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The Impact of Targeted Subsidies on Combination of Energy Consumption in Iran: The Case of Non-Metal Mineral Manufacturing Industries

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Abstract

Although targeted energy subsidies has been considered by policy makers since the First 5-year Economic, Social and Cultural Development Plan in Iran, they were partially implemented only in recent years. This issue specifically has great importance for industry sector that has benefited from subsidized energy prices. This research attempts to investigate the possible impact of implementing Subsidy Reform Plan on manufacture of non-metal mineral products industry by using Artificial Neural Network approach. This investigation focuses on new entered firms into this industry as one of the most energy intensive industries. The results indicate that by replacing electricity real price with subsidized prices, the consumption of this energy carrier will generally decline by 16 percent. Despite this reduction, the large entrance of new firms has raised the consumption in some years. Therefore, the results show that targeted subsidies do not have large impact on energy consumption in manufacturing industries. Furthermore, the impact of this policy highly depends on combination of firms in each industry.

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1. Introduction

Despite the huge subsidies and increased share of total subsidies from GDP from 9.3 percent in 2001 to more than 26 percent in 2005 (Energy balance sheet, 2005), In Iranian economy, effectiveness of payments for reasons such as distorted prices and disrupting the market mechanism and the lack of optimal allocation of resources, has failed to achieve its intended purpose (Tashkini et al., 2009). However, one of the indirect subsidies accounting for a significant proportion of subsidies is the subsidy paid to energy carriers. Energy commodity is a term involving concepts of fuel, the heat and power. In definition provided by the International Energy Agency, fuel is referred to any substance that is capable of firing as heat or energy source. Heat is also obtained from the combustion process in which carbon and hydrogen found in fuel substance combines with oxygen and cause the release of heat. Energy carriers are either extracted directly from natural resources (called as primary energy such as crude oil, coal and natural gas) or produced from primary carriers called secondary carriers (such as oil products derived from crude oil, coking furnace of coal, coke). However, the mean of energy carriers in this research is those energies that are listed in targeted subsidies law (Gasoline, gas oil, fuel oil, kerosene and liquefied petroleum gas, natural gas and electricity).

Subsidy Reform Plan of energy is one of the most important sections of economic reform plan which led to change in subsidy payment process. Based on this plan, government transfer payments for energy that was being done to hold down production costs and thus indirectly control the market price are removed and instead, domestic sale prices of gasoline, gas oil, fuel oil, kerosene and LPG and other oil derivatives, considering the quality of carriers and the associated costs (including transportation, distribution, taxes and legal duties) has been determined such that gradually by the end the fifth five-year Economic, Social and Cultural Development of the Islamic Republic of Iran is not Less than 90 percent of the price of delivery on board (FOB[1]) in the Persian Gulf. The average domestic selling price of natural gas which is determined gradually by the end of five-year Economic, Social and Cultural Development Plan of the Islamic Republic of Iran becomes equivalent to at least 75 percent of the average exported natural gas price after estimation of the costs of transportation, taxes and duties and the average domestic selling price of electricity be equivalent to its cost price. Nevertheless, evidences have shown that the energy intensity as a measure for evaluating the energy efficiency in economy which shows the ratio of consumed energy units (million barrel crude oil) to the value of a production unit (in billion dollars) is continuously at a higher level in Iran than advanced countries (Table 1).

Table 1: Energy Intensity Index

year	**Gross domestic product by fixed price of 1987** (Billion Rial)	**Marginal energy consumption** (million barrel crude oil)	energy intensity **(**Thousand Rial/ barrel crude oil**)**
2005	438899	833	1.9
2006	467930	907	1.94
2007	491088	971	1.98
2008	495266	986	1.99
2009	509895	1033	2.03
2010	539219	1034	1.92
2011	555436	1060	1.91
2012	555436	1058	2.02

Source: energy balance 2012

However, international experiences show that one of the most effective ways to reform energy consumption is to impose pricing. Nevertheless, it is obvious that the modification price does not lead to the optimal consumption alone and the industries should be optimized as well (Bazazan et al., 2015). Hence, it can be expected that one of the outcomes of decreased subsidies and increased energy carrier prices is reformation of consumption pattern at household and economic firm level. From this view, liberalization of energy carrier price will lead the household and producer to change their consumption and production patterns and move toward energy efficiency (Abasian and Asadbeigi, 2011). However, in Iranian economy the manufacturing industrial sector is considered as the driven economic development and it is expected that this sector play an important role in country's economic development. The manufacturing industrial sector consists of the firms account for a significant portion of country's employment. Also, data presented in Table 2 shows the importance and position of manufacturing industrial sector in consumption of energy carriers.

Table 2: Share of Final Consumers in Energy Carrier Consumption (Percentage)

	domestic, public and trade		industry		transportation		agriculture		Non-energy uses	
year	2005	2012	2005	2012	2005	2012	2005	2012	2005	2012
oil products	7.48	11.81	13.02	9.35	54.67	60.61	5.13	5.72	19.7	12.51
natural gas	6.66	11.21	27.52	35.14	0.556	6.90	-	0.77	65.27	45.98
electricity	3.18	1.82	33.66	36.10	0.08	0.19	12.16	15.87	50.93	46.02

Source: energy balance 2012

As seen, the manufacturing industrial sector in 2005 has accounted for the highest consumption level in natural gas and electricity consumption after domestic, public and trade sectors and in terms of oil products consumption, has placed in the third position after transportation, domestic, public and trade sectors. The energy consumption in manufacturing industrial sector is substantial and significant even during the last years. For example, Table 2 shows the share of manufacturing industrial sector in consumption of natural gas and electricity in 2012 which is in the second place after domestic, public and trade sectors. Hence, in general, the share of energy carriers is significant in the manufacturing industrial sector. Thus, with specificity of the position of manufacturing industrial sector in Iranian economy, this research attempted to evaluate the real impact of implementing Subsidy Reform Plan on possible change in combination of energy consumption in newly-established firms of manufacture of other non-metal mineral industry (ISIC code, 26) as one of the most important industries of Iran. Moreover, the manufacturing industry of other non-metal minerals has accounted for the highest number of industrial workshops in 2012 (3191 firms from total of 14784). This industry has also had the highest level of employment after the food and beverage industries (174731 persons from total of 1204699). Having the highest number of firms during last two decades, this industry is placed in the group of industries with the highest exploitation license taken from the ministry of industry, mining and trade. For example, this industry in 2006, 2011 and 2012 with 1731, 1177, and 751 exploitation licenses, respectively, has accounted for the highest number of exploitation license issued by the ministry of industry, mining and trade (statistical center of Iran, 2013). As such, this research attempted to examine the change in combination of energy carrier consumption in newly-established firms of manufacturing other non-metal minerals assuming other production factors fixed. This estimation is performed using Artificial Neural Network (ANN here after) as one of the accepted approaches in this field.

2. Literature Review

When subsidies reform plan became serious, various studies have attempted to analyze the impact of this economic decision on Iranian economy through different approaches. However, the impact of elimination or reforming subsidies has long been studied in other countries. For example, Hope and Singh (1995) in their study entitled "The increase of energy carrier prices in developing countries: a case study of Turkey, Colombia, Zimbabwe, Indonesia, Ghana, and Malaysia" investigated the impact of increased energy price on variables of poverty, inflation, growth, national income, and industrial competitiveness during 1980-1990. Their results in manufacturing industrial sector indicated that except for energy-consuming industries, in the case of increased energy prices, most industries have had sufficient flexibility for substituting and notwithstanding the price of energy carriers. Their study also showed that the impact of increased prices was less than other changes.

Uri and Boyd (1997) examined the impact of increased price of petroleum and electricity on 13 productive sectors, 14 consuming sector, and 4 domestic categories using a general equilibrium model. Results of their study indicated that increased prices leads to a decrease in energy consumption by households and producers, a decrease in production at productive sectors relying on these energy carriers, a decrease in environmental destructive materials and ultimately an increase of state's gains which can be employed for refunding foreign debts and adjusting it.

Shi and Polenske (2005) by stating that with economic reform in 1978 and increase of relative prices the energy intensity has significantly decreased. Their study was indicative of the negative impact of energy prices on energy intensity, the impact of price motivation on energy efficiency growth and more sensitivity of manufacturing industries sector to increase in energy prices on energy intensity than other sectors.

As noted earlier, in the recent decade various studies have been also conducted on subsidies reform in Iran. As an example, perhaps the report of Iranian Central Bank in 2005 can be considered as one of the pioneer reports on possible inflationary impacts resulting from the increase in energy carrier prices to the level of Persian Gulf FOB. The Central Bank (2005) stated that granting subsidies for basic goods and services, especially energy carriers, in addition to affecting the government budget, leads to the wasteful consumption of these goods and, on the other hand, leads to the expansion of high energy-consumed industries. Then, using input-output model and a computable general equilibrium model for energy investigates the inflationary impacts of increased prices according to information of the year 2004. The results of this research indicated that the impacts of sharp increase in prices to the level of Persian Gulf FOB is severe and regarding the lack of sufficient time for implementing compensatory policy, the decrease of the negative impacts of this policy would not be possible. Hence, this report concluded that the gradual implementation of the subsidies reform plan along with following a financial discipline (implementing strong financial and monetary policies) and designing a schedule is the best way to minimize the negative impacts of implementing this plan.

Sadeghi et al. (2010) for the period of 1991-2007 concluded that by reforming energy carrier prices the economic growth and the private sector energy consumption decrease, but inflation increases. Their findings also showed that, in the long term, shocks to energy price index would explain about 20 and 11 percent of private sector and GDP fluctuations, respectively.

Manzoor et al. (2010) investigated the impacts of increased energy carrier prices. Their study involved all of the goods of economy in 36 categories and all the economic sectors in 18 economic activities related to the energy. The results of their study indicated that increased price of energy carriers led to a decrease in households' welfare and the level of domestic production. Except for the upstream energy sector, other sectors faced with decreased activity level. Also, the demands of productive activities for energy as well as households energy consumption would decrease.

Among studies those which have been conducted on the impact of targeted subsidies on manufacturing industrial sector are worth mentioning here. Sharifi et al. (2008) studied the impact of eliminating energy carrier subsidies using 40-part input-output table of the year 1999. Their results implied that increased energy carrier prices affect cost of all the sectors so that this impact is more seen in industries of other non-metal mineral industry, foresting, and manufacturing of oil products more than others.

Naji and Sotodeh (2014) using the cost changes measure in partial equilibrium approach for the period 2010- 2013 found that the elimination of energy subsidies led to about 30 percent increase in cost of manufacturing industries in 2010, while this amount was 28, 30 and 32 percent for the years 2011, 2012 and 2013, respectively. After implementation of the plan in 2010 the government had to pay up to 6 trillion Rials to the manufacturing industrial sector to help them reach the initial utility level that they were before the price change. But perhaps the following studies can be considered as the only studies which examined the impacts of subsidies on intensive energy consuming in manufacturing industries.

Mahmoodzadeh et al. (2012) investigated the impacts of eliminating electricity subsidy during 1995-2007 using dynamic panel data model. Their findings showed that there was a negative and significant relationship between electricity energy intensity and its price and increased price index of other inputs which led to the replacement of the electricity. Also, using obtained dynamic functions the political plan of electricity price liberalization is implemented through 2010 to 2014 assuming the steady rise in nominal prices which after the liberation of electricity prices, energy intensity decreases so that the highest reduction has happened in the first year of liberalization, and in later years, the rate of decline in energy intensity has been reduced.

In another study Arman and Taghizadeh (2013) referring to the need for energy conservation in the whole country and the importance of the manufacturing industrial sector and using panel data approach identified the impact of energy prices, GDP and technology on energy intensity in 9 industries during 1995-2010. Their findings implied that the energy price and technology level had a negative relationship with energy intensity and the acceleration of increasing energy consumption was less than the acceleration of increasing value added of industries implying the increased efficiency of energy consumption in large scale industries. They finally recommended that the large scale industries be formed by integrating small scale industries. According to this, only few studies have investigated the impact of targeted subsidies on change in consumption combination of manufacturing industries. Therefore, this paper can be considered as a pioneer in this field.

3. Dataset and its Characteristics

As it mentioned before, this study aimed to approximate a function which can estimate the combination of energy carrier consumption in the case of replacement of FOB prices and cost price (for electricity) with domestic price of energy carriers with the assumption of stability of other production factors. This investigation has been for newly-established manufacturing firms of other non-metal minerals for the years of 1996 – 1999, 2001, 2003 and 2004 (Data for the years of 2000 and 2002 were not available) those have acted in this industry by the end of 2005. It is notable that in line with studies conducted on functions estimation, in this research the ANN approach and toolbox of MATLAB[2] has been also used.

Considering that the newly-established firms have specific characteristics and different life time, prediction of their behaviors in reaction to the increase in energy carrier prices for 7 periods (1996-2005, 1997-2005, 1998-2005, 1999-2005, 2001-2005, 2003-2005 and 2004-2005) were separately investigated. Data entered to the network in each year include output value, number of labor, annual consumption of energy carriers and estimated capital value. It is notable that data for output value and number of labor as well as the consumption level of heptad energy carriers (Kerosene, gas oil, natural gas, liquid petroleum gas, gasoline, fuel oil, and electricity) are extracted from census of industrial workshops with 10 or more workers. Also the price of energy carriers is obtained from the site of the national company of refining and distribution of petroleum products. It is noteworthy that the capital value in each year is estimated through the sum of investments in that year and the capital value of previous year multiplied by the difference between the price index and annual depreciation rate of the producer of industrial products. Also the value of capital in the first year of newly-established firms' activity is equal to the investment. The mentioned variables are input variables of neural network. For example, Table 3 illustrates data for the first year activity of newly-established firms during the studied period for each variable. As it seen, this table forming initial data entering to the neural network has several characteristics. For example, the table shows that in total and during the studied period 755 newly-established firms have entered the industry means that their annual average number is 108 firms. Nevertheless, as the obtained standard deviation shows, the number of newly-established firms was not homogenous during the studied period and this can be observed in the coefficient of variation, variation range and standard deviation in the last 3 columns of table. Difference of new firms in terms of employment, capital, input value, output value and value added has been shown in other 5 rows of this table[3]. As can be seen, during the studied period over 32000 jobs has been created in new firms, that is over 4600 jobs has been created per year. In addition, comparing scattering discriminant for variables of employment, capital, input value, output value, and value added all indicate the heterogeneity of these variables through newly-established firms. Yet highest coefficient of variation is related to the number of firms in the studied period.

The second part of Table 3 is allocated for describing energy carriers used in newly-established firms and these carriers are divided into 7 groups of kerosene, gas oil, natural gas, liquid gas, gasoline, fuel oil and electricity. The last line of the second part is also allocated to total (Rial) value of energy carriers; the newly-established firms use different combination of energy carriers and additionally the energy consumption is very heterogeneous through newly-established firms over the studied period. The final section of Table 3 describes productivity situation, energy productivity and the share of energy in new firms. Firstly, total productivity, labor productivity and capital productivity are calculated and the results of which indicated that the average labor productivity is greater than the average total productivity and capital productivity over the studied period. Different share of energy from the value of inputs of newly-established firms indicated that they have selected different combination of inputs in the first year of entering the other non-metal mineral manufacturing industry. The two last rows of third section are allocated to presenting results of calculating energy productivity in terms of output value and value added. As it can be seen, the average energy productivity is at a higher level than the average total productivity and the average capital productivity. Also, the average labor productivity has the highest amount among average factor productivity and total productivity over the studied period**.**

Table 3: Data for the First Year Activity of New Firms During 1996-2004

variable \ Year			New firms 1996	1997	1998	1999	2001	2003	2004	sum	average	Standard deviation	Variation range	variation ratio
Number of firm			23	83	32	78	69	318	152	755	108	102	295	0.94
Labor (person)			1807	8410	2406	3932	2986	7638	5204	32383	4626	2575	6603	0.56
Capital (million Rial)			374091	82867	75403	397080	362858	189263	262694	1744255	249179	136645	321677	0.55
Input value (million Rial)			36328	305031	114404	211735	185006	641241	515928	2009674	287096	218675	604913	0.76
Output value (million Rial)			99342	555532	213360	550254	359052	1360839	975082	4113461	587637	443687	1261498	0.76
Value added (million Rial)			63013	250501	98955	338519	174046	719598	459154	2103787	300541	230134	656585	0.77
Energy carriers (variables in term of million)	Kerosene	Quantity(liter)	0.64	0.81	0.13	0.24	0.81	3.32	0.36	6.30	0.90	1.10	3.18	1.22
		Value(Rial)	19	32	8	24	97	531	59	770	110	188	523	1.71
	gas oil	Quantity(liter)	4.73	23.79	10.10	12.06	6.60	32.44	29.42	119.15	17.02	11.32	27.71	0.67
		Value(Rial)	142	952	606	1206	793	5190	4855	13743	1963	2117	5048	1.08
	natural gas	Quantity(cm)	5.21	180.16	2.62	114.80	26.32	43.31	22.20	394.62	56.37	66.44	177.54	1.18
		Value(Rial)	156	10089	192	10906	3027	5557	3075	33002	4715	4372	10750	0.93
	LPG	Quantity(kg)	0.22	1.80	4.45	0.68	3.90	0.76	20.69	32.50	4.64	7.26	20.46	1.56
		Value(Rial)	4	32	89	15	93	22	656	910	130	235	652	1.80
	gasoline	Quantity(liter)	0.41	1.36	1.00	1.12	0.42	2.74	1.01	8.08	1.15	0.78	2.33	0.68
		Value(Rial)	54	218	201	391	191	1782	809	3646	521	607	1728	1.17
	fuel oil	Quantity(liter)	32.90	103.94	434.74	193.44	29.83	252.82	78.84	1126.52	160.93	146.08	404.91	0.91
		Value(Rial)	494	2079	13042	9672	1915	20276	7451	54928	7847	7159	19783	0.91
	electricity	Quantity(kw)	100.37	138.88	370.88	226.92	45.81	199.95	98.42	1181.22	168.75	108.66	325.07	0.64
		Value(Rial)	6671	11612	38089	25642	6119	32312	18209	138653	19808	12612	31970	0.64
	sum	Value(Rial)	7539	25013	52227	47856	12234	65670	35113	-	-	-	-	-
productivity	total		2.73	1.82	1.86	2.60	1.94	2.12	1.89	-	2.14	0.38	0.91	0.18
	Labor		54.98	66.06	88.68	139.94	120.25	178.17	187.37	-	119.35	52.34	132.40	0.44
	capital		0.27	6.70	2.83	1.39	0.99	7.19	3.71	-	3.30	2.75	6.92	0.83
Energy Share and	Share of energy in total inputs		0.21	0.08	0.46	0.23	0.07	0.10	0.07	-	0.17	0.14	0.39	0.82

intensity	Energy intensity	0.08	0.05	0.24	0.09	0.03	0.05	0.04	-	0.08	0.07	0.21	0.92
Energy productivity	In term of output value	13.18	22.21	4.09	11.50	29.35	20.72	27.77	-	18.40	9.20	25.26	0.50
	In term of value added	8.36	10.01	1.89	7.07	14.23	10.96	13.08	-	9.37	4.13	12.33	0.44

Source: Statistical Centre of Iran and the site of the national company of refining and distribution of petroleum products

4. ANN Model

The neural networks are of a class of intelligent systems transfer knowledge hidden beyond data to structure of network by processing experimental data (Boghzian and Nasrabadi, 2006). Because of having the characteristics of learning capability, generalizability, parallel processing (high functionality), and robustness (capability of damage tolerance, restorability and errors tolerance) (Monajemi et al., 2009), in some applications such as pattern recognition, clustering, modeling, function approximation, estimation and identification, and forecasting, the neural networks are distinct from other approach. Among other approximation methods we can name the methods of regression, fuzzy, and ANFI. In another definition, the neural network is a set of interconnected neurons in different layers that send information to each other (Sadeghi et al., 2011). Basically, the components of neural network are:

1. **Inputs**
2. **Hidden layer**
3. **Neurons**
4. **Weights**
5. **Transformation functions (activation or transition functions)**
6. **Output layer**

As it is mentioned earlier, to achieve the desired objective, this paper used MATLAB software, but a point which is noteworthy before entering data to this software was that to strengthen equal treatment of training algorithm with the weights of input variables which have different ranges and scales, it was necessary that data be normalized (Chadwick and Grimes, 2012). However, there are numerous methods for normalizing data among which the linear, whitening, and non-linear map methods are most important ones. For example, to create a new variable x prime to the base 10 logarithm existing variable x would issue the statement (Decoster, 2001). Normalization using these methods has been shown with relationships (1), (2), and (3), respectively. It is notable that in all of these relationships the actual data are shown with (x) and normalized data are shown with (x′).

$$x' = \frac{x - x_{min}}{x_{max} - x_{min}} \tag{1}$$

$$x' = \frac{x - \mathrm{mean}(x)}{\mathrm{std}(x)} \tag{2}$$

$$x' = \lg 10(x) \tag{3}$$

In neural network training, the training process is used in two methods of learning with supervision and learning without supervision. In learning with supervision, some samples of considered input and output values are chosen as the training model and in learning trend the connectional weights of network are set such as the model output become closer to desired output. In learning without supervision the target data are not given to the network and are generally used in clustering and recognition applications. Also, considering the layers of neural network, they can be classified into two types of Feed-Forward and Feed-Back. Feed-Forward neural network includes input, output and hidden layers and the information path is unilateral from the input layer towards the output layer and is classified into two categories of perceptron (single layer and multilayer) and Radial Basis Function (RBF). The most important model of neural network accounting for over 90 percent of neural network applications is multilayer perceptron trained by Back-Propagation Learning Algorithms the goal of which is supervision on training to minimize the error in forecast using training data. Feed-back neural network is in two classes of harmonistic resonance theory and Hopfield networks in which a part of data is returned from output layer to the input layer for correcting characteristics. Also the training models of Quasi-Newton, Conjugate Gradient, Levenberg-Marquardt are recommended to strengthen the performance of multilayer perceptron trained by Back-Propagation Learning Algorithms (Mirsoltani and Akhavan, 2013). It should be noted that neural networks are generally formed from an input layer, a hidden layer and an output layer (Nauck et al., 1997); in this research the neural network with characteristics of Table 4 is used.

Table 4: Neural Network Characteristics

Neural network type	multilayer perceptron	**Number of hidden layer neurons**	10
activation functions	tansig	**Training algorithm**	Levenberg-Marquardt
Number of input neurons	4	**Criterion for number of hidden neurons**	MSE
period of training and validation(year)	10,9,8,7,5,3,2	**Share of training, validation and test data**	70-15-15 (percent)

After testing different functions available for neural network in the software, the best type of neural network for estimating the amount of energy carriers' consumption was recognized to be the multilayer perceptron network with training algorithm of Levenberg-Marquardt defined as FITNET function in this software. Also, different cases of transformation functions were examined among which TANSIG function yielded the best answer in this study.

30 percent of input data are allocated to validation and test and consequently to forecast the output of these data according to the previous tests (to prevent overlearning). The outputs forecasted by neural network has error relative to desired data and to estimate network error and assess the ability of neural network model the measures of MSE (Mean squared error) and RMSE (Root mean squared error) have been used according to the relationships (4) and (5) where Y , Y' and N are target (actual) output value, model output and number of observations, respectively.

$$\text{MSE} = \frac{\sum (\acute{Y}-Y)^2}{N} \tag{4}$$

$$\text{RMSE} = \sqrt{\frac{\sum (\acute{Y}-Y)^2}{N}} \tag{5}$$

5. Model, Results and Discussion

Considering the fact that input data of firms are in different scales, to normalize data this research has to use non-linear mapping. The output (actual) variable to be entered the software is the level of energy carriers' consumption at domestic prices level. Training the neural network with mentioned inputs and outputs implies that the neural network can estimate a specific function for electricity consumption, but is unable to approximate a specific function for consumption of other energy carriers (gasoline, oil gas, fuel oil, kerosene, liquid gas, and natural gas). As an example, Figure 1 shows the status of neural network in training stage for newly-established firms in 1997 during 9-year period of operation in the industry of manufacture of other non-metal mineral industry. In the first part (Figure 1), the target electricity consumption and output of neural network training is observed and in the second part (Figure 2) the correlation coefficient (R) between these two values is observed. The third part (Figure 3) calculates MSE and RMSE measures and ultimately the fourth part (Figure 4) shows histogram, average values and standard error deviation in training of neural network. Also, in Table 5 the measures of MSE and RMSE calculated in the training process of neural network are reported to approximate the electricity consumption in newly-established firms of the mentioned industry during 1996-2004 those have operated by the end of 2005 in this industry.

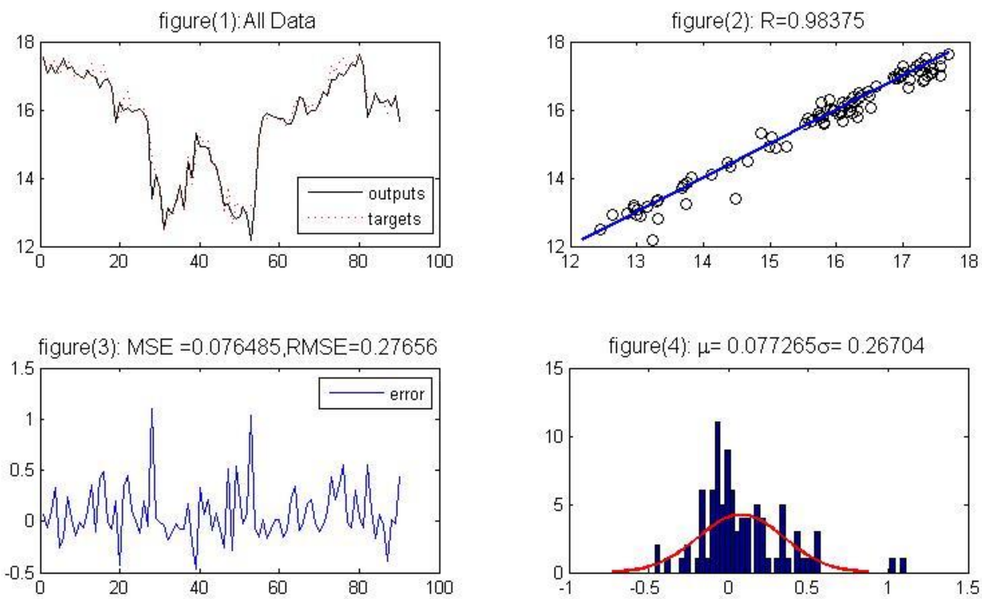

Figure 1: ANN Output in Training Stage for 1997 During 1997 to 2005

Table 5: Mean Squared Error and Root Mean Squared Error Index

	New firms						
	1996	**1997**	**1998**	**1999**	**2001**	**2003**	**2004**
MSE	0.19	0.07	0.26	0.18	0.09	0.39	0.37
RMSE	0.44	0.27	0.51	0.43	0.30	0.62	0.61

Source: MATLAB Software Output

As it can be seen, the neural network proposed based on the mentioned measures can excellently approximate a specific function for the level of electricity consumption in new firms of different years during the operation period. After confirming the ability of neural network, using NET function (the function estimated by neural network) by replacing domestic costs with costs of electricity, we found out that the electricity consumption of newly-established firms has been decreased during 1996-2004 except for 1999 and 2004.

Table 6: Total and Average Electricity Consumption for Newly-established Firms During 1996-2004

	year	Total consumption (million kw)		Consumption average (million kw)		derivation
		Before price liberalization	After price liberalization	Before Price liberalization	After price liberalization	
New firms	**1996**	2118	975	23.54	10.83	-0.54
	1997	1218	1184	13.54	13.16	-0.03
	1998	2306	893	28.83	11.16	-0.61
	1999	2055	3759	29.35	53.70	0.83
	2001	355	275	7.10	5.49	-0.23
	2003	481	10	16.03	0.32	-0.98
	2004	200	218	10.02	10.92	0.09
	sum	8734	7313	128	106	-0.16

Source: Author Calculations

6. Conclusion

The targeted subsidies plan with all ups and downs of the past years was ultimately implemented in 2010. But, since then has imposed different impacts on economic sectors. Among these, the impact of the targeted subsidies on changing the composition of energy consumption has been one of the possible impacts in this area and hence this research has attempted to investigate this in the manufacturing industrial sector. This investigation has been focused on newly-established firms of this industry as one of the most intensive energy-consuming industries. The results of ANN indicated that by replacing electricity cost with domestic costs, the consumption of this energy carrier will generally decline by 16 percent. Nevertheless, considering the quantity of newly-established firms in each year, this reduction can have a serious impact. This is while changing the price of energy carriers to the level of Persian Gulf FOB has not changed the consumption of other carriers significantly. According to this and as the point of policy increasing the price of energy carriers to the level of Persian Gulf FOB can lead to losing the competition power of firms in this industry. This finding clarifies the necessity of paying the share of industry sector from targeted subsidies that predicted in targeted subsidies plan.

Endnotes

1. Free on Board (FOB).
2. Learning MATLAB, student Version (Version 6), bye Math Works INC. 2001.
3. It should be noted that in this research, the variables of input value, output value and value added are defined based on definition of Iranian statistical center as follow:

   Input value of an industrial activity is the total value of raw material, consumed low-durability tools and supplies, consumed fuel value, purchased power and water value, the value of the materials and components used for building or creating the capital property by workshops and salary paid to industrial services.

   Output value of an industrial activity is the total value of manufactured goods, receipts for industrial services, changes in inventory value of goods in process, the difference of value of the purchase value from goods that have been sold without transformation, the value of capital property made by the workshop, the value of manufactured and sold electricity and water.

   Value-added of an industrial activity is the difference between the output value and the input value.

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