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The Economies of Scale in Iran Manufacturing Establishments

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Abstract

One of the topics after two decades of applying import substitution policy in Iran manufacturing sector is the importance of industrial export expansion and foreign relations. The main impetus to this policy transfer is the market expansion and potential gains of exploiting the economies of scale and technical upgrades. Based on this argument this research estimates the efficient scale and gains of producing the optimal scale in large establishments in Iran manufacturing groups at 2-digit ISIC (Rev.2). For this purpose a long run translog cost functional, flexible function form is selected on the theoretical basis. By using indirect seemingly unrelated regressions method, data at the mean of a representative establishment are chosen to estimate the minimum and the slope of LAC.

The result shows that the economies of scale exists in all of the industrial groups and in the last year of this research (2001) all of them except the manufacture of non-metallic mineral products (ISIC36) were producing lower than optimal scale. The study of market structure shows that the most concentrated market of manufacturing groups are overlapping with the most potential groups for exploiting the economies of scale. Both of these reasons implies that the domestic market constrain acts as a barrier to gathering the benefits of economies of scale and necessitates the importance of applying outward oriented policies.

Keywords: Economies of scale, Export Expansion, Minimum efficient scale, Iran industrial sector, Iran manufacturing sector.

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I. Introduction

The Manufacturing sector in Iran has been undergoing significant change during 1964-2001. Most of these changes are occurred owing to exchange rate fluctuation and interventional policies.

In first economic development plan after imposed war in 1989, the policy makers advocated a series of guidelines in favor of securing initial needs and inward-oriented trade policy, these policies were characterized by pervasive licensing, reservation of key areas for public sector, control over large domestic firms and distinctive loan interests and loan amounts among sectors. This policy follow in the second plan till 1999, while the priority of securing initial needs displaced by import substitution regime.

This policy sphere caused the production just for domestic market and loss of competitiveness despite of low price of labor, energy and access to the mineral sources. Findings about household demand reveal the lack of enough household demand to support some manufacturing plants in efficient scale.

However, as country succeeded to produce most of imported manufacturing goods isolation from global economy, created a high-cost industrial structure that characterized by technological obsolescence, low rates of productivity and capacity utilization and growth.

Third economic plan has been implemented on the base of export orientation view to enhance efficiency and competitiveness. Removing pervasive licensing regime and privatization led to an increase of private share in manufacturing sector.

Today, when globalization is the most controversial debate, this paper aims to shed light on this topic and considers potential competitiveness of Iran manufacturing sector against progressive surge of globalization. So the main questions of this paper are:

Do economies of scale exist in Iran manufacturing establishments? How much industries can reduce their average cost by moving toward efficient scale?

2. Economies of Scale

In the short-run, the production manager control daily or monthly production corresponding to an ordered schedule, his aim is to achieve to the predetermined product by the least costing way of production. On the other

level, the firm's strategic manager is in charge of long run targets. He should anticipate prices and market capacity and estimates the efficient production scale. Each short run or long run has its own cost function that theoretically both are U shape. But in the short term production manager envisages a U shaped cost curve because of diminishing return rule that is caused by constraints of fixed and quasi-fixed production factors. While in the concept of economies of scale there are no fixed factors[1] and the aim is to quantify the average costs changes in which all of factors can be varied.

In economic term the augment of all production factors entitled "scale expansion" can be accompanied by increase, constant or decrease in long run average cost, in which called economies of scale, no economies or diseconomies of scale and diseconomies of scale, respectively.

To find sources of economies or diseconomies of scale there are no distinct sources and there is a resultant set of factors in which economies or diseconomies of scale depends on their share in cost function, although "*specialization and technology* [2]" are most popular source of economies of scale. There is also another important source of economies of scale called "pecuniary gains" which may cause sharp decline in average cost. Despite of the fact that this source is part of a real world and firm's decision making but lots of studies attempt to filter out this effect, because it strictly depends on market structure and operation, and is not reliable.

3. Review of Literature

During the debate that led up to the implementation of a bilateral free trade agreement between Canada and the U.S. on January 1, 1989. Ian Keay[3] put

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1- Quasi-fixed cost can be existed even in long run, but there are small, the example of quasi-fixed cost is the annual electricity charge of a factory or even expert labors (engineers, managers etc).

2- Mostly embodied technical change comes up with higher output rate machines.

3- "An Empty Promise: Average Cost savings and Scale Economies Among Canadian and American Manufacturers, 1910-1988", I. Keay, (2001), queen's University

forward a cost comparison in both neighbor manufacturing sectors. In his research he considers nine[1] industries that had most value added of both manufacturing sectors. The results showed in 7 of industries out of 9, the cost difference is due to different rate of exploiting economies of scale . Among the 7 industries, in five of them Canada had a higher average cost against its counterpart, in which only in one of them (manufacture of steel) Canada can compete by moving toward efficient scale and decreasing average cost by 30%. As a result the study showed only four industry (oil, paper, wine, steel) can survive after free trade agreement.

S. Girma and H. Görg (2002) in order to be able to compare returns to scale and productivity across establishments of different nationality and in different sectors, estimate the system of equations described separately for each of the four two-digit sectors and the two nationality groups (domestic vs. foreign-owned) in UK manufacturing establishments. Lagged returns to scale examined the effect of the acquisition of a domestic establishment by a foreign owner on returns to scale and productivity growth. Results show that foreign establishments tend to have lower returns to scale than their domestic counterparts and the calculated RTS are electronics (d) =0.825, electronics (f) = 0.817, food (d) =0.772, food (f) = 0.747. The effect of foreign acquisition on productivity differs between sectors; establishments in the electronics sector experience a reduction in productivity post acquisition, while plants in the food sector increase productivity.

Sanja S.pattnayak and Thangavelu (2003) measured the economies of scale in 13 Indian manufacturing industries. A translog cost function is used to analyze the production structure in terms of biased technical change and economies of scale. A panel consisting of 121 Indian manufacturing industries from 1982 to 1998 was used in the estimation. The results support the evidence that there are economies of scale (only moderate) in the 7 out of 13 Indian manufacturing industries (Beverage; Textile; Rubber, Plastic, Petroleum, and

1- Including: Cement, Cotton, Distilleries, Oil, paper, Silk, Steel, Sugar, Wine.

Coal Products; Chemical and Chemical Products; Non-Metallic Minerals; Metal Products and Parts; Machinery and Equipments) and it has been exploited after the key economic reforms in 1991 change.

There is few research papers have carried out purely about measuring economies of scale in Iran manufacturing sector, but in a wide range of calculating productivity, production factor elasticity etc, the economies of scale can be calculated implicitly.

Khodadad Kashi (1995) measured economies of scale in his Ph.D. research study in four–digit ISIC of manufacturing establishment. In this research he measures minimum efficient scale (MES) and its magnitude as an entrance barrier to market. He applied "*existing size distribution*" method. His result shows in 81 industrial classes (ISIC-four digit), the economies of scale is significant by 83 billion rials (at current 1991 prices) in manufacture of tobacco products[1] and the efficient scale in 66 classes is less than one billion rial.

A. Tavakoli, K. Azarbaiejani and A Shahriarpour measured partial and total productivity in two-digit ISIC (Rev.2) of manufacturing sector. The estimation was run over the value add, labor and capital stock data (1972-1993) by using Cobb-Douglas as a production functional form. the results showed the increasing return to scale exists in manufacture of other products (ISIC39), non - metallic mineral products (ISIC36), machinery and equipment (ISIC38), basic metals (ISIC37), chemicals and chemical products (ISIC35), wearing apparel, textile and leather (ISIC32), wood, products of wood and furniture (ISIC33), respectively. Also in the manufacture of food, beverage and tobacco (ISIC31) there was evidence of decreasing return to scale and in manufacture of paper and publishing (ISIC34) the estimated function was insignificant.

4. Conceptual Framework

A fairly large literature has developed over the last decades on the measurement of economies of scale. Two issues are debated particularly in that

1- This industry is a perfect monopoly.

literature, namely, whether one should use production or cost functions, and whether to use industry or firm/plant level data for the measurement of MES. From duality theory point of view a restricted cost function should be sufficient to infer the structure of production. Commonly the choice between production and cost function is largely determined by the availability of data for the estimation of either function. Furthermore the use of production function method makes it easy to find the existence of the economies of scale but to determine the efficient scale. The task necessitates specifying a monotonically decreasing function of scale elasticity function that causes model manipulation and loss of flexibility[1]; hence in this case cost function appears to be more reliable for MES estimating.

In the choic e between industry and firm/plant level data, while returns to scale and productivity are micro phenomena, so the use of micro data is preferable to industry level data and applying industry level data may lead to biased results as they aggregate over potentially heterogeneous units. Albeit, in this research because of data restriction, we use industry level data but to cope with aggregation error two remedies implemented: first data over plants less than 10 employees were excluded from statistical universe[2]. Next all of the quantitative data were divided by the plant's number.

4.1. The Translog Cost Function

In the middle of 1950s, economists were aware of Cobb-Douglas and CES functional forms shortages, these functional forms are able to explain only one area of three neoclassical production areas in which impose the elasticities and return to scale are constant.

1- Zellner A. and H. Ryu, (1998), "Alternative Functional Forms for Production, cost and Return to scale Function", Journal of Applied Econometrics, 13, 101-127.

2- In average the small establishments (less than 10 employees) lave employed %47 of industrial employment, while they have produced only %19 of output in manufacturing sector, which shows the technical production different among small and large establishments.

While in many cases the aim is to identify the validity of these presuppositions that should consider as a result of statistical estimation. The flexible functional forms emerged to address these inspirations. The translog cost function is chosen for this study because it places no prior restriction on the nature of technology and substitution among the factors of production. Equally important, it allows scale economies to vary with the level of output. This feature is essential to enable the unit cost curve to attain the classical U shape. To approximate the translog cost function the Taylor series is applied, series usually used to estimate an unknown functional form or make the most flexibility. By expanding a Taylor series till second order, the translog cost function is as follow:

$$\ln C = \alpha_o + \alpha_Q \ln Q + \frac{1}{2}\alpha_{QQ}(\ln Q)^2 + \sum_{i=1}^{3}\beta_i \ln P_i + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3}\gamma_{ij} \ln P_i \ln P_j$$
$$+\sum_{i=1}^{3}\gamma_{iQ} \ln P_i \ln Q + \sum_{i}^{3}\gamma_{it} \ln P_i \ln t + \gamma_{Qt} \ln t \ln Q + \alpha_t \ln t + \frac{1}{2}\alpha_{tt}(\ln t)^2 \quad (1)$$

Where:

C: total cost, including payment for remuneration and wages, interest and capital depreciation, raw materials and intermediate inputs, fuel and energy.
P_L: Price of labor (total annual payments for labor divided by number of workers)
P_K: Price of capital (depreciation costs+ interest cost as an opportunity cost)
P_M: Weighted average price of raw material, intermediate inputs, fuel and energy.
(i, j=L, K, M)
t: Time trend as a technical change index (t=1,2,…,21)

But the cost function must satisfy the theoretical principles which are:

- Monotonicity

This principle insures the cost function is an increasing continuous function with respect to factor prices, this assumption means that entrepreneur uses factors on a logical base. This assumption requires:

$$\frac{\partial C}{\partial P_i} \geq \circ \qquad , \qquad i=L, K, M$$

- Concavity

The requisite and sufficient conditions for a continuous and second order derivative function in factor prices implies that the matrix of second order derivatives $\left[\frac{\partial^2 C}{\partial P_i \partial P_j}\right]$ be non-positive definite within the range of input prices in each output level. This principle insures the global curvature condition of the total cost function, which the MES point is unique.

-Homogeneity

The homogeneity principle implies that the cost function should be homogenous of degree one in input prices. The background argument of this principle refers to the optimization behavior of the firm. This property places the following restriction of the cost function on equation (1):

$$\sum_{i=1}^{3} \beta_i = 1$$
$$\sum_i \gamma_{ij} = \sum_j \gamma_{ij} = \sum_i \gamma_{iQ} = \sum_i \gamma_{it} = \circ \qquad (2)$$

4.2. The Scale Elasticity

The aim of estimating scale elasticity is to quantify the responsiveness of average cost with respect to change in output level. The elasticity of average cost to output is equal to the percentage change in average cost in response to a one percent increase in output.

$$SE = \frac{\partial \ln Q}{\partial \ln C} = 1 / \frac{\partial \ln C}{\partial \ln Q} = 1 / \left(\alpha_Q + \alpha_{QQ} (\ln Q) + \sum_{i=1}^{3} \gamma_{iQ} \ln P_i + \gamma_{Qt} \ln t \right) \qquad (3)$$

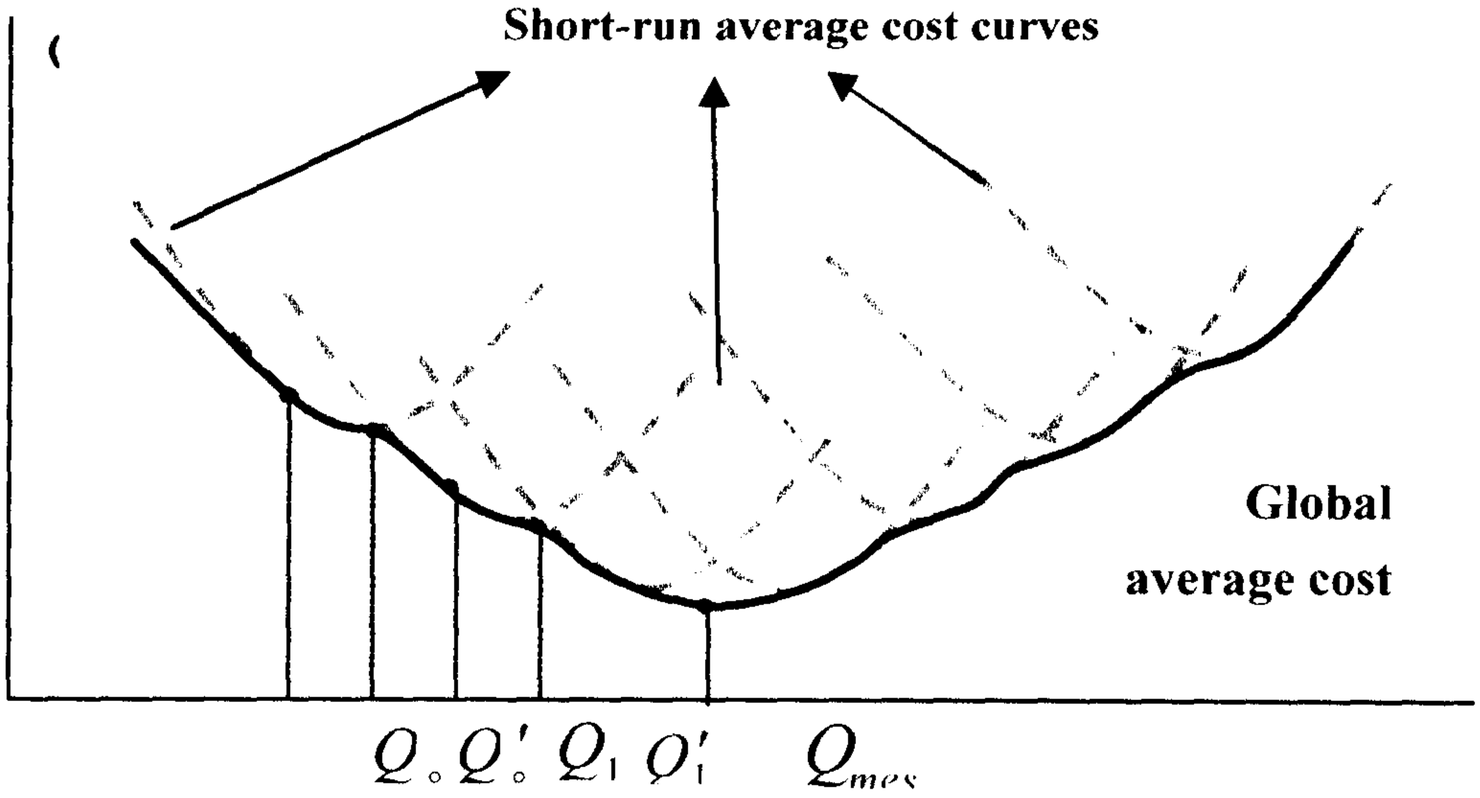
If scale elasticity is greater than one, indicates that average cost falls as output levels rises. If scale elasticity less is than one, it indicates the average cost increases as output levels rises. The scale elasticity ratio in (3) suggests the slope

of cost curve in local points, caused by the minor increase in output, so there may be statistically significant return to scale, but only minor cost saving associated with output adjustment and vise versa. To make a right deduction the global curvature condition must be considered.

4.3. Return to Scale and Economies of Scale

It is of importance to distinguish between return to scale and economies of scale. In general, movements along a long run average cost curve in response to changing output levels are accompanied by changing elasticity of average cost with respect to output. A firm which producing subject to statistically significant local increasing return to scale may be producing on the flat portion of its long run average cost curve (C to D), by contrast a firm may feels small economies of scale (A to B) while there is a large cost discount in moving toward minimum efficient scale (Q_{mes}), Figure 1 shows the difference between return to scale and economies of scale.

Figure 1 : The Conceptual Difference between Return to Scale and Economies of Scale



Hanoch (1975) showed the economies of scale must be evaluated along the expansion path, where as return to scale is defined along arbitrary input-mix ray. The return to scale mostly originated in internal technical factors such as capacity utilization[1], cost allocations etc. while the source of economies of scale are mostly emerge by increase in the plant size and the enterprise's activities as a whole. So theoretically return to scale and economies of scale will differ unless the production function is homothetic. To determine the output level at which the long run average cost would have been minimized using the estimated cost function, setting the scale elasticity equal to one, and solving the equation at mean of data, reveals the minimum efficient scale. The homogeneity principle insures that such a point is unique.

$$\ln Q^{mes} = \frac{-((\alpha_Q - 1) + \sum_{i=1}^{3} \gamma_{iQ} \ln \overline{P}_i + \gamma_{Qt} \ln \overline{t})}{\alpha_{QQ}} \qquad (4)$$

By calculating associated cost from estimated cost function (C_{mes}) the actual cost discount in moving toward MES can be yield as follow:

$$SE_{global} = \frac{d \ln Q}{d \ln C} \qquad (5)$$

In which if the estimated SE_{global} is greater than one, means the existence of economies of scale in firm scale expansion. If the SE_{global} is smaller than one, there is evidence of diseconomies of scale in output expansion.

1- If there is discontinuous accessible size of plant and machinery.

5. Model Specification

There are 24 parameters and 21 observations in estimating equation (1), due to the lack of degree of freedom it is impossible to estimate the translog cost function. As mentioned in section 4.1 the model must satisfy the microeconomic principles which can be taken into account as extra information. The homogeneity restriction is imposed as phrases (2).

By imposing homogeneity condition all of the factor prices are normalized with respect to one of the production factor price. In this study the capital price is chosen for normalizing, so it is dropped from the cost function. As Kmenta and Gilbert showed parameters' estimate are invariant to the choice of which variable deleted. But the capital price in Iran is a controlled variable and low variance of it provoked us to do so. The second theory that causes decrease in number of parameters is the Yang Theorem, this theory implies that the continuous second order derivatives are symmetric, which in the case of the translog cost function, this theory is formed $\gamma_{ij} = \gamma_{ji}$, (i?j). By imposing two latest restrictions, Yang theorem and homogeneity conditions, the final functional form is applied as:

$$\ln\frac{C}{P_K}=\alpha_{\circ}+\alpha_Q \ln Q+\frac{1}{2}\alpha_{QQ}(\ln Q)^2+\sum_{i=1}^{2}\beta_1 \ln\frac{P_i}{P_K}+\frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2}\gamma_{ij} \ln\frac{P_i}{P_K} \ln\frac{P_j}{P_K}+$$

$$\sum_{i=1}^{2} \gamma_{iQ} \ln\frac{P_i}{P_K}\ln Q+\sum_{i=1}^{2}\gamma_{it} \ln\frac{P_i}{P_K}\ln t+\gamma_{Qt} \ln t \ln Q+\alpha_t \ln t+\frac{1}{2}\alpha_{tt} (\ln t)^2 \quad \text{(i, j=L, M)}$$

(6) (6)

In which the estimation process is possible base on 15 parameters.

Estimation Method

On this phase the estimation is feasible by using an ordinary least square method. However, it neglects the additional information contained in the cost share equations. This information is derived by applying Shepherd lemma:

$$\frac{\partial \ln C}{\partial \ln P_i}=\frac{\partial C}{\partial P_i}\Big/\frac{C}{P_i}=\frac{X_i P_i}{C}=S_i \qquad (7)$$

The optimal procedure is to jointly estimate the cost function and the cost share equation as a multivariate regression system. Including the cost share

equations in the estimation procedure has the effect of adding additional degrees of freedom without adding any unrestricted regression coefficients. This will result in more efficient parameters estimate than would be obtained by applying OLS to the cost function alone. Since the cost share equations are derived by differentiation, they do not contain the disturbance term from the cost function. There are several methods will be proposed depending upon what assumption is taken about variance–covariance matrix as a subset of GLS method. Following Zellner (1962), the system estimated on assumption of heteroscedasticity and contemporaneous correlation in the errors across equations and zero correlation across years. Kmenta and Gilbert (1966) have shown that iteration of the Zellner estimation procedure until convergence results in maximum-likelihood estimation.

The Problem of Excess Capacity

The prerequisite assumption of being on a long-run cost function is that the production is optimized at the short times, but in real world in many cases a firm wittingly or unwittingly has been producing in non-optimal short run condition.

The under-utilization over large establishments usually resulted in an overestimation of scale elasticity. On the other hand excess capacity may cause the diseconomies to become larger. There are no distinctive factors that caused production in excess capacity. But factors such as uncertainty, monopoly, discriminative policies, lack of technical know-how, mainly cause the problem of excess capacity. On this occasion in Iran manufacturing sector, the problem mainly caused in war period (1979-1988) and discriminative policies have played the key role to this matter. In war period because of uncertainty as well as lack of enough income to import materials most of the industries were producing under-capacity. After that, the subsidiary policy to give cheap foreign currency rate and import license based on the installed capacity induced firms to expand their capacity in order to get more licenses. To tackle this problem we enter a dummy variable was entered for a possible under-utilization years. The dummy variable takes one in such case and zero for the years out of war period. We respect the coefficient of the dummy variable will be negative.

6. The Analytical Results

The manufacturing sector undergoing significant change during the period (1981-2001), most these changes are taken place after year 1994, the investment has been increased over time, on the other hand the number of firms boomed from 4466 plants in 1993 to 13247 plants in 1994, while the increase of investment in year 1993 is 20%, there is an intensive increase in material share in the period from 55% up to 80%. These evidences indicate (in the absence of sampling errors) the existence of *"Vertical Disintegration"* against economies of scale during two decades. Figure 2 shows the value-added trend over recent two decades.

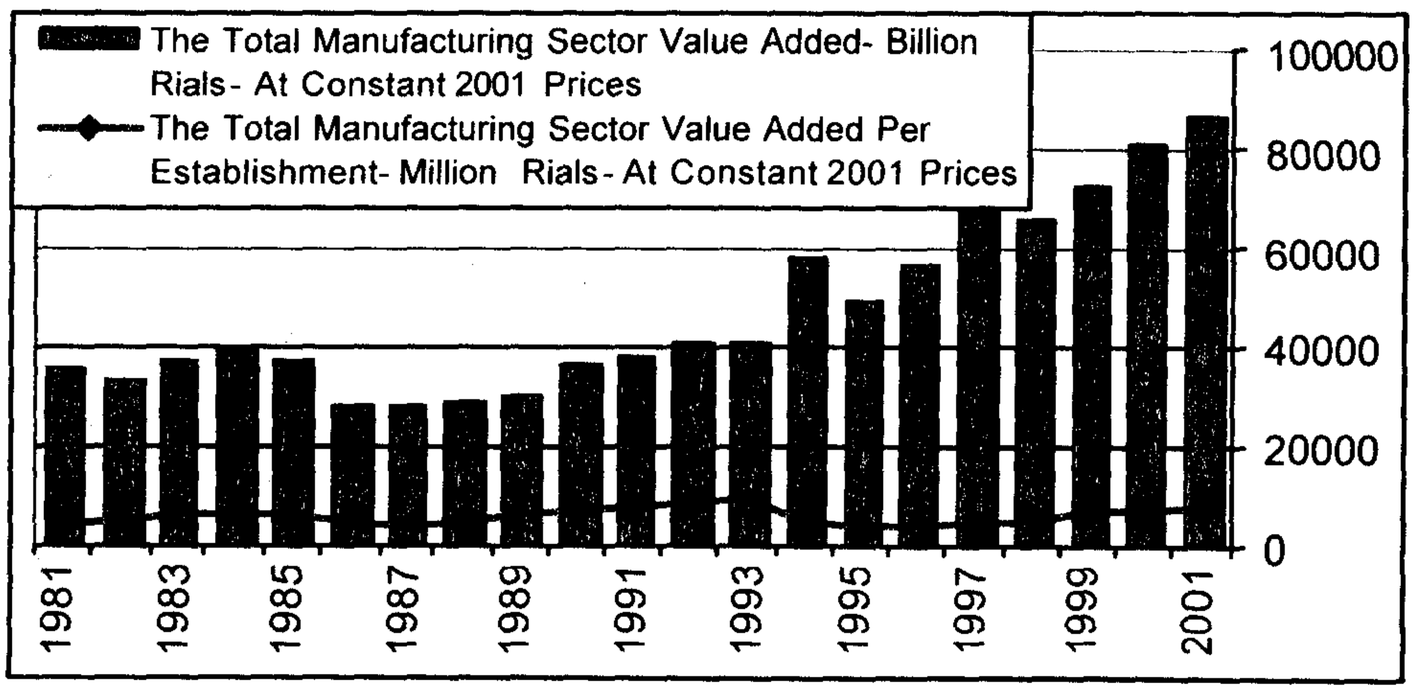


Figure 2: Total Manufacturing Sector Value Added over Time

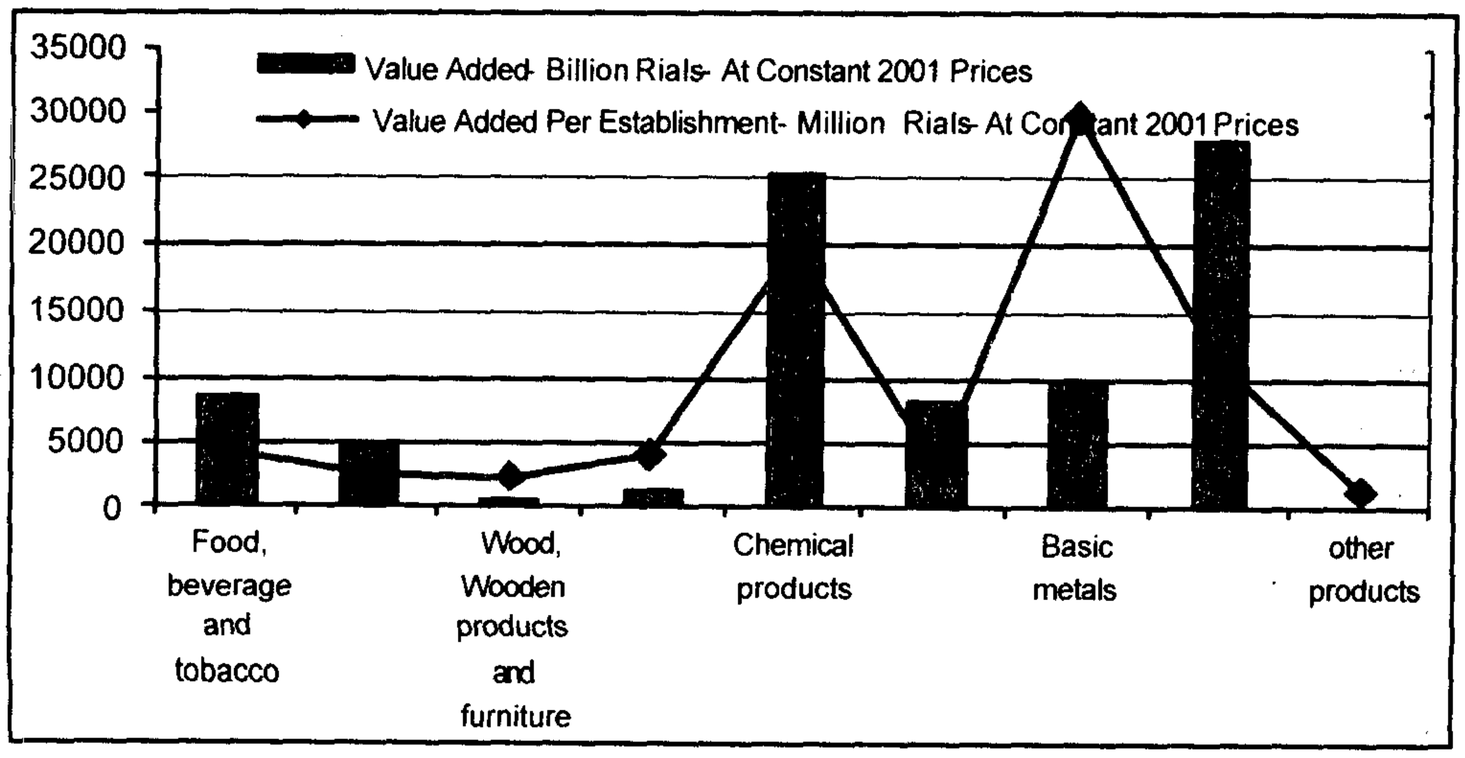


Figure 3: Industrial Value Added in Manufacturing Divisions Year 2001

6.1. The Economies of Scale in Aggregate Manufacturing Sector

The estimation procedure using SUR method presented in table 1. It is notably γ_{LQ} is negative and significant at two percent level which means the labor is utilized in third neoclassical production area and indicates the problem of over-employment at aggregate manufacturing level. It justify the productivity will increase by shrinking the plant's size in number of employment. The efficient scale is calculated equal to **17624.1 Million Rials**[1] per establishment at the mean of data. But the current scale is 18606.1 M.R. that near to the optimal scale. It is caused by two reasons: first the aggregation error tends to underestimate the economies and diseconomies of scale. Second it indicates the adequacy of number of plants and industrial relationships.

6.2. The Manufacture of Food, Beverage and Tobacco

The estimation of cost function is significant at 93% percent level. All of the main coefficients are significant except γ_{LM} which should kept in the model. But other parameters such asα_{tt}, d were insignificant and dropped from the model.

The calculation shows there are weak economies of scale in this group, and the optimal scale is equal to **17108.6 Million Rials**, respect to the current (2001) scale 13555.2 M.R. which means moving toward efficient scale needs each plant increases its production by 26 percent. As can be seen the LAC curve has a low slop. To find reasons of weak economies of scale, following factors are regarded as the reasons of the flat LAC: 1-The input/output ratio was (80%-95%), so the low share of labor and investment, bring no possibility to manage the production layout to exploit economies of scale. 2- This group is highly depends on the Agricultural sector, which there is usually constant return to scale, so no potential source of external economies of scale will active in manufacture of food, beverage and tobacco expansion. Figure 5 reveals the efficient scale and slope of LAC in this group.

1- To convert rial to dollar use the 2001market dollar rate in Iran as: **1 U.S. Dollar =8006 Rials.**

6.3. The Manufacture of Wearing Apparel, Textile and Leather

The LAC curve in this industry is rather flat This industry is the most labor–intensive grouping which the capital/employee ratio is equal to 1.4, so the source of economies of scale is mostly related to labor specialization in production line. As can be seen in figure 6 most of plants are producing in profitable conditions (LAC=TC/Q<1 in term of deflated values)[1]. The total cost function estimate is statistically significant at 98% percent.

Based on the estimated cost function the optimum production scale is **12150.9 Million Rials at 2001Constant Prices**. While a representative firm is producing at 6964.1 Million Rials means that for exploiting the economies of scale, each firm should increase its scale by 74% or the number of establishment decrease at the same rate.

6.4. The Manufacture of Wood, Wooden Products and Furniture

The 60% of the division total product is denoted to the manufacture of the wood and wooden products that is more capital intensive and remain is manufacture of furniture. The cost function estimation result is valid and most of the coefficients are significant at 10% level Table 1 slows the estimation results.

The study of LAC curve shows after a peak in the beginning of production, the LAC is decreasing dramatically. The extent of economies of scale is such a case in which a representative firms half its cost by doubling the output. This shape indicates that the production process was running in first neoclassic production area, and there was no observation out of this area.

To cope with this problem, the mathematical principle "*Symmetry property*" was applied. Base on the symmetry property a quadratic form is symmetric respect to the extremum point. By forecasting cost elasticity curve, the other second part of the curve is accessible. By solving the estimated equation on CE=1 there are two answer **Q=2996.5 Million Rials** and **Q= 26677.0 M.R.**, which are maximum and minimum of the LAC respectively due

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1- The real profitability is depended on nominal and market prices.

to the second order condition. So to exploit the economies of scale each plant should expand its production from the current scale 5504.5 M.R. up to **26677.0 M.R.**

6.5. Manufacture of Paper and Publishing

This division is capital and technical intensive (Capital/labor ratio=2). On the other hand as it was seen there were large economies of scale in the manufacture of wood, wooden products and furniture as a main supplier of manufacture of paper and publishing. So there are large internal and external potential sources of economies of scale.

The estimated LAC is decreasing with a negative slope, thus the associated scale elasticity is an increasing function. On this case as well as manufacture of wood, wooden product and furniture the cost elasticity function is estimated. Two result were achieved $\mathbf{Q_1}$**=5886.1 M.R.** and $\mathbf{Q_2}$**=48384.1 M.R.** in which due to second order condition they are the latter is minimum of the LAC. While the current scale of a representative plant is 10187.4 M.R., so to reap the economies each plant should increase its production in more than fourfold or the number of current plants should decrease from 279 plants to 57 plants under a kind of technical amalgamation.

6.6. The Manufacture of Chemical Products

This industry as an intermediate industry plays a key role to complete other activities value chain. So reducing the average cost in this group may leads to drop of production costs. The cost function estimation shows the model is significant at 77% level and most of the coefficient are weakly significant. The reason may be the intensive damage which caused by the imposed war and the controlled market price of its products which disrupted the theoretical optimization.

The cost function estimation shows that the minimum efficient scale is **58255.7 Million Rials,** while the current average scale per establishment of the group is 38651.7 M.R., means to utilize the economies of scale each plant should increase its production by 50%. Table 1 and figure 9 show estimation results.

6. 7. The Manufacture of Non-Metallic Mineral Products

This division mostly includes bricks, tiles, ceramic and porcelain. A detailed look shows after the restructuring (first socio-economic plan) period the share of bricks has decreased in favor of more technical intensive products. But around the 80% of the group is consumed in construction section, so in the absence of export, this group is mainly depend on the construction sector as a motivator. Table 1 shows the estimation results.

The result of efficient scale estimation reveals **Q= 4211.0 Million Rials** as the minimum efficient scale. The estimated LAC curve shows the economies of scale are rather strong and an average firm cans reduce its costs 20% by exploiting the economies of scale. In this case exceptionally there are evidences of diseconomies of scale and after a small flat portion; the diseconomies of scale begin at 6000 Million Rials. A representative firm currently is producing at 5949.6 Million Rials on the verge of flat part, so the current scale is optimal. But more production should implemented by establishing new plants.

6.8. The Manufacture of Basic Metals

This division mainly includes iron and steal and other metals which mostly producing iron and steel. The division has been received most supportive policy after the war period which makes this division as the most capital –using manufacturing division (capital/labor=4.1). On the other hand this group as a main supplier of manufacturing sector can lead to cost decrease in other groups.

The estimation of cost function shows there are large economies of scale in moving toward optimal scale. The calculated efficient scale is **2005183 Million Rials**. While the current scale of a plant as an average of the sector is **80873.9 M.R.** that necessitate each plant to increase its production in 2.5 times for turning to a profitable one.

6. 9. Manufacture of Machinery and Equipment

This group as the largest manufacturing division in Iran manufacturing sector and serves as a final manufacturing activity. This division mostly includes producing of fabrics, manufacture of equipment and machinery, manufacture of

home equipments and the manufacturing of transport equipments. The investment trend in this group has grown by 20% annually, with the manufacture of transport equipments and home industries are the most invested ones. The translog cost function is well behaved and most of the coefficients are highly significant. Table 1 shows details.

The estimated cost function shows there are large economies of scale and the cost elasticity is diminishing in all output range that is epitomize of producing in the first neoclassic area. Thus as well as other sim ilar cases the cost elasticity function was estimated as a quadratic form to simulate the second part of the function. As a result the **8634.3 Million Rials** and **84072.3 M.R.** are acquired as an extremum point of LAC, which in the second one the cost function is concave and satisfy the second order condition. So the **84072.3 M.R.** is regarded as an optimal scale, the current scale of each plant is 28296.6 M.R. which requires the increase of current scale in three fold.

6.10. The Manufacture of other Products

This division mostly invested by private sector, and has experienced a high grow of new investment. The investment is formed as establishing new plants and change in the production technology of the exciting plants. So the capital/output and capital/labor ratio increased over time. Furthermore this division is one of the initial industries, so reducing the average cost may lead to decrease of consumer price index.

The cost function estimation carried out by 85% of explanatory power, in which all of the coefficient except β_M are significant at 10 percent level. Table 1 shows the estimation results. Calculating the cost elasticity shows in this group most of plants are producing in first area of neoclassical production areas. Figure 13 reveals the LAC curve.

To treat this problem, again by applying a quadratic form to estimate the cost elasticity on output, the selected functional form was matched with the cost elasticity data in 95% percent of accuracy. By solving CE=1, two scale were selected as a possible optimal scale, in which $\mathbf{Q_1}$**= 1635.3 Million Rials** and $\mathbf{Q_2}$**= 28790.4 M.R.,** regarding the second order condition the $\mathbf{Q_2}$**= 28790.4 M.R.** is identified as the optimal scale. This result compare to the current scale of each plants Q= 3732.5, necessitate the bump of production over 7 fold.

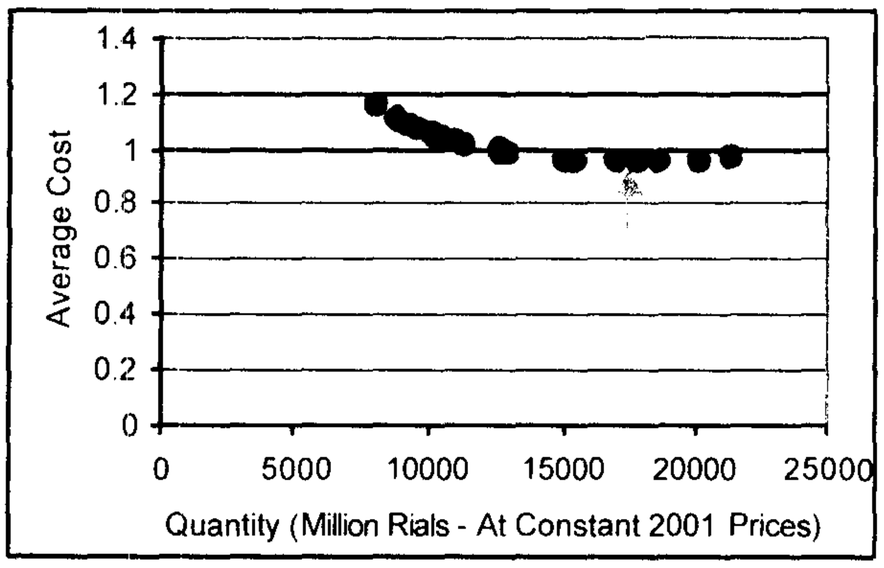

Figure 4 : The LAC (Fitted) Curve in Aggregate Manufacturing Sector per Establishment

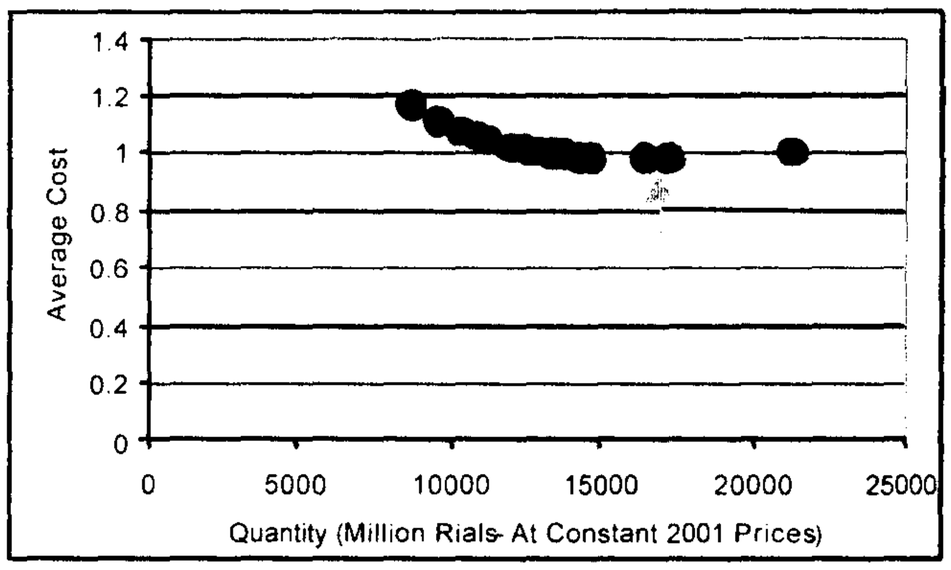

Figure 5 : The LAC (Fitted) Curve in Manufacture of Food, beverage and Tobacco

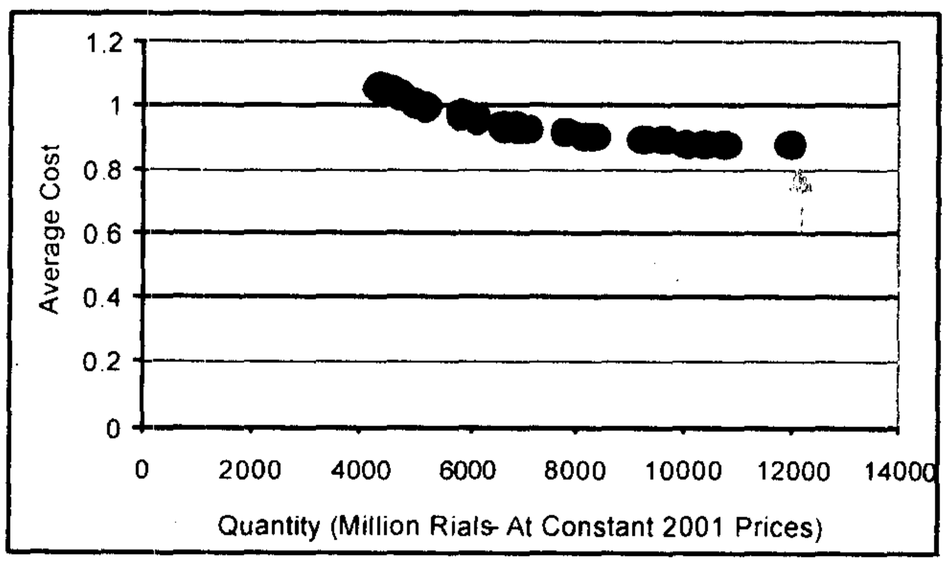

Figure 6: The LAC(Fitted) Curve in the Manufacture of Wearing Apparel, Textile and Leather

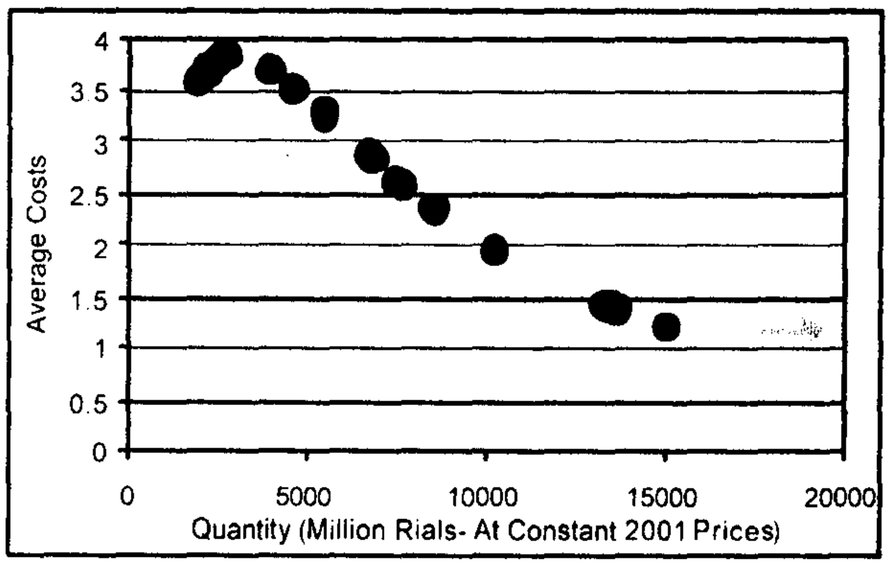

Figure 7 : The LAC Curve, The Manufacture of Wood, Wooden Products and Furniture

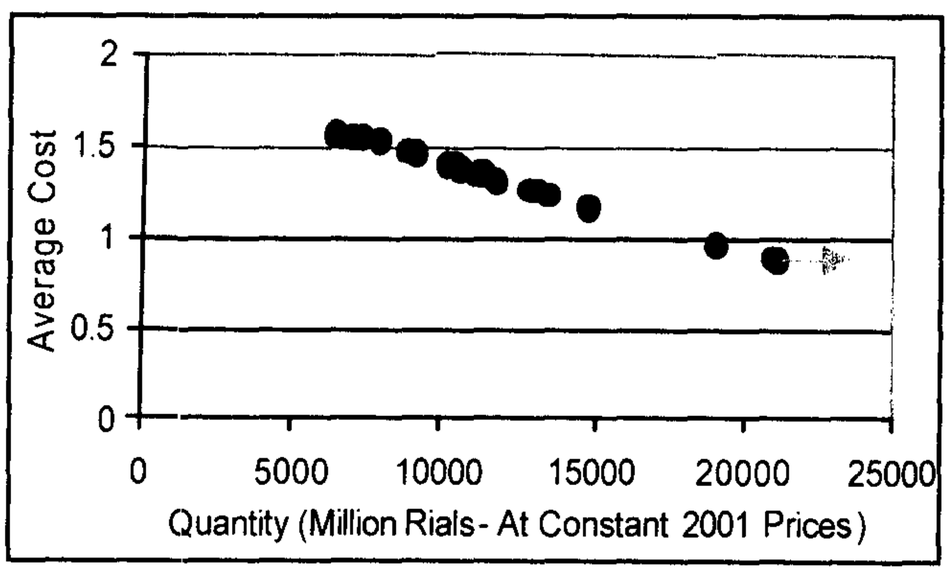

Figure 8: The LAC Curve, The Manufacture of Paper, Paper Products and Publishing

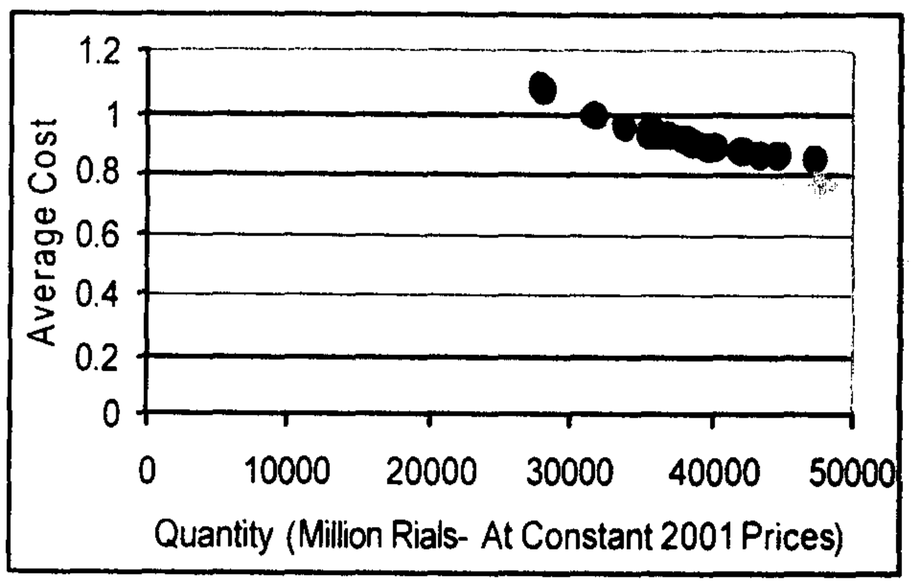

Figure 9: The LAC Curve, The Manufacture of Chemical Products

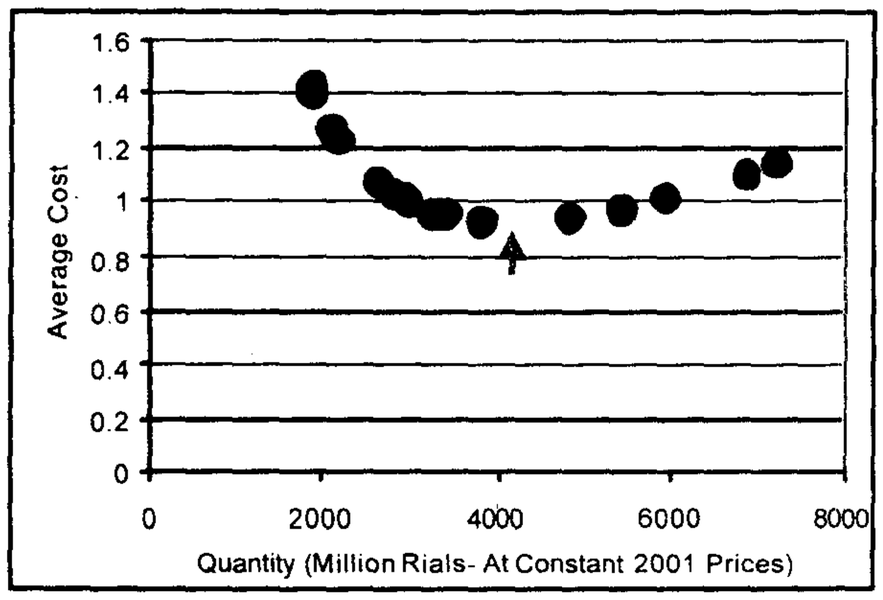

Figure10: The LAC Curve, The Manufacture of Non-Metallic Mineral Products

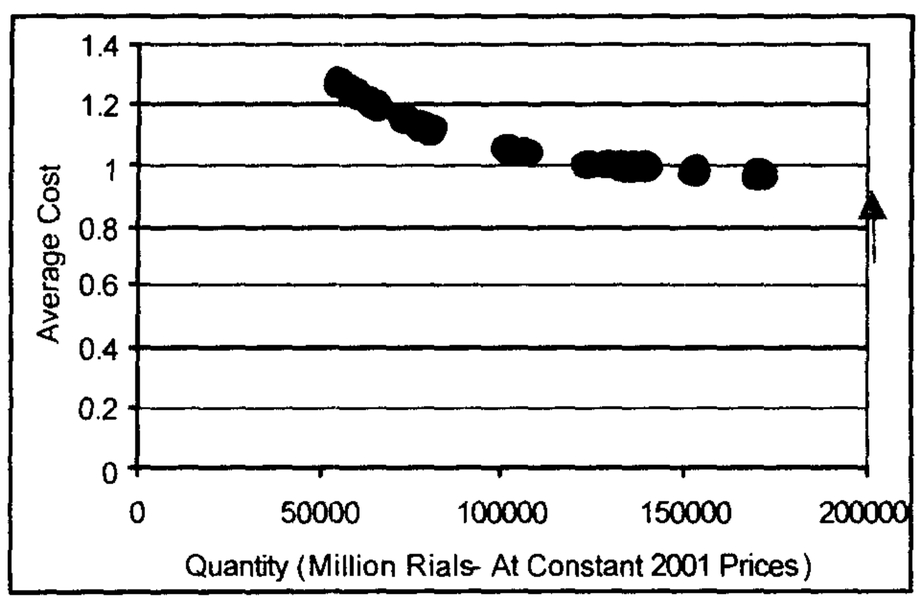

Figure11: The LAC Curve, The Manufacture of Basic Metals

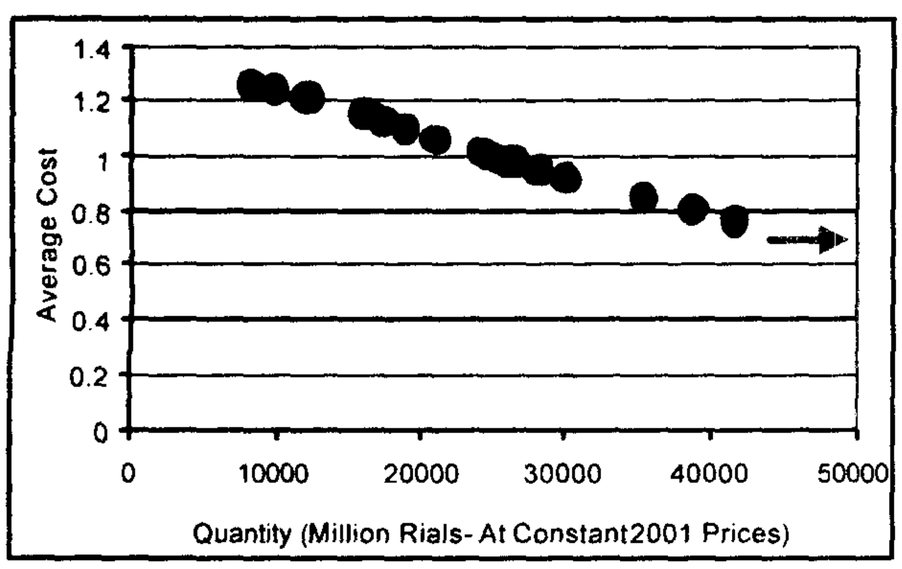

Figure12: The LAC Curve, The Manufacture of Machinery and Equipments

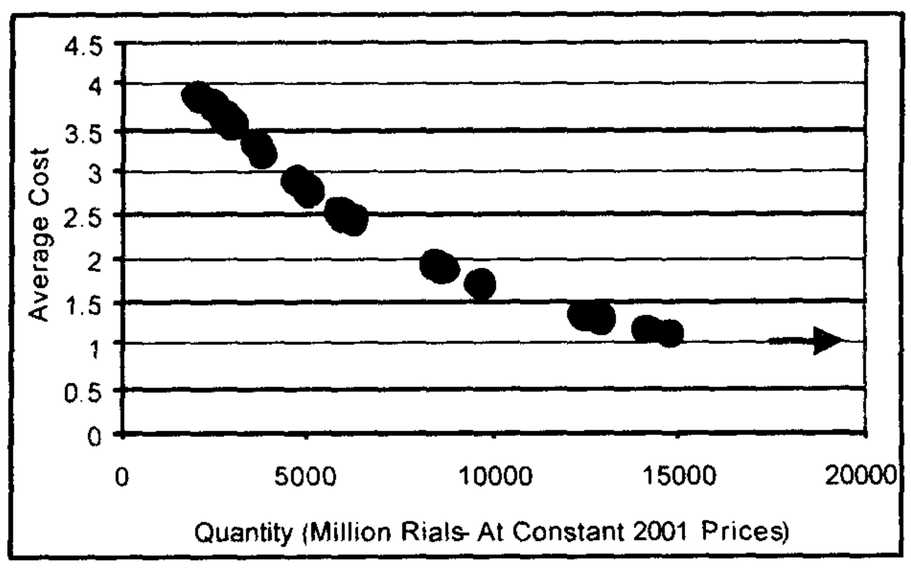

Figure13: The LAC Curve Manufacture of other Products

7. Conclusion

The measurement of economies of scale is an attempt to identify key policy implication to export expansion, potential comparative advantages and monopoly regulation. Considering the economies of scale in Iran manufacturing sector reveals the economies of scale exists in all of the Iran manufacturing groups and except the manufacture of non-metallic mineral products (ISIC36) all of the groups are producing less than efficient scale. the economies of scale is more important in capital-using groups such as manufacture of other products (ISIC39), wood and furniture (ISIC33), paper and publishing (ISIC34), machinery and equipments (ISIC38) and basic metals (ISIC37) respectively , in which they are producing in first neoclassical production area where the long-run cost function is increasing diminishingly. As can be seen in Iran

manufacturing sector the manufacture of wood, wooden products and furniture (ISIC33), manufacture of paper and publishing (ISIC34), manufacture of basic metal (ISIC37), manufacture of machinery and equipment (ISIC38) and manufacture of other products (ISIC39) are producing far from efficient scale and are in net loss, while by moving toward the efficient scale they can turn into a profitable firm. By contras, in the manufacture of wearing apparel, textile and leather (ISIC32), chemical product (ISIC35) and food, beverage and tobacco (ISIC31), they are profitable and rather producing on the flat portion of LAC.

National Demand Constraint

Nili M. et al. (2002) considered the domestic demand and the structure of the manufacturing product market in planning the industrial development strategy, findings revealed two deciles of the richest household are consuming 43% of manufacturing products and mostly consume high quality and imported products, while three deciles of the poorest household are consuming only 12% of manufacturing products. This asymmetry of industrial demand reveals the lack of enough demand to supporting producing in efficient scale. On the other hand industrial export as a main motivator of the industrial sector is around six percent of total export of Iran, while in new industrial zone of southeast economies the figure is more than 70% of the whole export. So the importance of implementing the export oriented policies is one of the key results of this paper.

Monopoly and Entrance Barriers

The economies of scale is the most important source of natural monopoly[1], on this way the first industry in reaching efficient scale can perform market power. The detailed survey shows the 45% of the industrial value-added was

1- Pratten C. F., "Economies of Scale in the Motor Industry", Readings in applied micro economies, oxford, 1973.

produced by more than 1000 workers establishments, while 17% of industrial value-added was producing in 500-1000 workers establishments.

The other studies in 1995[1] shows the manufacture of basic metal, manufacture of wood, wooden products and furniture, manufacture of paper and publishing and manufacture of other products are most concentrated groups respectively. In all of them the five largest companies dominated over 45 percent of the market.

The comparison shows that the most concentrated market of manufacturing groups are overlapping with the most potential groups for exploiting the economies of scale as mentioned in this paper. On the other hand the monopoly malfunctions are not confined to the sale market and monopolists are mostly monopsony in the input market and cease grow of suppliers. Both imply the domestic market constrain acts as a barrier to gathering the benefits of economies of scale and necessitates the importance of applying outward oriented policies.

1- Khodadad Kashi, F. (1995).

Table 1: Long-Run Cost Function Estimation in Iran Manufacturing Divisions

Parameter	3	31	32	33	34	35	36	37	38	39
α_o	12.55441 (4.60)**	17.16624 (2.19)**	6.376831 (1.70)*	-4.728713 (-4.34)**	-6.042064 (-2.57)**	20.56404 (0.828)	16.45444 (5.08)**	10.63061 (1.52)	-4.112292 (-2.19)**	-0.126393 (-0.12)
α_Q	-3.126531 (-3.30)**	-4.587929 (-1.74)*	-1.021839 (-0.79)	4.241303 (7.85)**	4.094459 (4.61)**	-5.218274 (-0.63)	-5.730280 (-4.28)**	-1.494858 (-0.79)	2.838024 (4.28)**	1.878361 (3.54)**
α_{QQ}	0.678832 (4.12)**	0.908541 (2.05)**	0.324692 (1.47)	-0.893939 (-6.74)**	-0.709669 (-4.17)**	0.939523 (0.68)	1.353277 (5.05)**	0.307716 (1.21)	-0.386997 (-3.28)**	-0.393907 (-2.84)**
β_L	0.565403 (3.83)**	0.373527 (2.80)**	-0.101816 (-1.15)	0.184730 (2.53)**	0.606291 (3.90)**	0.669463 (2.55)**	0.674705 (7.50)**	-0.486665 (-1.74)*	0.598321 (4.05)**	0.516767 (4.38)**
β_M	0.329317 (1.66)**	0.733039 (3.93)**	1.001568 (8.58)**	0.687487 (7.91)**	-0.022460 (-0.08)	0.059612 (0.19)	0.314521 (2.61)**	1.014434 (3.41)**	0.239540 (1.14)	0.148714 (0.61)
γ_{LM}	-0.276727 (-4.05)**	0.008979 (0.26)	0.039765 (1.18)	-0.172271 (-2.36)**	-0.177929 (-5.46)**	-0.300569 (-13.33)**	-0.234086 (-5.94)**	-0.088174 (-1.23)	-0.327859 (-6.80)**	-0.187303 (-4.91)**
γ_{LL}	0.350115 (6.85)**	0.119687 (3.35)*	0.073738 (1.37)	0.302302 (3.89)**	0.238377 (11.58)**	0.237215 (12.60)**	0.320268 (9.44)**	0.154739 (2.17)**	0.310050 (8.59)**	0.231174 (9.39)**
γ_{MM}	0.170194 (1.58)	-0.118270 (-3.13)**	-0.038977 (-1.19)	0.115829 (1.38)	0.247281 (4.44)**	0.272562 (5.03)**	-0.004948 (-0.07)	0.179673 (2.17)**	0.288898 (3.01)**	0.255034 (3.10)**
γ_{LQ}	-0.055068 (-2.29)**	-0.061822 (-2.95)**	0.044395 (2.75)**	0.014948 (0.98)	-0.063047 (-2.55)**	-0.044595 (-1.03)	-0.070461 (-4.62)**	0.082354 (2.18)**	-0.029308 (-1.27)	-0.036350 (-2.18)**
γ_{MQ}	0.069624 (2.36)**	0.030896 (1.05)	-0.068688 (-3.35)**	-0.032307 (-1.80)*	0.086192 (2.17)**	0.087465 (1.72)*	0.085498 (4.84)**	-0.062179 (-1.54)	0.057742 (1.95)*	0.048590 (1.64)*
α_t	0.160540 (5.63)**	0.077194 (4.62)**	0.264457 (4.67)**	0.814309 (6.15)**	0.273193 (4.78)**	-0.008764 (-0.10)	0.258254 (4.33)**	-0.207463 (-2.90)**	-0.065692 (-1.06)	0.638009 (6.50)**
α_{tt}	-0.087608 (-4.52)**	-	-0.163635 (-4.52)**	-0.476927 (-5.32)**	-0.153112 (-3.79)**	0.017094 (0.66)	-0.067733 (-3.78)**	0.115670 (2.33)**	0.148627 (3.46)**	-0.113445 (-3.73)**
d	-0.107740 (-4.06)**	-	-0.111302 (-3.05)**	-0.247417 (-2.76)**	-0.149718 (-3.20)**	-0.125391 (-2.06)**	-	-0.203875 (-4.07)**	0.099525 (1.91)*	-
R^2	**0.985**	**0.938**	**0.988**	**0.962**	**0.934**	**0.775326**	**0.960300**	**0.965021**	**0.963243**	**0.858174**

* Significant at 10% level, **significant at 5% level. (t-Stat)

Table 2: Summary of the Achieved Results

	Number of plants	Current scale	Profitability in current scale	Efficient scale	Necessary increase of scale (%)	Cost discount in MES	Profitability in efficient scale	Capital /labor ratio[1]
Aggregate manufacturing	10987	18606.1		17614.1	0	0		2.1
food, beverage and tobacco	1916	13555.2	0	17108.6	26	8		2.0
wearing apparel, textile and leather	1829	6964.1		12150.9	74	5		1.4
wood, wooden products and furniture	279	5504.5		26677.0	385	>60		1.4
paper and publishing	359	10187.4		48384.1	375	>40		2.0
chemical product	1254	38651.7		58255.7	51	10		3.5
metallic mineral product	2461	5949.6		4211.0	0	0		2.1
basic metal	332	80873.9		200518.3	148	34		4.1
machinery and equipments	2484	28296.6		84072.3	197	>34		1.6
other products	73	3732.5		28790.4	671	>28		2.4

Construction of Variables:

Price of labor (P_L) = Total emolument/No.of employees

Interest rate (r) = interest rate of mining and industry bank of Iran

Depreciation rate (d) = depreciation rate estimated by management and planning consultants

Price of capital (P_K) = Price index of capital (r+d)

Price of material inputs = a weighted average of price index built on input-output models, using two input-output tables (1988, 1999 published by central bank of Iran)

Total cost: Total emoluments+ total expenditure on materials+ Total expenditure on capital (Price of capital*Capital stock)

Output: output + receives for non-manufacturing services

Physical Output: debased divisions' output based year 1982

Share of labor (S_l) = Total emoluments/total cost

Share of inputs (S_M) = Total expenditure on inputs/total cost

Share of labor (S_K) = Total expenditure on capital (Price of capital*Capital stock) /total cost

ISIC – 2Digit (Rev.2)

Aggregate manufacturing(3)
food, beverage and tobacco (ISIC31)
wearing apparel, textile and leather (ISIC32)
wood and furniture (ISIC33)
paper and publishing (ISIC34)
chemical product (ISIC35)
non-metallic mineral products (ISIC36)
basic metals (ISIC37)

1- (Million Rials at 1981constant prices).

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