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Studying managerial efficiency within Iranian industries in separate ISIC two-digit codes

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Abstract. Although managerial efficiency has been paid attention in economic sectors and communities, few studies have been done on changes of managerial efficiency in Iranian industries. Therefore, the present paper attempts to study managerial efficiency within manufacturing industries of Iran in two-digit codes. Using analytic method of data envelopment analysis and Malmquist index, results show that most of Iranian industries have faced increase of managerial efficiency from 2004-2011. However, changes of managerial efficiency have been different in each industry considering requirements of each industry. Nevertheless, based on policy making, results suggest that similar strategies cannot be implemented for growth of managerial efficiency in manufacturing industries of Iran. Each industry requires different changes in order to grow managerial efficiency that is appropriate for its structure.

Keywords: Managerial efficiency, Manufacturing industries, ISIC two-digit codes

1. INTRODUCTION

Nowadays, management and measurement methods of its efficiency and quality have been considered as one of important discussion in industrial competitiveness. Therefore, this index should be identified and measured correctly in order to promote this index that includes economic development and promotion in Iran. In recent decades, data envelopment analysis method and Malmquist index are among methods considered in studying and analyzing this index in micro- and macro- levels. By using non-parametric methods and linear programming, this method enables researchers to divide total efficiency index into its components including technological changes, changes of scale efficiency particularly changes of managerial efficiency. In present study, these methods have been used to investigate managerial efficiency index in manufacturing industries of Iran. On this basis, theoretical basics and calculation of managerial efficiency index will be described after the introduction. In the third section, studies done in this field will be examined. Data are explained in the fourth section. Data envelopment analysis method (the method selected in this research) will be defined in section five. Results will be presented in the next section with respect to ISIC1 two digit codes. Summary and conclusion will be dealt with at the end.

2. THEORETICAL BASICS, CALCULATION OF MANAGERIAL EFFICIENCY USING DEA METHOD

As an index for measuring performance of a firm, efficiency has been studied in economic and managerial literatures for many years and many definitions have been presented for it during these years. Beside theoretic definitions, in order to define concept of efficiency explicitly particularly managerial efficiency, it is necessary to consider a simple process with

[1]International standard industrial classification of all economic activities

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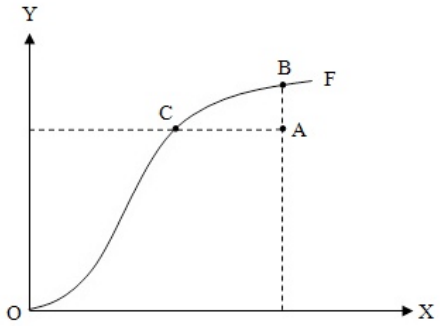
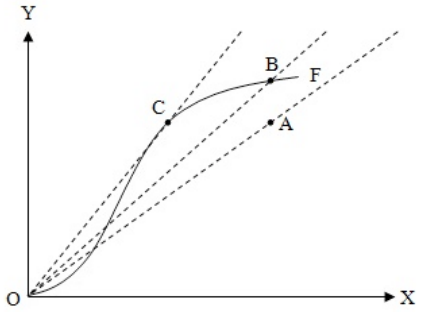
one manufacturing factor (X) and one manufacturing product (Y). Considering these hypotheses, OF curve indicates frontier function that shows the relationship between manufacturing product and factor. The frontier function indicates maximum production from manufacturing agent in different states thus showing status of current technology within the industry. It should be noted that firms placed on the frontier function are efficient[2] enough and those that place below the function are inefficient. It means that in graph 1-A, point A shows inefficiency and points B and C indicates efficiency. The firms that act in point A faces inefficiency because the current technology can increase its production without the need for increasing manufacturing factor in B level[3].



Graph 1. A: frontier function and technical efficiency



Graph 1. B: productivity, technical efficiency and economic scale

Graph 1-B can be used to explain different types of efficiency. In this graph, in order to measure productivity in mentioned points, a set of lines were plotted from coordinate source with gradient $\frac{Y}{X}$ to that point that is a standard for measuring productivity. If the firm in point A transfers to the efficient point B, the gradient of the line will increase showing higher productivity in point B. it can be said that point C (tangent point) suggests maximum productivity because the line gradient tangent on the curve increases by moving towards this point and maximizes in point C. point C is an example of economy resulted from firm's economic scale and technical scale. Activity in other points on frontier function will reduce firm productivity. Now, managerial efficiency can be separated on this graph. The difference of productivity between points B and C is net efficiency or efficiency resulted from firm management. Managerial efficiency suggests performance of managerial section of an expertise. It means that hard working, effort and good thought of management, efforts of personnel and correct combination of manufacturing agents increase efficiency and productivity in the firm(1).

3. LITERATURE REVIEWS

Concerning foreign studies done on managerial efficiency, the study of Trip.et.al can be referred to (2002). This study with aim of measuring managerial abilities, divided this decision making process into four stages: objective, planning, control and evaluation. Quality of each stage was measured in a panel including 26 flower manufacturers. In addition, random frontier function has been used in this study. Results indicate that there has been a positive relation between firm efficiency and decision making quality (especially control and evaluation of expertise). Hwang and Chang (2003) studied managerial efficiency in hotel industry of Taiwan. In this paper, managerial efficiency of 45 hotels and their productivity changes (from 1994 to

[2]It should be noted that efficiency and productivity are interrelated concepts so it is evitable to use efficiency in definition of productivity

[3]It can at least protect the available manufacturing level with lower manufacturing factor (point C)

1998) were studied in 1998 using data envelopment analysis method developed by Charnes.et.al and Malmquist index. Results indicated that efficiency of the hotels is strongly affected by managerial styles. In addition, the paper showed that managerial efficiency of international touristic hotels associated with their international level.

Shyu and Chiang (2012) studied managerial efficiency of bank branches in Taiwan. In this paper, 123 bank branches were chosen and traditional data envelopment analysis and the three-stage method were used for calculations. Results showed that branches with managerial services of wealth and loan were more efficient. Branches with more deposits obtained higher managerial efficiency as well.

Considering domestic studies, although many studies have been done on efficiency during many years within economic sectors in different geographical regions, the focus was on the studies done on managerial efficiency of manufacturing industries in past decade. For example, the study done by Lotfalipour and Razmara (2006) can be considered. In this study, total technical efficiency, net technical efficiency and efficiency resulted from the scale have been calculated for industrial sections and firms with 50 or more employee. Growth of productivity of total agents was calculated using Malmquist index for abovementioned sections from 1997 to 2001 and factors affecting productivity were studied and analyzed using panel data. Results indicated positive growth of productivity in 17 industries and negative growth of productivity in five industries. In addition, changes of total technical efficiency, technological changes, changes of managerial efficiency and changes of the scale efficiency were measured and presented for each industry. According to calculations of Lotfalipoor and Razmara, number of industries with negative managerial efficiency was high. The authors noted that this problem was due to lack of application of specialties and skills of people in the required locations.

A study was done by Abbasian and Mehregan (2007) titled as measuring productivity of manufacturing agents of economic sectors by data envelopment analysis method. In this study, changes of efficiency and productivity in seven economic sectors were calculated by data envelopment analysis and Malmquist index using statistics related to added value, work force and capital of different economic sectors with fixed price in 1966-2000. Industrial sector faced with the decreasing total productivity of manufacturing agents in the mentioned period. It is while that change of technological efficiency was considerably positive and the industry has used technical developments appropriately. But it faced difficulty due to managerial efficiency and the amount of this index was being decreased. Changes in scale efficiency were not compatible and the decreasing changes in scale and managerial efficiency affected technological changes.

4. DATA

Measuring managerial efficiency of manufacturing industries in Iran requires data of industrial inputs and outputs within an interval time. The present study dealt with this subject using data of industrial workshops with 10 employees, census of industrial workshops performed by census center of Iran from 2004 to 2011. Nevertheless, managerial efficiency within ISIC two digit codes has been calculated for 23 codes of manufacturing industries of Iran including those in table 1.

Table 2. Iran manufacturing industries base on ISIC two digit codes

Code	Name of industries
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office, accounting and computing machinery
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c.
37	Recycling

Source: Census center of Iran

In present study, three inputs and one output were chosen from variables available for each industry in order to compute managerial efficiency. Based on studies done in this field, it is necessary to consider two points while choosing inputs and outputs. Firstly, inputs and outputs should be precise. Secondly, a high number of inputs and outputs should not be used because if a high number of inputs and outputs are used, number of efficient firms will increased exaggeratedly. Therefore, inputs and outputs used in this study are as follows:

Inputs:

- Manufacturing and non-manufacturing employees of industrial workshops: total number of manufacturing and non-manufacturing employees of industrial workshops includes manufacturing employees (skillful and naive workers, technicians and engineers) and non-manufacturing employees.
- Investment value of industrial workshops: it includes purchase or obtaining foreign capital properties, construction or repairing capital properties by the workshop, repairs of capital properties by others and selling or transferring

capital properties such as computer software, land, building, facilities, vehicles, official equipment, instruments, tough working tools and machineries.

- Value of consumed oil, water and electricity purchased by industrial workshops: including water, electricity, charcoal, coal, fuel oil, petroleum, liquid gas, natural gas, gasoil, kerosene and other fuel substances.

Outputs[4]

- Value of output: output value of industrial activity includes total value of produced product, receivables for industrial services, changes of stock value of products under production, the difference between value of selling and value of buying products that were sold without any change, capital property value made by the workshop, value of produced and sold electricity and water

5. METHODOLOGY

In economic literature, efficiency is one of the most important indexes for studying the performance and it is defined with different definitions resulting from its measuring method. In present study, non-parametric method has been used to measure managerial efficiency of manufacturing industries in Iran. In non-parametric method, the researcher-made model and hypotheses are not required and it is possible to measure it by little information. Among linear programming methods, data envelopment analysis has been mostly used due to determination of different types of efficiency. Of its advantages, lack of limitation in using data and inputs, lack of requirement of presupposition for estimation of the function and lack of sensitivity to measuring unit for inputs and outputs can be referred to. In data envelopment analysis method, each of calculated efficiencies (scale efficiency, managerial efficiency and technological changes) is defined as weighted set of products to weighted set of productive agents. In order to calculate managerial efficiency, changes of productivity were measured using Malmquist index. Malmquist index was firstly developed in 1953 in field of consumption theory and completed in papers of Christensen and Diewert. By this index, total productivity of manufacturing agents was calculated using distance function. In 1994, Fare, Grosskopf and Zhang explained how total productivity of Malmquist manufacturing agents can be broken into different elements such as technological change and change of technical efficiency. Therefore, factors affecting productivity were measured as well. They indicated how criteria can be measured using distances to boundaries of data envelopment analysis. In order to explain this method, it is assumed that in time periods of t= 1, 2,…, T and using manufacturing technology of ، Ft, manufacturing agents of ($X^t \epsilon R^N$) can change into ($Y^t \epsilon R^M$) as products:

$$F^t = \{(x^t, y^t): x^t \text{ can produce } y^t\} \quad (1)$$

If true hypothesis of presence of inefficient firms is considered, Malmquist productivity index can be expressed by distance functions as follows:

$$M_i^{t+1}(Y^{t+1}, X^{t+1}, Y^t, X^t) = \left[\frac{D_i^t(y^{t+1}, x^{t+1}}{D_i^t(y^t, x^t)} \cdot \frac{D_i^{t+1}(y^{t+1}, x^{t+1})}{D_i^{t+1}(y^t, x^t)}\right]^{\frac{1}{2}} = \quad (2)$$

[4] The definitions mentioned above have been derived from census results of industrial workshops with 10-49 employees (2008)

$$\frac{D_o^{t+1}(y^{t+1},x^{t+1})}{D_o^{t}(y^{t+1},x^{t+1})}\left[\frac{D_o^{t}(Y^{t+1},x^{t+1})}{D_o^{t+1}(Y^{t+1},x^{t+1})}.\frac{D_o^{t}(Y^{t},x^{t})}{D_o^{t+1}(Y^{t},x^{t})}\right]^{\frac{1}{2}}=E_i^{t+1}\times T_i^{t}$$

Where E_i^{t+1} measures changes in efficiency and T_i^{t} is technological changes. On the other hand, multiplication of two ratios within the bracket into the relation (2) (that their mean geometries are calculated) calculates technological development by transferring frontier function during time period of t and t+1. It should be noted that this analysis has been done based on the technology hypothesis with fixed revenue to productive scale. In 1994, Fare, Grosskopf, Lindgern and Rose presented this index considering technology of variable revenue to the scale. Therefore, efficiency was divided in to managerial efficiency (net efficiency) and scale efficiency. At the moment, the relation between efficiency and productivity can be calculated based on relation (3):

Total productivity changes =Managerial efficiency changes × technological changes × scale efficiency changes (3)

It is noteworthy that based on maximizing manufacturing agents, if the size of efficiency index is smaller than 1, it will show reduction of efficiency and if it is higher than 1, it will indicate improvement of efficiency during studied time periods (1).

6. MEASUREMENT OF MANAGERIAL EFFICIENCY IN MANUFACTURING INDUSTRIES OF IRAN

As mentioned before, the main aim of this study is to measure managerial efficiency of manufacturing industries in Iran within two digit codes during years 2004-2011. In this direction, changes of managerial efficiency in each manufacturing industry of Iran have been presented in table 2 by separated codes. As seen before, managerial efficiency has experienced a variable trend except in Manufacture of coke, refined petroleum products and nuclear fuel (23) and recycling that were stable in studied time durations. But generally, by comparing the starting and ending revenues, it can be said that most of manufacturing industries of Iran (14 industries) faced with the increasing managerial efficiency. Increase of managerial efficiency in Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19), Manufacture of wearing apparel; dressing and dyeing of fur (18), Manufacture of medical, precision and optical instruments, watches and clocks (33) has been higher than other industries.

It also should be mentioned that by comparison of starting and ending years of the studied period, Manufacture of food products and beverages, Manufacture of tobacco products, Publishing, printing and reproduction of recorded media, Manufacture of rubber and plastics products, Manufacture of basic metals and Manufacture of machinery and equipment n.e.c faced with the decreasing managerial efficiency among which the highest reduction belongs to production of tobacco-cigarette.

Table 2. Managerial efficiency changes in Iranian manufacturing industries, 2004-2011.

Code	Name of industries	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
15	Manufacture of food products and beverages	1/13	0/87	1/67	0/66	0/87	1/15	1/1
16	Manufacture of tobacco products	2/9	1	1	1	0/51	1/95	0/54
17	Manufacture of textiles	0/84	0/92	1/47	0/73	0/83	0/99	0/9
18	Manufacture of wearing apparel; dressing and dyeing of fur	0/54	0/82	1/6	0/59	0/83	1/33	1/97
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0/59	1/12	1/7	0/41	0/95	1/19	2/45
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0/33	1/81	1/22	0/84	0/51	0/96	1/03
21	Manufacture of paper and paper products	1/08	1/13	1/13	1/27	0/35	1/04	1/78
22	Publishing, printing and reproduction of recorded media	1/52	0/52	1/98	0/6	1/02	0/79	1/39
23	Manufacture of coke, refined petroleum products and nuclear fuel	1	1	1	1	1	1	1
24	Manufacture of chemicals and chemical products	1/4	0/92	1/12	1/1	0/28	1/32	1/44
25	Manufacture of rubber and plastics products	1/07	0/7	1/51	0/72	0/85	1/04	1/04
26	Manufacture of other non-metallic mineral products	1/4	0/94	0/8	1/32	0/5	1	1/9
27	Manufacture of basic metals	0/89	1/35	1	1	0/22	1/09	0/88
28	Manufacture of fabricated metal products, except machinery and equipment	0/84	1/29	1/48	0/49	0/8	1	1/41
29	Manufacture of machinery and equipment n.e.c.	1/1	0/67	2/22	0/52	1/24	0/99	0/94
30	Manufacture of office, accounting and computing machinery	0/83	0/8	1/51	1/01	0/56	1/45	1/23
31	Manufacture of electrical machinery and apparatus n.e.c.	0/89	1/1	1/55	0/53	1/07	0/86	1/43
32	Manufacture of radio, television and communication equipment and apparatus	0/77	0/89	1/46	0/79	0/92	0/89	1/52
33	Manufacture of medical, precision and optical instruments, watches and clocks	0/71	1/58	1/81	1/18	0/65	0/82	1/46
34	Manufacture of motor vehicles, trailers and semi-trailers	1	1	1	1	1	1	1
35	Manufacture of other transport equipment	1/06	0/61	1/8	0/71	0/85	0/91	1/47
36	Manufacture of furniture; manufacturing n.e.c.	0/77	0/72	2/42	0/58	0/94	0/74	1/44
37	Recycling	1	1	1	1	1	1	1

7. CONCLUSION

Considering the increasing importance of management in manufacturing industries and lack of paying attention to it in Iran, in present paper, it has been attempted to take primary steps in this area in Iranian economy. For this purpose, managerial efficiency in manufacturing industries of Iran has been studied within two digit ISIC codes during 7 years from 2004 to 2011. Using data envelopment analysis and Malmquist index, results indicate that managerial efficiency has experienced a variable trend except in Manufacture of coke, refined petroleum products and nuclear fuel (23) and recycling that were stable in studied time durations. But generally, by comparing the starting and ending revenues it can be said that most of manufacturing industries of Iran (14 industries) faced with the increasing managerial efficiency (Manufacture of textiles, Manufacture of wearing apparel; dressing and dyeing of fur, Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear, Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, Manufacture of paper and paper products, Manufacture of chemicals and chemical products, Manufacture of other non-metallic mineral, Manufacture of fabricated metal products, except machinery and equipment, Manufacture of office, accounting and computing machinery, Manufacture of electrical machinery and apparatus n.e.c., Manufacture of radio, television and communication equipment and apparatus, Manufacture of medical, precision and optical instruments, watches and clocks, Manufacture of other transport equipment, Manufacture of furniture; manufacturing n.e.c.). Increase of managerial efficiency in Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19), Manufacture of wearing apparel; dressing and dyeing of fur (18), Manufacture of medical, precision and optical instruments, watches and clocks (33) has been higher than other industries. On this basis, it can be concluded that changes in managerial efficiency in each industry have been different due to requirements of each industry. In order to do precise analyses accorded with reality, it is necessary to do above analyses in homogenous industries and within two-digit codes in manufacturing industries of Iran. However, results suggest that cloth industry has managerially performed better than other industries. Regarding policy making, results show that similar strategies are not implementable in manufacturing industries of Iran for growth of managerial efficiency and each industry relative to its structure requires different changes for growth of managerial efficiency.

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