

How to Cite:

Mirhoseyni, S. V., Bahraminia, E., & Monsefi, M. (2022). Economics of scale and optimal size of hospitals (case study of shahid Rahnemoun hospital). *International Journal of Health Sciences*, 6(S7), 6674-6687. Retrieved from <https://sciencescholar.us/journal/index.php/ijhs/article/view/13651>

Economics of scale and optimal size of hospitals (case study of shahid Rahnemoun hospital)

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Abstract--Economies of scale are one of the important behavioral indicators of production units. In the presence of economies of scale, the scale curve is descending, which indicates a decrease in the average cost of production with an increase in production. Theoretically, the optimal size of a production unit is the volume of production at which the average cost is at its lowest. The issue of the need to pay attention to economies of scale and optimal allocation of resources on the one hand and the role and position of hospitals in providing medical services on the other hand and the high share of treatment costs in public spending in Iran, compared to the world average, The motivation was to evaluate the efficiency conditions in production and determine the optimal size of the hospital. In this study, in order to determine the optimal size of Shahid Rahnemoun Hospital in Yazd according to the number of beds, the cost quadratic function of the hospital translog was estimated based on production factors using the quadratic cost function method. The study period is 1390-1398, which uses Eviews econometric software. The coefficient of variable number of beds was -0.023 and the coefficient of variable of production index was 1.236 based on the obtained results. In addition, the optimal amount of beds for the mentioned hospital was 237 while the actual number of hospitals is 222.

Keywords---*Economies of scale, Shahid Rahnemoun Hospital, Second degree cost function ,Optimal size.*

Introduction

Economies of scale explain the increase rate in the amount of production to the increase of production factors in the long term. All production factors are variable during the production process in the long term. When the economies of scale indicate the effect of an increase in production on unit costs, the returns to scale focus on the relationship between input and output quantities in the production process. In fact, the economics of scale evaluate the effectiveness caused by an increase in production scale [13]. In this regard, economies of scale are derived from firm cost theory in microeconomics since this concept is explained in microeconomic theory using the long-term average cost curve. Thus, this curve is called the scale curve in the firm cost function. All of the points on the scale curve are the points that resulted from the optimization of the firm in the short term, indicating that the allocation of resources in the points on the scale curve has been conducted optimally. In the case of economies of scale, the scale curve is descending, which shows a decrease in the average cost of production with an increase in production [14]. Meanwhile, increasing the production rate to the optimal level of production results in the increasing trend of average cost and the firm moves away from the optimal allocation of resources [7].

Hospital is a highly complex social organization that plays a key role in providing, maintaining, and promoting community health by taking advantage of facilities, equipment, and human resources. Hospital is a symbol of the civilization of society and is a place where people with various specialties attempt to help other human beings by using different and complex medical and paramedical equipment [8]. Despite the high volume of resources allocated to hospitals and the health sector, there is a gap between the growth of accessible resources and required resources in the health sector and this issue necessitates the effective use of resources. The weak management of hospitals leads to the waste of resources such as money, human resources, building, and equipment. Such a waste means that a certain share of services can be obtained by spending fewer resources. As a result, better, higher quality, and cheaper services can be achieved by preventing the waste of financial and human resources [7]. The need to consider economies of scale and production in case of optimal allocation of resources on the one hand and the place of hospitals in providing medical services on the other hand, as well as the share of public medical costs in Iran than its average in the world, made the researchers of this study investigate the efficiency of production and determine the optimal size of Shahid Ranhemoun Hospital to answer the questions below:

- What is the optimal size of Shahid Rahnemoun Hospital in terms of the number of beds?
- What is the status of economies of scale at Shahid Rahnemoun Hospital?

Literature review

Economies of scale

Economies of scale caused by scale and scope can fundamentally affect the unit costs of a particular service. There may be numerous economies of scale in the hospital industry, and the costs may be eliminated by increasing the size of the hospital. Economies of scale include:

- Economies of scale due to a particular product
- Economies of scale due to a special device
- Economies of scale due to a particular firm [13]

Optimal size

In terms of theory, the best size of the production unit is the volume of production in which the average cost is at its lowest rate. The long-term average cost curve indicates the minimum cost per unit of production at each level of product volume, indicating that any scale of production can be created [9]. The word “scale” is more limited than the word “size.” If an increase in the scale of a unit is considered, all of the inputs, whether fixed or variable, should be increased in the same proportion. In this regard, if the level of production increases with the same scale that the inputs increased, there will be no difference in terms of economies and non- economies, and if the volume of production increases at a higher rate, there will be economies relative to the scale [13].

Feizpour et al. (2013) determined the optimal size of the food and beverage industry of Iran during the first years of the second, third, and fourth development plans. They applied the Comanor and Wilson approach to determine the optimal size. In the end, they concluded that 90% of the food and beverage industry firms were active at an extent less than the optimal size during the studied years. As observed, determining the optimal size has been highly regarded in domestic studies. In these studies, the survival method, Comanor Wilson approach, and statistical methods have been used to calculate the MES since the use of these methods has some limitations, including fewer data limitations.

Torabi and Mirzaei (2014) studied the effect of economies of scale on production scale and degree of centralization on the competitiveness index among the steel industry in Iran using the panel data method. The population of this study included the steel production companies in Iran from 2001-to 2013. The results indicated the significant positive effect of degree of diversity and economies of scale on the dependent variable of competitive advantage and the significant negative effect of market structure and labor status on the dependent variable of competitive advantage.

Rasekhi (2016) evaluated the determining factors of competitive advantage in Iranian factories from 2002-to 2010. The results obtained from the panel data method revealed that the economies of scale, product differentiation and the role

of government have a significant positive effect on the competitive advantage of Iranian industries.

Hajian and Basiratpour (2016) investigated the effect of structural elements such as concentration, entry barriers, product differences, and economies of scale on the profitability and performance of the banking industry. For this purpose, a simultaneous equation system including three behavioral, functional, and structural equations was estimated using SLS3. The results showed an inverse U relationship between centralization and advertising. In other words, the intensity of advertising decreased at low levels of centralization but increased with the increase of centralization.

Given that Spanish airports are publicly owned and often managed as natural monopolies but do not compete with other airports in other regions and cities, Martin et al. (2011) estimated economies of scale and the final cost of Spanish airports using the Translog cost function. The results of their study indicated that traffic stabilization reduces costs.

Simarmata (2012) interpreted economies of scale and their relationship with labor wages and production costs. Based on the findings of this study, labor wages should increase when production increases in order to meet the increase in demand. Wage increases should be less than unit cost reductions caused by economies of scale in order to be profitable. Eventually, the results indicated that the increase in the wage rate could increase GDP, employment, and better income distribution under the right conditions.

Machado et al. (2016), in research entitled "Economies of scale and technological advances in electricity generation," estimated the cost structure of electricity companies in Brazil from 2000-to 2010 using the Translog cost function. Larger firms have fewer costs, so they have more optimal production. During the studied period, technological advances resulted in a reduction in electricity costs.

Giancotti (2018) studied the efficiency and optimal size of hospitals in Italian public hospitals using data envelopment analysis. In this study, a number of 41 public hospitals were studied from 2010-to 2013, and the optimal number of beds in each hospital was estimated at about 200.

Method

The present study was applied in terms of the objective because the results of this study could be used in the decision-making process at Shahid Rahnemoun Hospital, Yazd. In terms of nature, the present study was descriptive and correlational. The data were collected from the studied database and sample. In addition, the Eviews econometric software package was used to estimate the model. The statistical population was selected from Shahid Rahnemoun Hospital in Yazd. The thematic scope of this study was economies of scale and size of hospitals, while the spatial scope was Shahid Rahnemoun Hospital. The time period was chosen as seasonal from 2011 to 2019. The main objectives of this study were to determine the optimal size of Shahid Rahnemoun Hospital in terms

of the number of beds and to measure economies of scale at Shahid Rahnemoun Hospital in the studied period.

The econometric methods were used to calculate the statistics related to the quadratic cost function in Eq. 1 , the Translog cost function in Eq. 2 and the Cobb Douglas cost function in Eq. 3 were calculated, and the appropriate form was identified to estimate the short-term cost function:

$$C(Q_T, K) = \beta_0 + \beta_1 Q_T + \frac{1}{2} \beta_2 Q_T^2 + \beta_3 K + \frac{1}{2} \beta_4 K^2 + \beta_5 Q_T K \quad (1)$$

$$C(Q_T, K) = \beta_0 + \beta_1 \ln Q_T + \frac{1}{2} \beta_2 \ln Q_T^2 + \beta_3 \ln K + \frac{1}{2} \beta_4 \ln K^2 + \beta_5 \ln Q_T \ln K \quad (2)$$

$$\ln C(Q_T, K) = \beta_0 + \beta_1 \ln Q_1 + \beta_2 \ln Q_2 + \beta_3 \ln K \quad (3)$$

In these equations:

C: Hospital operating costs

$$Q_T = Q_1 + Q_2 \quad (4)$$

Q_1 :DRG value for inpatients

Q_2 :DRG value for outpatients

K :The number of hospital beds

After identifying the appropriate form for the cost function in the short term for Shahid Rahnemoun Hospital and estimating the cost function, the equations below were used to calculate the optimal size of the hospital in terms of the number of beds:

$$\frac{\partial C(Q_T, K)}{\partial K} = \beta_3 + \beta_4 K + \beta_5 Q_T = 0 \Rightarrow K = \frac{-\beta_3 - \beta_5 Q_T}{\beta_4} \quad (5)$$

$$\frac{\partial \ln C(Q_T, K)}{\partial K} = \beta_3 + \beta_4 \ln K + \beta_5 \ln Q_T = 0 \Rightarrow \ln K = \frac{-\beta_3 - \beta_5 \ln Q_T}{\beta_4} \Rightarrow K = e^{\left(\frac{-\beta_3 - \beta_5 \ln Q_T}{\beta_4}\right)} \quad (6)$$

$$\frac{\partial \ln C(Q_T, K)}{\partial K} = \beta_3 = 0 \quad (7)$$

Since the long-term cost function related to the optimal points was the short-term cost function, extracting the appropriate form for the short-term cost function by

placing the optimal values for the number of beds in optimal conditions in the above-mentioned function, the long-term cost function could be extracted as follows:

$$C(Q_T) = \beta_0 + \beta_1 Q_T + \frac{1}{2} \beta_2 Q_T^2 + \beta_3 \left(\frac{-\beta_3 - \beta_5 Q_T}{\beta_4} \right) + \frac{1}{2} \beta_4 \left(\frac{-\beta_3 - \beta_5 Q_T}{\beta_4} \right)^2 + \beta_5 Q_T \left(\frac{-\beta_3 - \beta_5 Q_T}{\beta_4} \right) \quad (8)$$

In order to investigate the production status in the presence of economies of scale or non-economies of scale, the researchers derived from the above-mentioned function and considered it equal to zero:

$$SE_1 = \frac{\partial \ln C(Q_T)}{\partial \ln Q_T} = \beta_1 - \frac{2\beta_3\beta_5}{\beta_4} + \frac{\beta_3\beta_4\beta_5}{\beta_4^2} + \left(\beta_2 + \frac{\beta_4\beta_5^2}{\beta_4^2} - \frac{2\beta_5^2}{\beta_4} \right) \ln Q_T \quad (9)$$

$$SE_2 = \frac{\frac{\partial C(Q_T)}{\partial Q_T}}{\frac{C}{Q_T}} = \beta_1 - \frac{2\beta_3\beta_5}{\beta_4} + \frac{\beta_3\beta_4\beta_5}{\beta_4} + \left(\beta_2 + \frac{\beta_4\beta_5^2}{\beta_4^2} - \frac{2\beta_5^2}{\beta_4} \right) \ln Q_T \quad (10)$$

Eq. 9 measures the sum of first-order partial derivatives, while Eq. 10 measures the cost elasticity of production to production.

Findings

The first step of estimating a model is to conduct a stationary test on the model variables since if the variables are non-stationary, the condition for proving the model stability will not be met, and the results obtained from the model will not be valid. This test aims to determine whether the mean and variance values change over time or not? There are multiple tests for evaluating the hypothesis of the presence or absence of a unit root. In this study, the KPSS method was used to study the significance of model variables.

Table 1 displays the results of the KPSS test for all model variables at the level.

The results of the table indicate that the LM-STSTE statistics are less than the critical values at the levels of 1%, 5% and 10% for all research variables at the level in the presence of y-intercept and trend. Accordingly, the null hypothesis, which states the stationary of the variables at the level, is confirmed, and all of the variables are at the stationary level.

Table 1. Stationary test of variables by KPSS method

Description	Critical values			LM -STSTE statistics at the level	Time series
	10%	5%	1%		

Non-stationary	0.119*	0.146*	0.216*	0.204	<i>LnBED</i>
	0.347**	0.463**	0.739**	0.416	
Non-stationary	0.119*	0.146*	0.216*	0.382	<i>LnQ₁</i>
	0.347**	0.463**	0.739**	0.172	
Non-stationary	0.119*	0.146*	0.216*	0.149	<i>LnQ₂</i>
	0.347**	0.463**	0.739**	0.405	
Non-stationary	0.119*	0.146*	0.216*	0.865	<i>LnTC</i>
	0.347**	0.463**	0.739**	0.186	

Source: Research findings

*Critical values with y-intercept and trend and ** Critical values with y-intercept and without trend.

Among the different linear methods for estimating the model parameters, the ordinary least squares (OLS) method is known as the most extensively used and dominant method because of its desirable properties despite the relevant assumptions. This method which is attributed to the famous German mathematician Carl Friedrich Gauss attempts to fit the best regression line for data by minimizing the sum of squares of disturbance terms. After the stationary test, if all of the model data related to the dependent variable and explanatory variables are stationary, the model estimation by the ordinary least squares method will be acceptable.

Indeed, the use of OLS estimation in experimental work is based on the assumption that the used time series variables are stationary [8]. Based on the result of the stationary test, indicating the stationary nature of all of the research variables at the level, the cost function estimation in this study was conducted using the ordinary least squares method.

First of all, the cost function of Shahid Rahnemoun Hospital in Yazd was estimated with the help of the Cobb-Douglas function. The results obtained from estimating this function are summarized in Table 2. Since the variables were included logarithmically in the model, the estimated coefficients showed the elasticity of the production cost to the production factors. Based on the results, the coefficient of the number of beds (BED) was not significant, but the coefficient

of variable related to Q_1 (DRG value for inpatients) and Q_2 (DRG value for outpatients) was significant. Furthermore, the coefficient of determination (R^2) is 0.97, according to which 97% of the dependent variable changes, i.e., the operating cost of the hospital, could be explained using three factors the number of beds, DRG value related to inpatients, and DRG value related to outpatients. Accordingly, the short-term cost function in the studied period is as follows:

$$LnTC = 11.46 - 0.59LnBED + 0.542LnQ_1 + 0.273LnQ_2 \quad (11)$$

The limitation related to the Cobb-Douglas cost function is the impossibility of calculating the optimal number of beds. Accordingly, the hospital cost function in

the form of the Translog function and quadratic function provided the possibility of calculating the optimal number of beds. Therefore, these two functions should be evaluated, and an appropriate form should be selected for estimating the cost function of Shahid Rahnemoun Hospital in Yazd.

Table 2. Estimation of a cost function using Cobb-Douglas form

Variable	Coefficient	T statistics	Prob
y-intercept	11.467	6.34	0.0014
$\ln BED$	-0.590	-0.845	0.4366
$\ln Q_1$	0.542	2.75	0.0032
$\ln Q_2$	0.273	3.04	0.0027
R^2	0.97		
$D.W$	2.06		
F	55/5899		

Source: Research findings

After evaluating the forms related to the quadratic cost function and the Translog cost function, the results revealed that the specification of the cost function in the form of quadratic led to more appropriate results. Thus, this form was selected for estimating the cost function of Shahid Rahnemoun Hospital in Yazd. The results of the estimation are presented in Table 3. The results indicated that the coefficient of all of the studied variables was significant. Among the studied variables, the coefficient of the number of beds and the product of the number of beds in total production was negative, while the coefficient of other variables of cost function was positive. In addition, the coefficient of determination (R^2) was 0.99, according to which 99% of the changes in the dependent variable, i.e., the operating cost at Shahid Rahnemoun Hospital in Yazd, could be explained in this form using the independent variables.

Table 3. Estimating the cost function using the quadratic function form

Variable	Coefficient	T statistics	Prob
y-intercept	-0.023	0.502	0.1223
BED	-1.470	-2.997	0.0004
Q_T	1.236	2.987	0.0006
$(BED)^2$	0.694	4.456	0.0046
$(Q_T)^2$	0.112	3.768	0.0000
$BED.Q_T$	-0.678	-3.436	0.0000
R^2	0.99		

<i>D.W</i>	2.01
<i>F</i>	32.863

Source: Research findings

Accordingly, the short-term cost function at Shahid Rahnemoun Hospital in Yazd is as follows:

$$TC = -0.023 - 1.228BED + 1.426Q_T + 0.7996(BED)^2 + 0.1204(Q_T)^2 - 0.5406BED.Q_T \quad (12)$$

After estimating the cost function in the short term, the optimal number of beds can be calculated by deriving the short-term cost function in terms of the number of beds:

$$\frac{\partial TC(Q_T, BED)}{\partial BED} = \beta_3 + \beta_4 \cdot BED + \beta_5 \cdot Q_T \quad (13)$$

The results of derivation from the short-term cost function in terms of the number of beds are as in Eq. 14:

$$\begin{aligned} \frac{\partial TC(Q_T, BED)}{\partial BED} &= 0 \Rightarrow \\ TC &= -0.023 - 1.228BED + 1.426Q_T + 0.7996(BED)^2 + \\ &0.1204(Q_T)^2 - 0.5406BED.Q_T \\ \frac{\partial TC(Q_T, BED)}{\partial BED} &= -1.228 + 1.5992BED - 0.5406Q_T = 0 \Rightarrow \quad (14) \\ BED &= \frac{1.228 + 0.5406Q_T}{1.5992} \end{aligned}$$

The short-term cost function in the previous section was derived using the quadratic function form. Then, the relationship between the optimal numbers of beds was derived by deriving the short-term cost function.

Here, the long-term cost function of Eq. 15 is achieved by placing the optimal number of beds in the cost function (12) and eliminating the fixed cost. It should be explained that the long-term cost function of optimal points is the short-term cost function.

$$\begin{aligned}
LTC = & -1.228\left(\frac{1.228+0.5406Q_T}{1.5992}\right) + 1.426Q_T + 0.7996\left(\frac{1.228+0.5406Q_T}{1.5992}\right)^2 \\
& + 0.1204(Q_T)^2 - 0.5406\left(\frac{1.228+0.5406Q_T}{1.5992}\right)Q_T
\end{aligned} \tag{15}$$

Since at the desired point of the long-term cost function, the derivative of this function is zero relative to Q_T , first, the above-mentioned function was derived according to this variable, and Q_T the value was calculated. Then, the value of this variable was achieved as Eq. 16 by placing Q_T in the equation of the optimal number of beds.

$$BED = \frac{1.228+0.5406Q_T}{1.5992} = 237 \tag{16}$$

Based on Eq. 16, the optimal number of beds in the population was 237. Since the active number of beds in the hospital was less than the optimal amount, the evidence showed that this hospital was active in the descending part of the long-term cost curve and faced an ascending return relative to scale, which is studied in the next section.

Evaluation of economies of scale

If the objective is to measure the extent and procedure of change in the product are the same after changing different factors of production, economies of scale should be addressed. In other words, economies of scale refer to the rate of change in the product whenever all production factors change at the same ratio [3]. Economies of scale is a concept that is explained using a unit cost curve (scale curve). All of the points on the scale curve guarantee the efficiency, which means that each point of the curve guarantees the use of the least possible input for the intended production level. Every point on the scale curve not only shows a combination of factors that include the least cost but also these factors are assumed to be used optimally. In other words, the scale curve corresponds to the fact that the firm is located on the border of its own production facilities. Although economies of scale are defined according to the percentage of increase in production rate per one percent of the increase in all inputs, the definition of economies of scale in terms of the optimal cost level as a result of product change is more practical. In this regard, the coefficient of return to scale is defined as number one minus the cost elasticity coefficient based on the production level. In this study, economies of scale were calculated using the Translog cost function. As a result, economies of scale use the coefficient of return to scale as number one minus the cost elasticity coefficient based on the production level or a ratio of one to the cost-to-production derivative.

In this study, the above-mentioned method was used to determine the existence or non-existence of economies of scale, the equation of which can be expressed as follows:

$$Scale = 1 / \frac{\partial LnTC}{\partial LnQ} \quad (17)$$

In order to calculate the type of return to scale, the above equation can also be written as follows:

$$Economies\ of\ Scale = \frac{\partial LnTC}{\partial LnQ} \quad (18)$$

Table 4. Return to scale at Shahid Rahnemoun Hospital in Yazd

Year	Season	$\frac{\partial LnTC}{\partial LnQ}$
1390	1	1.32
	2	1.37
	3	1.31
	4	1.09
1391	1	1.11
	2	1.03
	3	1.05
	4	1.02
1392	1	1.03
	2	1
	3	1.02
	4	1.04
1393	1	1.31
	2	1.27
	3	1.34
	4	1.25

1394	1	1.19
	2	1.16
	3	1.11
	4	1.05
1395	1	1.17
	2	1.09
	3	1.15
	4	1.22
1396	1	1.38
	2	1.23
	3	1.14
	4	1.18
1397	1	1.26
	2	1.31
	3	1.14
	4	1.36
1398	1	1.15
	2	1.19
	3	1.21
	4	1.27

Based on the above-mentioned equation, the return to the production scale is established in one of the following ways:

A .Increasing returns to scale : $Economies\ of\ Scale > 1$

B .Constant return to scale $Economies\ of\ Scale = 1$;

C .Decreasing relative to scale $Economies\ of\ Scale < 1$;

In this study, the amount of return to scale was calculated by deriving from the cost function as the above-mentioned equation. The results obtained from these calculations are shown in Table 4, and the results indicated that an increasing return to scale was established at Shahid Rahnemoun Hospital in Yazd.

Discussion and conclusion

In order to determine the optimal size of Shahid Rahnemoun Hospital in Yazd in terms of the number of beds, first, the cost function of the hospital was estimated according to its production factors using the quadratic cost function method. In order to estimate this function, first, the stationarity of the studied variables was tested. After evaluating the stationarity of the variables, the model was measured using the ordinary least squares (OLS) method based on the number of beds and the income of outpatients and inpatients, and finally, the model parameters were obtained. As shown in Table 3, the coefficient of the number of beds is -0.023, and the coefficient of the production index is 1.236. The results indicated that the coefficient of the number of beds was negative, indicating that hospital costs decreased with increasing the number of hospital beds. The income coefficient resulting from the treatment of outpatients and inpatients was positive, indicating that hospital costs increased with more admission of patients. Thus, the maneuvering power of hospital management should focus more on increasing the number of beds. In order to determine the optimal bed size for this hospital, the function of the production factors was derived, and the optimal number of beds for this hospital was obtained at 237. Since the maximum number of beds used at this hospital was 222 during the studied period, this hospital still has some empty capacity, and the number of beds should be increased to 237 to make the best use of the hospital facilities and equipment. In the second hypothesis, the economies of scale at Shahid Rahnemoun Hospital in Yazd were evaluated. Accordingly, the number of economies of scale at various levels of the number of beds was calculated in the seasonal period for each year. The results obtained from economies of scale can be seen in Table 4. Based on this table, the return to scale is increasing on the number of beds, and there are economies of scale. Thus, the average cost of the hospital decreases as the number of beds in the hospital increases. In fact, the presence of increasing return to scale confirms that many of the used production factors lack the necessary return due to the lack of beds. In addition, the empty capacity of other production factors can be used by increasing the number of beds. Furthermore, the efficiency and return of other factors can be increased. Thus, the hospital management can increase the number of beds up to 237 to make the most use of other factors and significantly reduce hospital costs.

References

- 1- A. Simarmata, *DjaMES ter* (2012), "Appropriate Wage to Economies of Scale for Growth: An Exploratory Study on New Paradigm for Development" pp.1-30.
- 2- Dashti, Q, Sharfa, S(1388). *Economic analysis of the optimal scale and size of a poultry farming unit Laying of Tehran province. Journal of Agricultural Economics and Development. 17(68): 1-19. [Persian]*
- 3-Debertin. D. *Economics of agricultural production. (1376). Translation: Mohammad Gholi Musa Nejad and Reza Najarzadeh, Institute Publications Economic Research of Tarbiat Modares University. [Persian]*
- 4-Emadzadeh, M., Azarbayjani, K., and Zamanian, G (1390) *E. conomies of scale: An analysis of the situation of the smelting company Isfahan Iron. Journal of Economic Research. (59): 95-116. [Persian]*

- 5-Henderson, J. And Richard, k. (1386). *Theory of Microeconomics*, translated by Morteza Gharabaghian and Jamshid Pajhuyan. [Persian]
- 6-Isahanian. P (1397). *Prevalence of burnout of nurses in Iranian hospitals: a systematic review study and Meta-analysis*. *Journal of Health*. 10(2): 240-250. [Persian]
- 7-Malkan, J. (1390). *Investigating the effects of concentration ratio and economies of scale on profitability in Iran's industrial sector* *Quarterly Journal of Economic Research Trends*. 19(58): 99-125 . [Persian]
- 8-Mosadeghrad, A. M., Esfahani, P., & Nikafshar, M. (2017). *Hospitals' efficiency in Iran: A systematic review and meta-analysis of two decades of research*.
- 9-Nofersti., M. (1378). *Unified and cohesive root in econometrics"*. *Mopsa Rasa Cultural Services* [Persian]
- 10-Martín, J, Román, Concepción, Voltes-Dorta, Augusto, (2011), "Scale economies and marginal costs in Spanish airports", *Transportation Research Part E*, 47,238-248, 2011.
- 11-Machado, Mauricio Marins, Conceição Sampaio de Sousa, Hewings, Geoffrey, (2016), "Economies of scale and technological progress in electric power production: The case of Brazilian utilities", *Energy Economics*, 59, 290-299.
- 12-Rezapour A., Turani Sogand, Hakimeh Mania(1389). *Serial analysis of the final service centers of the training center- Alpha therapy of Qazvin University of Medical Sciences*. *Health management*. 13(41): 21-23. [Persian]
- 13-Shawalpou.S, Kaviani. A(1397). *The effect of oil price fluctuations on wind power capacity in developing countries the role of technical learning and economies of scale*. *Iranian Journal of Energy Emphasis on Economics*. 7(26): 25-50. [Persian]
- 14-Shehiki Tash, M, Nasiri, A. (1390). *Concentration, severity of barriers to entry and economies of scale in the Iranian water cooler industry and cost Welfare resulting from an effective monopoly structure*. *Quarterly Journal Welfare resulting from an effective monopoly structure*. *Quarterly Journal of Quantitative Existing Economic Studies*. 8(1): 7. [Persian]