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Determinants of Import Demand for Crude Oil in Pakistan

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ABSTRACT

This study analyzes determinants of import demand for crude oil in Pakistan. For this purpose, Co-integration technique has been used to estimates long run relationship between crude oil import demand and its determinants; GDP per capita, price of crude oil, real effective exchange rate, and electricity production from oil sources. This import demand of crude oil function empirically tested for Pakistan. Results show that import demand elasticity of crude oil with respect to its different determinants is different. The import demand of crude oil is affected positively and significantly by GDP per capita and electricity production from oil sources. Price and real effective exchange rate have negative and significant impact on crude oil import demand in Pakistan. This study provides guidelines for macroeconomic policymakers in order to formulate comprehensive and appropriate import policy for crude oil.

Keyword: Import demand, Crude oil, Pakistan

INTRODUCTION

Petroleum products are considered as life line of any economy. Recent fluctuation in crude oil prices attracted attention to analyze demand behavior of crude oil in Pakistan. Further Pakistan imports 467,738 barrels of crude oil per day (Worldometer, 2019). Import of petroleum products has highest share in total imports of Pakistan. Crude oil imports effect total foreign reserves, balance of payment and trade deficit. All of these concerns make it important to study about determinants of import demand of crude oil, which is primary objective of this paper. In modern world energy is getting more importance day by day. Now production of single unit of any commodity is not possible without use of energy (GOP, 2019). A lot of energy resources are available on earth, but most useful and familiar one is fossil fuel oil which is also called crude oil. It is used in many forms of it e.g. Petrol, Diesel, jet fuel, high octane, kerosene and etc. thus consumption, price and availability of crude oil is much important economic issue, because It stimulates economic growth and development of a country. Major usage of petroleum products is in transportation, industry, electricity production and agriculture sectors (Zaman, 2013; Asif et al., 2017).

Supply of petroleum products is chain process consists of exploration, extracting and transportation. Explored oil reserves are scattered in all over the world and owned by the different oil companies. These companies extract crude oil and refine it into number of petroleum products. World largest oil reserves are present in Middle East, Russia and America. Transportation of crude oil is held through tankers, pipeline and rail. OPEC (organization of petroleum exporting countries) has major share in international trade of crude oil (Rumi, 2000; Rafique et al., 2020).

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The world total consumption of crude oil in 2017 was 89.42 million barrels per day (worldometer, 2019). United States, China, Japan, India, Russia are biggest oil consuming nations. Transportation is biggest sector of oil consuming in all over the world which consume gasoline, diesel, jet fuel and kerosene. Industrial sector consume lubricants, adding dyes, waxes, asphalt and number of other by products. Mechanization of agricultural sector also increases consumption of petroleum product (Agbola, 2005; Khan et al., 2020).

International Price of crude oil in early 20th century has been controlled by oil companies' cartels under the Red line agreement 1927 and Achnacarry Agreement 1928. In 1960 organization of oil exporting countries (OPEC) was established in 1960 in Iraq, now it has significant role in price determination of international price of crude oil. The basic aim of OPEC is to counter the monopoly of oil companies. Now 12 countries are member of it. Kingdom of Saudi Arabia (KSA) is active player of OPEC because it has biggest exporter of crude oil in International market. Under OPEC each country has a fixed quota to extract crude oil to control total supply of it in international market (Aqeel and Butt, 2001; Anaman et al., 2001).

Pakistan is an importer of crude oil and refined petroleum products. Pakistan own production of crude oil is 88,262 barrels per day, but consumption is 556,000 barrels per day. Total 6 oil refineries with capacity of 186000 barrels per day are working in Pakistan. Most of them are using imported crude oil. Petroleum products are 31 % of total energy supply of Pakistan. Major usages of oil products are transportation, industry, and electricity production (Worldometer, 2019).

Imports related to petroleum products have significant effect on our economy. Economists agree on that availability of crude oil or other petroleum products have positive impact on economic growth (Ali et al., 2020). Reasons behind this phenomenon are; first is that every production method has involvement of energy usage due to mechanization, and second is that transportation facilities totally depend on oil consumption. So import of petroleum products is highly important for our economic growth (Ahmed and Hawdon, 1997; zaman et al., 2013). Pakistan is oil importer country, because we have a huge difference between our crude oil production and consumption. Share of petroleum products in total import is largest (Tsirimokos, 2011; Asif et al., 2020). On other hand we are also facing shortage of foreign reserves, so our trade balance and balance of payment is highly influenced by import of petroleum products (Sinha, 1997; Ziramba, 2010). Pakistan is a developing country and every developing country of the world is suffering problem of trade deficit. Imports of petroleum products have largest share in our total imports so crude oil import is sensitive issue related to our trade balance.

LITERATURE REVIEW

In literature, major determinants of import demand for crude oil are commonly aggregate national income and price of crude oil, which are derived from microeconomic demand theory. Some researcher also include other independent variables like population, exchange rate, degree of urbanization and price of natural gas as a substitute good in their import demand model.

Al-Azzam and Hawdon (1997) applied Stock and Watson dynamic OLS model to estimate energy consumption of Jordan from 1968 to 1997, the results shows significant positive relationship between oil demand and aggregate Income, construction activities and political stability, whereas real price of crude oil have insignificant and negative relationship. Zhao and Wo (2007) studied

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demand behavior of crude oil in china. They estimated that domestic energy production, industrial output, and total traffic volume have significant and positive impact on demand for crude oil in china, and relationship between price and demand of crude oil is negative and significant. Ghosh (2009) examined that import demand for crude oil in India is income elastic but inelastic with respect to price. On other hand, Ziramba (2010) studied that import demand for crude oil in South Africa is inelastic with respect to both price and income. Tsirimokes (2011) applied partial adjustment model to estimates price and income elasticities for crude oil of ten industrial countries and find out income and price are inelastic in short run but elastic in long run.

Marbuah (2010) studied import demand for crude oil in Ghana and he included population growth rate in his model, results confirm population growth rate has positive but insignificant impact on crude oil import. Comacho (2011) included price of natural gas as price of substitute good in his study of import demand for Mexican crude oil in USA. De Schryder and Peersman (2012) studied oil demand of 65 oil importer countries and exchange rate of US dollar with panel data estimation techniques and find out that when US dollar appreciate with respect to domestic currency of importer country then oil demand decline.

A number of studies related to Pakistan oil consumption, and its effect on economy are part of literature. Aqeel, and But (2001) studied causal relationship between energy consumption, economic growth and employment in Pakistan. Co-integration and Granger causality tests are applied to confirm relationships between energy consumption, economic growth, and employment. The results confirm that usage of petroleum products are positively affected by economic growth and total energy consumption has positive impact on employment level of Pakistan. Zaman et al (2013) studied energy consumption in Pakistan by using data from 1980 to 2011. They applied co-integration, ECM, and Granger causality tests to confirm long term relationship between commercial energy demand and macroeconomic factors. This study confirms long term relationship between oil consumption and exports, industrial production, and agricultural yield.

METHODOLOGY AND DATA SOURCE

According to classical demand theory, demand of particular commodity is function of income and price. In our model import demand of crude oil is also derived from microeconomic demand theory. In this study; import demand of crude oil for Pakistan is function GDP per capita, price of crude oil, real effective exchange rate and electricity production. In this study, Co-integration technique has been used to estimates long run relationship between crude oil import demand and its determinants. The functional form of our study is as given below:

OIL = f (GDP, PRICE, REER, ELEC)

OIL represents import demand for crude oil (Thousand Barrels Per Day) in Pakistan. It is dependent variable of our model.

GDP represents GDP per capita in current US$. it is taken as income level of country and income is necessary explanatory variable in demand function.

PRICE represents price of crude oil per barrel, and price is also essential variable of demand function according to demand theory.

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REER represent Real Effective Exchange Rate. It is also an explanatory variable and reason behind to add it into this model is continuous decline in our exchange rate. Another reason is all international trade of crude oil occurs in US$.

ElEC represents electricity production from oil sources (% of total electricity production from all sources). Pakistan is facing short fall of electricity from many year. Short term solution of electricity short fall is production of electricity from oil, this trend increase oil demand in Pakistan. Specific form of our model is given below;

$$\ln OIL_t = \alpha + \beta_1 GDP_t + \beta_2 PRICE_t + \beta_3 REER_t + \beta_4 ELEC_t + \varepsilon_t, t=1,2,3, \quad (2)$$

Logarithmic form of variables is used in this study, after taking naturel log of variables equation cab be written as;

$$\ln OIL_t = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln IPRICE_t + \beta_3 \ln XREER_t + \beta_4 \ln ELEC_t + \varepsilon_t, t=1,2,3, \quad (3)$$

Data sources

Import demand of crude oil is dependent variable and, GDP per Capita, Price of crude oil, Real Effective Exchange Rate and Production of electricity from oil sources (% of total electricity production from all sources) are independent variables of this study. The relationships between these variables are empirically tested from 1990 to 2020. Data for the variables of GDP per capita, real effective exchange rate and production of electricity from oil sources (% of total electricity production) is obtained from World Development Indicators (WDI) by World Bank (2021). Data for import demand for crude oil is taken from US energy administration data base, and data of prices of crude oil is taken from Illinois Oil & Gas Association.

RESULTS AND DISCUSSIONS

We have used ADF unit root test to check the stationarity of time series data in logarithmic form. According to these results variables of Import demand of crude oil (oil), GDP per capita, price of crude oil, real effective exchange rate (REER), electricity production from oil sources are not stationary at level. This implies that null hypothesis of unit root at level cannot be rejected for all variables. However, all the variables are stationary at 1st difference. This shows the null hypothesis of unit root for all variables is rejected when we use the 1st difference of the variables. Thus the variables have same order of integration. All of them are I(1).

Table No. 1
Augmented Dickey-Fuller (ADF) Unit Root Test Results

Augmented Dickey-Fuller (ADF) Test at Level		
Variables	**t – Statistic**	**p-Value**
ln *OIL*	-3.0607	0.0471
ln *GDP*	0.4880	0.9824
ln *PRICE*	-0.1824	0.9269
ln *REER*	-1.7405	0.3976
ln *ELCP*	-2.6817	0.0934

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Augmented Dickey-Fuller (ADF) Test at 1st Difference		
Variables	t –Statistic	p-Value
Δln *OIL*	-2.6684	0.0977
Δln *GDP*	-3.9714	0.0064
Δln *PRICE*	-4.1411	0.0047
Δln *REER*	-4.2052	0.0043
Δln *ELCP*	-3.1510	0.0387

In Vector Auto-Regressive (VAR) process maximum allowed lag length is 3, According to the number of observations, number of variables and lags requirement of the co-integration t0est. Schwarz Information Criterion (SIC) suggests that an optimal lag length of 1. So we used lag length 1 in our analysis. Johansen co-integration technique has been applied to check the co-integration among the variables of import demand of crude oil, GDP per capita, price of crude oil, real effective exchange rate, and electricity production from oil sources (% of total electricity production).

The results of Johansen's co-integration test are given in Table 2 and Table 3. Trace statistics and maximum eigen statistics are used to decide the number of co-integrating vectors. In both tests the null hypothesis is; there is no co-integration, and alternative is presence of co-integration. In table 2 Trace statistics are higher as compared to their critical values at 10 % level of significance till at most 3, So, series are co-integrated at most 4.

Table No. 2
Unrestricted Co-integration Rank Test (Trace)

H_0	Trace Statistic	0.1 Critical Value	Prob**
None *	136.8965	65.81970	0.0000
At most 1 *	79.16743	44.49359	0.0000
At most 2 *	40.24405	27.06695	0.0022
At most 3 *	13.83008	13.42878	0.0877
At most 4	0.846399	2.705545	0.3576

Trace test indicates 4 co-integrating eqn(s) at the 0.1 level
* denotes rejection of the hypothesis at the 0.1 level
**MacKinnon-Haug-Michelis (1999) p-values

Table No. 3
Unrestricted Co-integration Rank Test (Maximum-eigen value)

H_0	Max-Eigen Statistic	0.1 Critical Value	Prob**
None *	57.72911	31.23922	0.0000
At most 1 *	38.92338	25.12408	0.0012
At most 2 *	26.41397	18.89282	0.0082
At most 3 *	12.98368	12.29652	0.0789
At most 4	0.846399	2.705545	0.3576

Max-eigenvalue test indicates 4 co-integrating eqn(s) at the 0.1 level
* denotes rejection of the hypothesis at the 0.1 level

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**MacKinnon-Haug-Michelis (1999) p-values

Results given in table 2 and table 3 proves that series are co-integrated, so import demand of crude oil, GDP per capita, price , real effective exchange rate and electricity production from oil sources have Long run relationship and results of OLS regression are reliable. Results of OLS regression are given in Table 4. They represent long run elasticities of Import demand of crude oil with respect to GDP, price, real effective exchange rate and electricity production.

Table No. 4
Long Run Relationships

Dependent Variable: OIL			
Variable	**Coefficient**	**t-Statistic**	**p-Value**
ln *GDP*	0.820640	2.736444	0.0146
ln *PRICE*	-0.485201	-3.005754	0.0084
ln *REER*	-1.168116	-2.373380	0.0305
ln*ELCP*	0.604622	4.816239	0.0002
Constant	4.868471	1.588377	0.1318
R^2 = 0.831628 Adj-R^2 = 0.789536 F-Statistic = 19.75699 Prob(F-statistic) = 0.000005 Durbin-Watson = 1.715115			

Import demand of crude oil (OIL) is dependent variable and GDP per capita, price of crude oil, real effective exchange rate (REER) and electricity production from oil (ELCP) are independent variables. All the independent variables used in study have significant impact on oil import in Pakistan as showing their p-Values in table 4. GDP and Electricity production for oil have positive impact on oil demand and on other hand price and real effective exchange rate have negative impact on oil demand. Highest impact on oil import is REER which elasticity is (-1.168116) which shows depreciating trend in our currency makes imports expensive, and it is followed by GDP which is (0.820640), and after it electricity production from oil which is (0.604622). Impact of Price is lowest which shows Oil demand less elastic with respect to price because oil becomes necessary commodity in our economy.

All variables have theoretically correct signs, as microeconomic classical demand function. The value of R^2 is 0.83 which shows 83 % Change in Oil demand follows change in independent variables of this study. F-statistic shows significance of overall model. The value of Durbin Watson is also satisfactory.

Table No. 5
Diagnostic tests

Normality Test (Jarque-Bera Statistics)	Jarque-Bera Statistics = 0.631518	Probability = 0.729235

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Serial Correlation (Breush-GodfreySerial Correlation LM Test)	F-statistics = 0.09366	Probability = 0.9112
ARCHTest (Autoregressive Conditional Heteroskedasticity Test)	F-statistics = 1.009833	Probability = 0.3283
Heteroskedasticity Test (White Heteroskedasticity Test)	F-statistics = 0.562438	Probability = 0.8243

In Table 5 results of diagnostic tests are given, these tests are applied to check the validity of basic assumption of OLS regression. Jarque-Bera test is applied to check problem of normality, Breush-Godfrey serial correlation LM test is applied to check serial correlation, ARCH and White test are applied to check problem of Heteroskedasticity. Results of these test based on their probability values shows there is no serial correlation, autoregressive conditional Heteroskedasticity and residual are normally distributed.

CONCLUSION

The central objective of this study is to find out determinants of import demand of crude oil in Pakistan. The results favor the microeconomic demand theory as demand is function of Income and Price. Price elasticity of import demand of crude oil is 0.48 which is lowest in model, it means oil is becoming necessary commodity and nation is bound to purchase it at every cost, so this point is useful for revenue purposes. But the conclusion of this study is that real effective exchange rate and electricity production from oil sources impact on import demand of crude oil effectively. Continuous depreciating trend in our currency is making good impact to reduce demand of crude oil, which is major head of our import bill and has a worst effect on balance of payment and trade deficit. If depreciating trend in currency can reduce import of crude oil, it's never mean it is good sign. Reduction in oil import may be trade off sustainable economic growth and development, because existing economic literature shows highly dependency of economic growth on energy consumption. On other hand, increasing trend of electricity production from oil sources is alarming situation for an oil importing economy. If Pakistan remains dependable on oil for electricity production then trade deficit may increase too many fold. There is a strong need to find out others ways of electricity production like hydro, solar and bio fuel because Pakistan cannot afford such waste of foreign reserves to import crude oil.

REFERENCE

1) Agbola, Frank W. and Maylene Y. Damoense (2005), "Time Series Estimation of Import Demand Functions for Pulses in India," Journal of Economic Studies, 32, 2, 146-157.
2) Al-Azzam, Ahmed and David Hawdon (1997), "Estimating the Demand for Energy in Jordan: A Stock- Watson Dynamic OLS (DOLS) Approach," Mimeo, 16 pages.
3) Ali, S., Asif, M. F., Khan, M. K., Fatima, N., Safdar, H., & Lassi, Z. S. (2020). Moderating role of husband's education and their employment on female labor force participation in Pakistan. *Ilkogretim Online*, *19*(4), 5265-5276.
4) Anaman, K. A., & Buffong, S. M. (2001). Analysis of the determinants of aggregate import demand in Brunei Darussalam from 1964 to 1997. *Asian Economic Journal*, *15*(1), 61-70.

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2019.26.02.262

5) Aqeel, and M.S But (2001). The Relationship between Energy Consumption and Economic growth in Pakistan. Asia-Pacific Development Journal 8:2,101–109.
6) Asif, M. F., Mirza, U. K., Khan, A. H., Asif, M. Z., Riaz, S., & Ahmed, S. (2017). Job Satisfaction: Antecedent and Consequences. *Bulletin of Business and Economics (BBE), 6*(4), 185-194.
7) Asif, M. F., Safdar, H., & Ali, S. (2020). Factors affecting the performance of school students: A case study of Bahawalpur. *Ilkogretim Online, 19*(3), 3650-3660.
8) De Schryder, S. and G. Peersman (2012). The US Dollar Exchange Rate and the Demand for Oil. CESifo, Working Paper no. 4126.
9) Gosh, Sajal (2009), "Import Demand of Crude Oil and Economic Growth: Evidence from India," Energy Policy, 37, 699-702
10) K. Zaman, Mushtaq, and Mehboob. (2013). "Factors affecting commercial energy consumption in Pakistan: Progress in energy". Renewable and sustainable energy review 19, 107-135.
11) Khan, R. S., Jan, S. A., Afridi, J. R., & Asif, M. F. (2020). Impact of" Food for Education Program" on Child Labour incidence in Tribal Districts of Khyber Pakhtunkhwa, Pakistan. *Ilkogretim Online*, *19*(3), 3307-3320.
12) Mah, Jai S. (2000), "An Empirical Examination of the Dis-aggregated Import Demand of Korea –The Case of Information Technology Products," Journal of Asian Economics, 11, 237-244.
13) Marbuah,G (2010), "Understanding Crude Oil Import Demand Behaviour in Ghana",
14) Masih, Rumi (2000), "A Reassessment of Long –Run Elasticities if Japanese Import Demand," Journal of Policy Modeling, 22, 5, 625-639.
15) Rafique, T., Asif, M. F., Afridi, J. R., Rehman, N. U., & Mahmood, K. (2020). Credibility of social networking sites: impact on organizational attraction in recruitment filed. *Sarhad Journal of Management Sciences*, *6*(2), 279-294.
16) Senhadji, Abdelhak (1998), "Time-Series Estimation of Structural Import Demand Equations: A Cross- Country Analysis," IMF Staff Papers, 45, 2, 236-268.
17) Sinha, Dipendra (1997), "Determinants of Import Demand in Thailand," International Economic Journal, 11, 4, 73-83.
18) Thursby, Jerry and Marie Thursby (1984), "How Reliable Are Simple, Single Equation Specifications of Import Demand?" The Review of Economics and Statistics, 66, 1, 120-128.
19) Tsirimokos, C. (2011). Price and income elasticities of crude oil demand: The case of ten IEA countries. Published master thesis, Department of Economics, Swedish University of Agricultural Sciences, Uppsala, Sweden.
20) World Bank (2020). *World Development Indicators (WDI) Online Database*, Washington D.C., USA: The World Bank.
21) Worldometer (2019). Pakistan's crude oil consumption and reserves. Available at: https://www.worldometers.info/oil/pakistan-oil/
22) Zhao, Xingjun and Yanrui Wu (2007), "Determinants of China's Energy Imports: An Empirical Analysis," Energy Policy, 35, 4235-4246.
23) Ziramba, Emmanuel (2010), "Price and Income Elasticities of Crude Oil Import Demand in South Africa: A Cointegration Analysis," Energy Policy, 38, 7844-7849.