Econometric analyses like cointegration and Granger causality test are applied to examine this issue. The initiative to word energy-growth model was first established in the influential paper of Kraft and Kraft (1978), with the application of a standard form of Granger causality analysis, which presented evidence to sustain a unidirectional long run relationship running from GDP to energy consumption for the USA over the 1947-74 periods. This study recommends that government could follow the energy conservation policies. Akarca and Long (1980) utilized the same time span of 1947 to 1972 and unsuccessful to validate the Kraft and Kraft (1978) outcome and concluded that is no relationship exist between the energy variable and economy. So there is no consistency in the findings although its was the same country and same data set, only two more years data has used that gives different results.

In the study of Chang and Lai (1997), Cointegration analysis has done for energy and growth determinants for Taiwan. Cointegration approach has applied to examine the long run relationship and Hasio version of Granger causality technique has applied to examine the relationship among variables through bivariate approach. Monte Carlo simulation is used in this paper for having small samples. Finally, unidirectional Granger causality has examined between energy consumption to employment without feedback and also unidirectional causality from economic growth to energy consumption. In this era mostly studies used the bivariate approach that could lead to biased results due to omission of relevant variables.

In the twentieth century the more complex studies have been delivered such as cross country, panel data analysis. In the paper of Asafu-Adjaye (2000), uses the Asian countries in the context of energy and growth analysis by using Johansen's cointegration and error-correction modeling techniques. The results shows that there exist long run relationship between the variables, if we examine result of causal relationship between variables of this paper it can be seen that it shows unidirectional and also two way but not supports the result of neutrality between the variables for the countries like India, Indonesia and Thailand in short run and long run. So we can say that there is difference in results related to energy and growth for different countries.

Another study has used the methodology of cointegration and Granger causality test to examine the temporal causality between energy consumption, employment and output in case of Taiwan, Chang and Li (2001). Impulse response function and variance decomposition has also added in the methodology. All three variables, energy consumption, output and employment are cointegrated with one cointegrated vector. Bidirectional Granger causality has examined by using Vector Error Correction Model (VECM) between employment and output, employment and energy consumption. But only unidirectional causality as examined from energy consumption to output. Impulse response function and variance decomposition tells the same story. According to the results there is need to energy conservation.

Soytas and Sari (2003) presented the paper on causality relationship between energy consumption and GDP in G-7 countries and emerging markets. Cointegration and VECM model is use to test it. There is stationary linear association among the series. In Turkey, France, Germany and Japan, the causality runs from use of energy to GDP and exposed bidirectional causality in the case of Argentina. This point out suggest that in the long run energy saving may spoil economic growth in these regions. The reverse relationship has concluded for Italy and Korea. There is need of energy conservation according to this study.

In the debate of energy consumption and economic growth another study at disaggregate level is examined. Rufael (2004) studied the disaggregated industrial energy consumption and GDP in case of Shanghai. Aim of this paper to test the causality between variables by using the modified Granger causality by (Todo Yamamoto, 1995). Here are also different causalities are find like previous studies, unidirectional causality from coal, coke, electricity and total energy consumption to GDP. And there is no Granger causality from oil consumption to GDP. Moreover, there is needed to add more relevant variables in the model.

There are lots of studies has done on this crucial issue in Turkey, as Turkey is the one of the oil productive countries. Altinay and Karogol (2005) use the Lutkepohl test (Vector Auto regressive), Grange causality to test the relationship between electricity consumption and economic growth. Structure break test (Zivot and Andrews) is also use to test break in the data. According to Lee and Chang (2005), structure break test is important in causality analysis. Results are different then previous studied due to adding breaks factor in the data. Paper shows that there is no explicitly economic theory in explaining the energy consumption and GDP. In the findings of paper, there is unidirectional causality has examined from electricity consumption to real GDP. So increase in electricity consumption is leading indicator of economic growth. But there is no causality has examined when energy consumption in aggregate used. Lee and Chang (2005), study the causal relationship between the aggregate energy consumption and economic growth as well disaggregate energy consumption (oil, gas, electricity and coal) and economic growth. Cointegration and causality test is used and found variables are cointegrated. In the study the main focus on the break in the data, for causality analysis structure break should be included. So Zaviot Andrew test is used on the data. (Gregory and Hansen, 1996) test also used to test the stability of parameters and structure break. The test shows the different causalities. There is bi directional link between gross domestic product and aggregate energy and use of coal. Moreover, one way relationship between the coal, oil gas variables and growth. So energy is important indicator to stimulate the economic growth.

Multivariate approach has used in examining the causal relationship between the energy consumption, real income and prices for Turkey Levent and Korap (2007). The paper aims to check out the dynamic relationship among the in use of energy (electricity consumption) and real income and domestic inflation. Further, the effect of sectoral energy consumption (residential, commercial, and industrial) on real income has examined. Cointegration and Error Correction Model (ECM) model is used to find out the results. Different categories have made to test the causality. Inflationary framework is highly endogenous so cause to change in energy consumption. Industrial energy consumption has long run causal relationship.

A systematic study over 100 countries has done, to examine the energy consumption cause on economic growth in developed and developing countries Chontanawat et al, (2008). Causality test framework Chontanawat (2008), has given in this paper, which is used in many other studies. Different direction of causality is due to difference in data, source, methodology and country. So developed and developing has different causalities. Same test are used as applied by many papers, Augmented Dickey Fuller (ADF), cointegration and Hsiao version of causality. Results indicate that developed countries have high causality then developing. In the case of Pakistan there is no causality has examined. There is an important issue of global warming, if energy use causes GDP so reduction in its consumption may reduce the global warming but its leads to reduction in economic growth so need to invest in that energy sector that cause environment less.

Causality between disaggregate energy consumption and economic growth in turkey has estimated Erbaykal (2008). Bond test by Pesaran of cointegration using Auto Regressive Distributive Lag (ARDL) approach has used to test the causality between the oil and electricity consumption and economic growth (real GDP). Usually, economist focus only on the labor and capital but energy is very important in boosting the economic growth. This study indicates that oil and electricity has positive effect on economic growth in short run. Long run coefficients are not significant.

An important study has done by Bekhet and Yusop (2009) in Malaysia. In this paper two objectives are studied: impact of energy consumption on employment and economic growth and effect of oil prices on energy consumption, employment and economic growth. Cointegration test is used for long run relationship between variables and Vector Error Correction Model (VECM) Granger causality for short run. Results indicate that there is long run relationship between energy consumption, economic growth, oil prices and employment. There is unidirectional causality between real GDP to employment and energy consumption. Also unidirectional causality from oil prices to energy consumption but only bidirectional causality between employment and energy consumption. The study shows that world oil prices has no significant impact on Malaysian economy in short run and long run.

In this debate another work has added, to examine the causality between energy consumption and economic growth in china, by using the three stage causality method. Hsiao Granger version is used to specify the specific lag length Hou (2009). Purpose of study to test the whether the energy consumption is engine of economic growth or economic growth leads to energy consumption. Results inform that economic growth Granger cause energy consumption and vice versa. There are very important implications of results for China, as it is big consumer of energy. There is large gap between supply and demand of energy so need to settle down the prices and efficiency in use of energy.

Bhusal (2010) analyzes econometrically relationship between oil consumption and economic growth in Nepal. Numbers of studies are in literature to support the bidirectional and unidirectional causality between oil consumption and economic growth. Methodology of cointegration by Johansen and ECM approach has used to examine he relationship. Results show that there is bidirectional causality between oil consumption and economic growth in short run and long run. So oil consumption is important in every sector of economic growth. Same methodology, cointegration and granger causality test has used to examine the causality between oil and electricity consumption and economic growth (GDP) for SAARC (South Asian Association of Regional Cooperation) countries, by using bivariate approach Pradhan (2010). There is also policy implication of impact of energy on environment in this study. Paper concludes that different country has different causality in short and long run. If we see in case of Pakistan there is bidirectional causality between per capita oil consumption and economic growths in short run and long run. It indicates the suitable energy policy to boost the economic growth.

Threshold cointegration (Johansen approach) and causality test has used for energy consumption and economic growth in Vietnam Binh (2011). Structure break test (Qundt-Andrew test) has to test the break in data of per capita GDP and per capita energy consumption. Findings from these test shows that there is unidirectional causality runs from per capita GDP to energy consumption. Variables also have the long run relationship. In this study there is need to add other sector like industry, residential and transport sector.

To study whether the causality at aggregate or disaggregate level matters or not. A study investigates the causal relationship between energy consumption and economic performance for total economy as well industry, transport and residential sector for Tunisia Abidi and Sebri (2012). Augmented Dickey Fuller (ADF), Phillip Perron (PP) unit root test, cointegration (Johansen and Juselius), Engle Granger for causality (VECM) test are used to find out the results. At aggregate level, the outcomes of the paper shows that there is two way relationships between variable but no sign of relationship in short run. At disaggregate level, unidirectional causality from industrial income to energy consumption in short run but neutral in long run. Further, there is no causality from transport income to energy consumption in short and long run. Finally, bidirectional causality has examined between residential income and energy consumption in short run and unidirectional in long run.

3.3. Oil Consumption and Growth in Context of Pakistan

In Pakistan on the issue of energy growth relationship, there are countable studies available. These studies can be separate out by aggregate, disaggregate level and both.

At aggregate level, Alam and Butt (2002) use the Cointegration and Granger causality for energy consumption and economic growth and concluded the bidirectional causality between the variables. Khan and Qayyum (2007) examine the relationship between the energy use, output, labor and capital for four countries of south Asia. Output is taken as dependent and other variables are taken independent variables. ARDL bond approach and unrestricted ECM has used. Result indicates that variables are cointegrated and there is evidence of causality running from energy consumption to economic growth. Imran and Siddiqui (2010) this is study on the panel of three SAARC countries. Study finds that energy consumption and economic growth have long run relationship and have unidirectional causal relationship from energy consumption to economic growth.

At disaggregate level, Aqeel and Butt (2001), in the study aggregate energy consumption and sub three sector of energy oil, Electricity and gas are used to test the causal effect on economic growth by using cointegration ARDL and Hsiao version of Granger causality. According to results causality runs from economic growth to energy consumption, electricity to economic growth and economic growth leads to growth of oil use but gas use has no effect on both sides. Siddiqui (2004) delivered the study on causality between the economic growth and energy use of Pakistan.

Commercial sector is also included to examine the causality. This study shows that petroleum goods and power generation has great influence on the economy due to having reverse relationship between these determinants. Qazi and Riaz (2008), re estimation of bivariate causality between energy consumption (oil) and economic growth (GDP as proxy variable) for Pakistan have done. Three stage Granger causality test has used and concluded that economic growth causes energy consumption in short run and long run. Moreover, expenditure in energy boosts up economic development in dynamic analysis. Khalid et al (2008) find out the connection among energy utilization in agriculture sector and growth by using cointegration and Granger causality test. In the model three equations are used oil, gas and electricity consumption in agriculture, in function of real per capita GDP and price. Result shows that there is bidirectional relationship between gas and GDP. No causality in electricity and oil consumption. So shares of agriculture decreases in GDP. Zahid (2008) explore the causal relationship between GDP and energy consumption for five south Asian countries. In the study ECM of Engle Granger (1987) and VAR model of Todo and Yomamoto is used test the Granger non causality. Study is one on aggregate as well at disaggregate energy consumption level. Results show that there is unidirectional causality runs from GDP to total energy in long run and no causality between GDP and petroleum and gas. Khan and Ahmed (2009) examine the sectoral relationship between petrol, gas, electricity consumption with that of real GDP and domestic price. Johansen and Juselius cointegration approach has used and concluded that there is long run relationship in gas demand have positive impact on income and short run negative impact. No cointegration in electricity and coal so short run dynamic in both. Bedi uz Zaman et al (2011) gives the only study on the relationship between sectoral oil consumption and economic growth in Pakistan by using ECM approach. Result indicates that major sectors of oil have positive contribution and minor have negative. There is unidirectional causal relationship between real GDP, transport and industry. If we examine the study of Bedi-uz-Zaman et al (2011), it can be seen that in this study all consumption variables including majors and minors sectors estimated in singe equation model that could generate the biased results due to multicoliniearity problem. In the study oil price variable and shock dummies were not included although these are important to impact on our economic.

3.4. Studies on Oil Prices and Macroeconomic Variables

Here are studies related to Pakistan which shows impact of oil prices on economy other then including energy variables. Malik (2010) studies the impact of oil prices on macroeconomy, by using three models; IS function, Monetary Policy and augmented Phillips curve. Results indicate that oil prices and output are strongly related and increase in oil prices may or may affect until it crosses the threshold value. The study shows that instead of making adjustments at macro level, Govt should reduce the risk from increase in oil prices and explore other energy resources. . Saher (2011) aims to examine effect of oil prices on exports earning and economic growth in the study. Johnson and Juselius (1992) cointegration test and Fully Modified Ordinary Least Square (FMOLS) are used. Results indicate that there is long run relationship between oil prices and economic growth. In case of Pakistan capital (human and physical) and oil prices enhance the economic development. Oil prices impeded the export earnings. In case of India human capital, physical capital and oil prices positively related to export earnings and negatively economic growth.

Jamil et al (2011), uses the quarterly data and five macroeconomic variables and oil prices. In this study multivariate VAR model for IRF and variance decomposition has used to check how much oil shocks effects the macroeconomic variables. Results show that oil prices decline the real GDP and interest rate. Oil shocks cause the fluctuation in the money supply, exchange rate and interest rate by using Pakistan oil prices. But world crude oil price also affect Pakistan GDP.

Khan and Ahmed (2011), shows the impact of oil price shocks and food prices on economy of Pakistan. In this study Structural Vector Auto Regressive (SVAR), generalized impulse response function has used to test the impact by using monthly data. The study finds that IRF shows oil shocks cause inflation. Generalized Impulse Response Function (GIRF) shows exchange rate is one of most important factor to fluctuate the oil prices and food prices.

Shahbaz et al (2012) uses the production function to test relationship between energy consumption and economic growth. Auto Regressive Distributed Lag (ARDL) cointegration approach, Gregory and Hansen Cointegration test, Zivot and Andrews and Clement and Montoya's unit rot test and Error Correction Model (ECM) approach for causality are used in this paper. Results indicate that variables are cointegrated. Energy consumption enhances the economic growth and feedback hypothesis of causality satisfied between economic growth and energy consumption.

Ran and Voon (2012) investigated the impact of oil price shocks on the small open economies by using panel data of Hong Kong, Singapore, South Korea and Taiwan. They used real gross domestic product, unemployment rate, gross price level, import price, interest rate and oil import consumption as main macroeconomic variables. They employed VECM and did not found significant impact of oil price shocks on macroeconomic variables, where as they found significant positive impact on the unemployment after three time lags.

Ishaque (2008) suggested that Oil prices affect the whole economy due to various factors including cost of production, income effects, reallocation of resources, terms of trade and by uncertainties. In Pakistan, falling foreign exchange reserves have created immediate problem of oil import. Primary causes of sudden fall in oil prices deeply concerns with energy demand that was shrinking because of a US-led global economic slowdown. As a matter of fact among all major developing countries, Pakistan during 2008 had the worst levels of foreign deficit and inflation of GDP of about 8.5 % and 17% respectively; it was the weakest and most vulnerable situation for Pakistan's economy.

Ahmed (2013) used the data from developing country Pakistan to investigate the relationship between oil prices and unemployment. The study used monthly data of each variable for analysis and employed Toda Yamamoto causality test. The results of this study suggested the significant effect of oil prices on unemployment but found no significant association between real interest rate and unemployment, thus findings of current study are partially consistent with the efficiency wage model. Furthermore, results suggest that real oil prices cause significant changes in the real interest rate in

Pakistan. It can be concluded from the results that oil prices can be used in long run to improve the forecasting of unemployment and real interest rate.

Zhao et al (2008), Used an aggregate production model where capital, labor and energy are treated as separate inputs, this paper tests for the existence and direction of causality between output growth and oil consumption in China. Using the Johansen cointegration technique, the empirical findings indicate that there exists long-run cointegration among output, labor, and capital and oil consumption in China. Then using a Vector Error Correction (VEC) specification, the short-run dynamics of the interested variables are tested; indicating that there exist bilateral Granger-causality running between oil consumption and GDP.

Jawad (2013) the main objective of this research is to analyze the impact of oil price volatility on the economic growth of Pakistan. Secondary data from 1973 to 2011 were used to estimate the coefficients. Linear Regression analysis is used to analyze the dependency among the dependant and independent variables. Trade Balance, Private sector investments have a significant effect on Gross domestic production and Public sector investment, Oil price volatility has insignificant impact on Gross domestic production. Government should make a proper plan and procedure according to Pakistan's economic growth and requirement which would help to maintain the equilibrium of oil demand and supply and decreased the impact of oil price volatility on the economic growth. Meanwhile, the government of Pakistan also focused on its trade balance and also tries to increase private sector investment to increase its economic growth.

Akram (2011) analyzes the empirically effect of crude oil price change on economic growth of Indian subcontinent that includes India, Pakistan and Bangladesh. In this study multivariate VAR has been used including Wald Granger Causality and Impulse response function. Causality test showed that only Indian economy is affected by the decrease in the oil prices. Oil prices increase impacts insignificantly for all three countries for first year but for second year it is negatively significant for India and Bangladesh but positive for Pakistan.

Kiani (2011) this paper discussed the impact of higher oil prices on the Pakistan's economy during 1990 to 2008. Pakistan is not oil producing rather oil-importing country. An increase in oil price leads to inflation, increase budget deficit and puts downward pressure on exchange rate which makes imports more expensive. The rising oil prices are the major concern for all the developing economies and Pakistan is suffering from it too. The increase in oil price has further effect the daily consumption pattern of households badly. This study analyzes that, how change in real crude oil price effects the real GDP positively and many other factors differently. For example, a lower government spending, a higher real stock price and a lower interest rate would raise real output for Pakistan.

3.5. Concluding Remarks

The above literature can be summaries as, mostly studies used traditional Granger causality test and Error Correction Model has used to find out short run relationship. Also many studies use cointegration analysis to find long run relationship between the variables. Any how some studies uses Hsiao version of Granger causality and only few uses modified version of Granger causality of Todo and Yomamoto for panel and multivariate analysis respectively. Above literature can be concluded as follows:

If we examine the ***international studies*** that are discussed above it can be seen that literature in context to energy-growth has been initiated with the study of Kraft (1978). We can notice that mostly authors seem interested in finding the causal relationship between energy consumption and economic growth. Many initial studies have done bivariate analysis in this respect, which could generate biased results due to omission of relevant variables. Afterward more complex studies had stared in which aggregate as well as at disaggregate level studies delivered including oil consumption analysis but only few studies are available, such as; multivariate analysis like Levent and Korap (2007), panel data analysis using Hasio Granger causality test as Change and Lai (1997), maximum likelihood method of cointegration by Johansen (1988) and VECM approach as in Soytas and Sari (2002) were used in recent international papers. But these studies generated different results from each other even for same sample data as Askara and Long (1980), and very few studies has included the important oil shocks factor in their analysis as in Bekhet and Yusop (2009), these results could be different due having different techniques, different sample data, times series properties of the data and different country. So results could be different, although at international level, too many studies have done by using advanced econometric techniques.

If we look up the studies in context of ***Pakistan*** that are given above, only numbers of studies could be found on the issue of energy-growth, from above studies of Pakistan eight studies are at aggregate energy level and four are on disaggregate level of energy from these only one or studies that are specifically on oil consumption and economic growth like Qazi and Riaz (2008), and only one study that is on oil consumption and economic growth including major and minor sectors of oil consumption Zaman et al (2011). If we examine the previous study of Zaman et al (2011), that was first study in Pakistan that had investigated the relationship between oil consumption in sectors of Pakistan and economic growth. In previous study oil price variable and shock dummies were not included that could have significant impact on the economy. Oil consumption variables are positively cointegrated with economic growth in Zaman et al (2011) study. But oil consumption variables (including oil sectors) show unidirectional causal relationship by using pair wise Granger causality test. In this study Johansen cointegration test has used and found all variables cointegrated. But these results could be biased by estimating single the dynamic equation for aggregate as well as aggregate oil consumption due to multicoliniearity. But in our study separate dynamic model for each sector and total oil consumption will be estimated. Also oil shocks factor has ignored that will be added in our study that have important impact to effect consumption and growth of economy.

So finally it is examined that different cointegration and causality relationships are concluded from different papers of total energy and economic growth including oil consumption-economic growth analysis. Most of studies show that energy (including oil consumption) has positive impact on the over all economy.

Chapter 4

METHODOLOGY

4.1. Introduction

In this chapter the methods of analyzing the data using economic models and sources of data will be explained. First the economic model has specified that will be used in the study with the modification for energy growth modeling, further construction of VAR and dynamic model has explained that will be used for our analysis. Three steps methods are used to estimate dynamic models, first there is need to check the order of integration for applying Johansen test so unit root of the variables will be checked, after that; Johansen Maximum Likelihood Method (1988) has explained that will be used to check cointegration and finally dynamic Error Correction Model has explained below. Granger causality test (1969) has illustrated for testing the causality between variables.

4.2. Specification of Model

Neo classical production function [Y = f (K, L)] has used for this study, that is presented by Cobb-Douglas (1928), it has been modified by including energy variables for energy-growth model.

4.2.1. Economic Methodology

Neoclassical economist gave the theory of output (production) function as fellows;

$$Y = f(K, L) \quad \ldots\ldots \quad (4.1)$$

Among economists, Georgescu-Roegen (1975 and 1977) was the pioneer to remark on the lack of energy variable in the model. The Kraft and Kraft (1978) was first to use energy consumption variables in production function to analysis the energy-growth relationship. After that many studies comes in this line, as Khan and Qayyum (2007), Lee (2005) and Zaman (2011) has used in their study. Energy consumption plays very important part on affecting the economy as labor and capital do. In this study oil price of Pakistan has introduced in the model as Bekhet (2009) and Saibu (2011) used in their study. Oil prices significantly impact on GDP, consumption and overall economy. In literature existing studies like Ahmed (2013) has explained various transmission mechanisms for possible impact of oil price shocks on economic growth. First is the classic supply size effect, according to which, increase in oil prices leads to decline in the output level, because oil is considered as the basic input of the production (Beaudreau, 2005). Higher oil prices would result in the higher output costs, results in lowered production rate and declined growth rate. Second, the demand side effect discusses the adverse effect of oil price shocks on investment and consumption. The major input for the industries is capital that comes from the investments of local and foreign investors. When economic activities are at decline, investors withdraws their investments from markets and take money out of the country and invest in higher profitable and growing economies, resulting in further lowering of production and economic activities in the country (Brown and Yucel, 2002). Also Akram (2011) has introduced oil price variable in the production function in his study. So above model is modified as follows:

$$LY_t = f\,(LK_t, LL_t, LP_t, LOC_t, D_t, \mu_t) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; (4.2)$$

Where;

LY_t = Log of Gross domestic product, real data of GDP taken as the proxy of economic growth.

LK_t = Log of gross fixed capital formation divided by GDP is used as the proxy of the capital stock (K) as many paper has used this proxy for capital stock (K), Lee and Chang (2005), Sari and Soytas (2007), and Khan and Qayyum (2007).

LL_t = Log of labor force

LP_t = Log of average oil prices of Pakistan

LOC_t = Log of oil consumption, that includes total and three major sectors (transport, power sector and industrial sector) of oil consumption of Pakistan.

D_t = Dummy variable for in cooperating the effect of oil prices shocks to Pakistan's economy.

μ_t = error term, that is normally distributed with zero mean and constant variance $(0, \sigma^2)$.

It is assume that all variables are non- stationary and have long run relationship between economic growth and its determinant.

In Pakistan oil consumption takes place in different sector in which transport sector is biggest sector for use of oil but in this sector mostly consumption is shifted toward gas due to cheap alternative, power sector is the main cause of circular debt in Pakistan due to unpaid bills to PSO, industrial sector is third major sector and maximum requirement of energy is fulfilled through oil consumption. Therefore, these three sectors of oil consumption are included in our model.

4.2.2. Construction of VAR

General model of this study was specified above in equation (4.2). For the next analysis of this study there is needed to construct the vector auto regressive (VAR) model constructed for equation (4.2) given below in equation (4.3):

$$X_t = \sum_{i=1}^{k} \delta X_{t-i} + \gamma D_t + \alpha + \mu_t \text{ ………………….. } (4.3) \qquad \therefore \ \mu_t \sim N(0, \sigma^2)$$

Where, X_t is vector of variables (i.e. LY, LL, LK, LP, LOC) a 5x1 vector of integrated of order one I(1) taken as endogenous variables, D_t is the vector of exogenous variables, α is constant and μ_t is iid (0, σ^2).

4.2.3. Dynamic Models

Assuming the variables are non stationary and they have long run relationship among each other, we specify dynamic ECM model as:

$$\Delta X_t = \mu + \gamma t + \sum_{i=1}^{p} \Gamma_i \Delta X_{t-i} + \Pi \, ECM_{t-1} + \lambda D_t + v_t \text{………………….} (4.4)$$

$$\therefore \ \mu_t \sim N(0, \sigma^2)$$

In equation (4.4), $\Pi = \alpha \beta'$ and α is speed of adjustment of matrix and β' is matrix of long run coefficients. ΠX_{t-1} must be integrated of order zero I (0) and negative for having long run cointegration relationship. $\sum_{i=1}^{p} \Gamma_i \Delta X_{t-i}$; this term of model indicates short run part. λ indicates coefficient of shock dummies, γ coefficient of time trend of model μ and v_t are intercept and error term of the model respectively that are normally distributed as zero mean and constant variance.

Through the value of Π it can be shown that with how much speed model is converges toward equilibrium or we can say that error is correcting with speed of the Π. Its value also confirms our long run relationship.

So following are four ECM models of total oil consumption and three major sectors of oil consumption of Pakistan (transport, power and industrial), these will be estimated for finding the results of our study:

i. Total Oil Consumption and Growth

$$\Delta LY_t = \alpha_0 + trend + \Pi_1 ECM_{t-1} + \sum_{i=1}^{m} \alpha_{1i} \Delta LY_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta LK_{t-i} + \sum_{i=1}^{o} \alpha_{3i} \Delta LL_{t-i} + \sum_{i=1}^{p} \alpha_{4i} \Delta LP_{t-i} + \sum_{i=1}^{q} \alpha_{5i} \Delta LTOC_{t-i} + \eta D_i + \mu_{0t} \quad \text{..................................} (4.5)$$

Here is the dynamic model for total oil consumption and growth. Where the expected relationship between variables could be, $\alpha_0 \lesseqgtr 0$, $\alpha_{1i} > 0$, $\alpha_{2i} > 0$, $\alpha_{3i} > 0$, $\alpha_{4i} < 0$, $\alpha_{5i} > 0$, $\Pi_1 < 0$ and $\eta < 0$. μ_{0t} error term of the dynamic model normally distributed as $(0,\sigma^2)$.

ii. Transport Oil Consumption and Growth

$$\Delta LY_t = \beta_0 + trend + \Pi_2 ECM_{t-1} + \sum_{i=1}^{m} \beta_{1i} \Delta LY_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta LK_{t-i} + \sum_{i=1}^{o} \beta_{3i} \Delta LL_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta LP_{t-i} + \sum_{i=1}^{q} \beta_{5i} \Delta LTRANP_{t-i} + \phi D_i + \mu_{0t} \quad \text{..............................} (4.6)$$

The second dynamic model for transport oil consumption and growth is given above. So the expected relationship between the variables could be, $\beta_0 \lesseqgtr 0$, $\beta_{1i} > 0$, $\beta_{2i} > 0$, $\beta_{3i} > 0$, $\beta_{4i} < 0$, $\beta_{5i} > 0$, $\Pi_2 < 0$ and $\phi < 0$. μ_{0t} error term of the dynamic model normally distributed as $(0,\sigma^2)$.

iii. Power Sector Oil Consumption and Growth

$$\Delta LY_t = \delta_0 + trend + \Pi_3 ECM_{t-1} + \sum_{i=1}^{m} \delta_{1i}\Delta LY_{t-i} + \sum_{i=1}^{n} \delta_{2i}\Delta LK_{t-I} + \sum_{i=1}^{o} \delta_{3i}\Delta LL_{t-i} + \sum_{i=1}^{p} \delta_{4i}\Delta LP_{t-i} + \sum_{i=1}^{q} \delta_{5i}\Delta LPWG_{t-i} + \theta D_i + \mu_{0t} \quad \ldots\ldots(4.7)$$

Dynamic model for power sector oil consumption and growth will be estimated as above. Whereas anticipated relationship between variables might be, $\delta_0 \lesseqgtr 0$, $\delta_{1i} > 0$, $\delta_{2i} > 0$, $\delta_{3i} > 0$, $\delta_{4i} < 0$, $\delta_{5i} > 0$, $\Pi_3 < 0$ and $\theta < 0$. μ_{0t} error term of the dynamic model normally distributed as $(0, \sigma^2)$.

iv. Industrial Oil Consumption and Growth

$$\Delta LY_t = \lambda_0 + \text{trend} + \Pi_4 ECM_{t-1} + \sum_{i=1}^{m} \lambda_{1i}\Delta LY_{t-I} + \sum_{i=1}^{n} \lambda_{2i}\Delta LK_{t-I} + \sum_{i=1}^{o} \lambda_{3i}\Delta LL_{t-i} + \sum_{i=1}^{p} \lambda_{4i}\Delta LP_{t-i} + \sum_{i=1}^{q} \lambda_{5i}\Delta LIND_{t-i} + \omega D_i + \mu_{0t} \quad \ldots\ldots(4.8)$$

Finally, the dynamic model for industrial oil consumption and growth will be estimated as above. While the possible relationship between variables can be, $\lambda_0 \lesseqgtr 0$, $\lambda_{1i} > 0$, $\lambda_{2i} > 0$, $\lambda_{3i} > 0$, $\lambda_{4i} < 0$, $\lambda_{5i} > 0$, $\Pi_4 < 0$ and $\omega < 0$. μ_{0t} error term of the dynamic model normally distributed as $(0, \sigma^2)$.

In above four dynamic models; *α's, β's, δ's* and *λ's* are short run coefficients of variables in each model. Π_1, Π_2, Π_3, and Π_4 are coefficients of ECM_{t-1} of all four models respectively. η, ϕ, θ, and ω are coefficient of shock dummies.

4.3. Econometric Methodology

Here is the description of econometric techniques that we will use in this study for our findings, i.e. three step method and causality test.

Three Steps Method

1) Unit root analysis
2) Johansen Maximum likelihood method of cointegration
3) Dynamic Error Correction Model

Step I: Unit Root Analysis

Unit root test is important for cointegration analysis. To check the order of integration for variables whether they are stationary I(0) or non-stationary I(1) for analysis of Johansen cointegration as all variables should be non-stationary at same order for example integrated of order one I(1). There is concept that if we regress non stationary factor on non stationary the result will be spurious. But Johansen cointegration has exception for this law. In this test i.e. two non-stationary variable generates stationary I (0) linear long run relationship or called cointegrated. From here we can move forward toward VECM (vector error correction model) with combination of short and long run parameters. So following is the methodology of ADF (augmented dickey fuller) test for unit root testing.

Dickey and Fuller (1979, 1981) gives one of the generally used methods known as Augmented Dickey Fuller (ADF) test of identifying the order of integration I(d) of variables whether the time series data are stationary or not. Following is the general form of Augmented Dickey Fuller test that will be used to check the stationary of series.

$$\Delta X_t = \alpha + \beta t + \varphi X_{t-1} + \theta_1 \Delta X_{t-1} + \theta_2 \Delta X_{t-2} \dots\dots\dots \theta_p \Delta X_{t-p} + \varepsilon_t$$

Where, X_t denotes the time series variable to be tested, used in model. t is time period, Δ is first difference and φ is root of equation. βt is deterministic time trend of the series and α denotes intercept. The numbers of augmented lags (p) determined by the dropping the last lag until we get significant lag. The Augmented Dickey Fuller unit root concept is illustrated through equation $\Delta X_t = (\rho-1)\, X_{t-1} + \varepsilon_t$, Where, $(\rho-1)$ can be equal to φ, if $\rho = 1$ so series has the unit root, so root of equation is $\varphi = 0$.

$$\begin{cases} \text{if } \rho = 0 \quad \text{OR} \quad \text{if } \rho = 1 \\ \varphi = (\rho - 1) = 0 - 1 = -1 < 0 \\ \varphi = (\rho - 1) = 1 - 1 = 0 \end{cases}$$

The augmented dickey fuller test can be formulated such as:

a) When the time series is flat or have no any trend then it can be expressed as:

$$\Delta X_t = \varphi X_{t-1} + \theta_1 \Delta X_{t-1} + \theta_2 \Delta X_{t-2} \dots\dots\dots \theta_p \Delta X_{t-p} + \varepsilon_t \quad \therefore \varphi = (\rho - 1)$$

The standard t test does not fellows the normal distribution so McKinnon (1991, 1996) provide the critical values to test following hypothesis. ADF hypothesis fellow the left hand tailed test.

H_0: $\varphi = 0$ (the series is non stationary)

H_1: $\varphi < 0$ (the series is stationary)

b) When the time series is smooth but slow movement around non zero figure, it can be expressed as fellows by including intercept α but no time trend.

$$\Delta X_t = \alpha + \varphi X_{t-1} + \theta_1 \Delta X_{t-1} + \theta_2 \Delta X_{t-2} \ldots\ldots\ldots \theta_p \Delta X_{t-p} + \varepsilon_t$$

Again, the numbers of augmented lags (p) determined by the dropping the last lag until we get significant lag. Hypothesis is left tailed so:

H_0: $\varphi = 0$ (the series is non stationary)

H_1: $\varphi < 0$ (the series is stationary)

c) If the time series data has trend in it and move along the trend line so it can be showed as follows:

$$\Delta X_t = \alpha + \beta t + \varphi X_{t-1} + \theta_1 \Delta X_{t-1} + \theta_2 \Delta X_{t-2} \ldots\ldots\ldots \theta_p \Delta X_{t-p} + \varepsilon_t$$

Where, βt is deterministic trend term in model. In this equation there is intercept and trend term in it. Now the hypothesis will test the whether the data is trend stationary not.

H_0: φ **= 0** (the series will be stationary after differencing)

H_1: φ **< 0** (the series is time trend stationary and series should be examine with time trend other then differencing it)

Step II: Johansen Maximum Likelihood Method of Cointegration

If combination of two non-stationary variables generates linear combination, so they called cointegrated. Engle and Granger (1987) proposed the two step cointegration test also known as residual based test. But this test cannot estimate more than two variables. Another test of cointegration that is called autoregressive distributive lag model (ARDL) or unstructured vector error correction model (UVECM) by Pesaran et al (2001) which can also be used for all I(1) or I(0) or can be mutually cointegrated. But for this test we have follow some assumptions one of which is violated in our model that is explanatory variables shouldn't have linear relationship, which cause problems in our findings. So Johansen (1988) presented the Maximum Likelihood Method for estimating the more than one cointegration vector. But for this test all variables should have same order of integration I (d) i.e. I (1). In Johansen cointegration test we take all variables as endogenous so the problem can be avoided. Let us assume that the vector of variables Y_t as given above has the following representation;

$$Y_t = \alpha + \sum_{i=1}^{k} \delta Y_{t-i} + \gamma D_t + \mu_t$$

Where Y_t contains all n numbers variables of the model and μ_t is a vector of random errors that are normality distributed with zero mean and constant variance $(0, \sigma^2)$. So we can estimate the cointegration relation as follows:

Here is the method of Maximum Likelihood estimation through this we will estimate our long run coefficients and find the order of cointegration.

According to the hypothesis of rank of the Π matrix in the error correction form we define H (r) as a model VAR (p) such as:

$$\Pi = \alpha \beta'$$

Hypothesis of rank of matrix; H (r): $\Pi = \alpha \beta'$

Where; α and β are n x r matrices.

The reduced form error correction model is:

$\Delta X_t = \sum_{i=1}^{p} \Gamma_i \, \Delta X_{t-i} + \alpha \, \beta' \, X_{t-1} + V_t$ ……………………………………………(4b)

Where; V_t is normally distributed with zero mean and constant variance, $v_t \sim N(0, \sigma^2)$, Γ_i, ΔZ, Z_{t-1}, α & β' can be vary freely. In equation (4b) we will introduce notation as; $Z_{0t} = \Delta X_t$, $Z_{1t} = X_{t-1}$, and Z_{2t} the fixed variables ΔX_{t-1}…………..ΔX_{t-i+1}. And let ω is the matrix of parameters attracted to the Z_{2t} that is Γ_i,

So our equation (4b) become as:

$$Z_{0t} = \omega Z_{2t} + \alpha\beta' Z_{1t} + v_t \qquad \therefore v_t \sim N(0, \sigma^2)$$

This all procedure is given in detail in Johansen, (1995). The likelihood estimates of β could be calculated as follows Johansen, 1995): below equation will be solved first,

$$|\lambda S_{11} - S_{10} \quad S_{00^{-1}} \quad S_{01}| = 0$$

Where; S_{11},$S_{10,}$ S_{00} & S_{01} are n x n matrices defined in Johansen (1995).

Above equation will be solved for the Eigenvalue $1 < \lambda_i > 0$ and Eigen vectors V = (v_1……..v_n), which will be normalized as $V'S_{11}V=I$. so cointegrating relationship will be estimated as;

$$\beta^{\wedge} = (v_1 \ldots\ldots.. v_r)$$

The Maximum Likelihood function has derived from:

$$L_{max}^{-2/T} = |S_{00}| \prod_{i=1}^{r} (1 - \lambda_i)$$

The Likelihood Ratio test for Q((H(r)|H(n)) two term will be compared for r and n as follows:

$Q((H(r)|H(n))^{-2/T} = \dfrac{|S_{00}| \prod_{i=1}^{r}(1 - \lambda i)}{|S_{00}| \prod_{i=1}^{n}(1 - \lambda i)}$ ……………………………………………………(4c)

Two test statistics to find the rank of Π matrix.

- **i.** Maximum Eigenvalue test
- **ii.** Trace test

If we take the logarithm of above term (4c) it will become Trace statistics.

$$-2\log Q\ ((H(r)|H(n))\ =\ -T\sum_{i=r+k}^{n} log(1 - \lambda_i)$$

- **i.** **Trace Test:** It is joint significant test, to test the Π matrix that trace test's calculated value is increasing through summing Eigenvalue in it or not. Following hypothesis will be tested;

H0: rank k (Π) = r

H_A: rank k (Π) > r

Test Statistics: Π trace (r) = - $T\sum_{i=r+1}^{k} log(1-\lambda_i)$

Maximum Eigenvalue Test: It tests the how many no. of Eigenvalue are not equals to zero. It can be testes through following hypothesis. Where; r is the rank of matrix and its ranges from zero to k and k-1.

H_0: rank (Π) = r

H_a: rank (Π) = r + 1

Test Statistics: Π maximum (r, r +1) = - T log (1- λ_{r+1})

The test statistics for testing H (r) in H (r +1) Max statistics is:

$$-2\log Q((H(r)|H(r+1))= -T\ln (1 - \lambda_{r+1})$$

Johnson determines the no. of CI relationship on the bases of rank of Π matrix.

With T: The number of observations, λ: The Eigenvalue of the matrix Π, K: number of variables, r: rank of matrix Π. It will compare with the critical values provided by the Johansen (1992). If the λ maximum calculated is less than the critical value so H_0 will be accepted. After determining the rank of Π matrices, or number cointegrating vectors, we will run our dynamic model given in equation (4b).

Step III: Dynamic Error Correction Model

The four dynamic models of total oil consumption including three major sectors of oil consumption of Pakistan (Transport, Power and Industrial) are explained above in section 4.2, will be estimated through ordinary least square (OLS) method.

4.4. Diagnostic Tests

In Estimating the above models for getting the reliable results our model should be well specified and should fulfill all assumptions i.e. OLS statistical assumptions, otherwise our results could be spurious or misleading. Residual of any model is diagnosed for serial correlation through Breusch Godfrey LM test, to check the hetroscadasticity Breusch Pagan will be applied. For testing the normality of the residual of the model Jarque Bera test will be applied. Cumulative sum (CUSUM) and cumulative sum (CUSUM) of square test (Brown et al, 1975) will be used to check the stability of the mean and variance stability with in the model respectively. For examine the how well our data is good fitted and independent variable are explained by dependent variable R^2 and adjusted R square value is tested.

4.5. Source of Data and Limitation

For the estimation of above model we need data on variables. Eight macroeconomic variables have taken for analysis by studying the previous literature. Annual data has taken for all variables since 1972 to 2011. These are related to Pakistan economy. The data is in real format means inflation factor has excluded from it. The sources of data are given below:

I. GDP- Gross Domestic Product- real GDP is available in million rupees at economic survey of Pakistan publish by federal bureau of statistics, in the base year of 1999-2000.

II. K-Gross Fixed Capital Formation- as it self capital stock data is not available so proxy of Gross Fixed Capital Formation variable has used. Data is his taken in million rupees collected from the economic survey of Pakistan publishes by ministry finance. Having same base year 1999-2000.

III. Labor force-(L) in million numbers from economic survey of Pakistan (ministry of finance).

IV. TOC-total oil consumption-in million tons, taken from hydrocarbon institute of Pakistan (HDIP) ministry of petroleum.

V. IND-Industrial oil consumption-in million tons, taken from hydrocarbon institute of Pakistan (HDIP) ministry of petroleum.

VI. TRANP-transport oil consumption-in million tons, taken from hydrocarbon institute of Pakistan (HDIP) ministry of petroleum. T

VII. PWG-power sector oil consumption-in million tons, taken from hydrocarbon institute of Pakistan (HDIP) ministry of petroleum.

VIII. Oil prices (P)-oil (petroleum) prices monthly data of Pakistan has taken from the monthly statistical bulletins of Pakistan. As annual data on this variable is not available. This data is converted into annual data by taking averages of monthly data. Data is measured in rupees per tons.

4.6. Concluding Remarks

Finally, this chapter illustrates the methods to analysis the impact of oil price shocks and economic growth of Pakistan. In this chapter we describe our dynamic models which are used in fining the results. Unit root analysis has explained above for checking the order of integration of series. Johansen Maximum Likelihood Method of cointegration has explained that will be used in next chapter to find long run relationship between the variables and also OLS will be used to regress the dynamic model. Granger causality test has also explained which will be use for identify the causal relationship between the variables also diagnostic tests have been explained that will be applied on the models. Finally, the data source of variables has explained that are gong to use in finding our results in next chapter.

Chapter 5

RESULTS AND DISCUSSION

5.1. Introduction

In previous chapter we have discussed our methodology, now in this chapter we are going to use above methodology to analysis our data for all four models described above, this chapter comprises of main findings and discussion with the references. That includes results of unit root by Augmented Dickey Fuller test (1979), results of Maximum Likelihood Method of cointegration (Johansen, 1988) and causal relationship between variables. Through these results we can conclude our final results of the study.

5.2. Results of Unit Root Test

All data has been transformed into logarithm form. Augmented Dickey Fuller test has applied on the all eight variables. Before applying the ADF test, graphs of series has drawn to examine the pattern of series and present in the Figures 5.1 to 5.8. It can be seen from the all figures that there is trend in the series, as graph trended up ward with the time passes. So the time trend will be included in the model. Intercept is also included in the model because by examining the figures of series it can be noticed that data doesn’t fluctuate around the zero mean. The average of sample is also not zero so that’s why intercept will be included. These are only assumptions to check that these are true or not in other words data is stationary or non-stationary.

Figure 5.1: Real GDP of Pakistan

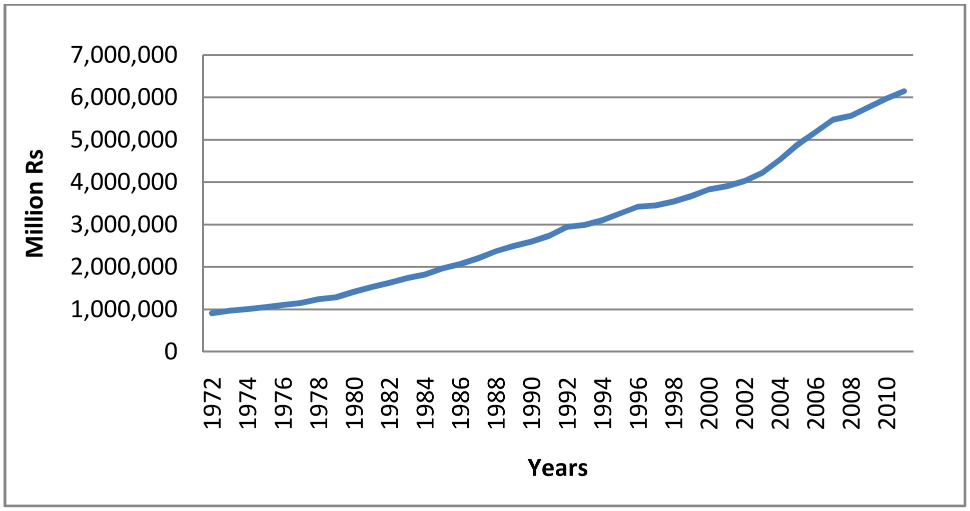


Figure 5.2: Capital Stock of Pakistan

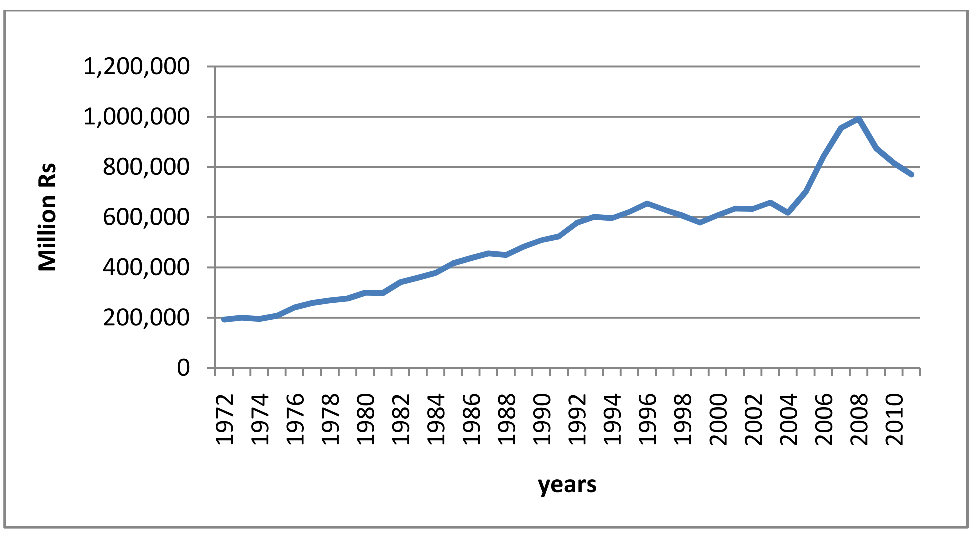


Figure 5.3: Labor Force of Pakistan

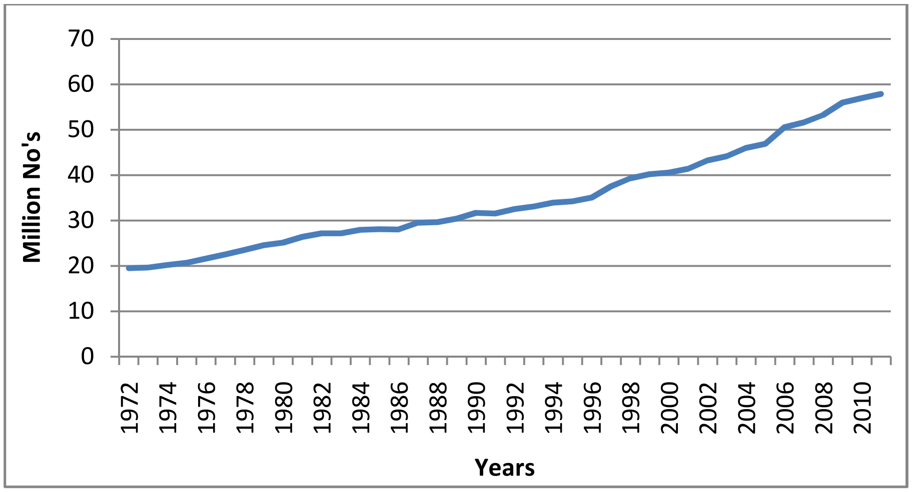


Figure 5.4: Oil Prices of Pakistan

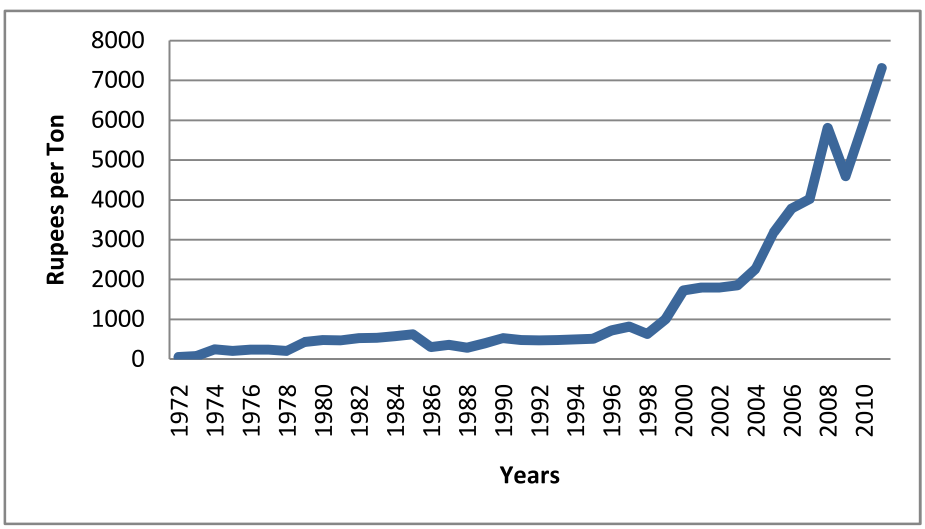


Figure 5.5: Total Oil Consumption of Pakistan

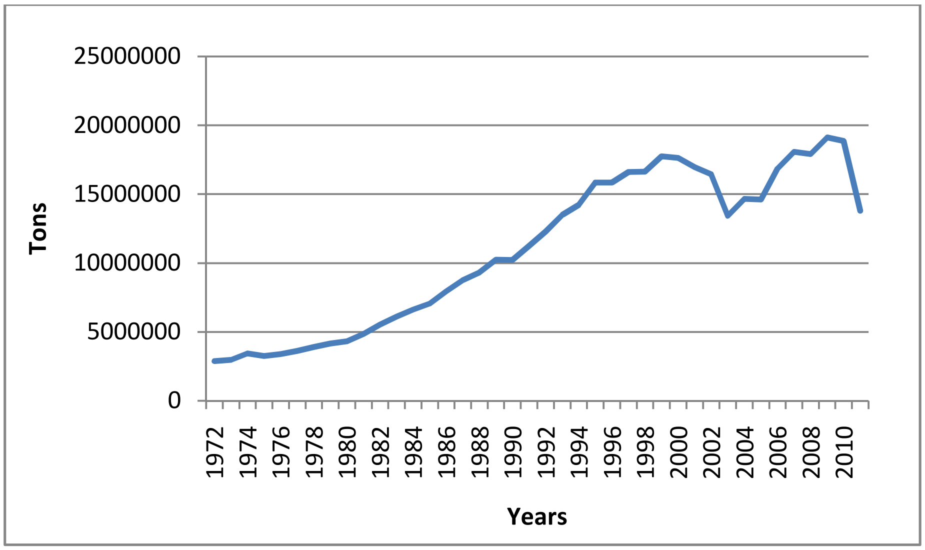


Figure 5.6: Transport Oil Consumption of Pakistan

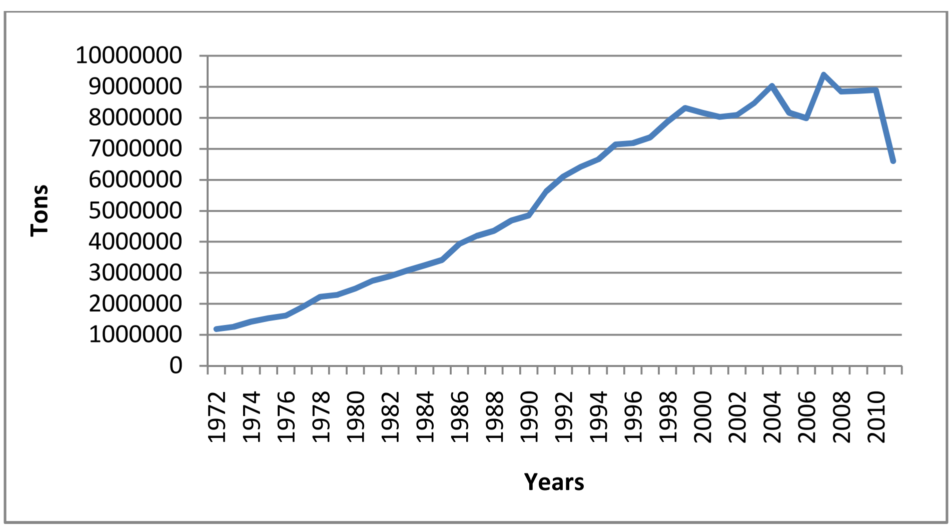


Figure 5.7: Power Sector Oil Consumption of Pakistan

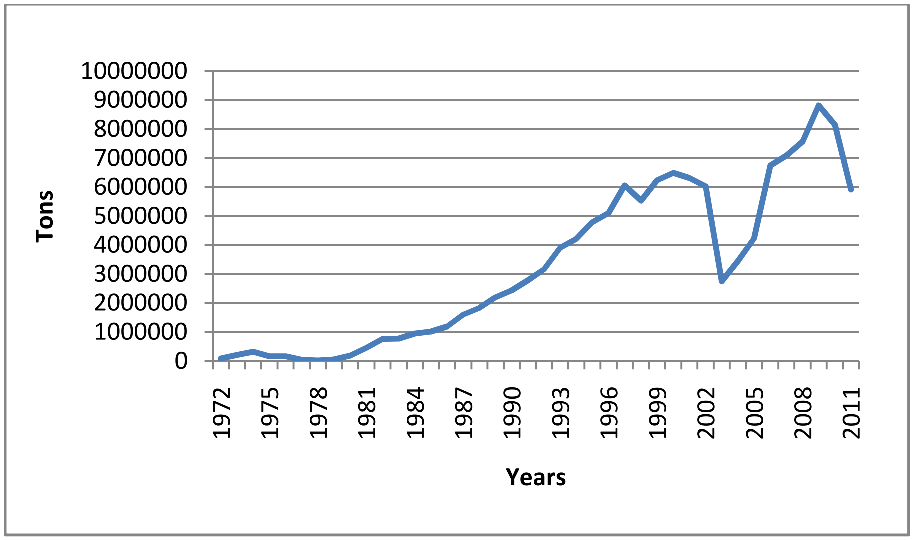
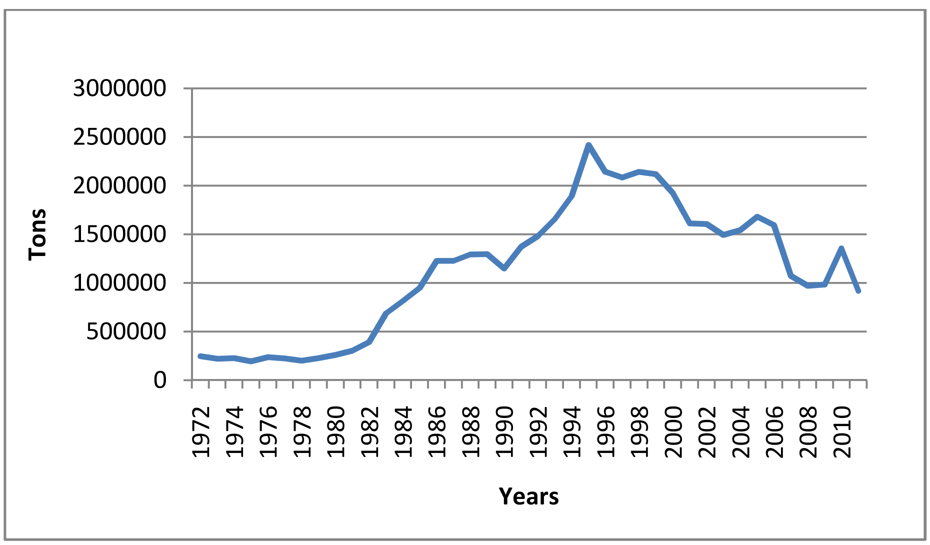


Figure 5.8: Industrial Oil Consumption of Pakistan



First, the equation of ADF (with drift and time trend in the model) has estimated, for all the variables. At first, unit root has tested at level or without differencing the data. For oil prices, transport and power sector oil consumption lags are taken to remove the problem of serial correlation so Dickey Fuller test become

Augmented Dickey Fuller test, otherwise it is Dickey Fuller test. The results are present in the Table 5.1. It can be seen from the Table that at level, variables are not stationary. So LY, LL, LP, LTOC, LPWG, LK, LTRANP and LIND are stationary at first difference. Therefore, all variables are integrated of order one, I (1).

Table 5.1: Unit Root Test of Augmented Dickey Fuller (Annual Data (T=40))

Level				
Variable	**Deterministic**	**Lags**	**ADF tau-stat**	**Outcome**
LY	Intercept	0	-2.48	I(1)
LTOC	Intercept	0	-2.34	I(1)
LK	Intercept	0	-2.05	I(1)
LL	Intercept and trend	0	-1.58	I(1)
LP	Intercept and trend	0	-2.47	I(1)
LTRANS	none	1	-1.84	I(1)
LIND	Intercept	0	-1.52	I(1)
LPWG	Intercept and trend	1	-2.67	I(1)
First Difference				
Variable	**Deterministic**	**Lags**	**ADF tau-stat**	**Outcome**
ΔLY	Intercept	0	-4.40	I(0)
ΔLTOC	Intercept and trend	0	-4.41	I(0)
ΔLK	Intercept	0	-3.99	I(0)
ΔLL	Intercept	0	-6.48	I(0)
ΔLP	Intercept	1	-5.96	I(0)
ΔLTRANS	Intercept and trend	0	-5.34	I(0)
ΔLIND	None	0	-4.00	I(0)
ΔLPWG	None	0	-4.32	I(0)

5.3. Dynamic Analysis for Total Oil Consumption and Growth

Cointegrating Analysis

In first model, for cointegration for estimating the Maximum likelihood estimates of the cointegration for the autoregressive process as explained by Johansen (1988), so the VAR model has estimated with five variables (LY, LP, LTOC, LL and LK) and two exogenous pulse dummies (dummy 1979, dummy 2008). In 1979 there was second big oil shock due to Iranian revolution, due to this oil prices of West Taxas Intermediate increase 250% (Angell, 2005). In 2007-08 whole word suffers the financial crisis so prices go high all over the world (Hamilton, 2011). Now we identify the numbers of lags to be included in analysis.

Lag length selection criteria such as Log Likelihood (LogL), Likelihood Ratio test statistic (LR), Final Prediction Error (FEP), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan Quinnin formation criterion (HQ) has been used to identify the optimal lag. Results are present in the Table 5.2. As can be seen in the Table 5.2 that LR, FPE and AIC criteria indicate the two lags for estimating the VAR at 5%. So VAR model can be has estimated by using two lags.

Table 5.2: VAR Lag Order Selection for TOC and Growth

Lag	LogL	LR	FPE	AIC	SC	HQ
0	302.5972	NA	1.84E-13	-15.1367	-14.4903	-14.90671
1	534.0998	365.5303	3.61E-18	-26.0053	-24.28148*	-25.39195*
2	565.3655	41.13905*	2.90e-18*	-26.33502*	-23.5339	-25.3384

*indicates significant lag at 5% level.

In the model we include the unrestricted trend and intercept in the model. Both data and cointegration contain trend, as discussed in the Johansen (1991, 1995) and Johansen and Juselius (1990) five different choices of intercept and trend. Cointegrating relationship between the variables has been examined through Maximum Likelihood Method of Johansen (1988). Johansen proposed two test statistics that is, Trace Test and Maximum Eigenvalue test to check order of cointegrating vectors. These results are given in the Table 5.3. According to the Trace test statistics the null hypotheses r = 0 is rejected at 5% against the alternative hypotheses r ≥ 1. Through the Maximum Eigenvalue test statistics the null hypotheses r = 0 is rejected at 5% against the alternative hypotheses r = 1. Both test statistics indicates one cointegrating relationships in the variables.

Table 5.3: Trace and Maximum Eigenvalue Tests of Cointegration for TOC and Growth

VAR order = 02

Hypothesis		**test statistics**	**Critical values**
H_o	**H_a**		**5%**
(λ_{trace})			
r=0	r≥1	112.0755*	88.8038
r≤1	r≥2	63.44853	63.8761
r≤2	r≥3	32.61129	42.91525
r≤3	r≥4	17.78000	25.87211
r≤4	r≥5	6.985741	12.51798
(λ_{max})			
r=0	r=1	48.627*	38.33101
r≤1	r=2	30.83724	32.11832
r≤2	r=3	14.83129	25.82321
r≤3	r=4	10.79426	19.38704
r≤4	r=5	6.985741	12.51798

*indicates significant at 5 %.

Now we estimate the cointegrating relationship by using Maximum Likelihood Method. The normalized long run coefficients are given in equation (5.1). (Chi square values are in parenthesis.)

$$LY_t = \underset{(20.52)}{0.01}trend + \underset{(0.03)}{0.05}LL_t - \underset{(17.97)}{0.27}LP_t + \underset{(4.12)}{0.13}LTOC_t + \underset{(75.16)}{0.63}LK_t \quad \ldots\ldots\ldots\ldots (5.1)$$

Examining the above cointegrating equation (5.1), it is noticed that capital has positive impact on the GDP as expected. But the labor force has not significant impact on the GDP, as labor force is not efficient in the Pakistan and it's not able to influence the GDP significantly. The oil consumption shows positive relationship with GDP, as there is 1% raise in the oil consumption so it can be seen that 0.13% significant enhancement in the GDP. As oil consumption is playing roll in the economic growth. Oil is needed in different sector of economy like transport, industrial etc. So in long run consumption of oil enhance the economic growth by utilizing it in different major sectors. If there would be less oil use so the economic growth could be effected badly in long run. The oil prices variable shows significant negative relationship with GDP in long run as expected. Pakistan's imports mostly comprising on the petroleum or petroleum products. So the oil is the costly input product and impacted the economic growth. So the overall oil prices have negative impact on the GDP of Pakistan about 0.27% examined through the long run equation.

Short Run Dynamic Results

Once the variables are cointegrated we can move forward to estimate the short run dynamic relationship between variables. For the analysis Error Correction model is estimated in first differenced form for short run estimates and error correction term is added in this model to confirm the long run relationship. Through general to specific approach (David Hendry, 2004) through this the model is mis-specification and the overfitting problems can be managed by remove insignificant variables; the parsimonious short run equations (5.2) are given below, estimated at second lag selected on the basis of diagnostics tests given below. (t-statistics given in parenthesis)

$$\Delta LY_t = \underset{(3.94)}{0.56} + \underset{(2.11)}{0.08}\Delta LK_t + \underset{(2.43)}{0.13}\Delta LK_{t-2} + \underset{(2.87)}{0.10}\Delta LP_t + \underset{(3.49)}{0.13}\Delta LP_{t-2} - \underset{(-2.51)}{0.34}\Delta LL_{t-1} +$$

$$\underset{(4.01)}{0.56}\Delta LL_{t-2} - \underset{(-2.96)}{0.01}D_{1979} - \underset{(-5.94)}{0.04}D_{2008} - \underset{(-2.86)}{0.01}D_{2005} - \underset{(-3.87)}{0.18}ECM_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5.2)$$

Diagnostic Tests:

$R^2 = 0.75$ $\overline{R}^2 = 0.63$

Breusch Godfrey LM test of Autocorrelation $F_{(1,23)} = 1.95$ (0.17)

Jarque Bera test of Normality $\chi^2_{(2)} = 0.52$ (0.76)

Breusch Pagan Godfrey Hetroscadasticity test, $F_{(12,24)} = 1.03$ (0.47)

The dynamic model (5.2) is diagnosed through testing the residual of the model, first by checking the serial correlation by LM test. The value of F statistics is 1.95 so we cannot reject the null hypotheses of no serial correlation. The chi square χ^2 value of Jarque Bera Test is 0.52 tells that residual follow the normal distribution as we cannot reject the null of hypothesis and also the residual have equal spread of variance by examining the F statistics value of hetroscadasticity test that is 1.03. R^2 and adjusted R^2 values shows 75 % and 63% goodness of fit respectively, and it can be said that independent variables are explained by dependent variables by the percentage of 63. For testing the stability of the parameters of dynamic model, CUSUM and CUSUM of squared (Brown, et al 1975) are plotted. Through figures 5.9 and 5.10 it can be noted that calculated lines are within the significance bounds of 5%. So model shows parameters or mean stability by CUSUM and variance stability by CUSUM of square test.

Figure 5.9: CUSUM of Mean Stability for TOC and Growth

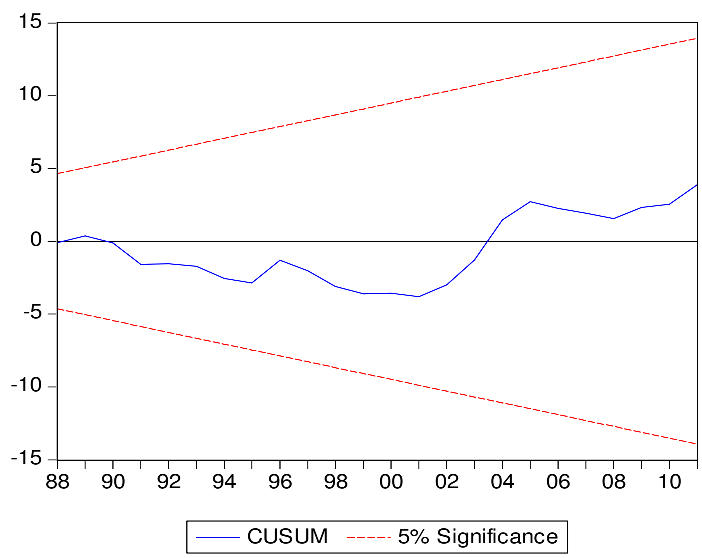
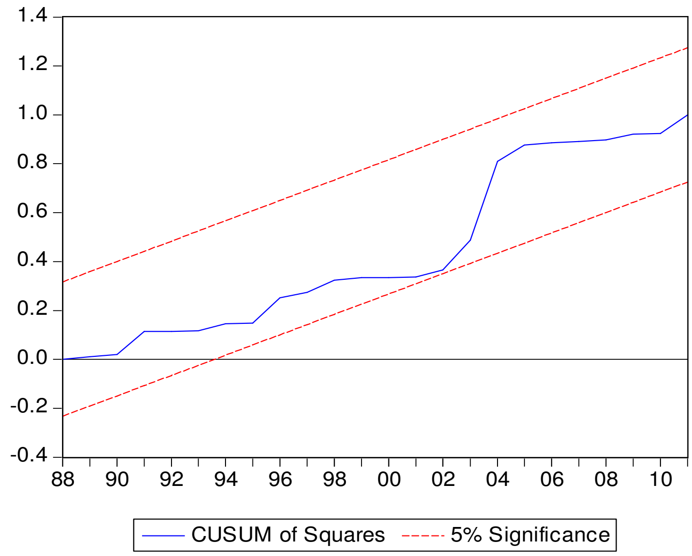


Figure 5.10: CUSUM of Square of Variance Stability for TOC and Growth



Here is the interpretation of dynamic relationship. In equation (5.2) the magnitude of ECM_{t-1} is negative and significant according to theory. As (Π) error correction term comprises of alpha (speed of adjustment) and beta (long run coefficient) as explained in the methodology, so the value of ECM_{t-1} shows that error is correcting with the speed of 0.18% in the one year. The significance of error correction term also approves the long run relationship between variables.

The coefficient of current and lagged variables of capital stock is positively impacting on the economic growth as expected and many previous studies gave same relationship. So increase in the investment in different sector of economy boost up the economic growth in short run. The magnitude of oil prices in current and lagged period shows positive impact on economic growth in short run. According to Rasmussen and Roitman (2011), 125 importing countries including Pakistan shows positive impact of oil prices on the GDP. If there is one percent increase in the change of current and lagged oil price there will be 0.10 and 0.13 percent increase in the economic growth. So increase in the prices some time takes as good time in the economy, as increase in oil prices generally appears to be demand driven Rasmussen and Roitman (2011). Also study of Akram (2011) shows positive significant relation between oil price increase and growth in case of Pakistan. Labor force is impacting the economic growth greater than the other variables in the model. There is negative impact of change in lagged labor force on economic growth as labor force is not so efficient; very few labors are available to impact the economy positively. In 1979 Pakistan economy faces difference ups and downs. Natural as well as political problems have faced by Pakistan economy. The second big oil price shock in 1979 due to Iranian revolution has impacted negatively to Pakistan economy. In 2005 oil prices hikes all over the world due to decline of oil supply from Iraq, as Iraq has major oil reserves also due to the great earth quack in Pakistan negatively impacted on all sectors of economy. In 2007-2008 there was financial crisis globally and rise in oil prices internationally and nationally, causes the bad impact on the economy.

Finally it can be concluded that total oil consumption has positive relationship with GDP and oil price negatively related with GDP in long run, but in short run total oil consumption has no significant impact on growth and oil prices related positively with the growth and the oil shock impacting negatively but have very little influence on the economic growth of Pakistan.

Restrictions are applied on the dynamic equation (5.2) to examine the causal relationship between variables. First, restriction is applied on the ECM_{t-1} through

Wald coefficient restriction test, to check the hypothesis that there is Granger non causality in the long run. The long run causality from capital, oil prices, total oil consumption structural dummies are confirmed by the significant value of lagged ECM in equation (5.2) and negative sign of this term also shown in the below Table 5.4, indicates long run causality between variables and hypothesis is rejected that there is non-Granger causality in long run.

Table 5.4: Causal Relationships between TOC and Growth

variables	**Short Run Coefficients** (F- statistics)					**Long Run Coefficient**
	ΔLK_t	ΔLL_t	ΔLP_t	$\Delta LTOC_t$	Break year	ECM_{t-1} (t-statistics)
ΔLY_t	4.1 (0.02)	10.7 (0.00)	7.3 (0.00)	_	10.8 (0.00)	-3.87**

** show significant at 5% level.

Second for the short run causal relation restriction are applied on the short run variables to verify the hypothesis that variables does not hold short run relationship, through examining the F-statistics given in above table that coefficient capital, labor force, oil prices and shock dummies are significant at 5% level, other than total oil consumption which has no short run causal effect. This implies that capital, labor force, oil prices and structural dummies Granger cause the GDP in short run.

5.4. Dynamic Analysis for Transport Oil Consumption and Growth

Cointegrating Analysis

For applying the Johansen cointegration test on second model that includes transport oil consumption in Pakistan. The VAR model has estimated with five variables (LY, LP, LTRANP, LL and LK) and two exogenous pulse dummies (dummy 1979, dummy 2008) and one step dummy of 2005. 1979 dummy is added for capture the effect of Iranian oil revolution, 2008 for global financial crisis and 2005 for oil prices increase up to $50 per barrel due to decline in the supply of oil from Iraq (Hamilton, 2011) and great earth quack in Pakistan. Both dummies influence significantly.

Results Lag length selection criteria are given in the Table 5.5. We can see in the Table 5.5 that, LR, FPE, SC and HQ criteria indicate the first lag for estimating the VAR at 5%. When the significant lag is selected the VAR model has estimated with one lag. In the model we include the unrestricted trend and intercept in the model. Trend in the data but have no trends in cointegration regression. As discussed in the Johansen (1991, 1995) and Johansen and Juselius (1990) five different choices of intercept and trend.

Table 5.5: VAR Lag Order Selection for TRANP and Growth

Lag	LogL	LR	FPE	AIC	SC	HQ
0	335.601	NA	5.51E-14	-16.34742	-15.27006	-15.9641
1	558.3949	328.3279*	1.76e-18*	-26.75763	-24.60291*	-25.99099*
2	586.4589	33.9722	1.76E-18	-26.91889*	-23.68681	-25.76894

*indicates significant lag at 5% level.

Long run relationship between the variables has been examined through the two test statistics, Trace test and Maximum Eigenvalue test given by Maximum Likelihood Method. These results are given in the Table 5.6. According to the Trace test statistics the null hypotheses $r = 0$ and $r \leq 1$ is rejected at 5% against the alternative hypotheses

$r \geq 1$and $r \leq 2$. Through the Maximum Eigenvalue test statistics the null hypotheses r = 0 and $r \leq 1$ is rejected at 5% against the alternative hypotheses r = 1 and r = 2.

Table 5.6: Trace and Max Eigenvalue Test of Cointegration for TRANP and Growth

VAR order = 1

Hypothesis		test statistics	Critical values
H_o	H_a		5%
(λ_{trace})			
r=0	r≥1	101.0587*	69.81889
r≤1	r≥2	50.68022*	47.85613
r≤2	r≥3	18.78234	29.79707
r≤3	r≥4	2.892517	15.49471
r≤4	r≥5	0.716806	3.841466
(λ_{max})			
r=0	r=1	50.37852*	33.87687
r≤1	r=2	31.89788*	27.58434
r≤2	r=3	15.88982	21.13162
r≤3	r=4	2.175711	14.26460
r≤4	r=5	0.716806	3.841466

**indicates significant at 5%*

Both test statistics indicates two log run cointegrating relationships within the variables for this model. But in this study we take only one cointegrating vector for further analysis.

Now we estimate the cointegration relationship by using Maximum Likelihood Method. Normalized coefficients are given below in equation (5.3). (Chi square values are in parenthesis.)

$$LY_t = - 4.47\ LK_t + 14.33\ LL_t + 3.96\ LTRANP_t - 4.38\ LP_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.3)$$
$$(46.5) \qquad (74.30) \qquad (28.19) \qquad (52.70)$$

Oil consumption in transport sector is major part of total oil consumption Pakistan. Almost 49% of total oil consumption has used by the transport sector in

2011. Observing the above normalize long run equation (5.3) labor force shows significantly positive impact on the GDP of Pakistan as expected but capital stock shows negative impact on GDP as explained above. The oil price shows significant negative impact on GDP, showing 4.38 % negative change in the GDP due to one percent change in the oil prices. Due to circular debt problem created by the oil creates negative impact on economic growth. In previous years of Pakistan the oil consumption especially in transport sector growth has decreased almost 0.97%. The consumption of oil is not efficient in the Pakistan so it allocates the negative impact on the overall economy or GDP.

There is positive relationship between the GDP and transport oil consumption in long run, there is 3.96% change in the GDP due to one percent positive change in the transport oil consumption. These results satisfy the theory having positive relationship between GDP and consumption.

Short Run Dynamic Results

Parsimonious Error Correction Model (5.4) for transport oil consumption and growth has estimated through general to specific approach (Hendry, 2004) at lag one selected on the basis of diagnostic tests. (t-statistics values in parenthesis)

$$\Delta LY_t = \underset{(5.90)}{0.07} - \underset{(-2.74)}{0.003t} - \underset{(-2.20)}{0.36\Delta LY_{t-1}} + \underset{(4.09)}{0.18\Delta LK_t} - \underset{(-2.79)}{0.47\Delta LL_{t-1}} + \underset{(4.27)}{0.16\Delta LTRANP_t} -$$

$$\underset{(2.88)}{0.02D_{1981}} + \underset{(3.19)}{0.02D_{1988}} + \underset{(4.32)}{0.004D_{2005}} - \underset{(-3.99)}{0.02ECM_{t-1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(5.4)}$$

Diagnostic Tests:

$R^2 = 0.63$, $\bar{R}^2 = 0.51$

Breusch Godfrey LM test of Autocorrelation $F_{(1, 27)} = 0.02\ (0.86)$,

Jarque Bera test of Normality $\chi^2_{(2)} = 0.81(0.66)$,

Breusch Pagan Godfrey Hetroscadasticity test $F_{(9, 28)} = 0.86(0.56)$,

Diagnostic tests of third dynamic model (5.4) are identified here, first by proving the no serial correlation through LM test. The value of F statistics is 0.02 so we cannot reject the null hypotheses of no serial correlation. The chi square χ^2 value of Jarque Bera is 0.81 tells that residual follow the normal distribution as we can not reject the null of hypothesis and also the residual have equal spread of variance by examining the F statistics of hetroscadasticity test that is 0.86. The R^2 and adjusted $\bar{R}^2$ shows that independent variables are explained 63% and 51% by dependent variable respectively.

Figure 5.11: CUSUM Test of Mean Stability for TRANP and Growth

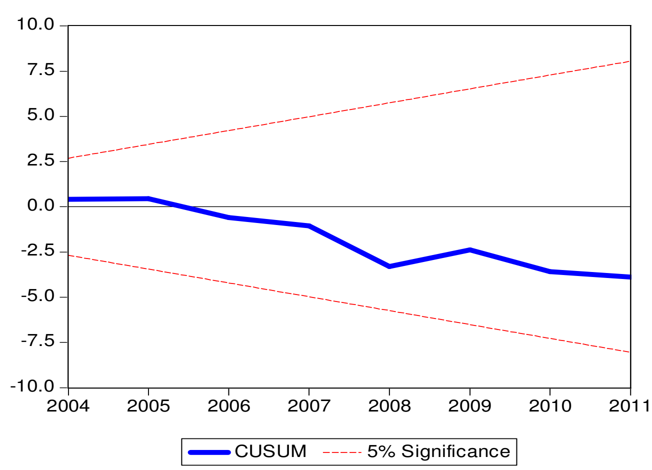
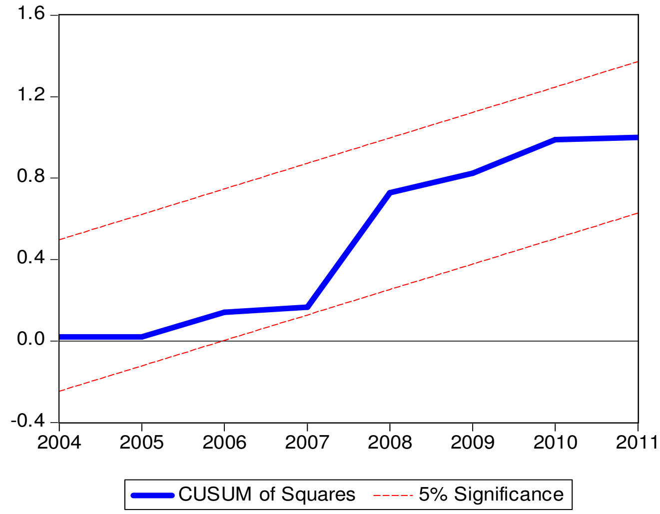


Figure 5.12: CUSUM of square Test of Variance Stability for TRANP and Growth



Above figures 5.11 and 5.12 for CUSUM and CUSUM of squares (Browne et al, 1975) are given, that indicates stability mean and variance of parameters of model respectively, as line lies between the significant bound at 5% level.

However, by examining the dynamic model it can be noticed that, the magnitude of ECM_{t-1} is negative and significant according to theory, in equation (5.4). The value shows the error is adjusting with the speed of 0.02% in the one year. We can see that the speed of adjustment is very slow to word equilibrium. The significance of this term ratifies the long run relationship between variables.

According to equation (5.4) the coefficient of change in current capital stock is positively impacting on the economic growth as expected and explained in the first dynamic equation (5.2). The value of change in first lagged labor shows negative relationship with economic growth as explained in above model that labor force is not efficient. The magnitude of change in current transport oil consumption shows positive impact on economic growth in short run. If there is one percent change in the current transport oil consumption there will be 0.16% change in the economic growth. The effect of dummies have already described above. In 1981 oil prices increases internationally, due to invasion of Afghanistan that's why lots of investment plans remained uncompleted and also due to Supply of oil from Iraq decline caused by Iran-Iraq war. In the start of 2005 the Pakistan economy was in its better condition due to increased growth of GDP in 2004, the oil prices were also stable in these years so it has positive impact on the economic growth of Pakistan and comparatively very low impact, international oil shock in 2005 has not affected the Pakistan economy. In 1988 the production and discoveries in the oil sector of Pakistan increased in this era, also average growth was 5.8%. So it has positive significant influence on the economic growth.

It is concluded from above discussion of dynamic model, that transport oil consumption has positive impact on GDP in long run and short run. Oil price has negative relationship between GDP in long run but there is no impact on growth in short run. Shock dummies have significant positive impact on the growth except one has significant negative impact but these shocks have very minute impact on the Pakistan economic growth.

Restrictions are applied on the dynamic equation (5.4) to examine the causal relationship between variables. First, restriction is applied on the ECM_{t-1} through Wald coefficient restriction test, to check the hypothesis that there is Granger non causality in the long run. The long run causality from capital, labor force, oil prices, transport oil consumption and structural dummies are confirmed by the significant value of lagged ECM in equation (5.4) and negative sign of this term also shown in the below the Table 5.7, indicates long run causality between variables.

Table 5.7: Causal Relationships between TRANP and Growth

Variables	**Short Run Coefficients (F-statistic)**					**Long Run Coefficient**
	ΔLK_t	ΔLL_t	ΔLP_t	$\Delta LTRANP_t$	Break year	ECM_{t-1} (t-statistics)
ΔLY_t	16.7 (0.00)	7.8 (0.00)	_	18.2 (0.00)	8.9 (0.00)	-3.99**

** show significant at 5 % level.

Second for the short run causal relation restriction are applied on the short run variables to test the hypothesis that there is no short run causal relationship between variables. The second dynamic model shows significant coefficients for the capital, labor force, transport oil consumption and shock dummy except oil price which is not showing short run causal relationship by noticing the F statistics given in the Table 5.7. So the short run Granger causality runs from the GDP to explanatory variables are confirmed through the F-statistics and significances of the variables.

5.5. Dynamic Analysis for Power Sector Oil Consumption and Growth

Cointegrating Analysis

For applying the Johansen cointegration test on third model that includes power sector oil consumption in Pakistan. There is need to set the VAR first so the VAR model has estimated with five variables (LY, LP, LPWG, LL and LK) and two exogenous pulse dummies (dummy 1979 & dummy 2008), these dummies has significant contribution in the VAR model, 1979 and 2008 dummies has explained already in above discussion.

Lag length tests has been used to identify the optimal lag. The results are given in the Table 5.8. As it we can examine through the Table 5.8, LR, FPE, SC and HQ criteria indicates the two lags for estimating the VAR at 5%. When the significant lag is selected the VAR model has estimated with two lags. In the model we also include the unrestricted trend and intercept in the model. Trends in the data but have no trends in cointegration regression. As discussed in the Johansen (1991, 1995) and Johansen and Juselius (1990) five different choices of intercept and trend.

Table 5.8: VAR Lag Order Selection for PWG and Growth

Lag	LogL	LR	FPE	AIC	SC	HQ
0	257.7832	NA	3.31E-12	-12.25175	-11.17439	-11.86843
1	484.9878	334.8278	8.36E-17	-22.8941	-20.73938*	-22.12746
2	517.3863	39.21921*	6.67e-17*	-23.28349*	-20.05141	-22.13354*

*indicates significant lag at 5% level.

Cointegrating relationship has examined between the variables, through the two test statistics, Trace test and Maximum Eigenvalue test proposed by the Maximum Likelihood Method of Johansen (1988). These results are given in the Table 5.9. According to the Trace test statistics the null hypotheses $r = 0$ and $r \leq 1$ is rejected at 5 % against alternative hypotheses $r \geq 1$ and $r \leq 2$. Through the Maximum Eigenvalue test statistics the null hypotheses $r = 0$ and $r \leq 1$ is rejected at 5 % against the alternative hypotheses $r = 1$ and $r = 2$. Both test statistics indicates two cointegrating vector or there are two log run cointegrating relationships in the variables. But in this study we take only one cointegrating vector for further analysis.

Table 5.9: Trace and Max Eigenvalue Test of Cointegration for PWG and Growth

VAR order = 2

Hypothesis		**test statistics**	**Critical values**
H_o	**H_a**		**5%**
(λ_{trace})			
r=0	r≥1	110.3783*	69.81889
r≤1	r≥2	59.87456*	47.85613
r≤2	r≥3	26.57852	29.79707
r≤3	r≥4	6.688208	15.49471
r≤4	r≥5	0.254841	3.841466
(λ_{max})			
r=0	r=1	50.50379*	33.87687
r≤1	r=2	33.29604*	27.58434
r≤2	r=3	19.89031	21.13162
r≤3	r=4	6.433367	14.26460
r≤4	r=5	0.254841	3.841466

*****_indicates significant at 5%_

Now the long run relationship has been examined through Johansen Maximum Likelihood Method. From here we can move forward to take cointegrating estimates and short run dynamics analysis of our model that is given below in equation 5.5. (Chi square values are in parenthesis.)

$$LY_t = -\ 2.10\ LL_t - 1.62\ LP + 0.22\ LPWG_t + 2.25\ LK_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.5)$$
$$(19.44) \quad (36.48) \quad (27.14) \quad (74.47)$$

In long run equation (5.5) for power sector oil consumption and growth the capital stock shows significant positive impact on the GDP of Pakistan as expected but labor force shows negative relationship with GDP because in Pakistan labor force is not so efficient nor productive to impact GDP positively. The coefficient of oil prices has significant negative influence on the GDP. If there is one percent increase in the oil prices there will be 1.62% decrease in the GDP. The reason of negative relationship has explained above in detail. We can say that increase in the oil prices in the energy sector cause increase in the electric bills, petrol prices, increase the tax and also increase in the circular debt, which has throws bad impact on economic growth. The coefficient of power generation oil consumption shows positive impact on the GDP. If there is one percent increase in the power sector oil consumption there will be 0.22% increase in the GDP. So oil consumption in this sector is important determinant to influence the economic growth positively in long run.

Short run Dynamics Results

Short run dynamic model given in equation (5.6) for power sector oil consumption and growth is evaluated through the general to specific approach (David Hendry, 2004) estimated with two lags selected on the basis of diagnostic tests. (t-statistics are in parenthesis)

$\Delta LY_t = 0.08 - 0.001t - 0.23\ \Delta LY_{t-1} + 0.13\Delta LK_{t-2} - 0.28\Delta LL - 0.22\Delta LL_{t-1} +$

(4.92) (-8.41) (-2.16) (4.18) (-4.01) (-2.53)

$0.01\Delta L\ PWG_t - 0.01\ \Delta LPWG_{t-2} + 0.05\Delta LP_t + 0.01\Delta LP_{t-2} + 0.01D_{1979} - 0.01D_{2005} -$
(4.05) (-4.62) (2.07) (6.71) (-5.14) (-6.60)

$0.01D_{2007} - 0.02ECT_{t-1}$……………………………………………………….....(5.6)
(-2.88) (-3.13)

Diagnostic Tests:

$R^2 = 0.95$, $\overline{R}^2 = 0.89$

Breusch Godfrey LM test of Autocorrelation $F_{(1,15)} = 0.81(0.38)$, Jarque Bera test of Normality $\chi^2_{(2)}$ = 5.43(0.06),

Breusch Pagan Godfrey Hetroscadasticity Test $F_{(20,16)}$ = 0.78(0.70),

Diagnostic tests of dynamic model (5.6) are demonstrated here, first by examining the serial correlation through LM test. The value of F statistics is 0.81 so we cannot reject the null hypotheses of no serial correlation. The chi square χ^2 amount of Jarque Bera is 5.43 tells that residual follow the normal distribution as we cannot reject the null of hypothesis and also the residual have equal spread of variance by observing the F statistics of hetroscadasticity test that is 0.78. The R^2 and adjusted $\overline{R}^2$ shows that independent variables are explained 95% and 89% by dependent variable respectively. For testing the stability of the mean and variance of parameters of model, CUSUM and CUSUM of squared (Browne et al, 1975) are plotted respectively. Through figures 5.13 & 5.14 it can be noted that calculated lines are within the significance bounds of 5%. So the model is stable in mean and variance.

Figure 5.13: CUSUM Test of Mean Stability for PWG and Growth

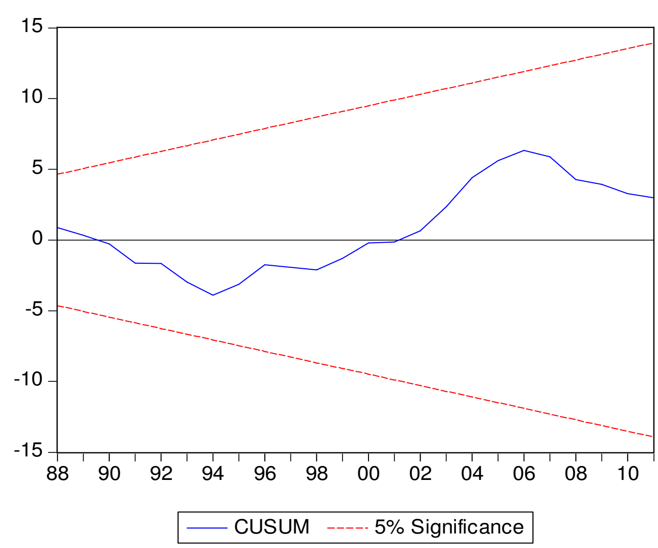
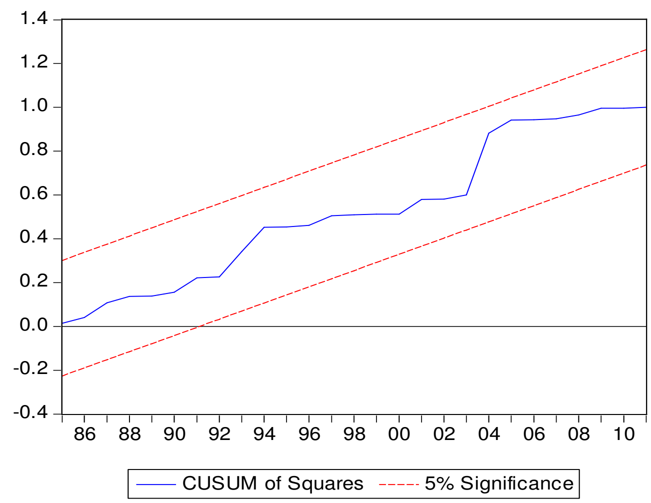


Figure 5.14: CUSUM of Square Test of Variance Stability for PWG and Growth



Now the model is well specified for explanation of dynamic relationship.

The value of ECM_{t-1} is negative and significant to theory. The value in equation (5.6) indicates the error is correcting with the speed of 0.02% in the one year. The significance of this term also approves the long run relationship between variables.

The coefficient of change in current capital stock in equation (5.6) is positively influence on the economic growth as expected and explained in the first dynamic equation (5.2). The value of change in current and first lagged labor shows negative relationship with growth as explained in above model that labor force is not efficient. The magnitude of change in current power sector oil consumption shows positive impact on growth in short run. If there is one percent change in the power sector oil consumption there will be 0.01% change in the GDP. But the change in lagged value of power sector oil consumption shows negative relationship with growth. It could be the reason of energy is treated as intermediate good in the previous year. The negative impact could be the alternative use of energy product like cheaper gas consumption. If there is one percent change in the current and lagged oil price there will be 0.05 and 0.01% change in the growth. This positive relationship has explained earlier. Dummy 1979 has positive impact on the growth of Pakistan however in 1979 there was second big oil shock in world. Dummy 2005 added due to increase of oil prices internationally due to destruction of Hurricane Katrina and decline in Iraq's oil supply and the great earth quack has badly impacted on all sectors of the economy and in 2007 the global financial crisis cause to increase in oil prices that have negative influence on the growth of Pakistan.

So finally it can be said that, power sector oil consumption effect positively to GDP in long run and also in short run. Oil price has negative relationship with GDP in long run and positive in short run. Oil Shock dummies variables also have significant impact on Pakistan economic growth.

Restrictions are applied on the dynamic equation (5.4) to examine the causal relationship between variables. First, restriction is applied on the ECM_{t-1} through Wald coefficient restriction test, to check the hypothesis that there is Granger non causality in the long run. The long run causality from capital, labor force, oil prices, power sector oil consumption and structural dummies are confirmed by the significant value of lagged ECM in equation (5.4) and negative sign of this term also shown in the below the Table 5.10, indicates long run causality between variables.

Table 5.10: Causal Relationships between PWG and Growth

Variables	Short Run Coefficients (F-statistic)					Long Run Coefficient
	ΔLK_t	ΔLL_t	ΔLP_t	$\Delta LPWG_t$	Break year	ECM_{t-1} (t-statistics)
ΔLY_t	17.5 (0.00)	15.7 (0.00)	17.4 (0.00)	15.9 (0.00)	20.6 (0.00)	-2.88**

** show significant at 5 % level.

Secondly, for the short run causal relation restriction are applied on the short run variables to test the hypothesis that there is no short run causal relationship between variables. The third dynamic model shows significant coefficients for the capital, labor force, power sector oil consumption, oil prices and shock dummy by noticing the F statistics given in the Table 5.10. So the short run Granger causality runs from the GDP to explanatory variables are confirmed through the F-statistics and significances of the variables.

5.6. Dynamic Analysis for Industrial Oil Consumption and Growth

Cointegrating Analysis

For applying the Johansen cointegration test on fourth model that includes industrial oil consumption in Pakistan. There is need to set the VAR first so the VAR model has estimated with five variables (LY, LP, LIND, LL and LK) and two exogenous pulse dummies (dummy 2004, dummy 1981). Dummy of 2004 is added that have significant exogenous impact in the given VAR system, increase in oil prices up to $40 in last quarter of 2004 and reaches at $50 per barrel in 2005 due to the destruction of hurricane Katrina and decline in the supply of Iraq's oil production. As Iraq contain large oil reserve. Dummy 1981 capturing the effect of second oil prices shock that led from 1979 to 1981, in 1981 there was decline in the oil supply from middle east and oil glut of 1981 due to decrease in oil consumption due to its high price (Hamilton, 2011).

Lag length selection criteria such as; LogL, LR, FEP, AIC, SC, HQ has been used to select the optimal lag. The results are given below in the Table 5.11. We can see that, According to the Table 5.11 LR, FPE and AIC criteria indicates the two lags for estimating the VAR at 5 %. When the significant lag is selected the VAR model has estimated with two lags.

Table 5.11: VAR Lag Order Selection for ND and Growth

Lag	LogL	LR	FPE	AIC	SC	HQ
0	267.9786	NA	1.14E-12	-13.31466	-12.66825	-13.08467
1	501.6226	368.9116	1.99E-17	-24.29593	-22.57215*	-23.68262*
2	532.2705	40.32621*	1.66e-17*	-24.59319*	-21.79205	-23.59656

*indicates significant lag at 5% level.

In the model we also include the unrestricted trend and intercept in the model same as previous model. Trends in the data but have no trends in cointegration regression. As discussed in the Johansen (1991, 1995) and Johansen and Juselius (1990) five different choices of intercept and trend.

Cointegrating relationship has examined the two test statistics, Trace test and Maximum Eigenvalue test calculated through the Maximum Likelihood Method by Johansen (1988). These results are given in the Table 5.12. According to the Trace test statistics the null hypotheses $r = 0$ and $r \leq 1$ is rejected at 5% against alternative hypotheses $r \geq 1$and $r \leq 2$. Through the Maximum Eigenvalue test statistics the null hypotheses r = 0 and r ≤ 1 is rejected at 5% against the alternative hypotheses r = 1 and r = 2. Both test statistics indicates two cointegrating vector or there are two long run cointegrating relationships in the variables for this model. But in this study we take only one cointegrating vector for further analysis.

Table 5.12: Trace and Max Eigenvalue Test of Cointegration for IND and Growth

VAR order = 2

Hypothesis		**test statistics**	**Critical values**
H_o	**H_a**		**5%**
(λ_{trace})			
r=0	r≥1	103.7253*	69.81889
r≤1	r≥2	52.30240*	47.85613
r≤2	r≥3	17.70686	29.79707
r≤3	r≥4	7.306180	15.49471
r≤4	r≥5	1.392491	3.841466
(λ_{max})			
r=0	r=1	51.42288*	33.87687
r≤1	r=2	34.59554*	27.58434
r≤2	r=3	10.40068	21.13162
r≤3	r=4	5.913689	14.26460
r≤4	r=5	1.392491	3.841466

******indicates significant at 5%*

Now will estimate the of long run coefficients of power sector and growth model by using Maximum Likelihood Method. (Chi square values are in parenthesis)

$$LY_t = 0.20LIND_t + 5.83LL_t - 2.46LP_t - 1.16\ LK_t \qquad (5.7)$$

(9.42) (102.01) (62.56) (18.31)

The normalized long run equation (5.7) given above whose estimates are given by adding the sectoral oil consumption of industrial sector. The labor force variables shows significant positive impact on the GDP as expected. The capital stock shows negative impact on GDP, if here is one percent increase in the capital stock there will be 1.16% decrease in the GDP. Negative relationship is due to inefficient investment in different sectors of economy also due to shortage of capital stock to influence positively on GDP. The oil price shows negative relationship with GDP. As explained above in the total oil consumption model. Higher oil prices have bad impact on the economy due to its cost. The industrial oil consumption indicated positive long run relationship with GDP. The positive relationship has explained above, such as oil consumption in industrial sector for different needs enhance the growth of the industry and overall economy. We know oil is becoming basic need in production sector. So if there is 1% increase in industrial oil consumption there will be 0.20% increase in the GDP.

Short run Dynamic Results

Now the Error Correction Model has estimated for industrial oil consumption and growth, it is estimated through general to specific approach (Hendry, 2004) at second lag selected on the basis of diagnostic tests illustrated below equation (5.8). (t-statistics are given in parenthesis)

$$\Delta LY_t = \underset{(5.32)}{0.19} + \underset{(3.40)}{0.17}\Delta LK_{t-2} - \underset{(-2.23)}{0.30}\Delta LL_{t-1} + \underset{(3.48)}{0.49}\, L\Delta L_{t-2} + \underset{(2.83)}{0.10}\Delta LP_t + \underset{(3.58)}{0.12}\Delta LP_{t-2} -$$

$$\underset{(-2.85)}{0.01}D_{1979} + \underset{(3.85)}{0.02}D_{1988} - \underset{(-5.00)}{0.04}D_{2008} - \underset{(-3.13)}{0.01}D_{2005} - \underset{(-4.96)}{0.01}ECT_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots (5.8)$$

Diagnostic Tests:

$R^2 = 0.73$ $\overline{R}^2 = 0.62$

Breusch Godfrey LM test of Autocorrelation $F_{(1,24)} = 0.02(0.88)$,

Jarque Bera test of Normality $\chi^2_{(2)} = 0.69(0.70)$,

Breusch Pagan Godfrey Hetroscadasticity Test $F_{(11,25)} = 0.62(0.78)$,

Diagnostics of second dynamic model (5.8) are described here, mainly by checking the serial correlation through LM test. The value of F statistics is 0.02 so we cannot reject the null hypotheses of no serial correlation. The chi square χ^2 value of Jarque Bera is 0.62 tells that residual follow the normal distribution as we can cot reject the null of hypothesis and also the residual have equal spread of variance by examining the F statistics through Breusch-Pagan Godfrey test of hetroscadasticity that is 0.62. The R^2 and adjusted $\overline{R}^2$ shows that independent variables are explained 73% and 62% by dependent variable respectively.

Figure 5.15: CUSUM Test of Mean Stability for IND and Growth

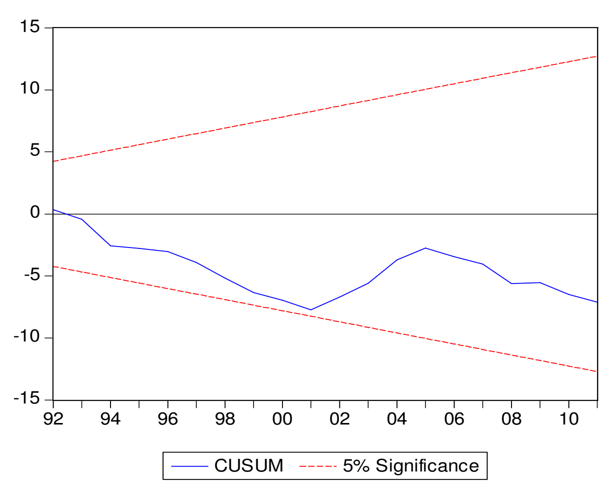
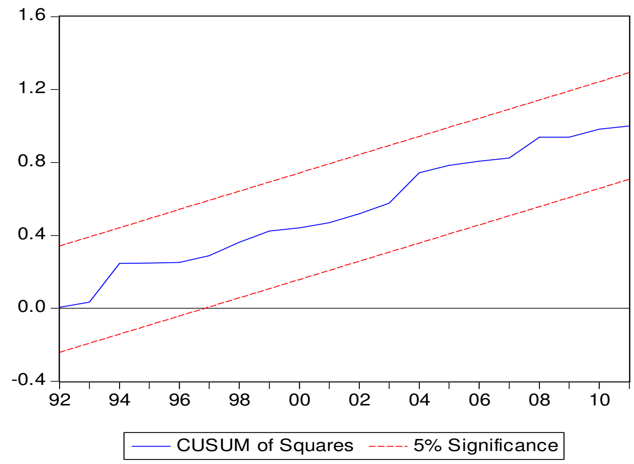


Figure 5.16: CUSUM of Square Test of Variance Stability for IND and Growth



The cumulative sum (CUSUM) and cumulative of squares test has used to test the constancy of mean and variance of the parameters with in the model respectively through figure 5.15 and 5.16 it can examine that line is between the significant bound so our dynamic model of industrial oil consumption is stable.

Now we move forward for description of dynamic relationship. The magnitude of ECM_{t-1} is negative and significant according to theory given in equation (5.8). The value shows the error is correcting with the speed of 0.01% in the one year. We can see that the speed of adjustment is very slow to word equilibrium. The significance of this term confirms the long run relationship between variables.

The coefficient of change in lagged capital stock is positively impacting on the economic growth as expected and explained in the first dynamic model. The value of change in first lagged labor shows positive relationship with economic growth as it's according to theory because labor force helps to increase the growth but second lag shows negative impact as explained in previous dynamic equation (5.2). The magnitude of change in oil prices in current and lagged period shows positive impact on economic growth in short run. If there is one percent change in the current and lagged oil price there will be 0.10 and 0.12 percent change in the economic growth respectively. The effect of dummies have already described above.

From the dynamic analysis between industrial oil consumption and growth it is summaries that, there is positive relationship between industrial oil consumption and GDP in long run but IND oil consumption has not influencing in short run to growth. Oil prices negatively related with GDP in long run and positively in short run. Oil shock dummies impacting negatively except one, but these have very less influence on the growth of Pakistan.

Restrictions are applied on the dynamic equation (5.4) to examine the causal relationship between variables. First, restriction is applied on the ECM_{t-1} through Wald coefficient restriction test, to check the hypothesis that there is Granger non causality in the long run. The long run causality from capital, labor force, oil prices, industrial oil consumption and structural dummies are confirmed by the significant value of lagged ECM in equation (5.4) and negative sign of this term also shown in the below the Table 5.13, indicates long run causality between variables.

Second, for the short run causal relation restriction are applied on the short run variables to test the hypothesis that there is no short run causal relationship between variables.

Table 5.13: Causal Relationships between IND and Growth

Variables	Short Run Coefficients (F-statistic)					Long Run Coefficient
	ΔLK_t	ΔLL_t	ΔLP_t	$\Delta LIND_t$	Break year	ECM_{t-1} (t-statistics)
ΔLY_t	255.4 (0.00)	8.1 (0.00)	7.1 (0.00)	_	10.6 (0.00)	-4.96**

** show significant at 5 % level.

The fourth dynamic model shows significant coefficients for the capital, labor force and shock dummy except industrial oil consumption which is not showing short run causal relationship by noticing the F-statistics given in the Table 5.13. So the short run Granger causality runs from the GDP to explanatory variables are confirmed through the F-statistics and significances of the variables.

5.7. Concluding Remarks

In this chapter results and discussion, first unit root has tested for all the variables by using the ADF test and found all variables of integrated of order one I(1). From here we move forward to find long run and short run relationship and causalities between variables. Johansen cointegration test of Maximum Likelihood Method has used to find the long run relationship, through this test it has found that all four models are cointegrated. Then short run dynamic relationship has tested. Finally restrictions are applied on ECM for causality analysis. Following results has concluded

1. The oil consumption variables total as well as sectoral have positive impact on the economic growth.
    i. Total as well as sectoral oil consumption variables have positive impact on economic growth in long run.

ii. In short run industrial and total oil consumption has no impact on economic growth.

iii. Current and second lagged variable of Power sector oil consumption has positive and negative impact on economic growth respectively. Current variable of transport oil consumption has also positive impact on economic growth of Pakistan.

2. The oil shock dummies variables in all four models, mostly negatively impacting the economic growth but showing less impact between 0.01-004 percent.
3. The oil price variable negatively impacting in long run for total and sectoral oil consumption models.
4. In short run oil price variable shows significant impact on economic growth except for transport oil sector model.
5. Labor force variable has no significant impact on economic growth for total oil consumption model but it shows significant impact for all three oil consumption sectors.
6. It is examined from the results that labor force and capital stock variables have greater impact on economic growth then oil consumption variables.
7. Transport oil consumption has influence about 3.96 % on economic growth greater then other two oil consumption sectors in long run.
8. All variables Granger cause in long run to GDP except labor force variable has no significant impact for total oil consumption model.

9. Also all variables cause economic growth in short run except the variables of total and industrial oil consumption and oil price variable for transport oil consumption dynamic model.

Chapter 6

CONCLUSIONS

Pakistan is facing oil related problems since many years, specifically oil prices and its increasing demand in every sector of economy. So keeping this point of view in this study impact of oil price and shocks on economic growth has been checked including sectoral oil consumption and causal relationship between them. Time series approach has been used in this study to test the long run and short run dynamics through Johansen approach of cointegration and Granger causality test for detecting the causal relationship and initially ADF test for finding order of integration I (d). Annual data has used since 1972-2011 for analysis. Four models of Cobb-Douglas production function are constructed for three major oil sectors and one for total oil consumption including oil prices depending on GDP. Shocks dummies are also included in these models as previous studies had not concern about the oil shocks in data. In Pakistan only one or two paper are hardly found related to causal relationship between oil consumption and GDP, in these papers authors has ignored the sectoral use of oil and impact of oil price and shocks specifically Pakistan's oil prices were not taken in any paper for this context, So oil price variable and shock dummies have been added in the analysis. From the analysis finally it can be concluded that oil consumption (total as well as at sectoral level) has positive impact on economy in long run and also shows the long run causal relationship from oil consumption variables to GDP also oil price variable shows negative impact as expected. In short run oil consumption variables shows very little impact on economic growth of Pakistan however, shocks dummies also influencing negatively to the growth in short run but with low percentage. In short run consumption as well oil price variables also show causal relation toward growth. So we can say oil consumption is important to enhance the economic growth of Pakistan specifically in long run scenario but less contribution toward economic growth in short run.

If we examine the previous study of Bedi-uz-Zaman et al (2011), that was first study in Pakistan that had investigated the relationship between oil consumption in sectors of Pakistan and economic growth and compare the results of our study it can be seen that by estimating individual dynamic model for each sector give different results up to some context. In previous study oil price variable and shock dummies were not included that have significant impact on the economy. Oil consumption variables are positively cointegrated with economic growth as concluded in previous study. Results of our study are also supports the results of the study of Akram (2011) shows positive significant relationship of increase in oil prices for Pakistan. The results are also consistent with the findings of Khan and Qayyum (2007) that capital and labor variables have grater impact on economic growth then other variables.

Additionally, the policy implications could be for this study are, firstly; investing on the labor and capital, we can get fruitful results as these variables shows greater impact on economic growth of Pakistan both in long run and short run. Secondly, the transport oil consumption that is the major sector of oil consumption of Pakistan creating larger impact on economy so there is need to make this sector improved and control the oil prices impacting negatively in the long run greater then any other sector. Finally, Industrial and power oil consumption are very important part of any economy that could boost up to growth but these sectors need to much planning in prices controlling and developing the safe guards for oil shocks, so that these sector could take part in up grating the economy of Pakistan.

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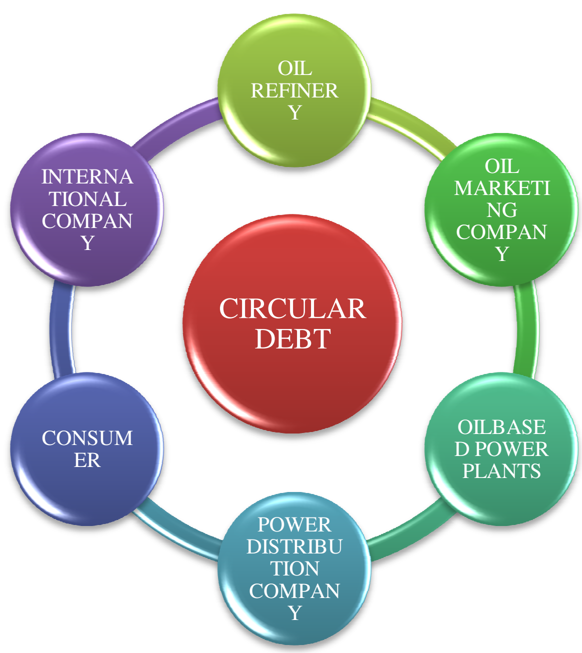
Appendix: A

Circular Debt

According to product officer Raheel Rao at Trade Development Authority of Pakistan (TDAP) "If A owes 50$ from B, and B owe 50$ from C and C owe 50$ from A." In Pakistan circular debt is the main problem in the energy sector especially due to oil sector of Pakistan.

Figure 2.6: Circular Debt



In Pakistan, government subsides the electricity consumer such as KESC have no funds to pay back to oil supplies like PSO, PSO also have no funds to pay to suppliers (National refinery) and national refinery has no fund to pay for imported oil to international companies so this cause circular debt to increase. It can also be shown by above flow diagram. An official of OGDC (oil and gas Development Corporation) said that, company was forced to supply the oil and gas to power sector and others by the pressure of government, so circular debt is mounting. Till last year 2012, according to Petroleum and Natural Resources Minister Asim Hussain, circular debt among energy companies stands at Rs.370 billion and increasing at the rate of 15 to 20 billion per month due to inefficiency and not pay back of companies.