

Energy Price Uncertainty and Energy Use in Iran

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ABSTRACT

In the present study researcher has attempted to investigate the uncertainty effects of energy price on its consumption in Iran with using of ARCH, GARCH and OLS models between 1976 and 2009. The results show that the uncertainty of natural gas and petrol price respectively have negative impacts on natural gas and petrol consumption. Also found that the impact of uncertainties have more effect on petrol consumers than natural gas. The other hand in both studied models we found that GDP as an important and effective variable than other variables has the greatest impact on the consumption of natural gas and petrol.

KEYWORDS: Uncertainty, Energy price, ARCH, GARCH.

JEL classification: C22, Q43

1. INTRODUCTION

For the first time the concept of uncertainty was introduced by Keynes in modern economy. He believed that if the uncertainty be very intense than future economic activities the monetary policy will be ineffective. The fundamentalist Keynesians with some economists of other doctrines emphasize on this important innovation of Keynes means the placing of uncertainty role in center of economic analysis. Keynes clearly state that the uncertainty conditions and risk are separate of each other and his emphasizing was on the uncertainty (Shakeri, 2007).

Past researches show that the investment and GDP growth has reverse relationship with energy price. This inverse relationship can be because of investment decisions' irreversibility. For example if with price change the enterprise use of new technology with inversion of this changing we cannot neutralize the done investment. In the traditional theories it was predicted that the uncertainty about future energy prices leads to slow response of investment also the reasoning is that the much uncertainty in energy price probably is interpreted like the reversibility of energy price. See Bernanke 1983, Pindyck 1991, Dixit and Pindyck (1994). Main objective of this study is investigating the effect of Energy price uncertainty on Energy use and partial objectives are effect of survey Petrol price uncertainty on Petrol use and natural gas price uncertainty on natural gas use in Iran. Finally we want to compare between Petrol price uncertainty and natural gas price uncertainty.

2. LITERATURE REVIEW

Rezaei (2000), in his research with this subject "The estimations of demand system for energy carriers in domestic sector" "the demand for main energy carriers in domestic sector includes electricity, gasoline, natural gas, LPG (Liquefied petroleum gas) and kerosene they concluded that gasoline, LPG and kerosene carriers for this reason that they have an income elasticity which is less than one then the essential goods and electricity and natural gas carriers will be luxury goods. The own price elasticity of electricity and Natural gas is calculated equivalent to -1 but the absolute of other carriers price elasticity is smaller than one. So the electricity and natural gas are the carriers with unit price elasticity but oil products gasoline, LPG and kerosene are low-elasticity.

Akmal & Stern (2001) have been studied on energy demand in Australia. Their model results state the substitution between natural gas and other energy sources. On the other hand in this model the natural gas and other energy sources are considered as luxury goods actually the one percentage increasing of Australian household income will increase the demand for natural gas more than one percent.

Gharbali moghadam and Eghdami (2002), in a research with this title "Studying on the effect of petrol price increasing on its consumption" "the results of two described pattern of petrol consumption show that using of price

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tool for adjusting of consumption and the reduction of paid subsidy to its has not great impact and the non-price factors have been effective on petrol consumption growth. The low elasticity of petrol consumption than to price increasing is emphasis on this subject that if the policymakers goal of petrol price increasing be on its consumption reduction then using of price tool has not efficient necessary and the elasticity approaching for total consumption and petrol per capita (where that the absolute of consumption price elasticity is larger than one) will occur in nominal prices six thousand Rials and higher.

Lotfalipour and Bagheri (2002) did a research with this title “The estimation of natural gas demand function in Tehran domestic consumptions”. The results indicate that in the case that other conditions being fixed, if the natural gas price from previous period increases (decrease) about one Rial then the average of total consumption natural gas will decrease (increase) about 2435165 cubic meters in current period. Also the coefficient variable of per capita income shows that with this assumption that other conditions being fixed with increasing (decreasing) each Rial in per capita income we will have the increasing(decreasing) about 149/25 cubic meters in the average of total consumption natural gas of Tehran domestic sector.

Khoshsima (2003), in a research with this title “Studying on energy demand function in domestic sector “achieved the following results: Oil products and electricity were inelastic while the natural gas is elastic. Because of being unrealistic price of energy carrier or lake of equal accesses for all households to energy carriers then the initial expectation based on the existence of substituting relation not performed between all energy carriers and we observe a nnegative cross elasticity between some energy carriers.In other words the households are regulated their consumption according to negative cross elasticity and do not attention to the ratio of carriers’ prices. The amount of carriers consumption's change because of one percentage increasing of households’ energy spending (not all income), cannot determine that carriers are luxury or necessary.

Moshiri and Shahmoradi’s article (2006), with this title “The estimation of natural gas’s demand and electricity of country households “all elasticity except the elasticity of electricity price is significant. So the natural gas is approximately inelastic goods. So that the increasing of natural gas price about one percentage can reduce the amount of natural gas’s demand in Tehran and Isfahan provinces respectively about 0.966 , 0.768.The electricity elasticity is in high level but is not significant in Tehran but it is estimated low in Isfahan then can say that electricity is an inelastic carrier. About the income elasticity as expected the income elasticity of natural gas’s demand is not larger than the unit it means that natural gas is an essential goods. Also this matter is true about the elasticity of electricity income.

The studying of Keshavarz hadad and Mirbagheri jam (2007), with the title “Studied on demand function of natural gas “domestic and commercial” in Iran “ shows that per capita consumption has reverse relationship with comparative price of gas to electricity .Although the nominal price of gas energy carrier is very low in compare to price of replaced energy carrier (Electricity) but the proportion of them has ascending process with passage of time, consequently consumer will follow this comparative increasing of price in his consumer behavior with saving in consumption. It means that he cannot find cheaper and more suitable energy carriers. Therefore with price increasing, the consumers will not create a significant change in his consumption amount of energy carrier. Per capita consumption of gas energy carrier has direct relationship with per capita income. The long-term elasticity of income is approximately 0.17.It means that natural gas is essential goods in an Iranian consumer fuel basket.

Abounoori and Khanaalipour (2009), in his study with this title “Can the uncertainty resulting from the oil price’s volatilities be effective on its supply?” First with using of GARCH pattern have calculated the uncertainty resulting from the volatilities of oil’s real price then were estimated separately the model’s long-term coefficients for any countries by the pattern of autoregressive distributed lag .Their study results suggest a positive and significant impact in Saudi Arabia and Libya but significant and negative effect is for England. But this effect was not significant in Iran and Nigeria. Also they concluded that this uncertainty effect of oil crude price on its supply depends on its utility function form.

3. Model Specification

3.1. Natural gas

At first we will discuss about natural gas and the extraction of gas price uncertainty series we perform the ARCH test on model at first stage after the modeling of natural gas price.

$$\text{LNGASP} = 0.34 + 0.85 * \text{LNGASP} (-4)$$

PROB: (0.0000) (0.0000)

LNGASP is the logarithm of gas price. Then we examined the Heteroskedasticity with using of ARCH test in the above model in continues.

3.1.1. ARCH Test

Table 1: Test results of ARCH Heteroskedasticity:

F-statistic	28.67	Prob. F(1,27)	0.0000
Obs*R-squared	14.93	Prob. Chi-Square(1)	0.0001

According to prob which is under 5% can conclude that there is heteroskedasticity in estimation regression (Abrishami H, 2009).Consequently with this subject that there is heteroskedasticity in model we will estimate the ARCH. The presented model in this paper is an ARCH (1) model. Then the conditional variance equation of residual term is as follows:

$$GARCH = 0.00007 + 2.32 * RESID (-1) ^2$$

PROB: (0.95) (0.03)

In the above equation the related coefficients to conditional variance equation of residual term is positive and significant. We estimate the natural gas demand after the estimation of natural price’s volatility indicator with using of Ols method.

3.1.2. Unit Root test of ADF

Now for preventing the occurrence of false regression it is necessary that the stationary of entered variables in pattern be tested. As can be seen from table, temperature variables (LNTEMP), uncertainty of gas price (LNGARCH), natural gas price (LNGASP), GDP (LNGDP), was not in stationary level which with one difference became stationary and the variable of natural gas consumption (LNGASCON) was in stationary level.

Table 2: The unit root test result of Augmented Dickey-fuller (ADF) for time series datum

Series name	Prob	Mac Kinon Critical ratio			unit Dickey-fuller root statistic with one difference	Dickey-fuller unit root	stationary
		10%	5%	1%			
LNGASP	0.0000	-1.61	-1.05	-2.63	-5.66	-	stationary with one difference
LNGDP	0.0020	-3.21	-3.56	-4.29	-4.96	-	stationary with one difference
LNGARCH	0.0000	-1.60	-1.95	-2.65	-4.84	-	stationary with one difference
LNTEMP	0.0083	-1.60	-1.97	-2.79	-3.05	-	stationary with one difference
LNGASCON	0.0000	-3.21	-3.56	-4.29	-	-7.48	Stationary in level.

According to previous studies in the energy sector researcher is considered the following variables in the case model of natural gas:

$$LNGASCON = F (LNGDP, LNGACP, LNGARCH, LNTEMP)$$

It should mentioned that researcher has tried making the variables like logarithmic form until to achieve a better estimation and even through this way can extract the elasticity which in continue we will investigate on it.

Table3: the model estimation-Independent variable of natural gas consumption (LNGASCON).

Independent variable	Coefficients (Elasticity)	probability
LNTEMP	-0.72	0.045
LNGASP	-0.47	0.000
LNGARCH	-0.02	0.001
LNGDP	0.69	0.0000
DW=1.49	$\bar{R}^2 = 98\%$	$R^2 = 98\%$

All coefficients are significant and under 5% also the absolute of t-statistics are larger than 2, because the coefficients are significant. On the one hand the R-squared is estimated 98%. This means that 98% of dependent variable changes are described by independent variables. Now we do the tests of violations classical assumptions for confirming the regression until to prevent of false regression.

3.1.3. Heteroskedasticity test

There are different tests for studying on the existence of heteroskedasticity in model which one of them is WHITE test.

Table 4: The Result of WHITE test

F-statistic	0.69	Prob. F(10,3)	0.71
Obs*R-squared	9.77	Prob. hi-Square(10)	0.46
Scaled explained SS	4.39	Prob.Chi-Square(10)	0.92

So according to prob which is over 5% can conclude that there is not the heteroskedasticity in the estimation regression (Abrishami H, 2009).

3.1.4. Autocorrelation in Residual Terms

Table5: The result of Breusch-Godfrey Serial Correlation LM test

F-statistic	1.09	Prob. F(2,8)	0.38
Obs*R-squared	3	Prob. Chi-Square(2)	0.22

So the prob over 5% indicate the lack of autocorrelation existence.

3.1.5. Collinearity

According to significant coefficients in estimated model, surly can say that there is not intense collinearity in the function (Abrishami H, 2009).

3.1.6. Normally distribution for Error Terms:

Table6: The result of Jarque-Bera test

JARQUE-BERA	1.66
PROBABILITY	0.43

Again in this test prob over 5% indicate the normality of the error term.

3.1.7. Specification Error in model

Table7: The Ramsey Reset test

F-statistic	0.72	Prob. F(1,9)	0.41
Loglikelihood ratio	1.08	Prob. Chi-Square(1)	0.29

In this model the prob over 5% indicate that the estimated model is estimated for the consumption of natural gas well. Therefore, according to estimated equation and with studying on tests of violations classical assumptions can say that the estimated model is estimated well and the existence regression is not a false regression. But should attention to an important and essential point which we use of datum level in this estimation then for solving this problem should study on Granger cointegration test.

3.1.8. Granger cointegration test

Table8: Unit Root test of estimated functions' error components

description	Critical ratio			Dickey-fuller statistic in level	Test result
	10%	5%	1%		
Residual01	-1.60	-1.97	-2.75	-2.68	Stationary in level

As can be seen in the table of previous page the error components of equations were stationary in level so the variables are cointegrated. So can say with waiver of variables stationary or non stationary there is long-term relationship between the model's variables. So these variables can be used in policymaking and the obtained results are quite compatible.

3.2Petrol

After the modeling of petrol price we do the ARCH Heteroskedasticity test on the below model.

$$LN\text{PETP} = 2.28 + 0.64 * LN\text{PETP} (-2)$$

PROB: (0.06) (0.0009)

LNPETP is the logarithm of petrol price. Now in continue we study on the Heteroskedasticity with using of ARCH test in above model:

3.2.1. ARCH Test

Table9: The result of ARCH Heteroskedasticity test

F-statistic	4.67	Prob. F(1,27)	0.0391
Obs*R-squared	4.30	Prob. Chi-Square(1)	0.0381

So according to prob under 5% can conclude that there is a Heteroskedasticity in estimation regression (Abrishami H, 2009).Consequently there is Heteroskedasticity in the model and we study on ARCH estimation. The presented model in this paper is a GARCH (1).

The conditional variance equation of residual term is as follows:

$$GARCH = 0.0021 + 0.904 * GARCH(-1)$$

PROB: (0.73) (0.0000)

In the above equation the related coefficients to conditional variance equation of residual term is positive and significant. In continue after the volatility index estimation of petrol price now we study on variables stationary then we estimate the petrol demand with using of ols method.

3.2.2. The Unit Root Test of ADF

The petrol price variables (LNPETP), GDP per capita (LNGDPC), Petrol consumption (LNPETCON) was not in stationary level and with one difference became stationary and the uncertainty variable of petrol price (LNGARCH) was in stationary level.

Table10: The Unit Root test result of ADF for variables

Series name	Prob	Mac Kinon Critical ratio			Dickey-fuller unit root statistic with one difference	Dickey-fuller unit root	stationary
		10%	5%	1%			
LNPETCON	0.0002	-1.61	-1.95	-2.64	-4.14	-	stationary with one difference
LNGDPC	0.0004	-1.61	-1.95	-2.64	-3.83	-	stationary with one difference
LNPETP	0.0000	-1.61	-1.95	-2.63	-5.76	-	stationary with one difference
LNGARCH	0.0000	-3.21	-3.56	-4.29	-	-37.72	Stationary in level.

According to previous studies in energy sector researcher is considered the following variables in the case model of petrol:

$$LNPETCON = F(LNGDPC, LNPETP, LNGARCH)$$

It should mentioned that researcher has tried making the variables like logarithmic form until to achieve a better estimation and even through this way can extract the elasticity which in continue we will investigate on it.

So we have:

Table11: The model estimation- Dependent variable of petrol consumption (LNPETCON)

Independent variable	Coefficients (elasticity)	probability
C	-1.26	0.095
LNPETP	-0.10	0.028
LNPETCON(-1)	0.49	0.000
LNGARCH	-0.28	0.000
LNGDPC	0.49	0.001
DW=1.56	$R^2 = 97\%$	$R^2 = 97\%$

As can be observed all coefficients are significant and under 5% also the absolute of t-statistics are larger than 2, because the coefficients are significant. On the one hand the R-squared is estimated 97%. This means that 97% of

dependent variable changes are described by independent variables which are a considerable amount. Now we do the tests of violations classical assumptions for confirming the regression until to prevent of false regression.

3.2.3. Heteroskedasticity test

Table12: The result of WHITE test

F-statistic	2.14	Prob. F(14,16)	0.07
Obs*R-squared	20.23	Prob. hi-Square(14)	0.12
scaled explained SS	11.51	Prob. hi-Square(14)	0.64

So according to prob which is over 5% can conclude that there is not the heteroskedasticity in the estimation regression (Abrishami H, 2009).

3.2.4. Autocorrelation in Residual Terms

Table13: The result of Breusch-Godfrey Serial Correlation LM test

statistic	1.78	Prob. F(2,24)	0.18
Obs*R-squared	4	Prob. Chi-Square(2)	0.13

So the prob above 5% indicate the lack of autocorrelation existence.

3.2.5. Collinearity

According to significant coefficients in estimated model, surly can say that there is not intense collinearity in the function (Abrishami H, 2009).

3.2.6. Normal distribution for Error Terms:

Table14: The result of Jarque-Bera test

JARQUE-BERA	0.58
PROBABILITY	0.74

Again in this test prob above 5% indicate the normality of the error term.

3.2.7. Specification Error in model

Table15: The Ramsey Reset test

F-statistic	0.002	Prob. F(1,25)	0.95
Loglikelihood ratio	0.003	Prob. Chi-Square(1)	0.95

In this model the prob over 5% indicate that the estimated model is estimated for the consumption of petrol well. Therefore, according to estimated equation and with studying on the test of violations classical assumptions can say that the estimated model is estimated well and the existence regression is not a false regression. But should attention to an important and essential point which we use of datum level in this estimation then for solving this problem should study on Granger cointegration test.

3.2.8. Granger cointegration test

Now we study on cointegration test. Test results can be seen in the below table:

Table16: Unit Root test of estimated functions' error components

description	Critical ratio			Dickey-fuller statistic in level	Test result
	10%	5%	1%		
Residual 01	-1.61	-1.95	-2.64	-4.40	Stationary in level.

As can be seen in above table the error components of equations were stationary in level so the variables are cointegrated. So can say with waiver of variables stationary or non stationary there is long-term relationship between the model's variables, so these variables can be used in policymaking and the obtained results are quite compatible.

4. RESULT

According to table 3 All coefficients are significant and under 5% also the absolute of t-statistics are larger than 2, because the coefficients are significant. On the one hand the R-squared is estimated 98%. This means that 98% of dependent variable changes are described by independent variables. Now we do the tests of violations classical assumptions for confirming the regression until to prevent of false regression. As we saw in the estimation of natural gas model the GDP variable has positive effect on the natural gas consumption means that if the GDP increase (decrease) also the natural gas consumption will increase (decrease) in such way that other conditions are fixed ,if the GDP increases about 1%,the natural gas consumption will increase about 0.69%. Air temperature is also quite significant and its effect on gas consumption is reverse and negative, this means that with temperature increasing the natural gas consumption will be reduced it means that if the temperature increases about 1 unit with this assumption that other conditions are fixed , the natural gas consumption will decrease about 0.72%. Also in the present paper the law demand is true because the gas price has negative and significant effect on its consumption. This means that if gas price increases this matter will reduce the gas consumption then if the natural gas price increases about 1% with this assumption that the other effective conditions are fixed the natural gas consumption will decrease about 0.47%. Also the uncertainty of natural gas price LNGARCH is estimated negative and significant which indicate the opposite effect on natural gas consumption it means that if in the natural gas market whatever the uncertainty is more than the natural gas consumption will be reduced. In such a way that with one percentage increasing of natural gas price uncertainty, with this assumption that the other conditions are fixed the consumption of natural gas will be reduced about 0.02%.

Also in table 11 as can be observed all coefficients are significant and under 5% also the absolute of t-statistics are larger than 2, because the coefficients are significant. On the one hand the R-squared is estimated 97%. This means that 97% of dependent variable changes are described by independent variables which are a considerable amount. Now we do the tests of violations classical assumptions for confirming the regression until to prevent of false regression. Also according to proving the accuracy of the estimation model of petrol, with using of different tests can be observed that the GDP per capita has positive and significant effect on petrol consumption. It means that if GDP increase (decrease) about 1% also the petrol consumption will increase (decrease) about 0.49,(with this assumption that other conditions are fixed).Also the petrol consumption with one lag period is quite significant and its effect on petrol consumption is positive and significant and this means that with one percent increasing of petrol consumption in the previous period, petrol consumption will increase 0.49% In the current period or better to say the petrol consumption in the current period depends on the consumption in the previous period(with this assumption that other conditions are fixed).Also the demand law is true in petrol model because the petrol price has significant and negative effect on its consumption. This means that if other conditions are fixed the petrol price will increase 1% then this matter will increase its consumption around 0. 10%. The uncertainty of petrol price LNGARCH is estimated negative which shows the opposite effect on petrol consumption. It means that if in petrol market whatever the uncertainty is more than the petrol consumption will be reduced. In such a way that with this assumption that other conditions are fixed, the uncertainty of petrol price increase about 1% then its consumption will decrease about 0.28%.

5. Conclusion

But the important and interesting point it is that with comparing two models of natural gas and petrol, found the uncertainty of petrol price (-0.28) is more in compare to natural gas (-0.02), means that the volatility of petrol price has more effect on petrol consumer than the consumer of natural gas. So according to this subject that air temperature (-0.27) and GDP (+0.69) have more effect on natural gas consumption as the uncertainty of natural gas price (-0.02) after the natural gas price (-0.47) has least influence on its consumption so can say that the air temperature and consumer income are important in issue of natural gas consumption not price and its uncertainty because the natural gas is an essential goods. So it is better to adopt some solutions in this field until the domestic and commercial consumers try to use less of this important source of energy. Also if it is possible looking for substitute fuels in industrial and agricultural sectors and so on. Also in petrol sector because the GDP (+0.49) has more effect on petrol consumption in such way that the uncertainty of petrol price (-0.28) and the natural gas price (-0.1) have least influence on its consumption, so can say that consumer income is important in the petrol consumption issue and in this part the petrol price has not much influence on its consumption. So can say that the government as far as the level of consumer welfare does not be low and if it does not be harmful for low income deciles can act to increase the petrol price.

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