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Estimating Allocation Efficiency of Energy Inputs in Agricultural, Industry, and Services Sectors

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Abstract

This study examined the effect of energy efficiency on the value added of Iran economic sections during the period of 1991-2016 in two parts; in the first part, the allocation efficiency of inputs has been calculated, using the frontier Translog production function with combined observations and with the first-order condition for minimizing the cost. In the second part, the effect of energy inputs efficiency was evaluated on the value added of economic sectors using the GLS method. The results showed that the allocation efficiency of gasoline and fuel oil with respective coefficients of 0.1016747 and 0.3700357 has a positive and significant effect on the added value of the economic sectors. Also, the allocation efficiency of electricity, kerosene and gas oil inputs have a positive and significant effect on the added value of economic sectors**.**

Keywords: Allocation Efficiency, Value Added, frontier Translog function.

JEL Classification: O13, E21, Q43.

1. Introduction

Iran is in the fourth rank in terms of oil reserves (British Petroleum, 2017). Many studies have been carried out in relation to energy efficiency including Naji Meydani et al. (2015), Sajjadifar et al. (2015), Farajzadeh (2015), Sadeghi Shahdani (2016). The results of these studies show that efficiency changes for both Iran and for the average of the studied countries has a decreasing trend and Iran's position in terms of energy efficiency is not favorable compared to other countries. The technical efficiency of energy in India was estimated by estimation of production function. The results showed that the average technical efficiency of the users is 75.5% and it is possible to increase production by improving the technical efficiency and optimal use of resources. Komb Hakar (1994).

1-1. The model

To calculate energy efficiency, we used a random Translog function with panel data.

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$$
\begin{aligned}
&lny_{it} \\
&= \alpha_0 + \alpha_K lnK_{it} + \alpha_L lnL_{it} + \alpha_{br} lnbr_{it} + \alpha_{bn} lnbn_{it} + \alpha_{ns} lnns_{it} + \alpha_{ng} lnng_{it} \\
&+ \alpha_{nk} lnnk_{it} + \alpha_t t + 0.5\alpha_{KK}(lnK_{it})^2 + 0.5\alpha_{LL}(lnL_{it})^2 + 0.5\alpha_{br}(lnbr_{it})^2 \\
&+ 0.5\alpha_{bn}(lnbn_{it})^2 + 0.5\alpha_{ns}(lnns_{it})^2 + 0.5\alpha_{ng}(lnng_{it})^2 + 0.5\alpha_{nk}(lnnk_{it})^2 \\
&+ \alpha_{tt} t^2 + \alpha_{kl} lnK_{it} lnL_{it} + \alpha_{Kbr} lnK_{it} lnbr_{it} + \alpha_{Kbn} lnK_{it} lnbn_{it} \\
&+ \alpha_{Kns} lnK_{it} lnns_{it} + \alpha_{Kng} lnK_{it} lnng_{it} + \alpha_{Knk} lnK_{it} lnnk_{it} + \alpha_{Lbr} lnL_{it} lnbr_{it} \\
&+ \alpha_{Lbn} lnL_{it} lnbn_{it} + \alpha_{Lns} lnL_{it} lnns_{it} + \alpha_{Lng} lnL_{it} lnng_{it} \\
&+ \alpha_{Lnk} lnL_{it} lnnk_{it} + \alpha_{brbn} lnbr_{it} lnbn_{it} + \alpha_{brns} lnbr_{it} lnns_{it} \\
&+ \alpha_{brng} lnbr_{it} lnng_{it} \\
&+ \alpha_{brnk} lnbr_{it} lnnk_{it} + \alpha_{bnns} lnbn_{it} lnns_{it} + \alpha_{bnng} lnbn_{it} lnng_{it} \\
&+ \alpha_{bnnk} lnbn_{it} lnnk_{it} + \alpha_{nsng} lnns_{it} lnng_{it} + \alpha_{nsnk} lnns_{it} lnnk_{it} \\
&+ \alpha_{ngnk} lnng_{it} lnnk_{it} + \alpha_t tlnk_{it} + \alpha_t tlnL_{it} + \alpha_t tlnbr_{it} + \alpha_t tlnbn_{it} \\
&+ \alpha_t tlnns_{it} + \alpha_t tlnng_{it} + \alpha_t tlnnk_{it} + v_{it} \\
&- u_{it} \qquad (1)
\end{aligned}
$$

where:
ui is technical inefficiency, Yit is the value added of sector *i* in year *t*, *X* represents the vector of inputs. (In this research, inputs include Capital stock, Labor force, Electricity consumption, gasoline consumption, Kerosene consumption, Gas oil consumption and Fuel oil consumption in Industrial sectors, Services And Agriculture), α denotes a vector of unknown parameters and *Vi* is a part of innovation.

2. Estimations

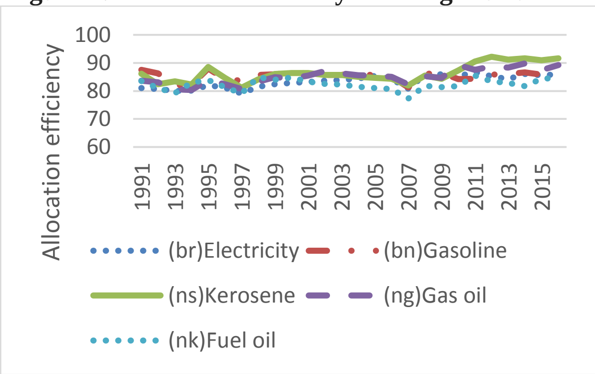
To estimate model parameters, first the combination data of the various tests presented in the previous section were used. The Translog production function is estimated for calculating the allocation efficiency. Based on the results obtained from the Translog production function, it was observed that, the coefficients of capital stocks, the amount of gas oil consumed, the amount of fuel oil consumed and the technology variable (time) are negative and significant. Hence, by increasing the values of these inputs, the distance to the efficiency will increase. It was also observed that the coefficient of inputs of labor force, electricity consumption and gasoline are positive and significant.

The positive coefficients of these inputs can be explained by the fact that the recession in the Iranian economy has been one of the main reasons for unemployment. That is, the economy does not use all production capacities and, as a result, there is a surplus capacity. Since the kerosene consumption coefficient is not significant, there is no reason for it to be positive. Empty capacities, lack of full employment in the system of production and consumption of a large part of the energy in the non-manufacturing section have made the estimated results inconsistent with the theory.

2-1. Estimating Allocation Efficiency of Energy inputs

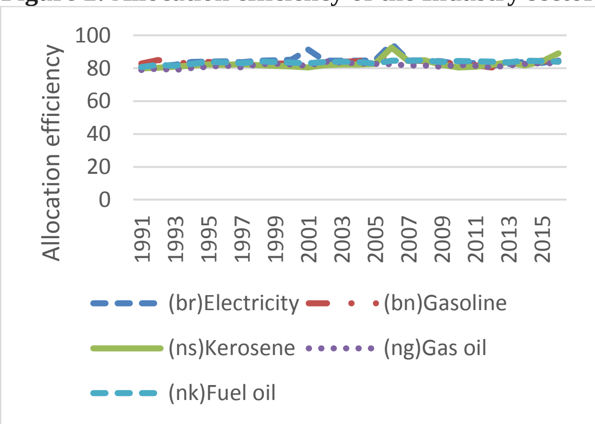
After estimating the parameters of the production function, using first-order conditional cost minimization, allocation inefficiency was calculated and, then, with difference of allocation inefficiencies from a hundred, the allocation efficiency of electricity, gasoline, kerosene, gas oil and fuel oil was calculated.

Figure 1: Allocation efficiency of the agricultural sr



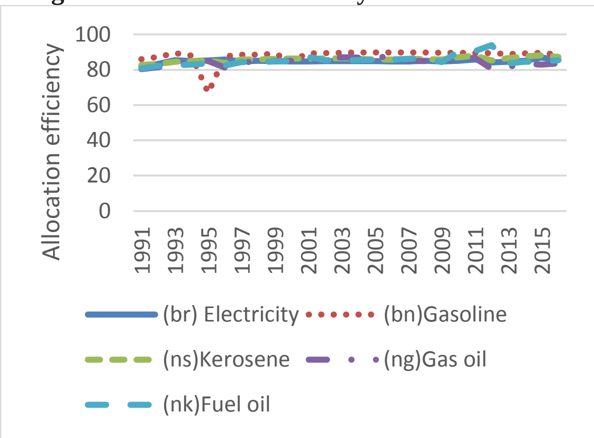
The allocation efficiency of inputs in agriculture sector has had roughly similar behavior over the years and kerosene, gas oil, gasoline, electricity and fuel oil, respectively, have the highest allocation efficiency in the agricultural sector. The lowest impact of these inputs was in 2007 and the highest impact of kerosene and gasoline was in 1995 and in the years from 2012 to 2016.

Figure 2: Allocation efficiency of the Industry sector



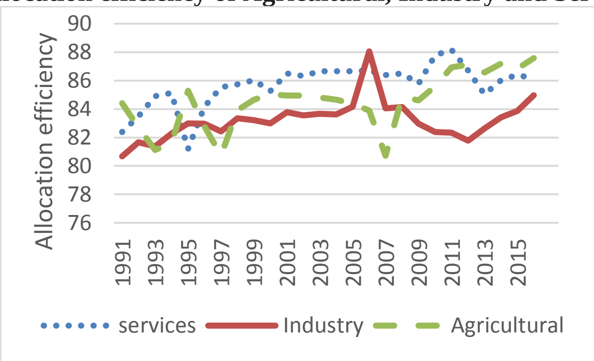
According to Figure 2, the allocation efficiency of inputs in the industrial section is almost equal throughout the years 1991 to 2015 and Fuel oil in 2001 and 2006 was the most efficient in this section.

Figure 3: Allocation efficiency of services sector



The allocation efficiency of inputs in the services sector is almost the same at all time periods, but gasoline had the least allocation efficiency in the service section compared to other inputs in 1995.

Figure 4: Allocation efficiency of Agricultural, Industry and Services sectors



The allocation efficiency of the three sections of agriculture, industry and services is shown in Figure 4. As it can be seen, the service section has had the most efficiency at almost all time periods. This sector has the lowest allocation efficiency in 1995 and the efficiency of this section is less than the agricultural section in 2011 and 2013. On the other hand, the agricultural sector has had the highest and the lowest efficiency, respectively, in 1995 and 2007.

2-2. Estimated Final Model

After calculating the allocation efficiency of energy inputs in different economic sectors, we used the following equation to study the effect of energy efficiency on the added value of different economic sectors.

$Q_{it}=f(br_{it},bn_{it},ns_{it},ng_{it},nk_{it})+u_i$

Table 1. Results of the GLS Model

Result	Possibility	Coefficients	Variables
insignificant	0.775	0.0325224	interception
insignificant	0.973	0.0017913	electricity efficiency(br)
significant	0.008	0.10116747	Gasoline efficiency (bn)
insignificant	0.329	-0.061254	Kerosene efficiency(ns)
insignificant	0.540	-0.0622482	Gas oil efficiency(ns)
significant	0.00	0.3700357	Fuel oil efficiency (nk)

Table 1 shows that coefficients of efficiency of gasoline and fuel oil inputs are significant at 5% probability level. The efficiency coefficients of the two inputs have a positive and significant effect on the added value of the economic sectors. According to Table 1, the impact of gasoline and fuel oil as inputs for production in the economic sectors is equal to 0.1016747 and 0.3700357, respectively, and shows that assuming other conditions are fixed, with a 1% change in energy consumption and fuel oil, the value added of economic sectors will change by 0.1016747 and 0.3700357 percent, respectively.

3. Conclusion

The results of this study showed that the allocation efficiency of gasoline and fuel oil increased the added value of economic sectors Therefore, the pricing of gasoline and fuel oil inputs should be done with great care in order to increase the allocation efficiency of these inputs. Also, the allocation efficiency of electricity, kerosene and gas oil has a positive impact on the value added of economic sections. And also the allocation inefficiency of gasoline, electricity, kerosene, gas oil, and fuel oil in the economy sections of Iran is indicative of too much use of energy inputs in all sectors relative to labor input.
Perhaps the main reason for the low energy efficiency is that in production, energy and capital are usually complementary and the exhaustion of capital stock reduces its productivity and energy efficiency. The second reason for the low energy efficiency is the low relative price of energy.

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Volume 8, Number 30, Summer 2019

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