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Analysis of Product Scale about Tabriz Oil Refinery in Iran

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ABSTRACT

Background: In the recent year, most of the world's energy resources are related to hydrocarbon reservoirs and fossil fuels which are refined through chemical method. So the present era, energy carriers have been considered as an important factor in production so that it can be said it's lacking causes economic ineffectiveness. **Objective:** The main objective of this study is to estimate the production cost function of Tabriz oil Refinery. **Results:** In this study, sensitivity of the production unit toward changes in crude oil prices and labor is identified with using of econometric methods and time series from1988 to 2011 also with simultaneous estimation of Translog cost functions and production inputs demand by SUR method. The results showed that inputs own price elasticity is negative and tensionless which shows the fully compatible with economic theory**. Conclusion:** Demand cross elasticity between two inputs, labor and oil is positive that shows substitution of these two inputs .Also positivity of them also their substitutionary shows that if the price of crude oil increases then it is possible to used of advanced machines In order to exploit with higher scale. So government can provide basis for increasing of efficiency and reduction of energy consumption by granting funds facilities to refineries at the time of increasing of oil price.

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INTRODUCTION

Energy is a crucial element of production which there is in nature in various forms of wood and fossil fuels at the lowest level of refinement to nuclear energy at the highest level of processing. Presently, most of the world's energy resources are related to hydrocarbon reservoirs and fossil fuels which are refined through chemical method. Oil purification process is complex and in parallel with emergence of new technology is constantly changing. Refinery researches not only lead to development of new inputs but also affect on manner of input's deployment and composition which shows inputs relations are continuously changing. As can be seen, at the present time, the production function can be affected by many factors that each of these factors are singly worthless and are meaningful in contrast to each other. Energy carriers are known to be important after the industrial revolution in production functions and even in cases lead to trivialize the other factors in the production function. They are important because were able to be replacement in about other factors as a production factor and can play a significant role in the production of goods and services. Initially, energy carriers were very useful and efficient in industrial sector but then with advances in technology and machinery as well as producing of machineries for providing services in different sectors showed its role as a factor in the production of goods and services. In the present era, energy carriers have been considered as an important factor in production so that it can be said it's lacking causes economic ineffectiveness, 'Falehi and Khalilian (2009)'.

MATERIALS AND METHOD

Smith (1988), in a research with title "Benefits of ration to scale and diversity in oil purification" studied on long-term cost structure of 25 oil refining companies in two periods 1981-1983.He used of Translog's multi-product functional form for estimating the cost function. He estimated cost equation with equations of share of production factors. The used estimation method is Iterative seemingly unrelated regression. In this paper there are 3 products like Motor Gasoline, distillate fuel and other products and production factors include crude oil, capital and other operations factors such as refined fuel, catalyst and maintenance, etc. After reviewing the

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circumstance of cost function's suitability then studied about benefits of scale in this industry. Therefore the radial average costs which can be mentioned in Multi-product cost functions is defined as follows:

$$RAC(Y)=\frac{C(Y)}{\sum Yi} \quad (1)$$

There are:
RAC(Y): radial average cost
C(Y): total cost
Yi: i number product

In continuing according to cost traction than to product and according to price of production factors with their average value in sample , amount of products are respectively 93, 76, 154 thousand barrels per day for motor gasoline, distillate fuels and other refined products and this implies product level that oil refining industry has constant efficiency than the scale. Benefits with respect to diversity which is used for showing efficiency in multiple product structures is investigated also in this paper ,researcher used of convexity radius concept in order to investigate existence of benefits with respect to diversity. In this way that if costs structure is with radial convexity so weighted average cost production of product vectors is separately lower than weighted mean product's cost production, it means:

$$C\ [kY^{a}+ (1\text{-}K)K^{b}] < kc\ (Y^{a}) + (1\text{-}k)(\ Y^{b}) \quad (2)$$

He concluded that there are benefits ration to variation in the refining industry and the total production costs of 3 products such as motor gasoline, distillate fuel and other refined products are more separately than simultaneous production cost about these products.

Griffin (1972), in his research about "Analyzing of process in front of statistical cost function , application in oil refinery" with using of linear programming garnered short term cost functions of oil refining also studied on it matching with cost theory. In the analysis process, production function is explained in a linear programming model. After explaining the production function, relationship of cost production is achievable as a result of optimizing behavior. For example, in the general case single-product of cost function is obtained by minimizing the cost of diversified product. So the price of production factors and function is given.

Also he in this paper garnered short term cost function in two modes single product and joint product .In first mode**,** assumes that U.S. oil refining industry produced series of products in constant ratios and solves problem by minimizing the cost of main variable for varied product levels with constant combinations.

According to marginal cost and short term average cost curves he concludes that these curves are consistent with classical assumptions. In this way that final cost curve is ascending in a wide range of product. Also minimum short term average cost is less than maximum production in product levels which represents u form of short-term cost. Griffin garnered average cost and final short term cost curve in simultaneous production mode and shows that they also are consistent with classic shape of cost curve.

Methodology:

Basically, studying on production cost structure of each enterprise is based on this assumption that production unit by considering a certain amount of production, minimizes production cost and each production unit produces a certain amount products with using of production factors. So production function can be defined for enterprise which shows maximum amount of product that can produce with a certain level of factors. Generally technology of production unit implied by implicit production function which is the following:

$$F(X, Y) =0 \quad (3)$$

There are:
Y: Product vector
X: Vector of production factors

According to this function, cost function is turned to a function that is secondary system of above function and shows minimizing cost of utilization of production factors for a certain level of production. The applying costs of production factors should be minimized according to certain level of production for obtaining production cost function which is expressed by the following formula:

MIN W.X. (4)
S.T F(X, Y) =0

There are
W: Vector of production factors cost

System 4 can be solved with using of Lagrange function, and provision of first order demand function means conditional demand function for production factors is gain function of product amount and prices of production factors. By placing this demand function in equation (5); production cost function is given which is function of product amount and prices of production factors.

(W, Y) =W.X (W, Y) C (5)

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This cost function should have some characteristics till to be as "Suitability" cost function, which is as follows:

A: It is descending than factors price. This means that if production factors cost increases then costs will be increased according to this price with declining rate.

IF $\acute{W} > W$ Then $C(\acute{W},Y) > C(W, Y)$

B: It should be first-rate according to price of homogeneous factors. In this way that if price of factors is as t fold also the costs will be t fold.

$C(tw, Y) = t.C(W.Y)$ for $t>0$

C: is concave to price factors

$C[t.w+(1-t).w.y] > t.c(w, y) + (1-t).c(\acute{w}, y)$ $0<t<1$

D: Cost function must be constantly suitable or differentiable than the factors price.

Shephard (1953) and McKinsey (1957) showed that with using of coverage theory can calculate conditional demand function of production factor from derivative of the cost function than to prices of production factors, it means:

$$X_i(w, y) = \partial C(w, y)/(\partial w_i) \quad (6)$$

Translog cost function:

Translog cost function is a flexible function form that was originally proposed by Jorgenson and Lau and is used for analyzing the structure of production and manufacturing or industry cost .It is flexible because does not apply any restriction for used elasticity and return than to scale and can calculate it after the model's estimation. The Translog's multi-product long term cost function which is used in this paper is obtained from expansion of double logarithmic Taylor series also from following equations:

$$F(Y, o, L, K, T) = 0 \quad (7)$$

There are:

Y: amount of produced product

O: Crude oil

L: labor

K: Capital

T: Process variable

Time variable will be used as replacement variable for technology index in this function and subsequently in the cost function. This variable is for studying on impact of technological changing on the production process. Cost function of equation (8) will be obtained by minimizing the cost than to conversion function of equation (7), which is a function of product amount and function of production factors price.

$$TC(Y, p_o, , p_L, p_K, T) \quad (8)$$

There are

P_o : price of crude oil

p_l : price of labor

p_k : price of capital

The common form of this function is as follows and it having again to be differentiable, non- Hemototic and non-neutral technological changes that some of these assumptions are testable after estimating.

$$\ln(c)=\ln\alpha_o+\alpha_k ln(p_k)+\alpha_l ln(p_l)+\alpha_o ln(p_o)+\frac{1}{2}\gamma_{ll} ln(p_l)^2+\frac{1}{2}\gamma_{kk} ln(p_k)^2+\frac{1}{2}\gamma_{oo} lnp_o)^2+\gamma_{lk} ln(p_l)ln(p_k)+ \gamma_{lo} ln(p_l)ln(p_o)+\gamma_{ko} ln(p_k)ln(p_o)+\gamma_{ky} \ln(y)ln(p_k)+\gamma_{ly} \ln(y)ln(p_l)+\gamma_{oy} \ln(y) ln(p_o)+\gamma_y lny+\frac{1}{2}\gamma_{yy} (lny)^2 \quad (9)$$

There are:

TC: total cost

Y: amount of product

P: price of production factors

T: time process variable of γ, α

As explained in the previous section cost function should be in a form till be introduced as suitable cost function. This condition including:

A: Linear homogeneous than to price of production factors that this condition is obtained through linear cost equation than to price factors. This assumption is applied as model's limitations before it's estimating as follows:

$$\sum_{i=1}^{n} \alpha_i = 1 \qquad \sum_{i=1}^{n} \gamma_{ij} = \sum_{i=1}^{n} \gamma_{ij} = 0 \quad (10)$$

B: Be univocal and non-negative than to prices of production factors and product that for this purpose the following condition should be:

$$\frac{\partial lnTC}{\partial lnpi} > 0 \qquad \frac{\partial lnTC}{\partial lnYi} > 0 \quad (11)$$

This is mentioned as first-order conditions and is testable after model's estimating that for validity of this assumption, the obtained results of estimated model should be positive.

C: the cost function must be concave than to price of production factors. Sufficient conditions for cost function's concavity it is that Hessian matrix of partial derivatives of second order cost function to Semi Definite is negative also this condition is testable after the model's estimation. There are two ways for testing this assumption. The first way is obtained the Hessian matrix of partial derivatives of second order cost function to factors price and show that Semi Definite is negative, another method is obtained by calculating the elasticity of substitution between production factors . Because cost function be generally concave, so it is necessary partial substitution elasticity of Semi Definite inputs be negative. Symmetry assumption is as an assumption that is applied into the model before estimating. Based on the principle of Yang for maintaining of variables' cross multiplication in cost equation the following limitations are inserted into the pattern.

$$\frac{\partial lnTC}{\partial lnY_i \partial lnY_j} = \alpha_{ij} = \alpha_{ji} \forall \quad i,j \to i \neq j$$

$$\frac{\partial^2 \ln TC}{\partial lnp_i \partial lnp_j} = \beta_{ij} = \beta_{ji} \forall \quad i,j \to i \neq j \qquad (12)$$

According to Lemma Shepherd the conditional demand function of production factor is obtained through derivation of the cost function to its cost. According to the Translog functional form which is logarithmic so derivation of this function with respect to the logarithm of inputs' price will give function of that production factor, which is as follows:

$$s_i = \frac{\partial lnTC}{\partial ln\, p_i} = [\frac{\partial TC}{\partial p_i}][\frac{p_i}{TC}]$$

$$s_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij}\, lnp_i + \sum_{i=1}^{n} Y_{ij}\, lnY_i \qquad (13)$$

That s_i is the share of i number of production factor

These equations plus cost equation is estimated with using of Iterative see mingly unrelated regression. By adding these equations to total cost equation do not gain any new coefficient. Just with adding them to Translog's equation, cost is added to estimation. It is important to note that total of costs' share is equal to the unit, consequently at the time of variance-covariance estimation its single disorder component also it's reverse-taking is faced with the problem, so to solve this problem, one of the equations in about cost share should remove from estimation and the share of removed factor is

$$s_i = 1 - \sum_{i=1}^{n} s_J \qquad (14)$$

So at first , first-rate homogeneity of the cost function than to production factors cost also symmetry to total cost equation should be applied for estimating the model, then one of the equations of cost's share removes and related parameters of this equation are obtained with using of homogeneity and symmetry proviso based on other parameters. The total cost equation and equations of production factors' share will be as follows:

$$\text{Ln}(\frac{c}{p_o}) = \ln\alpha_0 + \sum_{i=1}^{n} \alpha_i \ln(\frac{p_i}{p_0}) + \frac{1}{2}\sum_{i=1}^{n} \gamma_{ij} \ln(\frac{p_i}{p_o})^2 + \sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln(\frac{p_i}{p_0})\ln(\frac{p_j}{p_o}) + \sum_{i=1}^{n} \gamma_{iy} \text{lny} \ln(\frac{p_i}{p_0}) + \gamma_y \text{lny} + \frac{1}{2}\gamma_{yy} (\ln y)^2 \qquad (15)$$

$$s_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_i + \sum_{i=1}^{n} \gamma_{iy} \text{lny} \qquad (16)$$

Residual should be added to each equation for estimating equation 15 and 16, which is assumed that these Residuals having normal distribution with zero mean vector and positive variance-covariance matrix.

Result and Discussion:

In econometric studies , the energy demand model have several suitable criterion for evaluating the model that can refer to some of them such as flexibility, compatibility with theory, usability, computational facilities and verification of facts. All functions with constant elasticity substitution owned this criterion partly. In these functions only one or two of production factor will enter into the model as analytical tool and most of these models are used for evaluating on substitution between capital and labor. Later Researchers provided models with more than two production factors also with more limitations for constant elasticity substitution functions that Translog function is one of them.

In studying on functions, Cobb-Douglas and constant elasticity substitution functions are not flexible as it is necessary. Because in these models substitution partial elasticity α_{ij} are identical for all values of i and j between x_j and x_i inputs, while in the Translog function in addition to mentioned restrictions which there are not but also experimental results show that are suitable for energy and agriculture models.

So in this paper is used of Translog cost function for related parameters to derived demand equations for inputs in the refinery and agricultural section and calculation of substitution elasticity and factors price. The reason of its selection is because of its more flexibility than other cost functions estimation and repeatedly, in the recent decades, is used about refinery issues and particularly in agricultural matters.

In this part long-term cost function of Tabriz Oil Refining Company along with cost share equations are calculated as Iterative see mingly unrelated regression. As explained in the pattern foundations, symmetry and

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homogeneity proviso to cost function should be applied and with using of these provisions, one of the cost share equations is deleted. In this system of equations, it is for capital. Extensive form of the total cost equation along with cost share equations are as follows formula:

$$\ln(c)=\ln\alpha_o+\alpha_k ln(p_k)+\alpha_l ln(p_l)+\alpha_o ln(p_o)+\frac{1}{2}\gamma_{ll} ln(p_l)^2+\frac{1}{2}\gamma_{kk} ln(p_k)^2+\frac{1}{2}\gamma_{oo} lnp_o)^2+\gamma_{lk} ln(p_l)ln(p_k)+ \gamma_{lo} ln(p_l)ln(p_o)+\gamma_{ko} ln(p_k)ln(p_o)+\gamma_{ky}\ln(y)ln(p_k)+\gamma_{ly}\ln(y)ln(p_l)+\gamma_{oy}\ln(y) ln(p_o)+\gamma_y lny+\frac{1}{2}\gamma_{yy}(lny)^2$$ (17)

The share of each equation is calculated as follows:

$$s_k = \alpha_k+\gamma_{kk} lnp_k+\gamma_{kL} lnp_l+\gamma_{ko} lnp_o+\gamma_{ky} lnY$$
$$s_L = \alpha_L+\gamma_{LL} lnp_L+\gamma_{Lo} lnp_L+\gamma_{Lk} lnp_o+\gamma_{LY} lnY \qquad (18)$$
$$s_o = \alpha_o+\gamma_{ok} lnp_k+\gamma_{oL} lnp_L+\gamma_{oo} lnp_o+\gamma_{ky} lnY$$

There are:
Ln(c): Logarithm of total production cost
Ln (p_k): Logarithm of capital price
Ln(p_o): Logarithm of oil price
ln (p_l): Logarithm of labor wage
lny: Logarithm of total oil products
s_k : Share of capital cost
s_l : Share of labor cost
s_o : Share of oil cost

The conventional method for estimating the equations is SUR method that one of cost share equations is removed from equations system simultaneously and parameters of other equations are calculated then removed related parameters are calculated based on other parameters of equations. Therefore, one of variables is removed from cost share equation also price of other inputs appears in the model as their relative price "according to price of removed input" also about total cost. Therefore, by applying this condition and assumption of symmetry and homogeneity and cost share equations, the estimable form of cost function is summarized as follows:

$$\text{Ln}(\frac{c}{p_o})=\ln\alpha_0+\sum_{i=1}^{n}\alpha_i \ln(\frac{p_i}{p_0})+\frac{1}{2}\sum_{i=1}^{n}\gamma_{ij}\ln(\frac{p_i}{p_o})^2+\sum_{i=1}^{n}\sum_{j=1}^{n}\gamma_{ij}\ln(\frac{p_i}{p_0})\ln(\frac{p_j}{p_o})+\sum_{i=1}^{n}\gamma_{iy}\text{lnyln}(\frac{p_i}{p_0})+\gamma_y\text{lny}+\frac{1}{2}\gamma_{yy}(\ln y)^2 \qquad (19)$$

That j$\neq y$, i$\neq y$

$$s_i=\alpha_i+\sum_{i=1}^{n}\gamma_y\text{lny}+\sum_{i=1}^{n}\gamma_{ij}\ln(\frac{p_i}{p_0}) \qquad (20)$$

Then according to obtained coefficients from the results of cost function and inputs' demand, Allen's own substitution elasticity and cross substitution elasticity are calculated with using of following relations:

$$A_{ii}=\frac{(\gamma_{ii}+{s_i}^2+s_i)}{{s_i}^2} \qquad i=K,L,O \qquad (21)$$

$$A_{ij}=\frac{\gamma_{ii}+(s_i s_j)}{s_i s_j} \qquad (22)$$

According to Allen's own substitution elasticity*and Cross substitution elasticity**:

$$E_{ii} = s_i A_{ii}*$$
$$E_{ij}=s_j A_{ij}** \qquad (23)$$

So even if $A_{ji} = A_{ij}$ then cross elasticity would not be equal for production factor of i and j. Own elasticity of demand price 'E_{ii}' of an input production shows partial changes of demanded quantity of input and consequently shows relative changes in the price of that input. Cross elasticity of demand price "E_{ij}" measures the partial changes in about demanded quantity of input and consequently measures partial changes of price of i number input.

Cost functions and conditional demand of inputs are estimated as systemic and Iterative see mingly unrelated regression method also after imposing symmetry and homogeneity conditions on cost function and cost share equations which its results are given in Table 1. As previously stated, in usual method for estimating see mingly unrelated equations, firstly one of the cost share equations is deleted, SUR estimates are not sensitive to the deleted equations from the system, but they lead toward maximum likelihood procedure which is unique also independent form removed equations. Because of this reason the equation of labor input price is removed from equations after that the prices of other inputs by dividing the labor price be in a normal form. The coefficients of labor input are calculated with using of coefficients of estimated equations and given the imposed provisions on the functions.

Table 1: The results of Translog cost equation coefficients with using SUR method

Coefficients		Estimated value	T-statistics
C(1)	$\ln\alpha_0$	0.767368	2.62
C(2)	α_k	-0.032263	-3.79
C(3)	α_o	0.047977	3.04
C(4)	γ_{kk}	-0.01077	-4.83
C(5)	γ_{oo}	0.000867	3.096
C(6)	$\gamma_{ko}=\gamma_{ok}$	0.001908	2.92
C (7)	γ_{ky}	-0.004292	-3.53
C(8)	γ_{oy}	-0.001056	-2.99
C(9)	γ_y	-0.084443	-3.62
C(10)	γ_{yy}	0.001442	3.74
C(19)	$\text{Log}(\frac{tc}{pl})^{-1}$	0.001867	3.0
R^2	-	98%	-
$\overline{R}^2$	-	96%	-
D.W	-	2/17	-

Source: research findings

All the coefficients are significant at 1% level.

According to the results of estimation of cost function the determination coefficient of estimated cost function is 98% which shows high explanation of variables of cost function in relation to dependent variable.
In this paper Allen's own substitution elasticity and cross substitution elasticity were estimated for inputs.

Allen's own substitution elasticity and cross substitution elasticity and demand Price elasticity:

Determining the Allen's substitution elasticity and demand price elasticity has important role in optimal combination of inputs in about Determining the substitution relationship and Complementary between the inputs also has great significance in terms of policy. Positive cross-elasticity between production inputs means substitution between inputs. But negative cross elasticity indicates that two inputs are complement. Based on the calculated results in table 2, all Allen's own elasticity have expected negative and correct sign that is consistent with theories of economics and demanding law. In other words, inverse relationship between price and amount about them is confirmed about them.

Table 2: Allen's own and cross elasticity.

Inputs	Labor	Capital	Oil
Labor	-7.36	1.049	1.1541
Capital	1.0491	-2.8	1.01
Oil	1.1541	1.01	-1.23

Source: research findings

Allen's cross elasticity between capital and labor input is 1.1541 which is positive and greater than one that it shows strong substitution relation between capital and labor input. In other words, increasing in capital price reduces tendency to use of machines and increases amount of labor employment greatly in the refinery sector. On the other hand if wages increase in refinery sector then employment in that sector will be reduced that should replace more machines instead of labor.

Also Allen's cross elasticity is positive between capital and crude oil input which shows strong substitution relation between them. In other words, increasing of crude oil cost will reduce consumption of it and consumer 'refinery' with increasing of investment and purchasing advanced machines or repairing the product line to higher productivity, attempting to produce. On the other hand , gradually with increasing of crude oil tendency to use of capital in the refinery section will reduce and machines have been eroded over time also do not have enough efficiency that this matter causes increasing of consumption of crude oil for producing the same amount of oil products.

Also cross elasticity between labor and the crude oil input is 1.049 which shows strong substitution relation between them that indicates increasing of each input will increase consumption of other input with large elasticity. This implies that in Tabriz refinery sector with increasing of crude oil price about 1% then the amount of energy demand reduces therefore tendency to use of machinery is reduced and substitution of labor instead of machines is exacerbated with a tension. In summary we can say that elasticity of substitution between inputs are positive and greater than one which indicates a strong relationship between inputs. In other words, increasing of price about an input will increase the consumption of other input.

Calculation of own price elasticity and cross elasticity inputs demanding

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In this part is used of cost function of refinery sector for estimating the own price elasticity and cross demand elasticity of used inputs in production of oil products and with using of mentioned relationships in Materials and Methods part the own and cross-price elasticity are calculated and results about Tabriz oil refinery are shown in table 3. The positive cross-price elasticity between inputs shows substitution between inputs. But the negative substitution elasticity indicates that two inputs are complement. For example, it can be said that if the price of input A increases while input prices of B be constant thus demanding be constant for B input then demanding increases for B input so in this case, input B is replaced on the place of input A. But if demanding for B input decreases then can conclude that two inputs are complement of each.

Table 3: Own price and cross demand elasticity.

Inputs	Labor	Capital	Oil
Labor	-.92213	0.46323	0.4363
Capital	0.1447	-.5641	0.4201
Oil	0.1315	0.46323	-0.4845

Source: research findings

The obtained results in table 3 indicate that:
A: All own and demanding price elasticity having negative sign which are consistent with economic theories. This means that increasing of price in each of inputs causes reduction of demanding for that input.
B:The amount of absolute value about price elasticity for all inputs such as capital, labor and crude oil is smaller than 1, it means that demanding amounts of these inputs are with less elasticity than to their prices. In other words, it is clear that for every 1% changing in price of inputs their demanding amount will be less than 1%.
C: Demand cross-elasticity is smaller than 1 between all inputs like capital, labor and crude oil which shows there is weak substitution relationship between all inputs. The obtained results of demand price elasticity confirmed obtained results from Allen's substitution elasticity in aspect of relationship between production factors. On the other hand, asymmetry between the cross-price elasticity represents degree of substitution between inputs.
D: Demand cross-price elasticity between crude oil, capital and labor, respectively is 0.1315 and 0.46323 which indicates that with increasing of crude oil's price so demanding for labor input will be increased more than capital. For example with reduction of refinery feedstock subsidy so demanding for using of more capital for using of advanced machines that use of less fuel than the old machines is lower than employing of labor. In other words, with implying this way the labor input is better alternative for crude oil input. This indicates that using of labor input instead of advanced machines that require less fuel are more efficient.
E: The results show that two-way demand cross-price elasticity of labor and crude oil is positive which makes clear that labor and crude oil are each other successor. In other words, 1% increasing in crude oil price increases labor demanding about 0.1315 which indicates weak succession of labor instead of crude oil when that refinery feedstock subsidy is reduced. Similarly, if the price of labor rises 1% so consumption of refinery's oil crude increases about 0.4363 in order to more using of machines and succession of labor decreases.
F: Two-way demand price elasticity of labor and capital inputs is positive and with low elasticity which shows these two inputs can be each other successor or substitute and once again substitution of labor with advanced machinery of production line will be confirmed. However, these results indicate that power of labor substitution instead of capital in about needing to increase the capital interest rates, is lower than power of capital substitution instead of refinery labor in case of increasing wage rate of labor. It also confirmed productivity of Iran's refinery sector. It means that even with reduction in capital in the refinery sector also there is no need to more labor. This situation is due to the saturation of the labor input is Iran's refinery sector.

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