

Impacts of Petroleum Products on National Economy of Pakistan: An Input-Output Analysis

Farman Bhayo^{1*}, Faheemullah Shaikh², Khanji Harijan¹, Zeshan Abbas¹

¹(Department of Mechanical Engineering, Mehran University of Engineering & Technology,
Jamshoro, Sindh Pakistan)

²(Department of Electrical Engineering, Mehran University of Engineering & Technology,
Jamshoro, Sindh Pakistan)

ABSTRACT: Petroleum products are prime source of energy production, it is a conventional method and ease of use for energy production, it is key to stimulating the micro economic development of the national economy of Pakistan. In this study, direct, indirect and induced impacts of petroleum products on the national economy of Pakistan have been analysed by using input output approach. Two types of impacts are analysed (1) The total economic impacts coefficients on output, given each unit of final demands change in the petroleum industry were 2.73 and (2) The total economic impacts coefficients on Gross Domestic Product (GDP) given each unit of the final demand change in the petroleum industry were 0.18. The direct and indirect impacts on the total output of petroleum industry were 2.1 and induced impact of the sector were 0.629 in year 2013. Direct impacts were recorded higher on those sectors which directly indirectly consume mechanical and electrical power. In future, the impacts of petroleum products on the national economy of Pakistan will raise due to the uncertainty of imported oil.

KEYWORDS -Economic impacts, Petroleum Industry, Input-Output, GDP,

I. INTRODUCTION

The high growth rate of the national economy of Pakistan is supported by energy consumption, the economy of the country is steadily growing, for smooth progress of national economy of the country enough amount of energy is needed to quench the thirst of energy. Energy and economy are interconnected declining resource of energy, raising burden of imported oil on the national exchequer. The demand for energy is increasing and it has strong impacts on the national economy of the country. Thus, the country is directing to discover new sources of energy other than petroleum products. It is hard to shift from non-renewable to the renewable resource in a short time because it required huge initial investment. Therefore the consumption of petroleum cannot be denied, extraction of crude oil has increased 11.6% in 2013 [1]-[2]. Consumption of petroleum products in Pakistan increase upto 17.5% in the last thirteen years from 2000 to 2013. Since industrialization consumption of petroleum continuesly increasing, after analysing the current trend of consumption, it may increase further in future. Proven resource of petroleum in the country is not enough to meet the raising demand for energy, thus Pakistan has imported about to 136×10^6 barrels in year 2013 [3]. In July 2016 about to 35.57 million barrels of cured oil was imported and growth was recorded about 3.5% and the country has paid for imported oil US \$ 3.59 billion compared to US \$ 1.97 billion .Globally share of petroleum products in energy production is about 32.9% and more than 67% of petroleum products are consumed in the transport sector. Thus, the importance of oil cannot be denied, as its importance has increased worldwide when energy demand grows globally[4]. Consumption of petroleum in the world decrease 1.7% in 2009, this was the first time consumption was declined since 1982. This turn down was also recorded more sternly in developing nations like as Bangladesh, Pakistan etc. Consumption of petroleum products declined 4.9 in 2009 [5]. Tanaka H .et al [6] has investigated that big portion of energy comes from fossil fuels and fossil fuels and gases consider as the backbone of the economy. Thus, the priority is given to energy projects and needed to complete the projects within given time due to huge investment involved in the energy sectors. Consumption of the energy measure social and economical standard of the mankind, ener-

gy consumption improve living standard, energy and economy are interconnected and it is considered as driving force of national economy of the certain nation, as investigated by Shaligram. P. et al [7]. By using Hsiao's version granger causality and co-integration, Benjamin. S. at al [8] has investigated the co-relation of energy and Gross Domestic Product (GDP) from the period 1955 to 1993 findings of the study concluded that energy consumption and economic growth have strong co-integration, declined consumption forward negative impacts GDP growth. A large portion of energy comes from petroleum products, energy production directly depending on the production of petroleum products once production decline, simultaneously energy generation also decline and energy distributes its impacts on other sectors of the economy. Normally there are numerous methods which are used to understand the future demand of country, prediction of future demand can be understood by analysing standard consumption rate or previous status of the country, usually forecasting considered accurate if it correlate to past consumption and future demand. A method developed by Wassily leontief in late 1936 the method is known Input output analysis (IO). Usage of the model is not limited it can be used national and international levels. IO analysis based on transaction held within the economy and outside the economy and give clear picture of macro-economic, use of model is not limited it can be used multiple discipline, i-e Environmental studies, energy projection and planning procedure etc. later leontief work was extended by Manfred L et al [10], researcher has searched out different methods to organise data for the IO table and its usage worldwide. The required data for IO tables are tracked by various trusted organizations such as environmental protection agencies, monitoring departments, energy producers and consumers, and strategic planning boards. Input output table of Pakistan is developed by Multi-Regional Input-Output Table (MRIO), Table is organised by analysing the energy consumption, foreign trade, carbon foot printing, ecological and life cycle assessment. Pakistan is paying a big amount for imported petroleum products and keenly interested in the enhancement and development of the sector. However, previously number of researchers have attempted to understand the effects of petroleum on the energy or some specific sectors of the economy, that researcher work may not explain the importance of the petroleum sector properly.

In this study, impacts of petroleum industry on the different sectors of the economy, as well as total output and impacts on GDP has been calculated and compared by using Wassily leontief Input Output model. Study guidelines have defined the decency of individual sectors on the petroleum industry.

II. LITERATURE REVIEW

Growing demand for energy has increased the consumption of petroleum products. Declined recourse of natural gases and the increase of its usage in the urban areas has put burden on the oil industry. Pakistan import large amount of crude oil form gulf countries, consequently it has an adverse effect on the national economy of Pakistan. The economy of a certain region is actually dependent on collective production of different sectors either the indigenous production or external production. Due to interconnectivity among different sectors shortfall of any production forward its impacts on the other sectors. Like as some input is required to produce some useful product as output and for single useful output either in the form of physical shape or service number of input or raw material is required. Based on this concept leontief correctly estimated the final demand for different products and required service of labors in the national economy of the United states of America. IO model can be used engineering, social and economic sides as suggested by Wassily et al [11]. Sources of energy is not limited but only sophisticate sources are preferred for energy production, petroleum is a prime source of energy is usage cannot be denied. Importance of petroleum industry and its distributive effect was studied by Heo. J. Y. *et al* [11], the study was conducted by using IO model results of study illustrated that 0.1024 won increased in other sectors of the economy if the sum of 1.0 Korean won investment increased in petroleum industry. The gross productivity of the petroleum industry was recorded in year 50.37 trillion won in 2003.

A study conducted by lorentzen *et al*, [12] results of the study were calculated by using leontief model, emission of different sectors were estimated based on given data of final demand of different sectors, effects of different sectors on the national economy and sectorial change in the global market were analysed, results of the study defined that CO₂ emission mitigation potential have in these sectors, like as agriculture concentrate, chemical industry, passenger and freight transport, power generation, air transportation iron and steel industry.

If 10,000 yuan output increase in the processing of petroleum products and extraction of petroleum products it created about yuan 1886.72 and 2726.15 yuan equivalent jobs respectively. Results show that extractions have lower competence to generate employment and compared to processing of petroleum products, direct, indirect and induced impacts were also analyzed in the study, direct impact of extraction on employment income have 34.2% and processing of petroleum products has 7.2% as investigated by Tang et al [14] using IOmodel and IO data of China. Usage of energy found directly indirectly every sector of the economy, energy consumption of household have second higher impacts next to industrial final consumption. Ding Q et al [15] has investigated direct and indirect household consumption of energy in the prospective of public life style by using the IO model. Findings of the study suggested that out of total energy consumption more than 24% of energy directly consumed in household activities in china. However indirectly used of energy in household was 1.3 times greater than direct energy consumption.

For progressive development, enough amount of energy is required for china. The economy of the china may not sustain shortfall of energy and could not meet the global trade market. In global market importance of energy is quite noticeable, thus, Petroleum production and consumption, as well as its associated effect was analysed by Tang.X et al [16] finding of the study showed that total economic impacts of process and extraction of petroleum were 3.2747 and 1.9180, consequently 0.9001 and 1.0872 impacts on GDP, the researcher has investigated the probability of oil price increase and its impact on other sector's production, increase of 10% prices of extraction of petroleum products, it could raise 95% average price in the country. In top effected sectors, prices of processing of petroleum may increase 6.25% and supply of Gas 5.52% similarly price of transportation 1.42%. The impacts of green investment of greek economy were studied by Markaki. et al [17] with the support of IO data results of the study show that probably 100800 full time jobs will be created from year 2012 to 2020 if €47.9 billion invested in the green energy projects and given investment can increase production of national economy near to € 9.4 billion annually, similarly energy saving projects or the projects having potential of saving energy can create more jobs per € 1million, like as transport and building.

III. METHODOLOGY AND DATA COLLECTION

Data required for the table is published and maintained by World Multi-Regional Input-Output (WORLDMRIO). Data required for IO table of Pakistan is also published by the organization and that data compared with the standard data of developed countries which annually published IO data officially. IO data is in tabular form, the table is distributed into columns and rows, columns of the table is known as input of the table and row is known output Christian et al [18]. There are some assumptions in the table which proposed by the leontief, such as constrain return to scale, linearity, sector homogeneity and no capacity constraints, these assumptions may effect the accuracy of the table as pointed by Davis et al [19]. This model may not give correct information thus it is used for short term analysis.

$$\text{If a sector, } x_{i1} + x_{i2} + \dots + x_{ij} + \dots + x_{in} + y_i = X_i \quad (1)$$

Where: x_{ij} = production of sector i purchased by sector j , y_i is the final demand of the sector i , and X_i is total output of sector i .

$$\text{Where: } \alpha_{ij} = \frac{x_{ij}}{X_j} \quad (2)$$

Where X_j is total output of sector j

Eq. (2) can be defined as follows:

$$x_{ij} = \alpha_{ij} X_j \quad (3)$$

Eq. (1) will be

$$X_i = \alpha_{i1} X_1 + \alpha_{i2} X_2 + \dots + \alpha_{ij} X_j + \dots + \alpha_{in} X_n + y_i \quad (4)$$

Matrix notation is given below

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1j} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2j} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ a_{i1} & a_{i2} & \dots & a_{ij} & \dots & a_{in} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nj} & \dots & a_{nn} \end{bmatrix} \quad X = \begin{bmatrix} X_1 \\ X_2 \\ \dots \\ X_i \\ \dots \\ X_n \end{bmatrix} \quad Y = \begin{bmatrix} Y_1 \\ Y_2 \\ \dots \\ Y_i \\ \dots \\ Y_n \end{bmatrix} \quad (5)$$

In Eq. (5) $Y(n \times 1)$ is final demand vector, and $X(n \times 1)$ is a vector of output, $A (n \times n)$ is a technical coefficient matrix, Now the equation of Input-Output will become:

$$AX + Y = X \quad (6)$$

Eq. (6) can be written as:

$$(I - A) X = Y \quad (7)$$

In Eq. (7) $(I - A)$ is I and called Leontief matrix and identity matrix respectively,

Eq. (7) further expressed as:

$$Y = (I - A)^{-1} X \quad (8)$$

$(I - A)^{-1}$ is used for calculation of inverse matrix, Eq. (8) is final solution of IO model

final demand is divided into final consumption net export and investment.

Now the Eq. (6) becomes

$$AX + CX + TX + FD = X \quad (9)$$

In Eq. (9) CX and TX is vector of final consumption and vector of net export respectively, Final demand vector is FD and sometime called primary consumption and AX is intermediate consumption or secondary consumption and primary consumption is that which directly consumed by the end user.

In the Eq. (9) C and T are diagonal matrices where numbers of upper triangle and lower of the matrix are zero.

Given as follows.

$$C = \begin{bmatrix} c_{11} & & & & \\ & c_{22} & & & \\ & & \dots & & \\ & & & c_{ii} & \\ & & & & \dots \\ & & & & & c_{nn} \end{bmatrix} \quad (10)$$

$$T = \begin{bmatrix} t_{11} & & & & \\ & t_{22} & & & \\ & & \dots & & \\ & & & t_{ii} & \\ & & & & \dots \\ & & & & & t_{nn} \end{bmatrix} \quad (11)$$

In the above Eq. (10) term c_{ii} calculate the ratio of sector i 's final consumption in sector i 's output.

Where in the above Eq. (11) t_{ii} calculate the ratio of sector i 's net export in sector i 's output.

Eq. (9) further expressed as

$$(I - A - C - T) X = FD \quad (12)$$

Eq. (12) can be written as Eq. (13) where in Eq. (12) $(I - A - C - T)$ is a nonsingular matrix.

$$(I - A - C - T)^{-1} \times FD = X \tag{13}$$

If the change introduced in final demand FD , that change will occur on the X (output) as follows.

$$\Delta X = (I - A - C - T)^{-1} \Delta FD \tag{14}$$

Eq. (14) is used of Calculating total economic impacts,

By putting zero at the place of C , now Eq. (14) calculate only direct and indirect impacts because final consumption CX is not accounted for this case. Now the Eq. (14) will be:

$$\Delta X = (I - A - T)^{-1} \Delta FD \tag{15}$$

The difference of Eq. (14) and Eq. (15) calculate induce impacts.

$$\Delta X_{Inducing} = ((I - A - C - T)^{-1} - (I - A - T)^{-1}) \Delta FD \tag{16}$$

IV. RESULTS AND DISCUSSION

4.1. Calculation of economic impacts coefficients.

Impacts on output are calculated by using Eq. $(I-A-T)^{-1}$ taking the column of petroleum (column seven) from the table. Each element of the petroleum sector measures direct and indirect impacts on the corresponding sector. Total impacts are the sum of direct, indirect and induced impacts, by using Eq. (15) direct impacts and indirect impacts are calculated and Eq. (16) is used for calculating induced impacts. If per unit change is assumed in the FD vector same change will produce in the total output, FD is a contributor of Total output as shown in Eq. (6), Its mean that direct impact of petroleum sector is 1 and indirect impact on the total output is 1.261 in 2013. By using Eq. (16) induced impacts are calculated, induced impacts of the industry given each unit of final demand change in the petroleum industry is 0.629.

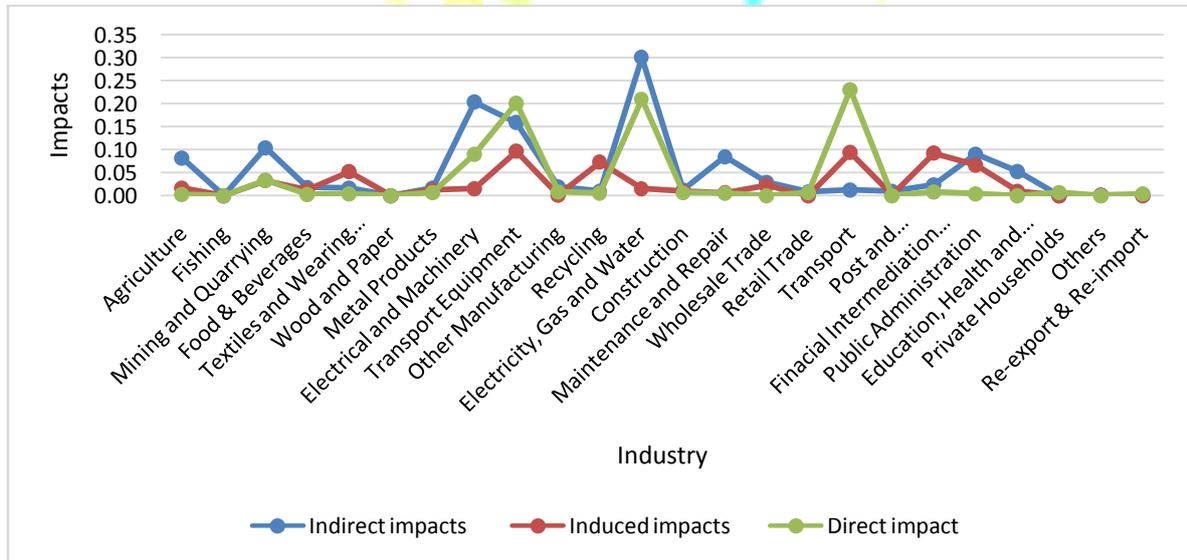


Figure 1. Impacts of petroleum industry on different sectors in year 2013

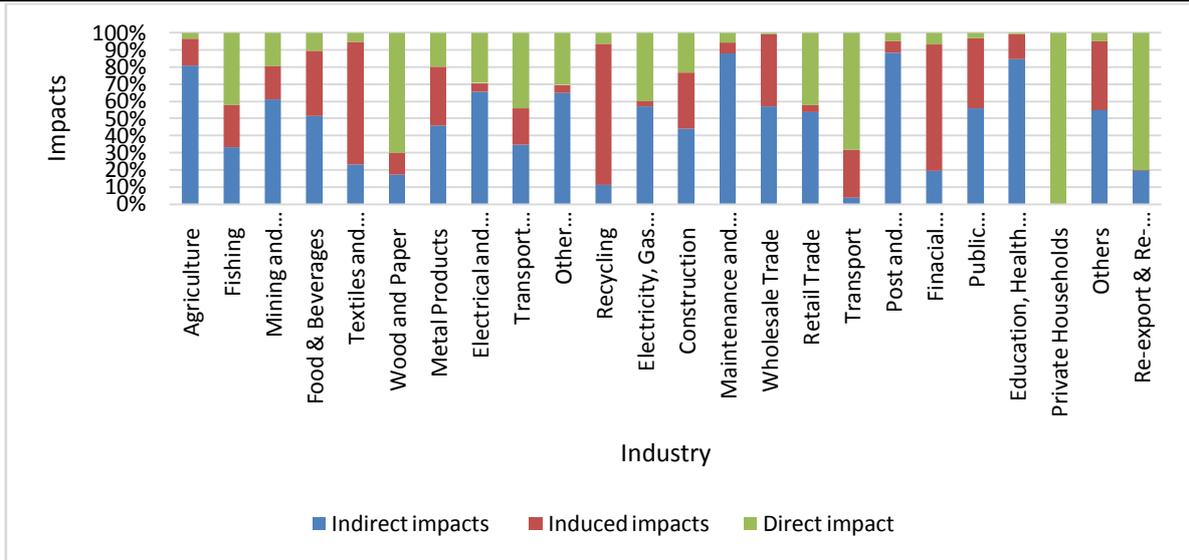


Figure 2. Share of direct, indirect and induced impacts on sectors

In Fig.1 direct, indirect and induced impacts are shown. The indirect impacts on sector Electricity Gas and water are recorded higher. In this tabular form “Electricity Gas and Water” is considered as a single component or single sector, similarly, Indirect impacts on Electricity Gas and water were greater. In year 2013 second higher impacts on electrical and machinery and transport have third higher impacts. It can be observed that the indirect and direct impacts are higher on those sectors that consumed mechanical and electrical power or produce mechanical and electrical power. In Fig.2 percentage of impacts are shown, in few sectors portion of direct impacts is higher and in few sectors direct and indirect proportion is lower as shown in Fig 2. Direct impacts on Private households are recorded higher in year 2013. Different sector’ have different impacts according to their consumption and operational behavior.

4.2 Calculation of economic impacts coefficient on GDP

Consumption of fuel in Pakistan is higher compared to its production, as shown in Fig.3. There isa big supply and demand gap which has created trade deficit in the country. In order to meet the demand of the country a large amount of fuel is imported from Gulf countries and that imported product has adverse effects on the national economy of Pakistan and put a negative effect on GDP. Impacts of petroleum products on GDP were

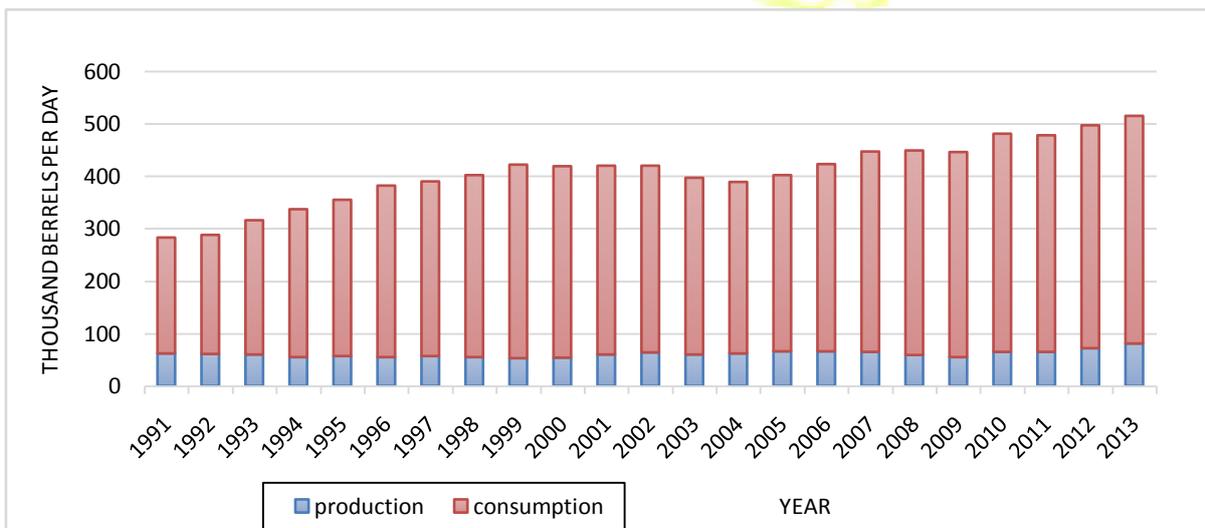


Figure 3. Petroleum consumption and production of Pakistan

studied by many researchers, in this study IO approach is used to calculate impacts.

In IO table a portion is called Value added, this portion is used for calculating Direct, Indirect and Induced Impacts of Petroleum on GDP. To investigate the economic impacts of the petroleum industry on (GDP) Gross Domestic Product, the value-added coefficient used in Eq. (17). Coefficient defines that how much GDP will be created given one-unit output increase. It can be calculated as follows:

$$Z_i / N_i = X_i \quad (17)$$

Where Z_i stands for the value-added coefficient in sector i ; N_i stands for value-added in sector i ; X_i stands for the total output in sector i .

Since last decade Consumption, as well as the demand for energy, is increasing continuously and supply and production is limited. Hence the country's energy supply could not meet with the demand, since a decade country is facing terrible loadshedding. By using Eq. (17) impacts of the petroleum industry are calculated these impacts justify the importance of the petroleum sector in the national economy. Value added coefficient varies time to time but in this study considered constant for a year.

Table 2. Economic impacts coefficient on GDP given each unit of final demands changes in Pakistan's petroleum industry.

Year	Direct + Indirect impacts	Induced Impacts	Total Impacts
2013	0.1821	0.0002	0.1823
2010	0.0840	0.0270	0.111
2007	0.1801	0.0188	0.199

Total impacts are the contribution of direct indirect and induced impacts. Total impacts on GDP decreased 44% from the year 2007 to the year 2010 and another hand impacts of the sector increased 40% from the year 2010 to the year 2013 as shown in the corresponding shown in Fig.4

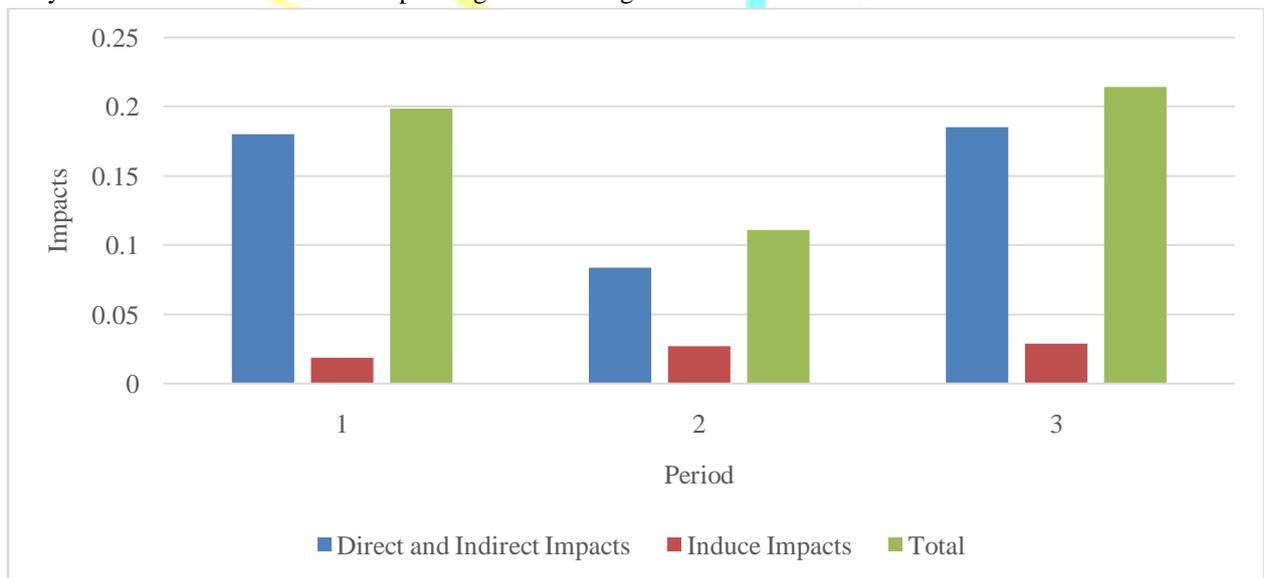


Figure 4. The change of economic impacts coefficients on GDP given each unit of final demand change in the petroleum industry

Induced impacts are formerly called the collective effect of the specific sector on other sectors of the economy. In total impacts, the contribution of induced is smaller as compared to direct and indirect impacts as discussed in the previous section. The induced impact coefficient per unit change in the petroleum industry on the GDP as shown in the Fig.4, impacts increase 44% from year 2007 to 2010, whereas from year 2010 to 2013 7% impacts

Impacts of Petroleum Products on National Economy of Pakistan: An Input-Output Analysis

increase, the lower growth of impacts justify that the energy production is shifting from non-renewable toward renewable resources, this converging shows that country is directing towards another resource of energy generation instead of relying on the petroleum products. The second major factor of stability of

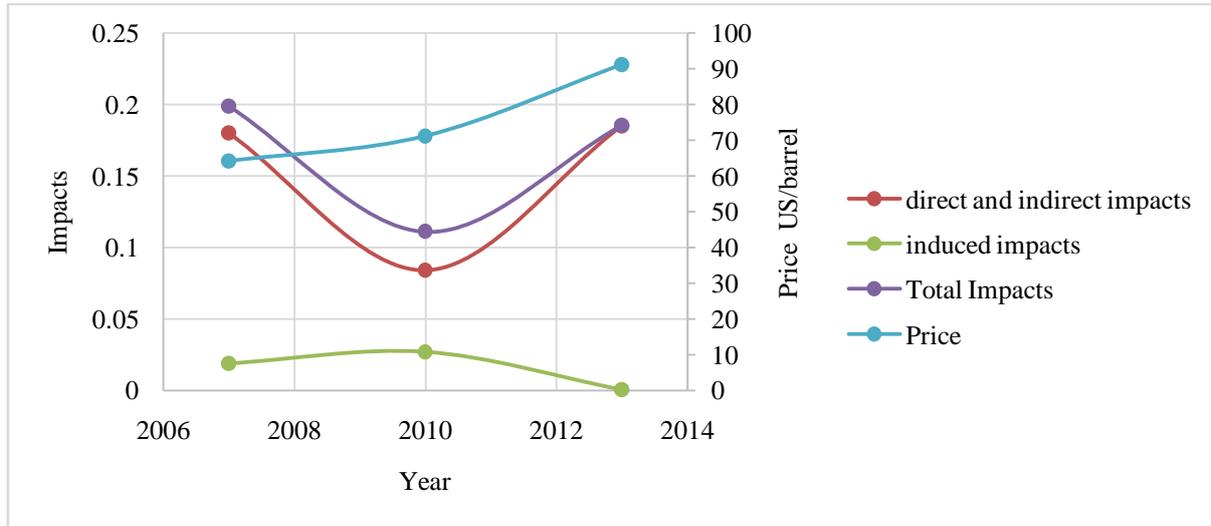


Figure 5. Comparison of petroleum prices and Impacts on GDP in year 2007,2010,2013

impacts in year 2013 were that the prices of petroleum were a stable and third factor is, that the country is using energy-efficient appliances and machinery that reduce energy consumption and retrofitting techniques in order to save the maximum amount of energy. Following few points are associated with the petroleum industry’s impacts on GDP

- Total impacts on GDP are associated with the use of petroleum consumption and its price.
- However, in year 2007 total impacts on GDP were 0.19903, and in year 2010 total impacts were also recorded 0.11113.
- Declined impacts have indicated stability of petroleum prices in the year 2010 whereas induced impacts were increased.
- If petroleum Prices rapidly increases, induced impacts will decrease and total impacts will increase, as shown in Fig. 5

The high price of petroleum products increases its impacts on the GDP where is the smooth progress of petroleum prices has declined impacts on GDP.

4.3 Contribution of the different sectors in total output of the Petroleum sector

Economic impacts coefficients measure the economic impacts given each unit of FD change in Pakistan’s petroleum industry. There is three main energy consumption sources are mentioned in Fig. 6. The given consumption data is maintained by HDIP and PES, provided data gives only information of specific organizations but does not provide the required data of individual sectors. In Fig.6 only major consumer of energy and energy is

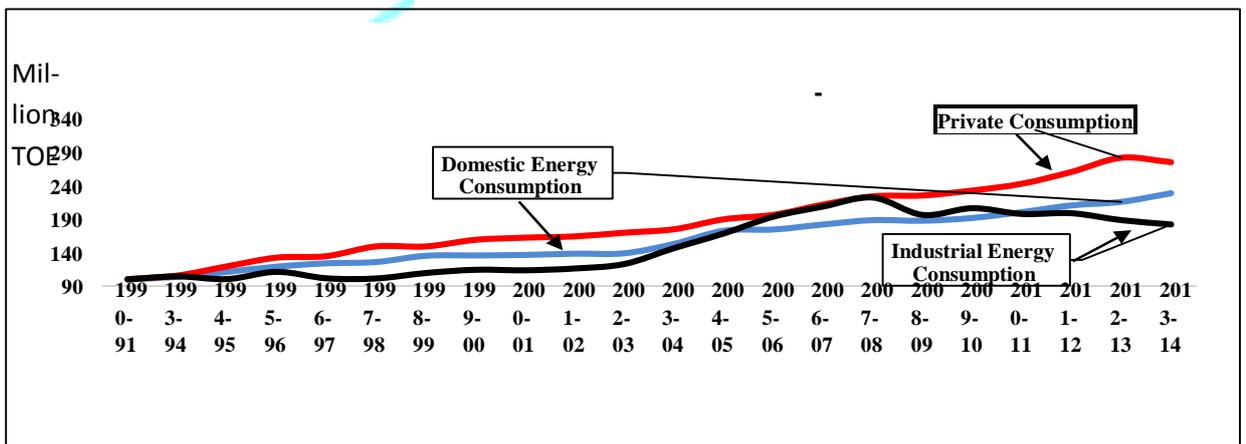


Figure 6. Relation between Private Consumption, Domestic and Industrial Energy Consumption

Impacts of Petroleum Products on National Economy of Pakistan: An Input-Output Analysis

more than 60% contributed by the petroleum products. Similarly petroleum is contributed by other sector and every sector of the economy contributed by number of sectors, similarly, petroleum sector is also contributed by many sectors as shown in Fig 7, the contribution of some sectors in total output in higher and some contribute lower. The share of Textile and wearing Apparel, construction and transport even petroleum is higher in total output. In the given Fig. 7 the contribution of the sectors in total output of the petroleum industry is shown. The agriculture sector, Mining and Quarrying sector, Transport sector, Electrical and Machinery, Constructions, Metal Products and Electricity Gas and Water, etc. Petroleum industry also directly contributing in the total output of the petroleum industry of Pakistan.

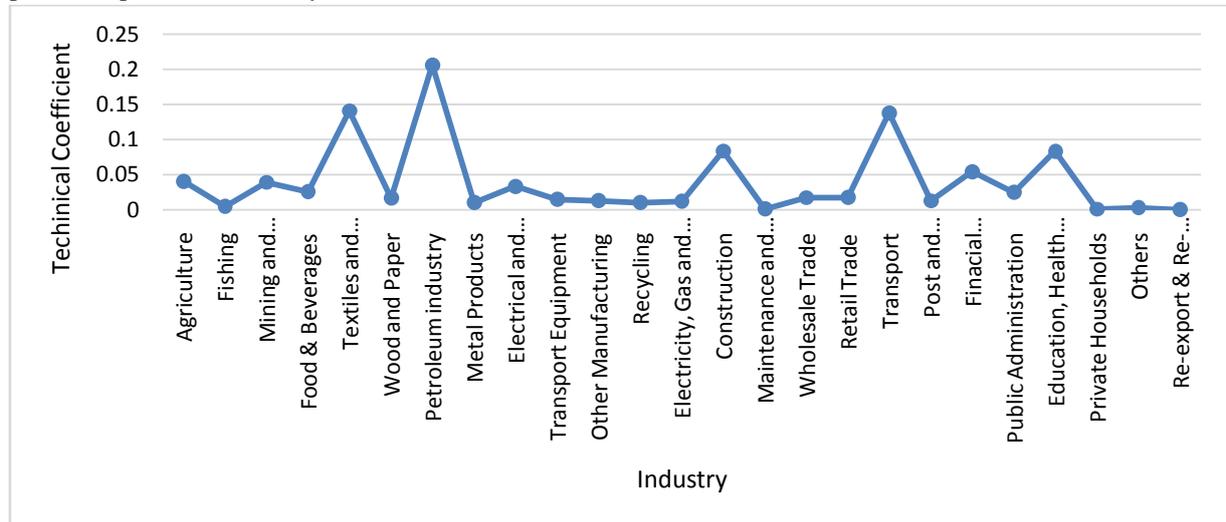


Figure 7. The contribution of the sectors in the total output of the petroleum industry

V. CONCLUSION

As a developing country, Pakistan's economy can't grow smoothly without the support of sufficient energy. Pakistan's petroleum industry is continuously playing an important role in the national economy. The total economic impact coefficients on output, given each unit of final demand change in the petroleum industry, is 3.267, and total economic impact on the GDP, given each unit of final demand change in the petroleum industry economic impacts coefficients is 0.1823. The findings show that the sum of the direct indirect impact ratio of the petroleum industry in GDP and total output is 99.83% and 93.12% respectively. Meanwhile, the induced impact of the oil industry has a greater contribution to overall output compared to GDP. Total output impacts were greater on those sectors that produce and consume electrical power or Mechanical Power. Like as, Electricity Gas and Water, Electrical and Machinery, Transport Equipment, Mining and Quarrying, Construction, Maintenance and Repaired. Petroleum is directly consumed in the transportation sectors, similarly, its impacts were recorded higher in these sectors. Higher production of petroleum products reduces its impacts on other sectors, vice versa. Higher prices of petroleum products can increase impacts on sectors and decline consumption. The high price of petroleum products increases its impacts on the GDP, where is the smooth progress of petroleum prices has declined impacts on GDP. Due to the rising demand for petroleum products, Pakistan's economy will probably face challenges because of uncertainty in oil import sources.

VI. ACKNOWLEDGEMENT

Extended gratitude goes to my supervisor Dr Faheemullah Shaikh and co-supervisor Prof. Dr Khanji Harijan for their endless support, true supervision, help and encourage, technical support throughout to accomplish this paper, I would not able to complete this research paper without the support. I am also thankful to my friend Zeshan Abbas who pointed the correct direction and assisted me to complete the work.

References

- [1] PES, (2015-2016), "Pakistan Economic Survey". Pp. 237-239;
- [2] HPES, (2013-2014), "Highlights of the Pakistan Economic Survey".
- [3] Website, <http://www.indexmundi.com/energy/?country.Data> extracted. 9.p.m .28/7/2 017
- [4] WEB. 2016. World Energy Resources. 2016. World energy council. United Kingdom: World Energy Council.
- [5] BP, (2010), "A Statistical Review of World Energy". Website, <http://www.bp.com/> 2010 [reports and publications]
- [6] Hiroshi, T.; (2014) "Toward Project and Program Management Paradigm in the Space of Complexity: A Case Study of Mega and Complex Oil and Gas Development and Projects". *Procedia-Social and Behavioral Sciences*. V. 119: pp. 65-74.
- [7] Shaligram, P.; (2006) "An Econometrics Analysis of Energy Consumption in Nepal". *Journal of Energy Policy*. V. 3. pp. 1-12.
- [8] Benjamin, S. C.; and Lai. T.; (1997). "An Investigation of Co-integration and Causality Between Energy Consumption and Economic Activity in Taiwan" *Energy Economics*. V. 4. Pp. 435-44.
- [9] Kooros, S.; and Kooros, K.; (1994) "A Markovian Approach for Forecasting Income Distribution for both the Industrialized and Newly Industrialized Countries" *Business Research Yearbook: Global Business Perspectives*, University Press of America, New York, V. 1. pp.431-436.
- [10] Manfred, L.; Keiichiro, K.; Daniel, M.; and Arne, G.; (2012) "Mapping the Structure of the World Economy". *Environ. Sci. Technol.* V. 46 (15), pp 837-8381.
- [11] Heo, J. Y.; Yoo, S.H.; and Kwak, S.J.; (2010) "The Role of the Oil Industry in the Korean National Economy: An Input-Output Analysis" *Journal of Energy Sources, Part B*, 5. pp.327-336. ISSN: 1556-7249.
- [12] Wassily, L.; (1936). "Quantitative Input-Output Relations in the Economic System of the United States," *Review of Economics and Statistics*, V. 18, pp 105-125.
- [13] Lorentzen, D. C.; and Pardo, C. S.; (2017). "Assessing the Impacts of Final Demand on CO₂-eq Emissions in the Mexican Economy: An Input-Output Analysis" *Energy and Power Engineering* V.09, pp 1-15. Article ID:73712.
- [14] Tang, X.; Zhang, B.; and Wei X.; (2013). "Employment Impacts of Petroleum Industry in China: An Input-Output Analysis" *International Journal of Global Energy Issues*, V. 36, pp 117-129
- [15] Ding, Q.; Cai, W.; and Wang, C. (2017) "Impact of Household Consumption Activities on Energy Consumption in China-Evidence from the Lifestyle Perspective and Input-Output Analysis" *Energy Procedia* 105. pp 3384 – 3390.
- [16] Tang, X.; Zhang, B.; Guo, K.; and Feng, L.; (2012) "Petroleum Industry's Impacts on Government Tax Revenues of China: An Input-Output Analysis", *Advanced Materials Research*, V. 524-527, pp. 3129-3133..
- [17] Markaki, M.; Roboli, A.B.; Michaelides, P.; Mirasgedis, S.; and Lalas D.P.; (2013) "The Impact of Clean Energy Investments on Greek Economy: An Input-Output Analysis (2012-2020)" *Energy Policy*. V. 57, pp 263-275
- [18] Christian. K.; and Klaus, H.; (2009) "Assessing the Suitability of Input-Output Analysis for Enhancing Our Understanding of Potential Economic Effects of Peak Oil. *Journal of Energy* V.34, pp. 284-90.
- [19] Davis H. (1990) "Regional Economic Impact Analysis and Project Evaluation". Vancouver, BC: University of British Columbia Press.