Estimation of Steel Ingot Production Function by Emphasis on the Placed Role of Scrap Metal in Esfahan Steel Company

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ABSTRACT

Objective: Today, the importance of metal and steel in the global development is in a way to say that the metal has formed the foundation of modern civilization. Materials and Methods: Required inputs for steel production in seven stages including iron ore, scrap iron, thermal coal, coke, natural gas, electricity and labor are classified. The production function combines these factors altogether and determines the level of production. The main objective of the research is to estimate the production function and distribute the steel ingot by the emphasis on the placed role of scrap iron in Esfahan Steel Company. Results: The results indicate that the scrap iron ingot is an inelastic input in the manufacturing sector and distribution of steel ingots and it’s the most important factor in the production of steel ingots and its cost is the final price of the molten iron.

INTRODUCTION

Focusing on industry and growth of the industrial sector in the developed countries is a necessity in order to reduce technological distance in those countries and developing ones [3]. Since the developing countries have now referred to spatial, electronic, more complicated and computer industries, necessity of paying more attention to the pace of development in the developing countries is felt more than before. In here, growth and development of the heavy industries have particular significance [5]. Due to having the greatest share in the metals used in various industries, Iron and steel are the cheapest metals and they provide their own specific functionality such as strength, hardness and corrosion resistance, facilities and infrastructure of economic growth and development. Moreover, Steel industries are in the center of attention in terms of providing a broad level of employment and its export possibility [8]. Therefore, the steel and iron products have vital importance in terms of economic development and national security and it’s required to study the problems, issues, obstacles, growth and development solutions of such industries.

The Importance of Iron and Steel Industry:

Steel and iron products for each country has vital importance in terms of national security and economic development and used as the essential metals for all industrial activities. Although existence of alternatives is acceptable in technical terms in most fields, therefore there is no alternative in short term and in practice due to lowness of iron and steel price and unavailability of other materials.

More than 90 percent of the metals used in most industrial countries in weight term are iron and steel; therefore, it’s necessary to make sure of continuous facilities for national security of these countries. This metal is applied for production of military equipment and support of non-military activities as well as being used as the main metal in ground vehicles, shipbuilding and machinery construction. Additionally, almost all large buildings can be built with reinforced concrete or steel structure.

Iron and steel have the most shares in the metals used in that section of the mineral, drilling activities and pipelines related to energy, refineries and power plants. Moreover, the small amount of steel is used in some sensitive areas of spacecraft. Thus, it is impossible to find an alternative in the short term due to its very varied and high use in comparison with other metals [9].
Creation of iron and steel industries not only has been considered in terms of independence and relative self-sufficiency and currency economy, but also this industry has very positive impact on other economic parts of the society and widely provides the required materials for various side dependent industries including transportation and construction of various industrial machineries and construction section of employment opportunities which should be regarded as subjects with importation facilities along with provision of local needs [2].

Considering role of the industry, especially parent and heavy industries including steel industry in the process of industrialization and development of the developing countries, it’s necessary to study and identify more the issues and problems related to these industries as well as trying to solve such problems. In Iran, Esfahan Steel Company is one of the greatest active companies in the industry and the subject of its activity is to produce some materials which have late the previous link with other industries such as steel. In addition, such industry has dedicated a wide volume of physical and human capital resources and it has faced losses continuously in most years due to various reasons including work force market, unnecessary costs and wasting sources and raw materials [2].

The Relationship between Production Factors and Production Volume:

An economic firm is a technical unit in which the goods are produced. Owner or manager of the firm decides about which amount must be produced, which type of products must be produced, which amount of benefits must be achieved or how much the loss will be.

The owner of the firms (production and raw materials factors) converts the inputs to outputs (products). Of course, regulation function is a technique to be determined by the production function. Difference between earnings from the product sales and cost of the production factors form its benefits. If this discrepancy is positive, it shows the benefits. If it is negative, it shows the loss.

Manufacturer’s production function represents the mathematical form of the relationship between the amounts of production factors used with the amount of goods which produces.

A production function can take different forms; the production function can be equivalent to a point, a continuous or non-continuous function, a single value or a set of equations.

An input is a product or service helping to produce a specific product. A producer generally uses various inputs for production of a product (good). Some inputs may be the products of other economic firms. For instance, steel plays a productive role in automobile industry, whereas the very steel plays role of a product or input for steel producer. Other factors and inputs (such as work forces, land and mineral resources) are not producible. Other factors or inputs (such as labor, land and mineral resources) are not producing. For a specified period of time, production factors are divided into two fixed and variable groups. One factor of fixed production (inputs) is necessary to produce the, but the required value of these factors is unrelated to the amount of production. Regardless to the maximum plan of profit in the short-term bears costs of this group of inputs. Amount of variable required inputs of the manufacturer depends on the amount of production. The distinction between fixed and variable factors of production is temporary.

Inputs that are fixed in a period of time will be variable in longer period of time (Henderson and Kowant, 1991).

The general explicit form of the production function can be written as below:

\[ y = f(X_1, X_2, ..., X_n; X_{n+1}, ..., X_m; X_{m+1}, X_{m+2}, ..., X_l) \]

In which: \( y \) is dependent variable of production and a function of below production inputs:

\( (X_1, X_2, ..., X_n; X_{n+1}, ..., X_m; X_{m+1}, X_{m+2}, ..., X_l) \)

For a multi-product and multi-agent manufacturing firm that uses the production factor to produce \( m \) different production. General form of the production function can be displayed implicitly as below:

\[ F(y_1, y_2, ..., y_m; X_1, X_2, ..., X_l) = 0 \]

\( y_k \geq 0 \quad (k = 1, 2, ..., m) \)

Dimensions of \( y_k \) and \( X_i \) are the same as physical units on time.

Variables and Research Model:

For compatibility with productive structure dominant on steel plant and based on the conducted studies in the previous chapters, a pattern is selected which is flexible regarding returns to scales, production area and form of the production function. In this study, the final and implicit form of the production function used for the steel plant is as below:

\[ Q = f(K, L, M, E) \]

In which \( Q \) is the production of steel converter, \( K \) capital, \( L \) labor, \( M \) raw materials and \( E \) energy.
\[ \ln Q_t = \alpha_1 + \alpha_2 \ln L_t + \alpha_3 \ln K_t + \alpha_4 \ln M_t + \alpha_5 \ln E_t + \varepsilon_t \]

**Methodology:**

The required information is extracted from the available documentations in Steel Company. The research period is a ten-year time series from 2005-2014. In this research, OLS method and Eviews software are used to estimate the results after conduction of the required tests. In order to distinguish durability of the variables and to determine their collective degree, generalized Dicky-Fuller test (ADF) is used and F statistic is used to study the significance of the regression model and t statistic is applied to study the significance of independent variables coefficients.

**Estimation of Model and Results Analysis:**

Considering the results from Dicky-Fuller test generalized in table 1, variable of work force in durability level and two other variables are not durable. Since the results of durability test on remains indicate durability of waste in the surface, so that there is no worry in terms of fake regression. The results of production function are submitted in table 2.

**Table 1:** results of durability test for the model variables

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Levin, Lin and Chu test</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>2/48</td>
<td>0/99</td>
</tr>
<tr>
<td>Work force</td>
<td>-5/08</td>
<td>0/004</td>
</tr>
<tr>
<td>Production</td>
<td>-2/80</td>
<td>Sep-00</td>
</tr>
<tr>
<td>Energy</td>
<td>-0/78</td>
<td>0/77</td>
</tr>
<tr>
<td>Raw materials</td>
<td>-0/91</td>
<td>0/73</td>
</tr>
</tbody>
</table>

**Table 2:** The results of the estimation model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T statistics</th>
<th>probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>0/38</td>
<td>2/99</td>
<td>0/003</td>
</tr>
<tr>
<td>Work force</td>
<td>0/86</td>
<td>11/10</td>
<td>0/001</td>
</tr>
<tr>
<td>Energy</td>
<td>0/43</td>
<td>2/82</td>
<td>0/036</td>
</tr>
<tr>
<td>Ingredients</td>
<td>0/95</td>
<td>4/89</td>
<td>0/004</td>
</tr>
<tr>
<td>R2 statistic</td>
<td>0/99</td>
<td>D-W</td>
<td>2/42</td>
</tr>
</tbody>
</table>

R2 statistic indicates that the model is appropriate explanatory. Moreover, value of Durbin-Watson statistic is equal with 2/42. This statistic is between 1/7 and 2/5; indicate the autocorrelation in the model.

Thus, there is no autocorrelation problem in the regression.

The results indicate that the scrap iron ingot is an inelastic input in the manufacturing sector and distribution of steel ingots and it’s the most important factor in the production of steel ingots and its cost is the final price of the molten iron.

**REFERENCES**


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