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The Survey of Effective Factors on the Diesel Consumption in Iran by Using the ARDL Co-integration Approach

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Abstract

This research attempts to examine the effect of real price of diesel, the real price of petrol, amount of production and import of diesel vehicles, population rate, and level of electricity generation in the diesel plants on the demand function of Diesel during the period 1976-2009 in Iran. The research uses a logarithmic model and finally employs the ARDL approach to estimate the model. The results of ARDL and ECM estimation imply that the real income, real price of petrol, level of electricity generation, population and level of production and import of diesel vehicles have positive and significant while the real price of Diesel has a negative and significant effects on the demand function of Diesel . The results of ECM test also show a high adjustment velocity of the demand function in the country. Thus, accordingly it is suggested that considering the non-price factors, creating a organized and appropriate basis of databases in the energy sector, pursuing the reduction policies of fuels usage which is come with high efficiency such as giving incentives to the private sectors to the transportation sector, training the drivers and repairers, building the Authorized repair shops by the auto makers.

Keywords: Demand Function of Diesel, Energy, ARDL, ECM, Iran.

Introduction

In one side, increasing trend of energy consumption decreases the power of the export of the energy carriers and in the other side it jeopardize the process of the sustainable development due to the environment pollution and lose of energy for the next generations. Hence, it is necessary to control the energy consumption economically and environmentally. The demand side also has a special role in the controlling process in the economic development.

Additionally, identifying the main effective factors on the consumption for policy makers is crucial to adopt an appropriate planning and forecasting for the upcoming years.

Estimating the demand function of the Diesel in addition to the identifying the chief determinant of the demand and finally offering some recommendation for policy making is the main goal of this paper. This study is trying to test the following hypotheses:

1- There is a positive and significant relationship between consumption of Diesel and national income.
2- The elasticity of Diesel demand is low.
3- There is positive and significant relationship for Diesel consumption and petrol price.
4- Price of Diesel has a significant and negative symptom with its consumption variable.
5- There is positive and significant relation for population rate and Diesel consumption.
6- Diesel consumption and electricity generation has a significant and positive to each other.
7- There is positive and significant relationship for Diesel consumption and amount of diesel production.

The difference of this study in compare with the other domestic researches is that the researchers have not had a deep focus on the demand function of diesel. On the other hand, the Iranian official and policy makers must pay attention more on the issue of energy consumption because of the western sanctions that has targeted the Iranian energy sector. Hence this paper attempts to examine the effect of real price of diesel, the real price of petrol, amount of production and import of diesel vehicles, population rate, and level of electricity generation in the diesel plants on the demand function of Diesel during the period 1976-2009 in Iran.

Literature review

Faal Nazari (2007) in a survey in Zahedan city examined the effect of diesel price, Fob price of diesel, electricity generation and number of trips by the citizens on the demand of diesel for the period 1998-2006. The study employed the auto regressive distributed lag technique to estimate the demand elasticity.

The results come from the ARDL approach indicate that the explanatory variables, electricity generation, number of trips and the Fob price of diesel have a significant and positive on the demand of the diesel while the real price of the diesel product has a negative and significant impact on the demand. Moreover, the results also show the greater impact of the smuggling in short run that long run.

Abonori and Haiwa (2005) using the ordinary least square method tried to study the demand function of petrol. The findings show that number of vehicles, national income and population growth have an effective impact on the demand in Iran. In other side, the price of petrol has not of a considerable effect on the demand.

Shakeri et al. (2010) estimated the structural model of the petrol and Diesel demand in the Iranian transportation sector. In this model, the utility function maximized in three stages. The findings show that the tren employed in the model has a non-linear essence. The results also implied that the piece elasticity of demand for Diesel and petrol is less than one so as the values of elasticity for petrol in short run and long run are -0.24 and -0.3 respectively. Additional the elasticity values of income or these products are 1.71 and 0.84 respectively.

Abdoli and Mohammadi (2011) identified the effective factors of petrol consumption in Tehran using ARDl approach for the period 1968-2009.

The findings indicate that per capita income, petrol consumption per each vehicle and real price of petrol are stationery at the first degree. The price and income elasticity of petrol in long run are -.17 and 1.28 respectively. The ECM value also was -.11 in the short run.

Ghosh (2006) in a paper entitled "the future of demand for oil products in India" using the Johansen-juselius technique extracted a co integrating relation between consumption of oil products and gross domestic products. The model used is as bellow:

$$L\,\mathrm{g}\,dp = F(Ltpp)$$

Lgdp : Logarithmic form of gross domestic products.

Ltpp: total consumption of oil products.

The long run co-integrating relation is as follows:

$$Ltpp = -3.0374 + 1.0153 L\,\mathrm{g}\,dp$$

Income elasticity of demand for the oil products was 1.01 according to the estimated equation above which indicated that the oil products are member of the normal Goods in India.

Interesting point pertaining to this estimation is that the ECT coefficient is not significant indicating that there is not a long run dynamic effect between the first difference of Lgdp and Ltpp.

AL-mansoori et al. (2012) in order to examine the demand function of diesel for the period 1995-2012 in EUA used the ARIMA model to forecast the demand for the future. The results showed that population, per capita income and number of vehicles have a significant and positive impact on the diesel consumption while real price of diesel, human capital index and the lagged form of the dependent variable have a negative and significant. The forecasting estimation indicated that the demand for the diesels does not have a considerable change after the year 2012.

Filippini and Hunt (2009) in a paper entitled "Energy Demand and Productivity in the OECD countries" using the stochastic frontier demand technique during the period 1978 2006 estimated the demand function of energy. The results show that the intensity index of energy is not an appropriate indicator for economies of energy necessarily. The findings also indicated that though the change in the intensity index is a good measure for explanation of productivity in some countries but it is not common for countries.

Empirical results

This paper tries to estimate the demand function of diesel. After then it goes on identify the value of elasticity of variables used in the main model using the auto regressive distributed lag during the period. The diesel demand function is considered as bellow:

$$LGA = \alpha_0 + \hat{\theta}_1 LPRGA + \hat{\theta}_2 LPRBE + \hat{\theta}_3 LVEH$$
$$+\hat{\theta}_4 LNI + \hat{\theta}_5 LPOP + \hat{\theta}_6 LELEC +$$
$$+\hat{\theta}_7 DU\,57 + \hat{\theta}_8 DU\,59 + \hat{\theta}_9 DT\,59 + U_t$$

Where:

LGA: logarithmic form of Diesel consumption

LPRGA: Logarithmic form of real price of diesel

LPRBE: logarithmic form of real price of petrol

LVEH : logarithmic form of amount of production and import of diesel vehicle

LNI: logarithm of national income

LPOP: logarithm of population rate

LELEC logarithmic form of electricity production.
DU57 : dummy variable due to the revelation in Iran
DU59 : dummy variable for the war of Iran with Iraq
DT59: the trend variable
U_t :disturbance term

With respect to the pesaran study (2002), we employ the bellow equation embodied the lagged variables:

$$LGA = \alpha_0 + \sum_{j=1}^{p} \alpha_i LG_{t-i} + \sum_{j=1}^{q_1} \beta_{1i} LPRBE_{t-i} + \sum_{j=1}^{q_2} \beta_{2i} LVEH_{t-i} + \sum_{j=1}^{q_3} \beta_{3i} LNI_{t-i} +$$

$$\sum_{j=1}^{q_4} \beta_{4i} LPOP_{t-i} + \sum_{j=1}^{q_5} \beta_{5i} LELEC_{t-i} +$$

$$+\sum_{j=1}^{q_6} \beta_{6i} LPRGA_{t-i} + \beta_7 DU57 + \beta_8 DU59 + \beta_9 DT59 + v_t$$

Table No 1: Estimating the short run coefficients of the demand function ARDL(1,1,1,1,0,0,1)

variable	coefficient	Standard error	t statistic	(prob) t
LGA(-1)	0.21	0.13	1.59	0.128
LPRGA	-0.17	0.04	-3.62	0.002
LPRGA(-1)	-0.12	0.03	-3.61	0.002
LPRBE	0.01	0.02	0.55	0.586
LRBE(-1)	0.07	0.03	2.34	0.031
LNI	0.35	0.07	4.90	0.000
LNI(-1)	-0.17	0.06	-2.71	0.015
LPOP	0.27	0.68	3.96	0.001
LVEH	0.04	0.01	3.28	0.004
LELEC	0.11	0.04	2.64	0.017
LELEC(-1)	0.11	0.04	2.62	0.018
C	-1.44	0.86	-1.66	0.114
DU57	0.15	0.04	3.71	0.002
DU59	0.12	0.03	3.98	.001
DT59	0.03	0.006	5.75	0.000
$R^2 = 99\%$			F(14,17)=483.444[0.000]	
Serial Autocorrelation			0.036 [0.861]	
Functional form			2.1508 [0.162]	
Normality			0.0663 [0.967]	
Hetroscadasticity			2.2107 [0.147]	

Source: Authors' findings

Based on the table above it is concluded that the variables, real price of petrol, amount of electricity generation, national income, population rate and number of diesel vehicles have a positive and significant impact on the demand amount while the variables real price of diesel has a negative and significant on the dependant variable.

All the classic hypotheses including the lack of autocorrelation, correct functional form, and lake of hetroscadascity are confirmed at the 0.05 significant level. The r^2 Value is 0.99. This quantity shows that the explanatory variables can explain the dependant variable at 99 percent.

After estimation of the model it is necessary to test the long run relationship between the dependent variable and independent variables. The critical value of Benrji-Dollar and Mostar showed the long run relationship at 99 percent of significant level as follows:

$$t = \frac{0.21969 - 1}{0.13738} = -5.6882$$

Table No 2: Estimating the long run coefficients of the demand function ARDL ARDL(1,1,1,1,0,0,1)

variable	coefficient	Standard error	t statistic	(prob)
LPRGA	-0.39	0.06	-6.29	0.000
LPRBE	0.12	0.03	3.12	0.006
LNI	0.22	0.06	3.33	0.004
LPOP	0.35	0.56	6.15	0.000
LVEH	0.05	0.02	2.62	0.018
LELEC	0.29	0.04	6.56	0.000
C	-1.85	1.05	-1.75	0.098
DU57	0.19	0.07	2.77	0.013
DU59	0.15	0.04	3.40	0.003
DT59	0.05	0.002	20.7574	0.000

Source: Authors' findings

The findings show that the real price of diesel is positive and significant on the demand variable such that if this variable up one percent then the dependent variable increases 0.39 percent. National income is the other significant variable that its coefficient value is near 0.22. the population rate is the other significant and positive on the demand amount. The electricity variable has values with 0.29 on the dependent variable.

ECM Estimation

The ECM format for the ARDL pattern is modeled as:

$$d(LGA) = \alpha_0 + \sum_{j=1}^{p} \alpha_i d(LGA)_{t-i} + \sum_{j=1}^{q_1} \beta_{1i} d(LPRBE)_{t-i} + \sum_{j=1}^{q_2} \beta_{2i} d(LVEH)_{t-i}$$
$$+ \sum_{j=1}^{q_3} \beta_{3i} d(LNI)_{t-i} + \sum_{j=1}^{q_4} \beta_{4i} d(LPOP)_{t-i} + \sum_{j=1}^{q_5} \beta_{5i} d(LELEC)_{t-i} +$$
$$+ \sum_{j=1}^{q_6} \beta_{6i} d(LPRGA)_{t-i} + \delta_1 LPRGA_{t-1} + \delta_2 LPRBE_{t-1} + \delta_3 LNI_{t-1}$$
$$+ \delta_4 LPOP_{t-1} + \delta_5 LVEH_{t-1} + \delta_6 LELEC_{t-1} + \delta_7 DU57_{t-1} + \delta_8 DU59 +$$
$$\delta_9 DT59_{t-1} + \varphi EC_{t-1} + u_t$$

Table No 3: ECM Estimation of the variable DLGA based on ARDL(1,1,1,1,0,0,1)

coefficient	Standard error	t statistic	(prob)
dLPRGA	-0.17	-3.62	0.002
dLPRBE	0.01	0.55	0.585
dLNI	0.35	4.90	0.000
dLPOP	0.27	4.96	0.001
dLVEH	0.04	3.28	0.004
dLELEC	0.11	2.64	0.015
dC	-1.44	-1.66	0.110
dDU	0.15	3.71	0.001
dDU59	0.12	3.98	0.001
dDT59	0.03	5.75	0.000
ECM(-1)	-0.78	-5.68	0.000

Source: Authors' findings

the ECM coefficient is significant statistically indicating the adjustment velocity is so high. This coefficient also verifies the long run relationship between the variables. Theoretically this coefficient means that if the model moves one step to the next year, the model variables can adjust the diversion of the demand function as 78 percent.

Figure 1: Q cusum figure for stability test

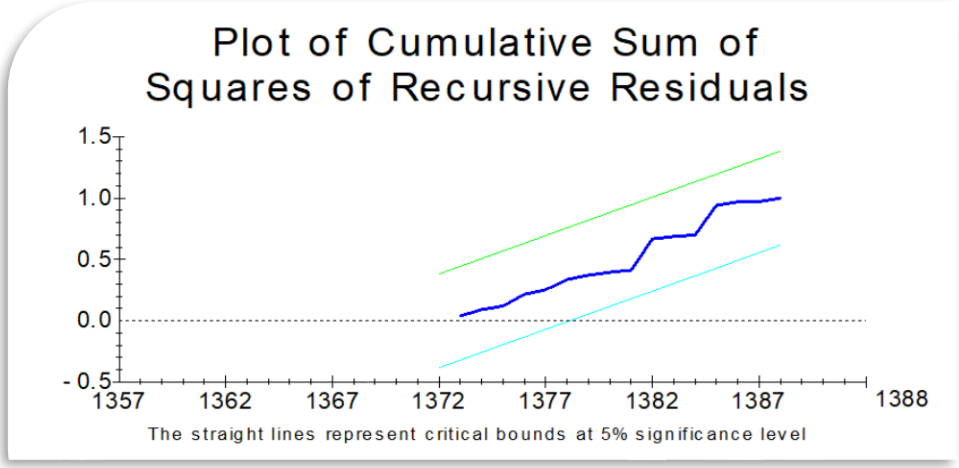
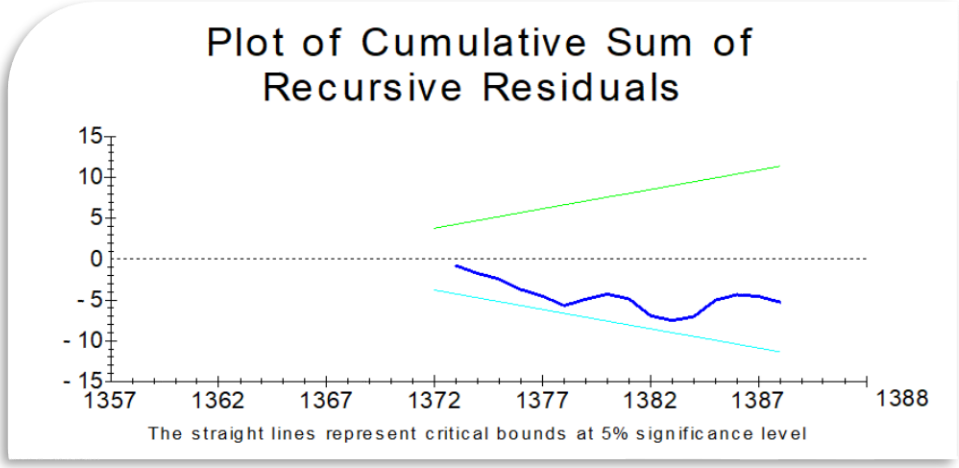


Figure No2: plot of cumulative sum of recursive residuals



According to the plot of cumulative sum of recursive and of cumulative sum of squares of residuals of model estimated it is derived that the model is stable.

Conclusion and recommendations

The results showed that the national income, population rate and real price of diesel have the greatest impact on the dependent variable respectively according to the elasticity values of the diesel consumption in long run.

Based on results it can be concluded that the petrol commodity is a substitute of the diesel. Because there is a positive relationship between the petrol price and diesel consumption in the model estimated.

According to the findings of diesel demand relative to price in both short run and long run it is concluded that the price factors have less impact on the dependant variable that the non-price factors such as production rise of the vehicles and abandonment of old cars and vehicles.

It is necessary to use the cheep energy such as gas which causes to decline the consumption of the diesel.

To establish a coherent database of the energy data for the use of the researchers and finally policy makers is an important solution for further studies.

To raise the intensive of the private sector to invest in the transportation part of the economy can enhance the spirit of competition.

Recommendation for the further Studies

1- To examine the effect of intelligent fuel cart on the demand function of diesel in Iran.
2- To study the amount of fuel smuggle and its impact on the demand of Diesel.
3- Examining the demand function of diesel in the different provinces of Iran using the Panel and Dynamic models.

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