

Capital and Labor Force Substitution Degree in Iran Great Industries (With Using Allen Elasticity Substitution)

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Abstract: In this study with the use of shephard lema function, share of each factor of production in total costs has been estimated and with the use of these estimates price elasticity's and cross elasticity's have been achieved. Also in this study, Allen elasticity have been estimated. As Allen elasticity are explanatory factors showing changes in the ratio of all factors (due to price change of one of the factors of production) utilization of factors of production has been considered. The factors of production in this study are capital and labor force. The statistical society in this research is a large workshop with 100 personals and more. This classification is according to the latest international classification for the industrial large workshops (2000-2008).

Key words: Cost function, Allen elasticity substitution, SUR, personals, statistical society, classification

INTRODUCTION

Industry is one of the largest sectors of the country economy. Economical growth and development require industrial development and growth. The industry development and growth provide a ground for the development and growth of other sectors such as agriculture, hygiene and treatment and transportation. The industry section in any country despite having much capacities has a lot of complexions and because of that in recent years many economical researcher are studying in this field.

As, it was mentioned because of having many capabilities and the capacity of being an engine for the steady development and growth in a country and because of the variability and abundance of products and having a high power for employment this sector needs optimal source allocation for producing cheap and abundant products. By allocating optimized primary sources such as energy, work, raw materials and capital and economical activity in the second sector, the efficiency and the production of the industrial sector reaches to an optimal limit and it will be followed by an increase in productivity and production and the country material power. According to this, now-a-days the 2 terms of the developed and industrialized countries are used in many cases. There is a need for studying the industry sector situation and recognizing the industry dependence

coefficient on the used production structures. In industry sector, the unknown amounts of the flexibility in using these structure caused an ambiguity in the effects of this factors on industry, 50 policy making in this sector became difficult. Therefore in this survey, the amount of being impressionable and the dependency of industry with respect to the structures are addressed. It should be said that in the current survey, considering the theory branch of small economy as duality or being twin, we study the company's production behavior by their expense function. The use of the expense function is because of the statistical grounds and the survey aims. In another word because the aim of this survey is acquiring the amount of the industry flexibility in using the structures or in fact the elasticity between structural, a subordinate form of Tran slog is specified for expense function and then by acquiring structure portion, the elasticity between the factors are acquired. The statistical society in this research is a large workshop with 100 personals and more that are active in 22 sectors. This classification is according to the latest international classification for the industrial large workshops and the second edition isic and the research period is 2000-2008.

Theoretical basis: Tran slog is made of the two words of transiently and logarithmic so some times it is recalled as exalted logarithmic function. These economical functions have been used many times and their special property is

their flexibility. This means that the number of their parameters is so that all different economical effects such as elasticity, price tensions, scaling tensions, technical change rate can be estimated and evaluated.

Also, under special situation and with enforcing definite (certain) limitation with the use of Taylor extensions, abundance function forms can be extracted.

From the time of the exalted logarithmic production function presentation by Christensen and Jorgenson in 1971 till now, the expense function model for analyzing production structure in different economic sectors is considered very much.

Translog functions are one of the forms of the flexible function that is used and considered very much because of its ability in specifying aspect and the production structure of different characteristic and is employed in many survey and researches because of having properties as following and being continuous derivational from the second degree tension's variability, the ability for showing reciprocal relations and because of the feasibility in interpretation. Some of the important properties of these functions are:

- In such functions, the technical substitution rate is fixed but the efficiency varies according to the scaling and optimized proportion of the production parameters
- These functions can be changed to multi-product and multi-structural models easily
- These functions have many parameters so their degree of freedom and the estimation power are reduced but the model does not lose its validity

The general form of the Translog production function is as following:

$$Y = a_0 \prod_{i=1}^n X_i^{a_i} e^{\frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n b_{ij} \ln X_i \ln X_j}$$

Where:

- y = Receivers
- a₀ = Efficiency
- x_i and x_j = Structures amounts
- j, i, a_i, b_{ij} = Unknown parameters

Also, for extracting cost function which is analogous with the above production function, the second extension of Taylor should be used.

MATERIALS AND METHODS

Model introduction: The model chosen for this survey is on the basis of the model presented by Chambers (1988):

$$\ln c = \ln \alpha_0 + \sum_{i=1}^n \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n \beta_{ij} \ln p_i \ln p_j + \alpha_y \ln y + \frac{1}{2} \alpha_{yy} (\ln y)^2 + \frac{1}{2} \sum \beta_{iy} \ln p_i \ln y$$

This cost function is first degree with respect to the structures price when the sum of the first power logarithmic coefficients is one. This is the necessary condition for the expense function, also the sum of the reciprocal effects should be equal to zero:

$$\sum \alpha_i = 1, \quad \sum \beta_{ij} = \sum \beta_{iy} = 0$$

Now for not estimating, the coefficients in the translog expense function freely and for enforcing this restriction for this function that the sum of the expense part is equal to 1 with the proportion of logarithmic differential to the expense and with the use of Shephard's lemma:

$$\frac{\partial \ln c}{\partial \ln p_i} = \frac{p_i}{c} \cdot \frac{\partial c}{\partial p_i} = \frac{p_i X_i}{c} = \alpha_i + \sum_{j=1}^n \beta_{ij} \ln p_j + \beta_{iy} \ln y$$

where:

$$c = \sum X_i P_i$$

And with respect to neoclassic production theory properties, on the basis of the sum ability of cost and homogeneity and good and good behavior parts in this function, we have the following restrictions structure part demand for equation system:

$$\sum \beta_{ij} = \sum \beta_{ji}, \quad \sum \beta_{ij} = \sum \beta_{iy} = 0, \quad \sum \alpha_i = 1$$

It should be mentioned that in this survey because of inability and limitations of the equations and that raw material data and consumed fuel are in the summed form we enter 3 variables of E, K, L in the model and according to them, we can extract the structure part equations. On this and by considering klem structures, we have:

$$\begin{aligned} s_k &= \alpha_k + \beta_{kE} \ln L + \beta_{kE} \ln E + \beta_{kk} \ln k + \beta_{ky} \ln y \\ s_L &= \alpha_L + \beta_{LL} \ln L + \beta_{LE} \ln E + \beta_{Lk} \ln k + \beta_{Ly} \ln y \\ s_E &= \alpha_E + \beta_{EL} \ln L + \beta_{Ek} \ln E + \beta_{EE} \ln k + \beta_{Ey} \ln y \end{aligned}$$

But because the expense part system can be parted such that $\sum s_i = 1$, n-1 number of these expenses part have linear independence. So for each of the observations, sum of the interfering sentences between equations always are

zero and this means that the pars variance code matrix become single. Now to solve the mentioned problem, seemingly unrelated regression model is used and because sum of the parameters partial equations equals with one, there is a need forth singularity of variance code matrix. On this basis, expenses part become as following:

$$s_k = \alpha_k + \beta_{kk} \ln\left(\frac{P_k}{P_e}\right) + \beta_{kL} \ln\left(\frac{P_L}{P_e}\right) + \beta_{kL} \ln(\ln y)$$

$$s_L = \alpha_L + \beta_{Lk} \ln\left(\frac{P_k}{P_e}\right) + \beta_{LL} \ln\left(\frac{P_L}{P_e}\right) + \beta_{Ly} \ln(\ln y)$$

After evaluating equation system, expresses part for acquitting E cost part coefficient of the mentioned restrictions is used. For estimating the parameter of the mentioned equation system, model of Iterative seemingly unrelated (1) equations will be used. Parameter estimated in such models will not be effected by the type of the demand equation which is omitted from the model system which are solved by this model has the following characteristic:

- Enforcing linear restriction between coefficients as was mentioned in Tran slog expense function good behavior situation, there is a relation between Tran slog expense function coefficients and this relation is one of the conditions for creating systems which are it's estimating method (ISUR)
- Unpresence of descriptive variable as function variable in a concurrent equation system when an internal variable and an equation act as an independent variable, it should be entered in another equation as the function variable to relate this equations with each other. If in an equation system, this relation between it's variables does not exist that system is converted to a seemingly unrelated system (Kamanta, 2004)
- The correlation between interference parts in some separate regressions if we have some equations which have no relation with each other, we can estimate each of them separately. But if the interference parts in this equations have relation with each other, we cannot estimate any of the equation, separately so, we should estimate them as a system of ISUR model

After estimating structure part, Alen Allen elasticity, substitution and complementary degree between structure can be estimated (Allen, 1938; Allen and Hicksk, 1934). Elasticity show a variable sensitivities to the other variables changes but the main purpose in this survey is

evaluating a special type of elasticity, called Alen elasticity s for Iran industry sector structure. This type of tension is named ozava-Alen elasticity and is used for grouping each pairs of the structure with respect to the substitution or complementary characteristic or in an exact term, the complementary substitution power.

This elasticity is very interesting because at the time of comparing proportions of goods not only we can express the opinion about the substitution and complementary property of them but also we can define the degree of their substitution or complementary power. As an example, although tea and sugar may be complementary, certainly the right and left mater of shoes are more powerful complements than they.

From the view of interpreting the sign of such tension type, we can say that if the Algebraic amount of this tension be positive, it shows that there is a substitution relation between the 2 structures and it this amount be negative, it shows that there is a possessive relation between the 2structure, also it is expected that Alen selfness tensions have the negative sign (Allen, 1938):

$$A_{ij} = \frac{c_{ij}c}{c_i c_j}$$

Where:

- c_i = Expense function derivation with respect to the j-th structure price
- c_{ij} = ith structure derivation with respect to jth price that considering above formula for Tran slog function

Alen elasticity are acquired by the following relation:

$$A_{ij} = \frac{\beta_{ij} + s_i s_j}{s_i s_j}$$

so we have:

$$A_{Lk} = \frac{\beta_{Lk} + s_L s_k}{s_L s_k}, A_{Le} = \frac{\beta_{Le} + s_L s_e}{s_L s_e}, A_{ke} = \frac{\beta_{ke} + s_k s_e}{s_k s_e}$$

Also, on of the indexes which can show the technology of a production unit is the demand price tension for production structures:

$$E_{ij} = \frac{\partial \log x_i}{\partial \log p_j}$$

This tension shows the proportional changes of the ith structure demanded amount, resulted from proportional in jth structure price. We can show that then substitution are related to the production factors, so we can write:

$$E_{ij} = s_j A_{ij}$$

Where, s_j is j th structure part and A_{ij} is Allen elasticity between i th and j th structures (Allen 1938; Allen and Hicks, 1934).

RESULTS AND DISCUSSION

This part includes results acquired from the estimate of Allen and intersectional tensions between the 2 structures, work and capital. The elasticity, measure the possibility of substituting structures in a way that the product level remain constant. The importance of estimating these tensions is that at the time of the changes in price and consuming parameters, industry managers can decide in away that the least possible cost in production is created. Moreover, having tensions or not having tension property of the demand for the managers is important for government policymaking with respect to defining and changing consumed structures in some industries. For example if the demand for the primary material in basic metals industry (select, iron melting) be elasticity, the increase in the price of the primary materials (iron stone) by government cause a more proportional reduction in the demand amount for these material and this will be ended in the production level decrease and a reduction in income.

For doing measurements after evaluating structure proportional part functions from the whole expense by concurrent equations and a is or system (Iterative seemingly unrelated regressions) with the use of the coefficient's evaluated in Allen tensions and interesting equations, the results acquired will be discussed briefly about 3 sub-groups of clothing, chemical and motor vehicle device industry.

The results for other industries are mentioned in the study (Greene, 1993). And all the calculations done with a soft ware package device stat 9.1 which are cited in Appendix. As it can be shown in Table 1-3, Allen elasticity and cross elasticity between parameters of work force and capital have a positive Algobirc sing so we can say that there is a substitution relation between these structures and this substitution relation in vehicle devices and clothing is more powerful than the substitution relation between work and capital in chemical industry. So with the use of Allen partial cross elasticity numerical amount, we can conclude that the substitution relation between work force and capital in the two industry of clothing and vehicle devices with proportion to chemical industry is more.

Table 1: Clothing group

Years	Cross elasticity's between labor force and capital	Allen elasticity between labor force and capital
2000	2.32853	14.24010
2001	1.65596	7.01768
2002	1.51630	9.20916
2003	1.21222	6.82453
2004	1.31324	8.48930
2005	1.32326	5.72225
2006	4.75199	9.03664
2007	4.48762	8.35591
2008	5.85687	11.40220

Table 2: Vehicle group

Years	Cross elasticity's between labor force and capital	Allen elasticity between labor force and capital
2000	2.011099	11.589590
2001	1.760331	9.041215
2002	1.674792	12.015760
2003	1.776009	11.710180
2004	1.681125	9.823339
2005	1.496360	9.897564
2006	1.728084	11.975050
2007	2.128621	15.253330
2008	1.202303	2.369673

Table 3: Chemical material group

Years	Cross elasticity's between labor force and capital	Allen elasticity between labor force and capital
2000	-0.13910	0.328000
2001	-0.11782	0.311370
2002	-0.10140	0.318390
2003	-0.05039	0.130190
2004	-0.10099	0.207790
2005	-0.28684	0.754440
2006	-0.32972	0.901970
2007	-0.61895	0.726090
2008	-0.53102	0.620375

In another word in the 2 above industries with the increase in one structure price use of the other structure, increases very much and this in probably because of this industry technological capability and their flexibility or in a more exact term, putty-putty is available without them. But in an industry like chemical industry the substitution between work and capital happens slowly and this is because of the lunch technological expenses in refineries and chemical factories, mainly in the form of imports.

Also as Table 1-3 show an intersecting tension in subgroups of clothing, chemical and vehicle devices industries these tensions show the change percent of industry demand for it price change for each of the parameter.

The positive sign between tensions in clothing subgroup 1 all the year shows that with the increase in the price of work structure, the amount of capital use increases that in another word, it shows a substitution relation between these 2 structure in clothing. The results shown in the Table 1 show how the change percent in demand for capital is the result of work force price change. As shown in the Table 3, the change percent in demand for capital which showed itself in demand increase had an

incremented trend because of the payments change. In another word, the demand for capital and technology with respect to the work force price change has become more sensitive. And this probably is because of the increase in worker's minimum payment by the government.

A similar trend is shown in Table 2, in the case of vehicle devices industry in motor vehicle device production in dusty the elasticity for workforce and capital structure is positive and this means that in this industry, work force and capital act as a substitute and this result is compatible with the existed fact, too if for example in automobile industry by mechanizing production lien. Of this industry by partial rises in the price of work force are encouraged to use more automatic machines and developed technologies which have a higher efficiency then human force. So, recognizing this tension can be used as an important parameter for a change in work force use and capital proportion in this industry.

Therefore, if the aim of government for mechanizing and capitalizing some industries such as vehicle device production industry be its profitability and compete ability international scene, one of the policies can be a proportional increase in work force price and granting necessary facilities for buying and importing technologies and providing facilities for research and internal technology production. It should be said that the useful effect that the use of capital and technology has with itself in a proper condition, most of all includes the increase in power and work function that it's result if is compensating work force shortage and supplying it is excess for working industries and much of it for the agriculture and service but provided that there be a possibility for work force attraction in other divisions

because if not so the free work force will appeal to false jobs and unemployed villagers emigration to the cities has it is increasing problems.

But in the Table 3, intersecting for chemical industry have negative signs and Algebraic amounts are <1 . And this shows that the complementary characteristic is weak. For example in year 1380 for a unit increase in price of workforce, the demand for capital parameter has reduced -0.13 amount and in the rest years, there has been such a relation between structure but this completely relation between work force and capital can be because of the fact that in chemical industry, the work forces are mostly professional and the necessity of professional work force use along with capital and technology in that industry can be sensed.

CONCLUSION

The results of the assessments show that there is a substitution relation between capital and labor and also show that Alen elasticity and cross elasticity between parameters of labor force and capital have a positive coefficient.

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