Effects of World Crude Oil Prices on Crude Oil Import: Evidence from Pakistan

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Abstract

The objective of this paper is to analyze the long and short run effects of crude oil price on crude oil import demand of Pakistan by employing time series data from 1981-2014. The long run relationship between crude oil price and crude oil import was tested by using johansen and juselius cointegration approach. The short run effect is analyzed by using error correction model. The analyses reveal significant long run negative impact of prices on crude oil import demand of Pakistan. However this study found insignificant effect of respective variable in short run. Pakistan should take various energy efficiency and demand side management measures like expanding and strengthening indigenous resource base, imports of advance technology, substituting imported crude oil by domestic crude oil and looking for alternative energy sources.

Keyword: Crude oil price and imports, Resource base, Domestic crude oil production.

Introduction

Crude Oil is one of the most important sources of energy and prerequisite for economic development, so the demand for oil has increased over time, and it will continue to hold a prominent position at the heart of the world economy. It accounts for about 40.6 percent of primary energy consumption and also used as a raw material in petrochemical industry internationally. Energy consumption is considered a development, and it was examined by (Vita et al 2006) that energy consumption relates positively to GDP i.e. as the GDP is increasing, the consumption of oil will also increase. For the last 30 years from 1971 till 2000, the consumption of world crude oil has increased from 2,412 to 3,519 million tons per annum i.e. about 46 percent increase (Cooper 2003).

Pakistan is a developing country ranking 26th in terms of Purchasing Power Parity (PPP) and 44th in terms of nominal GDP having a population of over 186 million making it the sixth populous country in the world. Imported crude oil and petroleum products are the main sources of energy for Pakistan. It ranks 33th among global consumers of oil. According to U.S. Energy Information Administration (EIA**)** the current crude oil production in Pakistan is 64,000 barrels per day (EIA 2012). This amount is not sufficient to fulfill the needs of the country which is 437,000 bbl/d. The production of crude oil in Pakistan has remained very low as compared to the demand (Kazim 2007). Pakistan heavily depends on the imported oil to fulfill its needs. Pakistan produced about 20 percent of its oil (Ghani 2007) and imports the rest. Mostly the demand for crude oil and petroleum products is met through imports mainly from Middle East countries (Saudi Arab is playing the leading role).

Oil has always been an imported source of energy for Pakistan, the price of which has increasing continuously. The price of oil was $10 per barrel in 1995 which increased to $110 per barrel in May 2014 showing an increase of almost hundred times as compared to its

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prices in 1995 and due to this increase in oil prices it leads to an increase in oil prices domestically escalating to Rs 107 per liter in May 2014 from Rs 9 per liter in 1995 (Pakistan Economic Survey). According to Pakistan Energy Outlook by Petroleum Institute of Pakistan (2007) the per capita consumption in Pakistan is increasing. In 2009-10 the per capita consumption was 0.42, in 2014-15 it will be 0.52 and in 2019-20 it would be 0.64. According to Pakistan Energy Outlook by Petroleum Institute of Pakistan (2007) the increase in imports will be high in the coming years. In 2009-10 the imports of crude oil were 26.5 (37%), in 2014-15 it would be 33.4 (35%) and in 2019-20 it would be 43.4 (34%). Due to increase in crude oil prices globally, our precious foreign exchange will be used to import crude oil. About 44 Percent of export earning is spent on oil imports during 2006-07. This percentage was only 27 percent in 2004-05. And this is continues to rise. The import of crude oil remained about 44.9 million barrels during FY14 as compared to 40.9 million barrels in the last period. The dependence on imported crude oil is increasing and it will make the economy vulnerable to oil price shocks internationally. Since the oil price shocks of the 1970s many economist, policy makers and businesses attracted to the fluctuation in crude oil prices. They attempt to develop models, how oil prices affect various economic magnitudes.

Pakistan is a developing country. It needs huge amount of oil to carry on its day to day activities. Currently Pakistan is short of energy sources and due to increase in crude oil prices in international market; it put an extra burden on our foreign exchange reserves, because we fulfill our crude oil demand mainly through import. The study is worth important because about 60 percent of the people are living below the poverty line, and when the prices of crude oil increase, it reduces their purchasing power, and they are unable to avail many basic necessities of life, causing many economic and social problems.

The paper tries to investigate the short run and long run effects of world crude oil price on crude oil import demand for Pakistan. Our study will contribute to the literature in an important ways. Pakistan is an oil importing country and thus we will try to find out whether the empirical results obtained for advanced oil importing countries regarding the effect of oil price increase on crude oil import demand, hold for a developing country like Pakistan.

The rest of the study is organized as follows. Next section deals with the literature review on crude oil prices and crude oil import demand, section third is about methodology and data, section fourth shows empirical result and discussion and the last section is the conclusion and policy recommendation.

An Overview of Literature on Crude Oil Prices and Exchange Rate Relationship

This section will review the previous studies that have been conducted to investigate the crude oil price–crude oil import demand nexus.

Kim and Baek (2013) examined the relation among short run and long run import demand for crude oil, its price and economic growth in Korea using autoregressive distributed lag (ARDL) method on data from 1986-2010. Finding shows that in Korea the short run oil price is major determinant of crude oil demand, while income in the long run. While the long run elasticity of Namibian energy demand for the period 1980-2002 has been analyzed by (Vita et al, 2006) by using Autoregressive Distributed Lag (ARDL) bounds testing approach to co- integration. They find that energy consumption relates positively to GDP while negatively to temperature and energy price.

Ghosh (2009) by using autoregressive distributed lag (ARDL) bounds testing approach of co-integration, and implying data for the period 1970–1971 to 2005–2006, long run relationship was establish among crude oil import quantity, price and income for the period. Long run elasticity is 1.97 for the imported crude oil and unidirectional long run causality also exist which runs from economic growth to crude oil import. The economic growth of India in the long run will not be affected by the reduction in imported crude oil.

India can reduce dependence on the import of crude oil by adopting certain measures; prefer domestic fuel over imported, expand its own resource base and de-control the price of petroleum products.

Altinay (2007) using data for the period 1980-2005 analyzed the short run and long run elasticity of Turkey's import oil demand through autoregressive distributed lag (ARDL) bounds test. For the specific events which occur in Turkey he took crude oil demand as a function of variables such as price, income and dummies. He estimated two models due to nominal and real variables. With real price for crude oil he found a relation while not for the model having nominal price. The import demand for crude oil was both income and price inelastic with long-run values of 0.61 and - 0.18 respectively.

The short run and long run price elasticity of demand for crude oil has been estimated using data for the period 1980-2012 employing the autoregressive distributed lag model (ARDL). The result indicated that both the short run and long run demand for crude oil is price inelastic. Factors affecting crude oil import are domestic crude oil production, real effective exchange rate and population (Marbuah, 2014).

Xiong and Wu (2009) studied Chinese crude oil demand implying data from 1979-2004. Their method of analysis was johansen co integration test and error correction model. His findings say that in china the demand for crude oil is both price and income inelastic. Another study for china has been undertaken by (Jiping & Wu, 2008) the period 1979-2004 to study crude oil demand by utilizing co-integration and error correction model and forecasts for the period 2008-2020. The long run relationships among variables have been checked by johansen co-integration test. The main factors which determine the crude oil demand for china are population, gross domestic product (GDP), oil price and the share of industry in GDP. Ziramba (2010) used johansen co-integration multivariate analysis to study the long run income and price elasticity for South Africa, employing data from 1980-2006. He find that long run relationship exists between crude oil imports and the explanatory variables, price and income elasticity are - 0.147 and 0.429 meaning that both import demand for crude oil is both price and income inelastic. Error correction method is used for the estimation of short run relationship. Unidirectional and long run causality exists and runs from real GDP to crude oil imports.

Stambuli (2013) examined how we can control oil importation in the long-run without disturbing the normal functioning of the economy as the demand for oil in Tanzania changes due to change in income of the country and international oil price. He found that the demand for oil in the short run is both income and price inelastic, while in the long run it is income elastic and price inelastic, showing that income has more effect on oil demand than price.

Farinelli et al (2008) examined import demand models for Brazilian ethanol by using ordinary least squares (OLS), taking quarterly time series data for the period 1997-2007. The study finds long run income and price elasticity for import demand. It was also clarified that factors which influence import demand for ethanol vary across countries. In many regions like Caribbean(-1.66), (-2.08), Japan (-1.44) and Nigeria (-1.38), the import demand for ethanol was price elastic, while in Europe and US it was price inelastic having values - 0.21 and - 0.76.

In this study they examined OECD and non-OECD countries for long run income and price elasticities of demand for crude oil. Point out the factors which affect the demand for energy and crude oil such as changes in oil prices and income. The speed of adjustment of income and price has been analyzed. The long run price and income elasticity of demand for crude oil for OECD and non-OCED countries are - 0.64, 0.56, - 0.18 and 0.53 (Gately & Huntington, 2002).

Data and Methodology

In this study monthly time series annual Data is taken from 1981 to 2014 for respective variables. The variables of interest are imports of crude oil in thousand barrels per day by Pakistan, world crude oil prices in US dollars. The data on world crude oil prices is taken from knomea.com and Imports of crude oil from United States Energy Association. This study is based on time series data for which it is necessary to check the stationarity of the data which is the preliminary process of employing the regression model. The stationarity is checked by two methods: Augmented Dickey Fuller (ADF) and Philips-Perron (PP) test. In this study we have applied ADF test for checking stationarity of variables.

Augmented Dickey Fuller (1979) test is based on following regression model

$$\Delta Y_t = \beta_1 + \beta_1 t + \delta Y_{t-1} + a_i \sum_{i=1}^{m} \Delta Y_{t-1} + \mu_t$$

Where Δ represents differences, α, β and δ are coefficients and y is variable to be estimated.

For estimating the long run relationship between the variables Johansen and Juselius (1990) is under taken. This test is based on two tests Trace and maximum Eigen value test. Both tests are applying the procedure of maximum likelihood.

The maximum Eigenvalue test is based on the following equation

$$\lambda max = -T\, ln\,(1 - \lambda r + 1)$$

Where T shows the observations and λ_{r+1}, λ_{r+2}+……λ_n represent the n-r smallest squared canonical correlations.

The trace test uses the following equation $\lambda trace = -T \sum ln\,(1 - \lambda i)$

The short run dynamics between variables is tested by using error correction model. The model explains short-run disequilibrium i.e. deviation from the long-run relationship and its adjustment in time. The sign of the ECM may either be positive or negative. The positive sign indicates unstable equilibrium, whereas the negative sign indicates stable equilibrium. The error correction model is based on following equation

$$\Delta Zt = a0 + \Sigma \beta jk - 1j = 1 \Delta Zt - j + \delta Zt - k + \varepsilon t$$

Where $\delta = -I + \Sigma \beta jki = j + 1$ **and ΔZt is** the first difference for the underlying variable.

Empirical Findings and Discussion

Before estimating the long run relationship through cointegration analyses, it is necessary to check for the stationarity of all variable to be integrated of order *I* (1). The stationarity is checked by using Augmented Dickey Fuller (ADF) (1979) test. Table (1) represents the analyses of unit root tests. The analyses reveal that all the variables are stationary at first difference. ADF (1979) provides knowledge about integration of all variables at order *I* (1). Hence we can test cointegration between these variables.

Table 1
Unit root results

Variables	Level	1st Difference	Inference
Crude oil import demand	-1.107043	-5.857823	1(1)
Crude oil price	-0.360787	-6.063770	1(1)

Critical value is -2.866879 at 5%

The Johansen and juselius cointegration test is followed in order to know about the long run relationship between crude oil and import demand. For this purpose suitable lag value is selected in order to test the cointegrating vectors. The lag value is selected on the

basis of VAR statistics by the confirmation of minimum value of Schwarz criterion. The analyses reveal to select suitable value of Lag 1.

Table (2) provides the results of Johansen and juselius cointegration analyses results, which show the existence of long-run equilibrium relationship in the case where oil import demand is modeled as a function of only world crude oil price. The analyses reveal that over the long run oil prices have negative effects on the crude oil import demand, implying that Pakistan's crude oil imports tend to decrease as crude oil price increases. In the long-run, real import demand for crude oil is more responsive to real international crude oil price. This is also due to the fact that people switch over to substitute products in Pakistan like CNG and LPG, because it is difficult for people to continue buying expensive oil in the long run.

Table 2
Long run equation results

Variable	coefficient	Standard error	T-statistics
Constant	-9.626701*	(0.42943)	[-22.4173]
Oil price	-0.259039*	(0.12394)	[-2.09007]

* indicates p< 0.05
Dependent variable is crude oil demand

We next examine the short-run behavior of Pakistan crude oil imports demand by estimating dynamic error correction model. The error correction model shows in short run there is insignificant effect of crude oil prices on import demand of Pakistan. meaning in the short run price has no effect on the demand of crude oil import The absolute value of ECT (−1) shows the speed at which import demand for crude oil adjust to changes in price of world crude oil before converging to its equilibrium level. As such, the result suggests that, with shock to the Pakistani oil market, the import demand equation for crude oil tends to its long-run equilibrium position. The speed of adjustment toward the long-run equilibrium is _0.012746.

Table 3
Short run equation results

Variable	coefficient	Standard error	T-statistics
Constant	0.011415	(0.02245)	[0.50845]
Crude oil demand(-1)	-0.024074	(0.19970)	[-0.12055]
Oil price(-1)	-0.040119	(0.10033)	[-0.39986]
ECT(-1)	-0.012746	(0.09929)	[0.21225]

* indicates p< 0.05
Dependent variable is crude oil demand

Conclusion and Policy Recommendation

The primary contribution of this paper is to examine the Pakistani import demand for crude oil in a dynamic framework of johansen and juselius cointegration. Time series data have been utilized for the period 1981-2014. Special attention has been given to assess the short- and long-run effects of crude oil price on its import. The results show that there exists a significant long run relationship between crude oil price and crude oil import demand. Meaning, that high price affects the demand for crude oil negatively. Pakistan is a net importer of crude oil and if price increases in the world market, this will cause a huge cost to the economy because a lot of foreign exchange reserve will be spent on the import of crude oil. If price increases in the long run people will not purchase oil, but rather will switch to

alternative sources of energy. On the other hand the short run relationship is not significant, indicating that the demand for crude oil is not affected by its price in the short run.

Policy Recommendation

In order to decrease the dependency on imported crude oil and to save the precious foreign exchange reserve some policy suggestion has been put forward.

First: The government should initiate such policies and give incentives which may not only attract the domestic investors but also foreign investors, to come and invest in oil exploration projects. This will not only increase FDI, but also help to fulfill the energy needs of our country.

Second: The economic performance of a country is very much related with the political stability. If there are frequent changes in government, the policies will also change and it will discourage investors and therefore they will shy to invest in long term risky projects like oil exploration. So if the government wants to increase domestic oil production then they have to devise such policies which are not affected by the change of a government.

Third: The government should launch such projects which results in the production of educated, technical and skillful peoples. Because we need technical and skillful peoples for the successful completion of difficult projects like oil exploration.

Fourth: The government should focus on the law and order situation prevailing in our country, they should provide safe and secure environment to investors so that they may invest in the oil exploration projects.

Fifth: The government should emphasize on the achievement of advance technology. Instead of importing oil, the government should import heavy machinery necessary for oil exploration, so that the domestic oil production may increase.

Sixth: The government should not wholly and solely depend on oil, but also look for alternative energy sources like

- Coal energy: As coal is a cheap source of energy in Pakistan due to its abundance. The major source of coal in Pakistan is Ther Coal**.** So the government should initiate such projects to utilize this source of energy in order to bridge the gap between demand and supply of energy.
- Wind energy: Another cheapest source of energy is wind energy. Government should install wind turbines in those areas with high average wind speeds.
- Hydro energy: Water being a natural resource available in abundance in our country, so the government should install hydraulic turbines on water sources like rivers, canals etc.
- Nuclear energy: Being a nuclear power, the government should install nuclear power plants for the generation of nuclear energy which can be used to offset the energy crisis.
- Solar energy: Sun being the biggest source of energy in the universe and particularly in Pakistan because there are virtually 300 sunny days out of 365.So the government should take steps to promote use of solar energy through easy availability of solar cells.

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