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Energy Consumption, Price, and Value Added of the Industry

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ABSTRACT

Energy has constantly been one of the most important economic issues of each country. Production and, consumption of energy have constantly been playing a significant role in various aspects of economy. Industry is a major part and consumer of energy, and of course industrialized countries have inviolate the great shareholder in energy consumption in the world. Awareness of the consumption of energy in industry has many applications. This is due to the fact that factors dependent on the consumption of energy are somehow well- known and hence decision making about them would be done easier. Production is a function of some factors, which definitely includes energy as one of its factors. Therefore, a Vector Auto regressive (VAR) procedure is used. These components are natural gas, oil products, coal, gasoline and their prices. The time period of this study is the annual data of 1967-2017, the structure of applied variables in equations is separately investigated. There is a weak relationship between industry value added and price and energy consumption. Energy consumption growth does not have proportional relationship with production growth. The low price of energy is one reason for energy deprivation in Iran. Calculated price elasticity indicates that relationship between price and industry value added could be in a negative level.

1. Introduction

The industrial sector uses more delivered energy than any other end-use sector, consuming about 54% of the world's total delivered energy. The industrial sector can be categorized by three distinct industry types: energy-intensive manufacturing, nonenergy-intensive manufacturing, and nonmanufacturing. The mix and intensity of fuels consumed in the industrial sector vary across regions and countries, depending on the level and mix of economic activity and on technological development. Energy is used in the industrial sector for a wide range of purposes, such as process and assembly,

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steam and cogeneration, process heating and cooling, and lighting, heating, and air conditioning for buildings. Industrial sector energy consumption also includes basic chemical feedstocks. Natural gas feedstocks are used to produce agricultural chemicals. Natural gas liquids and petroleum products are both used for the manufacture of organic chemicals and plastics, among other uses.

In our country, energy plays a main role in unlike economically aspects. On one hand, energy is one of the prominent factors in unusual economical sections such as commercial and home transport industry. On the other hand, energy shows its role in the government budget, foreign commerce and political and economic consistency. The role of energy is very important for two different points of view. First, the investigation of energy issues through division approach makes it possible to investigate the issues of the sections, which are related to economic development and proper the field for establishing the goals and policy in long-term programs. Second, today it has been proved that the estimation of energy demand through division approach has a considerable efficiency than other estimation approaches.

Iran represents an appropriate choice for a study of this type for some obvious reasons. First, the country has suffered a myriad of internal political turmoil and severed external relations over the years with attendant consequences on her political and economic fortunes in general and her energy consumption in particular. Iran, a member of OPEC, ranks among the world's top three in both proven oil and natural gas reserves. The country is OPECs second-largest producer and the fourth-largest exporter of crude oil globally with Natural gas accounting for half of its total domestic energy consumption and the remaining half being predominately oil consumption. Iran’s production of total liquids in 2007 was about 4.1mbbl/day out of which about 3.8mbbl/day was crude oil. Iran has limited refinery capacity for the production of light fuels, and consequently imports much of its gasoline supply (IEA, 2009). On the average, primary energy demand and GDP grew at the rate of 7% and 3% respectively between 1967 and 2017 over the years, the countries refining capacity could not maintain the level of internal demand for petroleum products and this had led to increased importation to meet rising local consumption. It is imperative therefore to assess the likely impact that this growth in energy demand portends for her economic emancipation. Second, the results of a causal relationship between energy use and economic growth, if established can serve a useful policy making tool in determining what variables can be influenced if economic growth is to proceed. Furthermore, to the extent that this study will establish a long-run relationship between energy consumption and economic growth via a cointegration analysis, the results could confirm or deny the expectation regarding the future role of energy in economic development.

Energy is foundation stone of the modern industrial economy. Energy provides essential ingredients for almost all human activities. Modern energy services are a powerful engine of economic and social development and all these will gain through precise planning in energy field that requires accurate and reliable energy statistics. In this respect, for a better planning and management and also to present a current view of the energy sector of our beloved country, Power & Energy planning Department provides a series of Iran energy information and compares it to some selected countries of the world. This collection will present in “Iran and World Energy Facts and Figures”. This book covers all kind of energy carriers from reserve, production through to final consumption.

Finally, the outcomes of the investigation have practical implications for policy and macroeconomic planning in typical oil exporting country like Iran. The decision makers in most of these major oil-exporting country subsidies energy to keep home prices below a free market level, resulting in high levels of domestic energy consumption. This kind of policies can only be justified if the direction of causality is from energy consumption to growth.

In the 2017, refinery of 1.8 million barrels of crude oil and condensates and production of 283.4 million liters of petroleum products, per day, 77.9% of the total petroleum products of the refineries were allocated to the gas oil, fuel oil and gasoline with the share of 32.4, 22.5 and 23.0% respectively.

Increase in the fuel oil export by 45.96 million liters with the growth of 0.4% considering its previous year, due to the expansion of south Pars phases and increase in natural gas production and reduction in the usage of this product in power plants. Also reduction of 6.6 million liters of gas oil per day with a decrease of 40.5% considering its previous year due to the increase in the consumption of this product in industrial, transport, and agriculture sectors. A 4.3% increase in motor gasoline imports considering its previous year. Consumption of 72.7 billion liters of major petroleum products with the drop of about 0.2% considering its previous year, of which the biggest share was allocated to gas oil and gasoline with 41.6 and 40.5% respectively.

Share of natural gas consumption in the 2017 by sectors was 33.4% in the power plants, 26.4% in residential, commercial, and public sector, 14.6% in the industry, 12.7% in the petrochemical consumption, 8.1% in the oil and gas refineries, gas compressor station, fuel of the diesel generators of the pipelines, fuel of the hydrogen conversion units, coke plants and blast furnaces units, 3.7% in the transport and 1.0% to the agricultural sectors.

Total of 3486.9 thousand tons of coal extracted in 2017 of which, 3134.9 thousand tons was allocated to the coking coal and 324.3 thousand tons to the steam coal and the rest 27.8 thousand tons was allocated to the mines which type of their extracted coal has not been specified. Production of 1200.4 thousand tons of coal in 2017 with a 15% increase over the previous year due to increased demand for coking units and rising coal prices.

The remainder of this paper is organized as follows. The next section reviews the literature on the studies of energy and empirical Studies, Section 3 outlines the theoretical framework and methodology, Section 4 summarizes the empirical findings and compares results and Finally, Section 5 concludes with our discussion.

2. Literature Review

Earlier studies analyzed the time-series data of a specific country. Bentzen and Engstead (1993) used Danish data over a 43-year span from 1948 to 1990 to estimate the aggregate energy demand as a function of real gross domestic product (GDP), real price of energy demand, and temperature. They concluded that the short and long-term output elasticities were 0.666 and 1.213, respectively, and the corresponding own-price elasticities were 0.135 and 0.465, respectively. Hunt and Ninomiya (2005) identified the long-term relationship among primary energy demand, GDP, and real energy prices in Japan over 115 years from 1887 to 2001 using the Autoregressive Distributive Lag (ARDL) model. The estimated long-term output and elasticities were 1.06 and 0.20, respectively. Some studies analyzed the country-level energy demand using panel data. Al-Rabbaie and Hunt (2006) used the ARDL model for 17 OECD countries from 1960 to 2003 to show that the long-term output and price elasticities ranged from 0.5 to 1.5 and 0.1 to 0.4, respectively. Adeyemi and Hunt (2007) used the data for 15 OECD countries over 42 years from 1962 to 2003 and calculated both the price and output elasticities of energy demand in the long term. Assuming asymmetry price responses with no time effects, the long-term output elasticity of industrial energy demand was calculated as 0.8, whereas the corresponding price elasticity for a price increase was around 0.6, and a price cut was 0.3. Lee and Lee (2010) used the data for 25 selected OECD countries over 26 years (1978 to 2004) and estimated the total energy demand and electricity demand as a function of real output and real price. The estimation results suggested that the demand for total energy is largely driven by strong economic growth and is inelastic to price changes.

Adom et al., (2012) assessed the drivers of electricity consumption in Ghana and the estimation results indicated that real per capita GDP, industry efficiency, structural changes in the economy and degree of urbanization influence electricity consumption in the long-run while real per capita GDP, industry efficiency and degree of urbanisation affect short-run electricity consumption.

Sekantsi et al., (2016) found that financial development, industrialization, Lesotho Electricity and Water Authority (LEWA) and urbanisation positively affect the long-run electricity consumption in Lesotho. In the short-run; however, they reported that political instability reduces electricity consumption while financial development positively affects electricity consumption.

Amadeh et al. (2014) estimated demand for electricity of Iranian agricultural sector by using annual data during the period 1973-2010. Based on Kalman filter algorithm, the estimation of the electricity demand by using the variables of electricity price, the value-added of a sector and the price of gas oil as a substitution in the agricultural sector. The results of their estimation showed that price and income electricity demand in the short-run of -0.1422 and 0.441. Long-run elasticities were equal to -0.355 and 0.07773, respectively.

Campbell (2018) used the bounds testing approach to cointegration to obtain long-run price elasticity of demand estimates for the period 1970–2014. The analysis focuses on aggregate electricity demand and three categories of consumers: residential, commercial, and industrial. The findings suggest that residential and industrial consumers are most responsive to price changes, with long-run price elasticities of demand of −0.82 and −0.25, respectively.

Saha and Bhattacharya (2018) estimated price and income elasticities of electricity demand for four consumer categories, Agriculture, Commerce, Industry, and Domestic, for two major utilities (one public and the other private) that supply electricity in West Bengal, India. They used panel data analysis covering 15 years for the four consumer categories.

Feehan (2018) used the natural experiment allows for a simple differences-in-differences calculation of the long-run price elasticity of residential demand for electricity in the similar adjacent regions in a Canadian province. He showed that the price elasticity of demand is -1.2.

Azarbayejani et al. (2006), with using time series data for the period of 1984-2007 and employing Autoregressive distributed lag model (ARDL) and error correction model (ECM), the industrial electricity demand of Iran estimated in long-run and short-run. The results showed that due to the lack of significant changes in the price variable of electricity in the long-run and its low price elasticity in the short-run, pricing policies such as government subsidy policies would not have much effect on demand management. Also, the elasticity of demand in the long-run and short-run is 0.71 and 0.16, respectively.

2.1. The industry share in energy consumption

Nowadays, one of the indicators of economic development in different societies is the increase of the industry share in the gross national product (GNP). On the other hand, developed countries are the chief consumers of energy. This shows that as the economics evils and along the process of industrialization, the energy consumption increases. So, industry section is one of the industries section of some countries is as follows:

China allocates 62 percents of its consumed energy to industry. In the eastern, this ratio is 52 percents, in South Korea 41 percents and India 22 percents. Narayan and Prasad (2008) examined European countries included Czech Republic, Iceland, Italy, Portugal, and Slovak Republic and found causality running from energy consumption to economic growth. Hatemi-J and Irandoust (2005) examined Sweden, Narayan and Prasad (2008) examined Finland, Hungary and Netherlands and they found same results. Hondroyiannis (2002) in his paper found two-way relationship for Greece. Erol and Yu (1987) for West Germany and Aktas and Yilmaz (2008) for Turkey found the same results. Yu and Choi (1985) for Poland and United Kingdom and Narayan and Prasad (2008) for Belgium, Denmark, France, Germany, Ireland, Luxembourg, New eland, Norway, Poland, Spain, Sweden, Switzerland and Turkey investigated causal relationship and found no evidence of causal relationship between these variables. Although there is so much study examining countries all over the world, especially European countries, there is not enough study examining Iran. Iran has big capacity about petroleum and gas. These energy sources are important advantages for Iran.

In our country, energy during the period of 1967-2017 has increased from 12.6 million barrels of crude oil to 254.8 million barrels. From 1967-2017, the share of energy consumption in industry has increased. In 1967 the share of energy consumption as 25.4% from total energy consumption and decreased to 14.9 in 2017. This shows that during this period the share of energy consumption in industry hasn't changed a lot. The 20.22 times increase of energy consumption is seen in other sections.

2.2. The consideration of consumption process

From 1967 to 1969 the share of energy consumption in industry hasn't changed much on to average and the change of this period has increased about 0.5 percent and then has decreased about 0.3 percent. From 1969 to 1971 it can be seen that, it has decreased about 2 percents. From 1972 this share has had a rising trend and it has continued up to 1975.From 1967 to 1979 this trend was falling. In this period the share of energy consumption in industry is about 29.3 in 1975 and reaches 24 percents in 1979 from 1983 the falling trend begins up to 1986 and amounts to 26.5 percents. There is a rising trend from 1987 to1991. In 1992, we can see the most shares which are about 30 percents and it decreases to 29.9 percents in 1993. Of course, 1992 is the end of the first program because most of the industrial projects have reaped the fruits. In 2017 the share of energy consumption in industry has 20.32 percents and total energy consumption in industry was 254.8 million barrels. In general, after 1979 the share of energy consumption of the industry has had a rising violent trend.

2.3. The examination of the trend of industry share in gross national product

From 1967 to 1971, when the share of industry in GNP was 5.9 percents, there has been a short rising trend and the share of industry of GNP has amounted to 6.2 percents. From the beginning of the 1970s this rising trend become more severe and it has come up to 8.7 percents up to 1981. Because of the desired foreign exchange condition and more important facilities of the factories, the share has an increase about 4 percents and comes up to 12.8 percents from 1982. This trend continues to 1984 and the amount is 13.6 percents in those years 1985, because of the decrease of the oil income, the share has decrease about 12.5 and 1988 when the war ends it gets to 11.9 percents. In 2017 share of industry in GNP was 20.05 percents. Finally in 2017 it is about 20 percents and during the fourth program the share if the industry changed so much. The comparison of the industry share in the national economics with the energy consumed of this section shows that industry has not the same share in the national economics that in consumed energy.

2.4. The consumed fuels in industry section

The carriers of the consumed energy in industry section in our country include petroleum products (PETR), natural gas (NGAS), and black coal (COAL). The consumed solid fuel of our country industry is the black coal, which is used, in Irons steel industry.

During the period 1967-2017, the (PETR) had the most shares among other fuels. In such a way that in 1967 about 80 percents of the consumed fuels and in 2017 was 28.5 percents the (PETR). The use of natural gas, in spite of the existence of the rich gas resources doesn’t refer to many years adjoins 1967 only 1.32 percents of the consumed fuel was gas. This trend has grown up a little up to 1971 and has come up to 2.67. From 1972 to 1976 this trend has a rising form in which 13.6 percents of the consumed fuel is allocated to natural gas. From 1977 there is falling trend in natural gas consumption. This ratio amounts to 2.68 in 1989 and the revolutional and political events rising trend began from 1980 and it got better from 1982 up to 1984 when the ratio is about 13.34. During the years 1984 to 1986 the share of natural gas declined again and reached to a point of 10.9. This increased trend started from 1987 and a movement could be seen during 1989-2017. The share came to 52.3 percents in 1993 and 28.54 in 2017 and this shows that during the execution of the first program the issues of carrying gas more attention than before. With regard to the share of (PETR) and (NGAS), one can say that those two fuels have acted as substitutes for each other. Whenever one share has decreased so the other share has increased.

3. Modeling with Vector Auto regressions

The inspection of the relationship between two or more variables is common in econometric models and it is done widely. These inspections do not necessarily examine the cause and effect relations but with the help of multi-variable regressions different techniques, they look for the variables which describe the change of the dependent variable. Moreover, within the frames of the known models the effects of the changes of the exogenous and endogenous variable are examined. Different methods have been applied for the stagnancy of the series.

Some researchers have taken steps toward the stagnancy of the data through the omission of the special time procedure. The other method, which is used in most of the studies, is the subtraction technique. The Unit-Root test is varying important in the examining of the stationary or no stationary of the time series. The Augmented Diky-Fuller (ADF) is used in testing the Unit Roots.

Stern & Cleveland (2004) observed that in most of the studies energy and GNP growth cointegrate and that energy use does Granger cause GNP growth rather than GNP growth causing more energy consumption demand when additional variables such as energy prices or other production inputs were included. This limits the prospects for further large reductions in energy intensity. They observed that energy has a higher cost share in industrial sectors encouraging energy saving innovation in those sectors. Akarca and Long (1980), Yu and Hwang (1984), Yu and Choi (1985), Yu and Jin (1992) and, Cheng (1995) found no causal relationship between total energy consumption and income for the US. On the other hand, Kraft and Kraft (1978) and Abosedra and Baghestani (1989) detected a unidirectional causality from GNP growth to energy consumption. Similarly, Soytas and Sari (2003) investigated causality relationship between energy consumption and GDP in G7 along with nine other emerging markets and found that causality runs from GDP to energy consumption in Italy and Korea.

Hwang and Gum (1991) had evidenced a bi-directional causality for Taiwan, while Masih and Masih (1997) had found the same for both Taiwan and Korea. Subsequently, Yang (2000) had also confirmed bidirectional causality for Taiwan. Yu and Choi (1985) and Masih and Masih (1996) yielded contradictory results for the Philippines. Yu and Choi (1985) using data from five countries, confirmed the absence of causality between GNP and total energy consumption for the US, the UK, and Poland but the causality from GNP to energy consumption was found for South Korea and the reverse for the Philippines. While, Erol and Yu (1987) and Soytas and Sari's (2003) results were similar for Turkey, but a similar result for France, Germany, and Japan were also found holding true in Soytas and Sari (2003) indicating a unit-directional causality from energy consumption to GDP growth. However, Erol and Yu (1987) found a bidirectional relation for Italy out of six industrialized countries studied. Mozumder and Marathe (2005) examined for Bangladesh and found that there is a unidirectional causality from per capita GDP to per capita electricity consumption. It indicates that the studies conducted in different countries context yielded different results. The differences in results may be due to the differences in the period of study considered, the structure and pattern of energy consumption and the statistical techniques applied.

Ebohon (1996) examined the casual linkage between energy consumption and economic growth for Nigeria and Tanzania. The results showed a simultaneous causal relationship between energy and economic growth for both the countries. The implications being were unless energy supply constraints are eased, economic growth and development would remain elusive. Energy plays a key role in economic development. Horn (1999) observed that energy consumption per GDP unit and energy consumption per capita in relation to GDP per capita were extremely high for Ukraine, even in comparison to Russia and other transition countries. He attributed to the reasons of technical inefficiencies, structural factors (high share of basic industry) as well as the persistent economic crisis. Electricity consumption per capita in contrast nearly corresponded to the low average income in Ukraine. Their future projection for energy demand on the basis of certain assumption regarding the price elasticity’s, income elasticity’s and technological progress for each sector indicated that in contrast to the official projections the energy consumption in 2010 may be lower than in the base year 1995, even with a higher economic growth. They also projected that the use of renewable energy (wood, solar, wind, hydropower, etc.) would nearly double along with an increase in demand for oil and electricity consumption while there would be drop in coal and natural gas consumption during the projection period. In view of the slow growth prospect of overall energy demand the study suggested that it would not be necessary to expand coal production and electricity generation with nuclear energy in order to reduce energy imports. This conclusion would be strengthened if the government takes measures for improving the efficiency in energy use. The study also observed that energy efficiency in Ukraine today is far below than the western standards in all sectors, and a greater reduction of energy demand would be possible only by accelerating the replacement of old inefficient appliances and facilities by new ones.

3.1. Methodology

Joehans in 1998 resolved the difficulties of the omission of the series Long-term information through the victory long-term convergence method and entering this method into the traditional model of Vector Auto-Regressive (VAR). Thus, through this method without the stagnancy of the series in VAR, one can examine the long-term relation of the series. This study is based on VAR technique. VARs may be regarded as reduced forms of structural econometric models. For this reason, the regression coefficients do not have any economic meaning. The moving average representation, however, provides depositions of forecast errors and impulse responses that highlight the relationships among the variables in the model and is analyzed with special stoical techniques.

The study employs time series econometric procedures in order to understand the dynamic relationship between Price and Energy Consumption with Industry Value Added. Before utilizing the time series model for estimating the relationships, the study carries out unit root testing procedures in order to apply suitable time series estimating procedures appropriate to the context as disregarding the unit root tests may result in biased estimates. Since the growth rates are usually expected to be stationary at their levels, the study proposes to employ variance decomposition analysis of vector auto regression method for empirical analysis. One of the important points needs to be born in mind is that variance decomposition analysis of VAR is most suitable techniques when all the variables are stationary at their levels.

Furthermore, it is only possible to infer a relationship between non stationary time series when the variables concerned are cointegrated. If cointegration analysis is omitted, causality tests present would give the evidence of simultaneous correlations rather than actual causal relations between the variables. Decomposition analysis explains the variation in one variable due to the shocks in it and shocks in another in an out of sample forecasts. In other words, variance decomposition can be viewed as an out of sample causality test. In carrying out these econometric tests, one of the important factors is to properly determine the lag length of the variables in the models. The lags of the models have been selected on the basis of Akaike Information Criteria (AIC). However, in a VAR system all variables are endogenous.

The data base of this study is the time series of the data related to the Annual 1967 to 2017 and its variables are industry value added with real price (IV), natural gas consumption (NG), real price of natural gas (PNG), petroleum consumption (PE), real price of petroleum (PPE), black coal consumption (CO), and real price of black coal (PCO) which are examined in three separate systems. A VAR model consists of a set of equations in which each variable is regressed on its own lagged values and on the lagged values of all other variables in the model.

The VAR(p) model can be written as:

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + \varepsilon_t \quad (1)$$

where:

$Y_t = (Y_{1t}, Y_{2t}, Y_{nt})'$:an ($n \times 1$) vector of time series variables

α : an ($n \times 1$) vector of intercepts

β_i (i=1, 2, …, p): ($n \times n$) coefficient matrices

ε_t : an ($n \times 1$) vector of unobservable i.i.d. zero mean error term (white noise)

$$\begin{aligned} IV_t = \alpha + \beta_1 IV_{t-1} + \beta_2 IV_{t-2} + \beta_3 IV_{t-3} + \beta_4 PNG_{t-1} + \beta_5 PNG_{t-2} \\ + \beta_6 PNG_{t-3} + \beta_7 NG_{t-1} + \beta_8 NG_{t-2} + \beta_9 NG_{t-3} + \varepsilon_{1t} \end{aligned} \quad (2)$$

$$IV_t = \alpha + \beta_1 IV_{t-1} + \beta_2 IV_{t-2} + \beta_3 IV_{t-3} + \beta_4 PPE_{t-1} + \beta_5 PPE_{t-2} + \beta_6 PPE_{t-3} + \beta_7 PE_{t-1} + \beta_8 PE_{t-2} + \beta_9 PE_{t-3} + \varepsilon_{2t} \quad (3)$$

$$IV_t = \alpha + \beta_1 IV_{t-1} + \beta_2 IV_{t-2} + \beta_3 IV_{t-3} + \beta_4 PCO_{t-1} + \beta_5 PCO_{t-2} + \beta_6 PCO_{t-3} + \beta_7 CO_{t-1} + \beta_8 CO_{t-2} + \beta_9 CO_{t-3} + \varepsilon_{3t} \quad (4)$$

t : time period, 1967-2017.

4. Empirical results

All the variables applied in this model are in the critical level of 5 percents Mcakinon and have been shown in table 1.

Table 1. Unit Roots Test

Variable	Lag	ADF ratio	Order of Integ.**	Result
IV	2	-4.13	I(0)	*
PNG	2	-5.30	I(0)	*
NG	2	-4.18	I(0)	*
PPE	2	-4.23	I(0)	*
PE	2	-5.15	I(0)	*
PCO	2	-3.72	I(0)	*
CO	2	-4.27	I(0)	*

Source: Energy Balances and Research Calculation

* Indicates the rejection H_0: hypothesis or existence of the unit root

**Integrated of order 0 or I(0)

(The critical amounts of Mackinon at the levels of 1% and 5% are relatively -4.35 and -3.59)

Table 2. VAR Parameter estimates of the equation 2

Explanatory Variable	**Dep.Var. IV**		**Dep.Var. PNG**		**Dep.Var. NG**	
IV(-1)	0.82 (3.51)	*	0.22 (2.74)	*	0.11 (2.04)	*
IV(-2)	0.15 (2.61)	*	0.07 (0.25)		0.00 (0.07)	

IV(-3)	0.34 (3.28)	*	0.84 (2.02)	*	0.04 (2.63)	*
PNG(-1)	-2.47 (-3.66)	*	0.38 (2.25)	*	-0.01 (-2.59)	*
PNG(-2)	-4.37 (-1.95)	*	0.12 (3.09)	*	-0.08 (-0.04)	
PNG(-3)	-11.79 (-3.11)	*	0.21 (1.56)		-0.21 (-3.22)	*
NG(-1)	2.38 (3.59)	*	7.95 (1.15)		0.82 (4.21)	*
NG(-2)	1.04 (1.57)		-12.65 (-2.71)	*	0.03 (0.61)	
NG(-3)	1.74 (4.96)	*	-17.54 (-3.00)	*	0.36 (1.17)	
C	6.34 (2.29)	*	-12 (-0.41)		5.14 (2.15)	*
R^2	0.91		0.89		0.86	
D.W	1.97		2.11		2.13	
S	4.12		9.02		4.3	
ESS	15.53		16.77		2.19	

** t statistics are in parentheses, * Significant at the 5% level, respectively, Durbin Watson Statistic (D.W), Explained Sum of Squares (ESS), Standard Deviation (S)
Source: Energy Balances and Research Calculation

As table 2 illustrates, the industry value added depends on previous period and on previous periods and it also depends on the PNG in previous periods and on the NG consumption in previous periods and also on the fixed amount of the same way, the NG price is dependent on the IV previous period and previous periods and the NG consumption is dependent on the IV in periods before.

Table 3. Variance decomposition of forecast errors

Var.Deco. of IV				Var.Deco. of PNG			Var.Deco. of NG		
Period	IV	PNG	NG	IV	PNG	NG	IV	PNG	NG
1	100	0	0	83.17	16.82	0	39.13	5.19	1.67
2	99.9	.08	.01	90.57	9.28	.14	93.16	5.19	1.64
3	99.8	.15	0	97.48	2.2	.04	92.66	1.39	.16
4	99.5	.46	0	99.69	.28	.02	98.44	.17	.05
5	99.9	.02	0	99.59	.39	.01	99.77	.03	.01
6	99.9	0	0	99.04	.08	0	99.96	.05	0
7	99	0	0	99.94	.04	0	99.94	.03	0
10	99.9	0	0	99.98	0	0	99.95	0	0

Source: Energy Balances and Research Calculation

Another way of characterizing the dynamic behavior of the model is through variance decomposition. This breaks down the variance of the forecast error for each variable into commoners that can be attributed to each of the endogenous variables. Table 3 shows the variance decomposition for IV, PNG and NG. The scanned column of the table 3 shows the percentage of the IV forecast variances that can be attributed to shocks in IV along, as opposed to PNG and NG. The third column shows that percentage of the IV forecast variances that can be attributed to shocks in PNG, and the fourth column shows the percentage attributed to NG, (table 5,table 7). For example, if the model makes a 4 year forecast of IV, 99.5% of the forecast variance will be attributable to IV shocks, 0.46% to PNG shocks, and 0% to NG shocks.

Table 4. VAR Parameter estimates of the equation 3

Explanatory Variable	Dep.Var. IV		Dep.Var. PPE		Dep.Var. PE	
IV(-1)	0.91 (2.24)	*	0.81 (0.45)		-0.01 (-2.14)	*
IV(-2)	0.31 (2.39)	*	0.55 (2.24)	*	0.01 (0.68)	
IV(-3)	0.13 (7.00)	*	1.91 (1.01)		-0.05 (-0.41)	
PPE(-1)	-0.35 (-6.11)	*	0.13 (0.21)	*	0.01 (2.35)	*
PPE(-2)	-1.65 (-2.09)	*	1.17 (2.22)	*	0.60 (0.41)	
PPE(-3)	-6.67 (-1.19)		12.21 (7.90)	*	0.33 (2.04)	*
PE(-1)	3.20 (2.41)	*	-1.91 (-3.27)	*	-0.59 (-0.77)	
PE(-2)	0.09 (4.39)	*	-3.08 (-1.33)		-0.79 (-6.53)	*
PE(-3)	0.09 (2.41)	*	-5.05 (-1.25)	*	0.18 (0.25)	
C	-5.00 (-1.21)		-12.58 (-1.72)		8.25 (1.25)	
R^2	0.95		0.93		0.90	
D.W	1.96		2.18		2.20	
S	20.7		10.5		16.2	
ESS	4.63		7.6		3.39	

** t statistics are in parentheses, * Significant at the 5% level, respectively

Source: Energy Balances and Research Calculation

Table 4 illustrates that IV depends on the IV of this section in the period last. The PPE depends on its price in the previous period but consumption is dependent on each of the factors.

Table 5. Variance decompositions of forecast errors

	Var.Deco. of IV			Var.Deco. of PPE			Var.Deco. of PE		
Period	IV	PPE	PE	IV	PPE	PE	IV	PPE	PE
1	100	0	0	62.77	37.2	0	47.2	12.5	40.2
2	99.1	0.35	0.46	65.5	33.5	0.8	64.9	12.3	22.6
3	99.2	0.97	0.73	93.1	3.7	0	86.4	4.7	8.8
4	99.1	0.76	0.04	97.0	1.3	1.2	98.7	0.5	0.7
5	99.5	0.49	0	98.7	1.1	0.1	99.4	0.4	0.08
6	99.3	0.65	0	99.4	.5	0	99.2	0.7	0.03
7	99.3	0.65	0	99.3	.6	0	99.4	0.5	0
10	99.3	0.62	0	99.3	.6	0	99.4	0.5	0

Source: Energy Balances and Research Calculation

Table 6. VAR Parameter estimates of the equation 4

Explanatory Variable	**Dep.Var. IV**		**Dep.Var. PCO**		**Dep.Var. CO**	
IV(-1)	0.54 (2.36)	*	1.91 (1.42)		0.01 (0.29)	
IV(-2)	0.15 (1.96)	*	-6.18 (-1.58)		0.11 (2.28)	
IV(-3)	1.02 (2.29)	*	3.28 (2.54)	*	0.01 (0.98)	
PCO(-1)	-0.17 (-2.64)	*	0.19 (6.23)	*	-0.10 (-1.97)	*
PCO(-2)	-0.74 (-2.29)	*	0.41 (1.94)		-6.57 (-2.21)	*
PCO(-3)	-1.03 (-4.51)	*	1.52 (3.68)	*	-0.01 (-0.91)	
CO(-1)	-13.04 (-1.17)		-3.31 (-2.29)	*	0.13 (3.24)	*
CO(-2)	3.03 (2.04)	*	0.26 (2.98)	*	0.91 (2.02)	*
CO(-3)	2.78 (2.17)	*	3.81 (1.03)		0.15 (0.38)	
C	0.77 (1.25)		3.00 (0.26)		2.41 (5.81)	*
R^2	0.94		0.90		0.88	
DW	2.18		2.15		2.13	
S	10.72		9.67		1.36	
ESS	8.14		6.3		1.27	

** t statistics are in parentheses, * Significant at the 5% level, respectively

Source: Energy Balances and Research Calculation

As table 6 indicates, the IV depends on the IV in previous periods and also on the PCO in the periods last, as well as on its consumption in the last periods.

Table 7. Variance decompositions of forecast errors

Var.Deco. of IV				Var.Deco. of PCO			Var.Deco. of CO		
Period	IV	PCO	CO	IV	PCO	CO	IV	PCO	CO
1	100	0	0	68.7	31.23	0	11.1	88.66	.7
2	94	5.97	0.02	88.1	11.59	0.01	47.9	52.05	0.01
3	99.5	0.46	0	77.9	2.07	0	89.5	10.52	0.02
4	90.3	9.64	0.05	93.3	6.62	0.03	79.1	20.87	0.02
5	99	1	0	97.9	2.11	0.03	99.1	.81	0
6	94.4	4.54	0.02	99.3	1.68	0.01	88.3	11.68	0.01
7	98.5	1.32	0	97.3	1.64	0	99.1	0.9	0
10	98.7	1.32	0	97.5	0.44	0	95	4.51	0.03

Source: Energy Balances and Research Calculation

Price elasticity calculated and summarized in table 8 shows that if PNG increases one percent while other conditions are fixed, IV will decreases about 0.66 percent and if the PPE increases about one percent with conditions fixed, the IV will decrease about 0.062 percent and if the PCO increases about one percent with other conditions fixed, the IV will decrease about 0.029 percent Therefor, the calculated price elasticity indicates that the relationship between energy price and IV can be in a negative definite level

Table 8. Price Elasticity

Depe. Vari	In.Depe.Vari	Elasticity
LIV	LPNG	-0.660
LIV	LPPE	-0.060
LIV	LPCO	-0.029

Source: Energy Balances and Research Calculation
LIV=LN (IV), LPNG=LN (PNG), LPPE=LN (PPE), LPCO=LN (PCO)

5. Conclusion

Usually the industrial sector is split into three major sub-sectors: mining, manufacturing and construction. Manufacturing is then broken down into various categories of industries to understand the demand pattern of energy intensive and non-intensive industries. The proportion of final energy consumed by the sector varies from one country to another depending on the degree of industrialization and stage of economic development of the country. Note that the energy consumption of the energy sector should not be included in the final energy consumption of industry since these energy sectors own uses are accounted for in the transformation of primary energy into final energy. The electricity generated by industrial sector itself, known as captive power or self-generation, should also be included in the transformation sector and the consumption of this energy should be included in electricity consumption of industry.

Iran, like other oil producing countries, provides subsidy for national oil product consumption. The increase of oil products can decrease the present trend of consumption. Fast growth of oil products with regard to the inflammation up to the year 1995 has continually had a falling trend.

The main national industries such as steel, petro chemistry and, etc. generally use energy and the main part of their export income is infecting considered as the export of petrol freely. On the one hand, Iran's accession to the world trade organization necessitates the gradual remove of all kinds of subsidies. On the other hand, removing of subsidy in national industries at the present conditions means the deprivation of the industry section and is considered as one of the most important relative economic advantages, there for making a decision in establishing the price system of energy is difficult in the production section.

There is a weak relationship between the industry value added and the price and the amount of all kinds of energy in long-term at the definite level of 5%. The increase of energy consumption in industry section is expected to have a great value added, but the relation between the growth of the industry value added and the energy consumption of this section is very low, so this weak relation is open to question in Iran's economy.

The consumption growth of the oil products has not followed the average of the economic growth rate or even the population growth rate. Because of the severe decrease of the world oil price and the war, the national mixed production with a fixed price in 1977-1989 has decreased about 7 percents, while the population has increased about 40 percents in the same period of time and the energy has increased about 78 percents. The factors, which have influenced oil production trend, are the war, the oil shocks, and the stagnancy of economic activities.

The energy consumption is under the influence of 3 factors: 1.The political and economic changes, 2.The relative low price of energy, and 3.The substitutions of new fuels.

Moreover, the rate of energy consumption growth does not have proportional relation with the rate of production growth and if the energy consumption decreases to some extent, it doesn't demand the national production.

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