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DEMAND AND SUPPLY ANALYSIS OF TRANSPORT ENERGY IN PAKISTAN

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Abstract

Over the last decade, the importance of energy consumption in transport sector has burgeoned forth and has been growing rapidly in Pakistan, and the course is being augured to linger over the coming decades. This paper brings about the function of transport energy demand, economic growth (GDP), oil rents, gas rents, road length and number of registered vehicles for Pakistan over the 1980-2015 by using Autoregressive Distributive Lag (ARDL) approach. The results which have come about shows preponderance of the fact that there is significant relationship between all concerned variables when transport energy demand is used as a dependent variable in Pakistan. Hence, Autoregressive Integrated Moving Average (ARIMA) model is used for the future forecasting related to the consumption and production of gasoline and oil. According to the forecasted results, consumption (demand) is much greater as compared to production (supply) in both non-renewable sources. As policy makers suggest, we can make up for this lacuna by bourgeoning forth new technology (hybrid vehicles) as well as an awareness campaign through which we can make others abreast of this research may be launched about energy conservation methods to curtail the transport energy demand (TED) in the country.

Key words: transport; energy; GDP; hybrid vehicle

JEL Codes: O18, R11, R41, R42

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Introduction

Pakistan has been put onto the list of developing countries (Jeswani, Wehrmeyer et al. 2008). Population is on the surge in Pakistan. The cascadation in economic activity and population growth are the paramount causes for rise in the personal travel and freight transport in Pakistan. With time passing by consumer taste in travelling is changing because of the availability of new technology which is being introduced to the world as well as to Pakistan with every passing minute (Jansson, Marell et al. 2010). As incomes of the denizens of Pakistan is increasing so is their demands for the new vehicles to run their daily chores.[(Habib and Alam 2003), (Zakaria 2003), (Fuster and Colantonio 2004)]. Due to the surge in the economic activity, the demand in transport sector has increased manifolds. Aforementioned are the rudimentary indicators which cause the increase in the TED with the passage of time.

Hence, the numbers of vehicles has been surged which inadvertently galvanize the increase in demand for transport energy. The vehicles for personal consumption and freight transport system are the main cause of the increase in the transport energy in Pakistan.

In these times, Pakistan has been bolstered on the inefficient transport energy modes. Due to the very fact that a major usage of energy is on the inefficient modes of transport sector, a large quantity of transport energy is going to the drains in the transport sector. Transport sector and Employment sector in Pakistan they coincide with each other (Arif, Nazli et al. 2000), because myriads of job holders commutes easily from one place to another. Due to the increase in technology across the globe has happened and will keep on happening which in result is instigating economic growth as well as the labor productivity. This trend is taking place not just in Pakistan but is happening across the blue planet (Lakshmanan 2011). In the economy of Pakistan, as in the case with global economy, there are two main actors of market commonly known as producer and consumer, both of these depend upon the transport sector to minimize their cost and maximize their profit. There is a strong correlation between energy consumption and economic growth, so if energy demand diminishes, GDP decreases (Twerefou, Akoena et al. 2007).

In transport sector, energy is a very exigent aspect which makes sure to keep the wheels of new technology and consumer behaviors on roll. As time is moving by, there is a growing propensity for oil for a growing world (Campbell and Laherrère 1998). According to estimates of International Energy Agency (IEA) around 93 million barrels per day (bbl/day) is total worldwide oil consumption. Basic economic development indicates that quality of life correlates with energy consumption, but people working in industry beg to differ as they are of the opinion that there is no correlation between quality of life and energy consumption (Weidema and Wesnaes 1996). There is, has been and will be an upward for the demand of energy for transport albeit there is not any change in the energy supply for transport. (Armaroli and Balzani 2007).

Paucity of fuel is the major problem for Pakistan as the fuel-demand (transport energy) is very high as compared to local supply in transport energy sector. Catering for this increased demand, fuel is being imported. Major determinants of high demand for transport energy are length of roads, length of Railway lines, population, low occupancy rate, large number of vehicles, and low efficiency of vehicles, poor infrastructure and price level. World has been made to come face to face with the new crises especially for those countries who import oil. The influx of oil is causing an economic instability around the earth, for example, Pakistan. If we compare the predecessor prices with the years of 2016 ($37.02) and 2017 ($42.63), we can see that the increase in oil prices is higher in 2017 as compared to 2016 in $/barrel (Inflation Data, 2017). Huge amount of foreign exchange is expended (import bill $10.22bn for 2018 July, Report of PBS) on the import of transport fuel in Pakistan. This exorbitant amount of foreign exchange cost has had induced the researchers to get into the profundity of economic growth and transport energy demand (TED) for the country. Hence, this research has been put about to find out the pith of three important research questions which correlates with each other, such as supply and demand analysis of transport energy in Pakistan, while second is to forecast the supply and demand for transport energy in Pakistan, and third one is, to suggest the policy interventions to fill the gap between supply and demand for transport energy. In this study, Autoregressive Distributive Log Model (ARDL) is being used for the demand analysis of transport energy and ARIMA model is applied for the estimation of supply and demand forecasting in future.

Literature Review

There has been plethora of studies done to find out the relationship among the TED and economic growth, transport energy prices, length of roads, number of registered vehicles. The paramount variable which came into play to estimate the TED was economic growth

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(GDP), which had been used by the various case studies. Similarly, all concerned studies manifested that there has been a positive nexus between TED and economic growth. It will not be wrong if we were to put about that economic growth is the function of TED so much as it moves in the direction as TED but has positive sign. For a case study of central and Eastern Europe, Zachariadis and Kouvaritakis (2003) found positive relationship between TED and economic growth, similarly He, Huo et al. (2005) conducted the study in China and bolster the positive evidence within these variables. Further, Haldenbilen and Ceylan (2005) and (Say and Yücel 2006) also lends credence to the evidence for developing nations. This fact was supported by Hughes, Knittel et al. (2006) and Ang (2007), later on Ceylan, Ceylan et al. (2008) for a case study of Turkey buoyed the positive relationship between economic growth and TED. Furthermore, the researches that has been carried out and is being carried through substantiate the positive evidence between TED and economic growth, such as Anson and Turner (2009), Pradhan (2010), Limanond, Jomnonkwao et al. (2011), Geem (2011), Chandran and Tang (2013), Li and Lin (2015) and Edelenbosch, McCollum et al. (2017).

Second to that price is the most exigent variable in transport energy, which has been the pivotal source to jeopardize the utilization of concerned good. While traipsing through literature, we stumbled upon myriads of studies that had been carried out the same issue and put forth the inverse relationship between TED and price of energy, such as case study of Greece supports the inverse relationship for Christodoulakis, Kalyvitis et al. (2000), this evidence was supported by Zachariadis and Kouvaritakis (2003), Hughes, Knittel et al. (2006) and Brons, Nijkamp et al. (2008). Put about this notion that there is no significant effect on TED of the price, similarly case study of south Korea also lends credence to this relationship (Geem 2011), another study of Jordon concurs the aforementioned inverse relationship, that fuel prices had negative impact on the TED (Al-Ghandoor, Samhouri et al. 2012). Additionally, Ajanovic and Haas (2012) propounded that the oscillation in the TED had been due to the fluctuation in the price level and this relationships was explained by Yeh, Mishra et al. (2017). To further cogitate our point, it is being said that the number of registered vehicle also had positive significant effect on TED as fulcrum by pieces of evidence provided by following studies, the study of Thailand (Limanond, Jomnonkwao et al. 2011) and study of Jordon (Al-Ghandoor, Samhouri et al. 2012).

Similarly, to carry through various studies, ARDL model has been used, for the explanation of long run relationship between TED and those variables, which directly affect the energy demand, likewise, these are some case studies which used the ARDL econometric technique including Liu (2009); Shahbaz and Islam (2011); Adom and Bekoe (2012); Farahani Yazdan and Hossein (2012); Bildirici and Kayıkçı (2013); Aslan (2014); Bölük and Mert (2015); Nathan, Liew et al. (2016) and Mert and Bölük (2016). Similarly for the estimation of various studies, ARIMA model was used and for the estimation of future forecasting about energy supply and demand as well. There were case studies of Turkey and Iran and both of them have used ARIMA model (Ediger, Akar et al. 2006); (Albayrak 2010).

Model development and Data

The imperative purpose of this study is to estimate relationships among the economic aggregates (transport energy demand, economic growth, and population growth, number of registered vehicles, occupancy rate, and length of roads, railway lines, oil rents and gas rents) in Pakistan for years 1980 to 2015. In this case study, TED is used as dependent variable whereas GDP (current US$), Oil rents (% GDP), gas rents (% GDP), occupancy rate (no. of passengers carried in millions), trade, length of roads (km), number of registered vehicles (annually registered), and urban population (Annual %) are used as independent variables. Number of registered vehicles were covered Buses, 2 wheels motor, 3 wheels motor, Motor jeeps, wagons, Motor taxies, Trucks and Others. Data for different variables such as GDP, trade and urban population growth was taken from the various sources chiefly from the World Bank, oil and Gas rents data was taken from the Index mundi, total length of roads, number of registered vehicles and occupancy rate data was taken from the Economic survey of Pakistan.

Econometric Models

Two models had been used to check in the relationships between transport energy (dependent variable) and oil rents, gas rents, GDP, number of registered vehicles, total length of roads, trade of Pakistan, (independent variables). To put about this case study a demand function has been brought about as.

Transport energy = f (log of GDP, Oil rents, Gas rents, length of roads, number of registered vehicle, Trade) (1)

GDP is the paramount variable in this research. This was substantiated by taking after the case studies which had already been done in the past as Cuenot, Fulton et al. (2012), Al-Ghandoor, Samhouri

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et al. (2012),Chandran and Tang (2013) , Liddle and Lung (2013), Mraihi, ben Abdallah et al. (2013), Lin and Du (2015), Li and Lin (2015), Yeh, Mishra et al. (2017) and Edelenbosch, van Vuuren et al. (2017) . While working through the haystacks of studies, we came upon a study which propounded the whim that price has had no effect on transport, energy demand (Dreher, Wietschel et al., 1999). Our other important variable which has come into play is price which as mentioned earlier hurt the TED, If one were to look into this theory which shows the negative relationship between TEDs and price level, according to law of demand. As it was, there had been many studies which concurred with the aforementioned view as well such as Christodoulakis, Kalyvitis et al. (2000), Zachariadis and Kouvaritakis (2003), Hughes, Knittel et al. (2006), Brons, Nijkamp et al. (2008), Ajanovic and Haas (2012), Geem (2011), Al-Ghandoor, Samhouri et al. (2012), Yeh, Mishra et al. (2017).

Another independent variable which has been brought about in here is 'Road Length' which influences the TED. Our theory posits a positive relationship between TED and length of road. There has been a study which vindicate our research i.e. Polydoropoulou, Baker et al. 2003). Numbers of registered vehicles has been used as an independent variable, which positively affects dependent variables used in our study. According to theory, both variables correlate positively with each other, in its support there were two case studies, which corroborate this view such as Al-Ghandoor, Samhouri et al. (2012). Interaction term, log multi (length of roads X number of registered vehicles) was also used, likewise it was also used by other studies like Ehrlich and Holdren (1971), Holdren and Ehrlich (1974) and Salim and Shafiei 2014)].

In the study at hand, trade is included as another variable. While in the studies known to the authors; trade had not been put into the study as an independent variable while analyzing transport energy demand. This theory has put about a study of positive relationship between transport energy demand and trade of an economy.

Transport energy = f (GDP, Gas Rents, Oil Rents, length of roads)

Its general form can be written as:

$$TEd = \beta 0 + \beta 1 \sum_{i=0}^{n} lnGDP + \beta 2 \sum_{i=0}^{n} O.R + \beta 3 \sum_{i=0}^{n} G.R + \beta 4 \sum_{i=0}^{n} \ln r + \varepsilon t \quad (2)$$

TED = Transport energy; Log r = length of roads; Log G = growth of economy (GDP);

O.r and G.r = Rents of Oil and Gas

Transport energy = f (Trade, Gas Rents, Oil Rents, log multi.)

$$TEd = \beta 0 + \beta 1 \sum_{i=0}^{n} trade + \beta 2 \sum_{i=0}^{n} O.R + \beta 3 \sum_{i=0}^{n} G.R + \beta 4 \sum_{i=0}^{n} \ln multi + \varepsilon t \quad (3)$$

TED=Transport energy

G.R = gas rents

O.R = oil rents

`Log multi = length of roads X number of registered vehicles

Model Discussion

As per Equation 2, the length of roads increases as the demand for transport energy goes up as the economy grows. Price is a vital variable which affect the demand for TED, as per the market forces, there is an inverse relation between demand and prices of transport energy.

Further, as per our Equation 3, which contains additional variable which is indicated by log of multi (length of roads was multiplied by number of registered vehicle). It also has positive relationship with TED according to our base theory as number of registered vehicle increase the demand for transport energy also increases. This was the all-embracing background discussion about the model aforementioned.

Autoregressive Distributive Lag Model

In this study we used the ARDL model which was proposed by the Pearson and Shin (1998). This model has been used to estimate the relationship among the concern variables shown as below. In the case of endogenous repressor, ARDL can provide the unbiased long-run estimates. For the estimation of long run relationship among the concern variables, we used bound co-integration test to determine the long run relationship among variables, then we moved up to ARDL-VECM to explain the short run relationship among the variables.

$$TEd = \beta 0 + \beta 1 \sum_{i=0}^{n} lnGDP + \beta 2 \sum_{i=0}^{n} O.r + \beta 3 \sum_{i=0}^{n} g.r + \beta 4 \sum_{i=0}^{n} No.of\ r. + \beta 5 \sum_{i=0}^{n} l.r + \beta 6 \sum_{i=0}^{n} Trade + \varepsilon t \quad (4)$$

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Next step in the F-bound test is, if the estimated F-value exceeds the upper critical value, we conclude the co-integration relationship between TED and all concern variables and vice versa. There had been plethora of studies which had carried out the same studies by using the ARDL technique for the estimation of energy demand in the growing world such as Ang (2007), Liu (2009), Sultan (2010), Shahbaz and Islam (2011), Bernstein and Madlener (2011), Srinivasan, Kumar et al. (2012), Adom, Bekoe et al. (2012), Farahani Yazdan and Hossein (2012), Bildirici and Kayıkçı (2013), Aslan (2014), Bölük and Mert (2015), Nathan, Liew et al. (2016) and Mert and Bölük (2016)].

Forecasting Methodology

In this study, we used the ARIMA technique to estimate the future production and consumption of gasoline as well as oil in Pakistan. This model is applicable on the time series data and it is among the nonpareil methods used for the forecasting of time series data. However, this is originated by Autoregressive (AR) and Moving Average (MA), and the combination of ARMA models, and this has been applied on many case studies which forecast the usage of energy in future such as Ediger and Akar (2007), Erdogdu (2007), Koutroumanidis, Ioannou et al. (2009), Albayrak (2010), Mohammadi and Su (2010), Amini, Kargarian et al. (2016) and Barak and Sadegh (2016). This ARIMA model is only applicable when data has two consecutive features, no missing data as well as stationary. Similarly, when we bring seasonal components in the estimation of ARIMA that makes it seasonal ARIMA (SARIMA).

Empirical Results and Discussion

To test the unit root properties of variables, we applied the GLS/ Dickey Fuller, Augmented Dickey Fuller (ADF) and PP unit root test. Results are given in Table 1, Appendix 1 and 2.

Table 1: Augmented Dickey Fuller

Variables	At level		At 1st difference	
	Without trend	With trend	Without trend	With trend
Log of GDP	0.688730	-1.46000	-5.58625***	-5.84246
Log of roads	-4.41631***	-1.03560	-2.39843	-5.26818
Oil rents	-2.63212	-2.85830	-5.93072***	-5.92716
Gas rents	-1.410256	-2.11817	-5.145417***	-5.05729

Trade	-1.70110	-2.36506	-7.48891***	-7.55264
Log multi	-0.56705	2.18044	-3.73273***	-2.42965
Transport energy	-1.36857	-2.40879	-2.68185*	-2.71013

Note: * significance at 10%, ** significance at 5% and 10%, *** significance at 1%, 5% and 10%.

Findings of Table 1 depicts that variables are stationary at I(0) and some are at I(1) and this condition insist to apply ARDL methodology.

Table 2: Result of Bound F-testing

F value	**probability**	**Critical value at 1%**		**Critical value at 5%**		**Critical value at 10%**	
		I(0)	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
10.5946	0.000	3.29	4.37	2.56	3.49	2.2	3.09

In the above Table 2, we found the long run relationship among dependent and independent variables, because the F-statistics value is greater at all level of significance from the lower as well as for upper bound. So thereby, we reject the null hypothesis of no co-integration among variable and accept the alternative hypotheses.

Table 3: Long Run Coefficient by using ARDL approach (2, 4, 4, 3, 4)

Variable	**Coefficient**	**T-ratio**	**p- value**
Log of GDP	0.888302	33.18198	0.0000
Log of Roads	0.937022	19.33409	0.0000
Gas Rents-GDP	-0.267119	-13.523	0.0000
Oil rents-GDP	-0.111656	-4.890	0.0006
C	-10.4296	-43.192	0.000

In the Table 3, the transport energy demand was taken as dependent variables. Findings showed that the coefficient on GDP is positively and statistically significant at 1% which suggests that an increase in economic growth would cause 0.88% increase in TED and this view has been substantiated from literature such as Tol, Pacala et al. (2006), McKinnon (2007), Polydoropoulou, Baker et al. (2003). Further, 1% increase in road length would cause 0.93% increase in the TED. While, the prices of oil and gas had inverse relationship with dependent variable. This means that 1% increase in gas and oil rents would bring about a decrease the 0.26% and 0.11% in the TED and these results were supported by Zachariadis and Kouvaritakis (2003) and Hughes, Knittel et al. (2006).

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According to the short run results (Table 4), the value of error correction term [ECT (-1)] that explained the convergence from short run to long run, was -2.282237. It showed that there was convergence of 2.2823% from short run to long run within a year with a change of selected variable i.e. GDP (economic growth), length of roads, Gas prices and Oil rents. Whereas, the value of R^2 explains about the precision of model, and it was 95.3%, showing variation in TED due to selected four variables. DW-statistics was 2.308639, which showed that there was no problem of autocorrelation in the model.

Table 4: Short run results of ARDL

Variable	Coefficient	T-ratio	p- value
Log of GDP	1.048787	7.960900	0.0000
Gas rent	-0.264824	-9.869466	0.0000
Oil rents	0.048646	2.010426	0.0721
Road length	-0.872662	-1.844513	0.0949
ECM(-1)	-2.282237	-9.764802	0.0000

R^2 (0.953871) R-Bar squared (0.904666)

F-statistic 260.45 [0.0000] DW-Statistic (2.308639)

Table 5: Results of F-bound Test

F value	Probability	Critical value at 1%		Critical value at 5%		Critical value at 10%	
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
6.136529	0.000	3.29	4.37	2.56	3.49	2.2	3.09

In the above Table 5 results of F-bound test are given. We acquired the long run relationship among dependent and independent variables because the F-statistics value is greater than the level of significance from the lower as well as for upper bound. So, we reject the null hypothesis of no co-integration among variable and accept the alternative hypotheses.

Table 6: Long Run results of ARDL

Variable	Coefficient	T-ratio	p- value
Log – multi	0.875339	20.27403	0.0000
Trade	0.009816	1.848363	0.0774
Oil rents-GDP	-0.233215	-2.467140	0.0215

Gas rents- GDP	0.081883	1.908245	0.0689
C	-2.609336	-7.015952	0.0000

In the start of this model (Table 6), we took TED as a dependent variable, the coefficient on Log multi (number of registered vehicles X road length) is positively and statistically significant with 1% increase in Log multi (Number of registered vehicles X road length) will cause an increase of 0.87% in the TED. Substitution effect on the TED would be explained in this model also. Similarly, gas rents and trade have positive and significant effect on the TED, which means 1% increase of these variable would cause an increase of 0.009% and 0.08% respectively in the TED [Polydoropoulou, Baker et al. (2003), Al-Ghandoor, Samhouri et al. (2012)]. Authors were not able to find any study that had validated the positive relationship between TED and Gas rents. According to results, 1% increase in oil rents would cause a decrease of 0.23% in the TED [Geem (2011), Yeh, Mishra et al. (2017), Edelenbosch, McCollum et al. (2017), Pablo-Romero, Cruz et al. (2017)].

According to the short run results, the value of ECT (-1) was -0.6540 which means the speed of adjustment was 0.65% from short run to long run. The value of R^2 was 0.691029, which explained that 69% variation in dependent variable was due to independent variable. Similarly, value of F-test explained overall significance of the model. DW-statistics is 2.093061, which vindicates that there is no problem of autocorrelation in the model.

Table 7: Short run results of ARDL selected model: (1, 2, 1, 1, 1)

Variable	Coefficient	T-ratio	p- value
Gas rent	-0.05328	-1.67799	0.106
Log-multi	0.24983	2.14144	0.043
Trade	0.00221	-0.82625	0.417
ECM (-1)	-0.65405	-6.69502	0.000

R^2 (0.691029) R-Bar squared (0.635855)

F-statistic 125.15[0.000] DW-Statistic (2.093061)

ARIMA Forecasting

Forecasting is an important aspect in the future demand and consumption of transport energy such as oil and gas. In this section, ARIMA model was used for future forecasting the demand and supply of transport energy in Pakistan up until 2030. Following are the selected

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models of ARIMA for future forecasting about the oil and gas production as well as consumption.

ARIMA Model Parameter

Table 8 represents the values all of the parameter in the model. There are four models, where value of ***p*** parameter takes (1, 2, 0, 2) while the q parameter takes (1, 1, 1, 1) and *d* (0, 3, 0, 3) parameters equals at 5% level of significance.

Table 8: Selected ARIMA models

Model	Trend	P	Q	ARIMA
Gasoline consumption	Upward	1	0	(1,1,0)
Gasoline Production	Upward	2	3	(2,1,3)
Oil Production	Upward	0	0	(0,1,0)
Oil Consumption	Upward	2	3	(2,1,3)

Table 9 explains the forecasted values of concern models, such as Gasoline consumption, Gasoline production, oil production and oil consumption. The results indicated that there would be more than 1 % increase in the gasoline consumption and production, as well as oil production and consumption with the passage of time till 2030. According to the forecasted values of all concern models, we can say, consumption (demand) would continue to increase at annual rate of more the 1 % and the final demand of oil and gasoline in year 2030 would be 119.17 (000 barrel / day) and 637 (000 barrel / day). While, the production (supply) of gasoline and oil will increase with the passage of time but it will not be equal to the values of demand, Hence, forecasted values of gasoline and oil supply would be 53 (000 barrel / day) and 124.3 (000 barrel / day).

Table 9: Model forecasts for consumption and production of Gasoline and Oil (000barrel/day).

Forecasted Model	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Gasoline production	41.1	41.9	42.7	43.5	44.2	45.0	45.8	46.6	47.4	48.1	48.9	49.7	50.5	51.3	52.0	52.8	53.6
Gasoline Consumption	85.4	87.5	89.6	91.7	93.8	95.9	98.0	100.1	102.2	104.3	106.5	108.6	110.7	112.8	114.9	117	119.1
Oil Production	87.3	89.6	91.9	94.2	96.5	98.8	101.1	103.5	105.8	108.5	110.4	112.7	115	117.3	119.6	122	124.3
Oil Consumption	443	453	463	473	483	493	503	513	523	533	543	553	563	573	583	593	637

Conclusion

Between TED, economic growth and in the case of the length of the roads a positive significance association has been found. While the energy rents (the oil rents, gas rents) showed the inverse relationship with TED. Results have shown a substitution effect between oil and gas rents. Further, negative association has been found between the TED and oil rents, whilst positive relation was observed with gas rents showing the substitution effect in the second model. Trade has had a positive significant effect on TED. Therefore, going by the same inculcation TED will increase due to the increase in the trade activities in Pakistan. According to the study that is carried out put about that the production of transport energy is not increasing when compared it with consumption (demand) and same is the case for supply as it is also not increasing as it ought to. Therefore, times are dire and we need to bring about a shift in existing transport energy sources where in lieu of oil something else is used as is evident from the shift that has taken place in china. The void of demand and supply gap between different types of transport energy stipulates that this lacuna is only going to increase in the near future.

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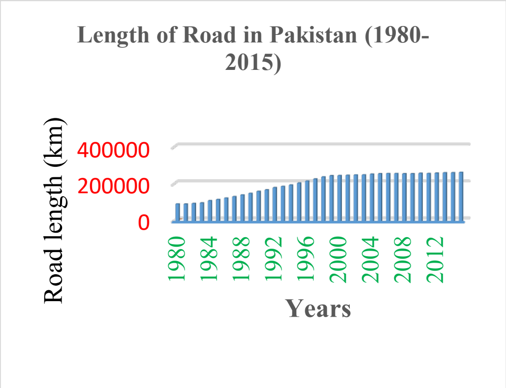
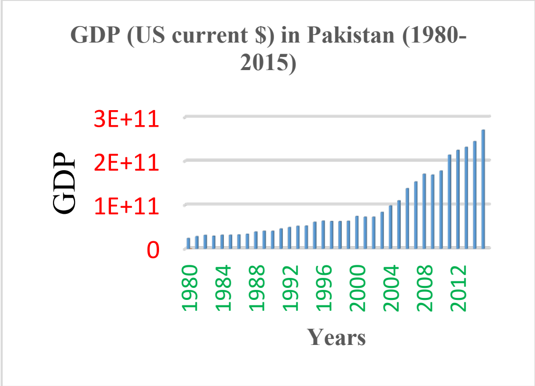
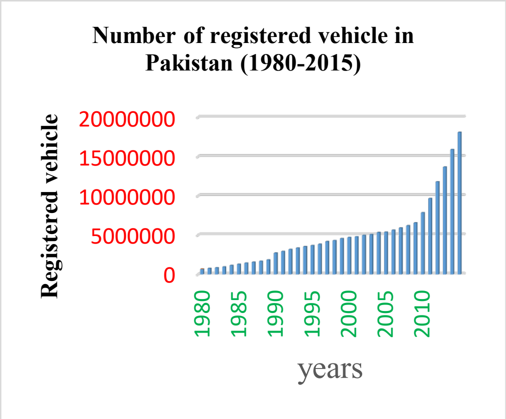
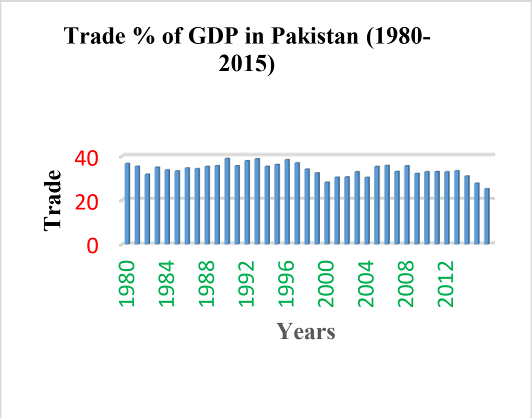
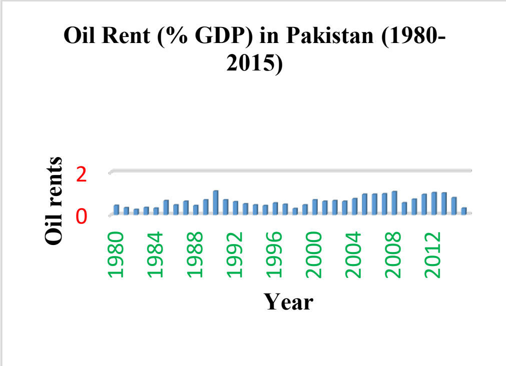
Appendix: 1

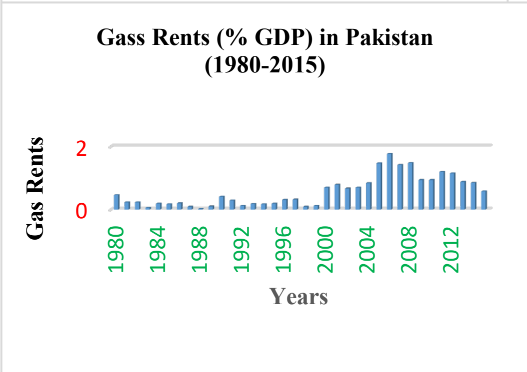

Length of Road in Pakistan (1980-2015)
Road length (km)
400000
200000
0
1980
1984
1988
1992
1996
2000
2004
2008
2012
Years

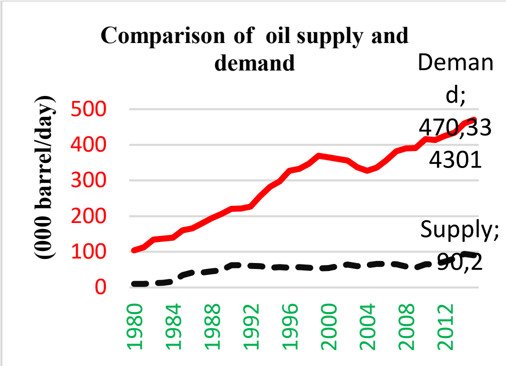

GDP (US current $) in Pakistan (1980-2015)
GDP
3E+11
2E+11
1E+11
0
1980
1984
1988
1992
1996
2000
2004
2008
2012
Years

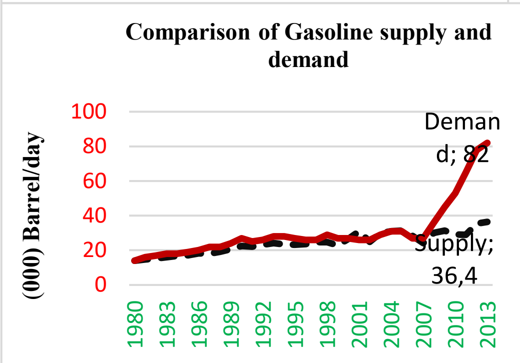

Number of registered vehicle in Pakistan (1980-2015)
Registered vehicle
20000000
15000000
10000000
5000000
0
1980
1985
1990
1995
2000
2005
2010
years


Trade % of GDP in Pakistan (1980-2015)
Trade
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008
2012
Years


Oil Rent (% GDP) in Pakistan (1980-2015)
Oil rents
2
0
1980
1984
1988
1992
1996
2000
2004
2008
2012
Year


Gass Rents (% GDP) in Pakistan (1980-2015)
Gas Rents
2
0
1980
1984
1988
1992
1996
2000
2004
2008
2012
Years


Comparison of oil supply and demand
(000 barrel/day)
500
400
300
200
100
0
Demand; 470,334301
Supply; 90,2
1980
1984
1988
1992
1996
2000
2004
2008
2012


Comparison of Gasoline supply and demand
(000) Barrel/day
100
80
60
40
20
0
Demand; 82
Supply; 36,4
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013

Appendix 2: Stationary of data GLS test

Variables	At level		At 1st difference	
	Without trend	With trend	Without trend	With trend
Log of GDP	1.98937	-1.51077	-4.41768***	-5.32021
Log of roads	-1.33513	-2.00260	-2.10378**	-3.479855
Oil rents	-2.48291**	-3.06898	-5.32662	-5.93817
Gas rents	-1.42051	-2.02244	-4.44295***	-5.9381
Trade	-1.64038	-2.58589	-7.15543***	-7.64596
Log multi	0.55588	-1.64745	-3.78363***	-3.79392
Transport energy	0.58904	-2.09059	-2.28329**	-2.75212

Note: * significance at 10%, ** significance at 5% and 10%, *** significance at 1%, 5% and 10%.

Appendix 3: Results of PP

Variables	At level		At 1st difference	
	Without trend	With trend	Without trend	With trend
Log of GDP	0.80642	-1.46000	-5.58625***	-5.92022
Log of roads	-3.44039**	0.21559	-2.44072	-5.43133
Oil rents	2.56835	-2.81920	-6.204423***	-6.33419
Gas rents	-1.37141	-2.26973	-5.10793***	-5.00399
Trade	-1.77142	-2.48510	-7.50383***	-7.61618
Log multi	-0.63657	-1.69600	-3.67611***	-3.61611
Transport energy	-1.50033	-2.36311	-6.46341***	-6.44614

Note: * significance at 10%, ** significance at 5% and 10%, *** significance at 1%, 5% and 10%.