Adv. Math. Fin. App., 2024, **9**(2), P.470-494

Advances in Mathematical Finance & Applications
www.amfa.iau-arak.ac.ir
Print ISSN: 2538-5569
Online ISSN: 2645-4610
Doi: 10.22034/amfa.2022.1953814.1710

Original Research

Patterning Mergers and Acquisitions by Network Data Envelopment Analysis in the Iranian Insurance Companies

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ARTICLE INFO

Article history:
Received 2022-02-28
Accepted 2022-05-08

Keywords:
Mergers and Acquisitions (M&A)
Technical or Learning Efficiency (LE)
Harmony or Scope Efficiency (HA)
Scale or Size Efficiency (SA)
Network Data Envelopment Analysis (NDEA)
Modified Slack-Based Measure (MSBM)

ABSTRACT

One of the most important factors of the development of an economy is the mergers or acquisitions (M&A) at the level of its active companies such as insurance companies. The main purpose of this study is to examine the efficiency of merger and acquisition before doing this process in the insurance industry using network data envelopment analysis and can select the companies that potentially facilitate achieving the purposes of the merger and acquisition process and improve of this action. For this purpose, in this study, first the efficiency of 20 insurance companies was measured through the Modified Slack-Based Measure (MSBM) in the two-stage data envelopment analysis approach during three years 2017, 2018 and 2019. Then, considering the calculated efficiency, Asia Insurance Company, Parsian, Dey, Pasargad, Kowsar and Taavon, which have had efficient performance in the last three years, were excluded from the calculations and other companies were selected for M&A. After ensuring that no monopoly is considered via Herfindahl- Hirschman Index, M&A is performed and then the overall efficiency was measured and it was divided into three parts: technical, harmony and scale. The results showed that the two consolidations Dana-Mihan and Dana-Sina had the best efficiency and the three consolidations Alborz-Mellat, Sina-Arman and Sina-Sarmad had the lowest efficiency and potential for the highest improvement. Calculations also showed that if the scale effect in the composition is greater than 1, then the coordination effect is smaller than 1 and the inverse relationship are not necessarily satisfied.

1 Introduction

One of the issues which is used of the empowerment of insurance companies, which sometimes have low financial capacity, is the mergers and acquisitions. Mergers and acquisitions in the management and coverage of risks that weak companies are unable to perform well can be a

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good method [37]. In mergers and acquisitions, one company is remained, or both companies may be destroyed and a new company may be established. In the process of merging, two or more companies consolidate to form a completely new unit. Acquisition is a consolidation of two or more companies in which the resulting company maintains the identity of the acquiring company [26]. Numerous studies have been carried out on the mergers and acquisitions of companies, especially insurance companies, which have examined its reasons and motives [3, 17, 31] Many scientific debates have also investigated the failure of the merger and acquisition process [34]. But on the other hand, some studies have dealt with the failure of the merger and acquisition process. [2, 27, 36]. One of the critical steps that a bidder company must take in order to reduce the high failure rate of M&A activities is trying to identify suitable target companies before action by determining if the prospective partner can provide the necessary synergies and Related features required to complete the features of the acquiring company. The need to predict M&A outcomes has attracted the attention of many researchers [32,8]. This paper focuses on a strategic fit of M & A deals involving Iranian Insurance Companies by using Modified Slack-Based Measure (MSBM)model variant as the cornerstone method to compute several efficiency indicators of virtually merged companies. In Iran, the insurance industry does not have a good position and the low penetration rate of insurance (2.6% in Iran compared to 7% in the world) and low acceptance of insurance services is a sign of this, which unfortunately, inefficiency in parts of this system has led to such results. Conditions are prevailing in the Iranian Insurance market, which, given the nature and function of the Insurance industry, should provide confidence and calm in society and cover the risks of economic sectors; risks that can be a factor in reducing investment and economic activities and caution actors in what they are doing. Therefore, one of the measures that can boost this section and facilitate the conditions for economic activities is the occurrence of mergers and acquisitions at the level of insurance companies. Despite many studies focusing on insurance companies' efficiency and productivity using DEA In Iran [23, 30] and the world [14, 22], there is still no more systematic research approach for M&A insurance companies in in Iran is still missing which represents a literature gap. Thus, if it is possible to improve and empower companies by using the consolidation, then we can take a step towards repairing the position of insurance companies and, the development and progress of the country can be attained and as explained prior to this action, the efficiency prediction allows the system to choose the best consolidation using its facilities and strategies. These facilities are sometimes in the field of resource allocation, sometimes in company potential and sometimes the size of the company, so identifying each of these capabilities or deficiencies allows the decision maker to identify the position and resources available to choose the best strategy. One of the suitable and efficient tools in measuring and evaluating efficiency is data envelopment analysis, which is used as a non-parametric method to calculate the efficiency of decision-making units. Today, the use of data envelopment analysis technique is developing rapidly and is used in the evaluation of various organizations and industries such as banking industry, post, hospitals, training centers, power plants, refineries, insurance, etc [20,33]. Accordingly, considering the nature of the data in this study, which are sometimes negative values, the Modified Slack-Based Measure (M.S.B.M) is used and the efficiency of the consolidation is calculated and its components are determined. Therefore, this research is innovative in this context because it adopts Modified Slack-Based Measure approach to assess M & A in the Iranian Insurance Companies. The motivations for the present research are as follows: Section 2 defines the

theoretical basics of the research. Section 3 describes the model used in the paper. Section 4 discusses the data and sample selection. Section 5 also calculates the Herfindahl- Hirschman Index, selects companies to merge, and investigate the overall efficiency and efficiency components of the merged virtual companies. Finally, Section 6 presents conclusions and future recommendations.

2 Theoretical Basics of Research

2.1 Merger and Acquisition

Literally, merger means the unification and joining of two or more things [1]. Merger of two or more companies is achieved when either one company dissolves the other, or two or more companies are dissolved and another company is formed. Merger dissolves companies that are going bankrupt without liquidating their assets. Indeed, the assets of companies that are dissolved as the result of merger are transferred to the new company [38]. A merger occurs when two or more units that were previously independent become one unit [4]. Mergers, in fact, involve transactions and agreements that lead to the unification of firms. Unlike a merger, the acquisition does not require the loss of the independent economic and legal entity of the parties, and eventually one company may be owned by another. In this case, the main criterion is to gain control. That is, the criterion for acquiring control over ownership determines the degree of acquisition. In the existing literature, the terms "merger and acquisition" are used together whether the merger process or the acquisition process is achieved. Thus, these two terms are always observed together as mergers and acquisitions (M&A). Therefore, these two terms are similar that in many cases they synonym and in other cases they are used interchangeably [37].

2.2 Network Data Envelopment Analysis

Data envelopment analysis is one of the most widely used methods in measuring the relative efficiency of a set of homogeneous decision-making units (DMUs) with the same inputs and outputs, introduced by Charnes, Cooper and Rhodes [7]. In this method, based on linear programming, the relative efficiency for a group of decision-making units is calculated using the weighted sum of inputs and outputs [18, 25, 45]. This technique is a non-parametric method to compare units to efficiency frontier and its significant advantage is that it does not need to specify parametric specifications (e.g., production function) to obtain efficiency scores [43]. Using the data envelopment analysis models, besides determining the relative efficiency, determine the weaknesses of the organization in various indicators and by providing the given value, the organization's policy is defined toward improved efficiency and productivity. Also, efficient models on which inefficient units are evaluated are also introduced to inefficient units. Efficient models are units that, with inputs similar to the inefficient unit, generate more outputs, or the same outputs, using fewer inputs. It is this wide diversification of results that has led to the rapidly increasing use of this technique. In the early DEA models introduced by Charnes et al., the assumption that the input and output variables were positive was considered as the default. However, in relation to scientific issues, there are situations where the assumption of positivity of inputs and outputs is not true, so models were proposed that were able to evaluate units with negative inputs and outputs, and accordingly, different measurement scales for negative data handling have been proposed, one of which is slack-based measure (SBM) model. Sharp et al. in [41] rewrote the SBM model to calculate performance in the presence of negative variables, assuming that:

1. At least one of the inputs is positive.
2. At least one of the outputs is positive.
3. Some input variables and some output variables are negative.

Then, assuming that there are n decision units with m inputs and s outputs, they proposed the MSBM model 1.

When R_{io} and R_{ro} are equal to zero, division by zero is avoided and zero is considered as the coefficient s_i^- and s_r^+.

The network structure that links the different stages of production with intermediate inputs and outputs in a set of processes was first introduced by Färe [15] and was extended. Network data envelopment analysis (NDEA) models measure the overall efficiency of an organization and the efficiency of each of its sub-processes. Also, these models allow the overall efficiency to be divided using mathematical relationships between organizational efficiency and process efficiency. In NDEA models, instead of the hierarchical structure of activities, the network structure is used [19]. In NDEA, each DMU consists of two or more sub-DMUs, and each source is consumed by a sub-DMU, and the output generated enters the next sub-DMU as input, until the final output leaves the last sub-DMU. Figure 1 shows a view of DMUs in network data envelopment analysis [21].

$$Min \quad \rho = \frac{1-\sum_{i=1}^{m} w_i s_i^- / R_{io}}{1+\sum_{r=1}^{s} v_r s_r^+ / R'_{ro}} \tag{1}$$

$st:$

$$\sum_{j=1}^{n} y_{rj}\lambda_j - S_r^+ = y_{ro} \qquad (r = 1, 2, \ldots, s)$$

$$\sum_{j=1}^{n} x_{ij}\lambda_j + S_i^- = x_{io} \qquad (i = 1, 2, \ldots, m)$$

$$\sum_{j=1}^{n} \lambda_j = 1 \qquad (j = 1, 2, \ldots, n)$$

$$\sum_{i=1}^{m} w_i = 1 \qquad \sum_{r=1}^{s} v_r = 1$$

$$\lambda_j, S_r^+, S_i^-, v_r, w_j \geq 0$$

Where R_{io} and R'_{ro} are as follows:

$$R_{io} = x_{io} - \min_j \{x_{ij}\} \qquad (i = 1, 2, \ldots, m)$$

$$R'_{ro} = \max_j \{y_{rj}\} - y_{ro} \qquad (r = 1, 2, \ldots, s)$$

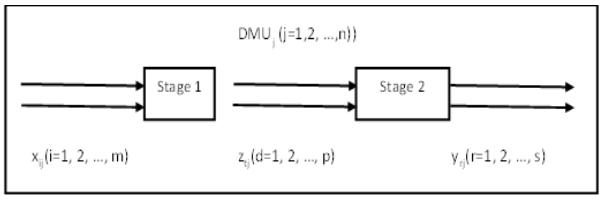

Fig.1: Two-Step Process

2.3 Herfindahl- Hirschman Index

In the general policies execution Law, Article 44 of the Constitution [9], in Chapter 9, facilitates com-

petition and hinders monopolies regarding mergers. Article 47 states that no legal or real entity will be authorized to own capital or share of other companies or firms in a way that would hinder competition in one and/or more markets. Sections 3 and 4 of Article 48 state that when the merger will lead to extreme centralization of the market and when merger will lead to establishment of a firm or a controlling company in the market, the merger of companies or firms is prohibited. Thus, one of the issues that should be considered before the merger is the lack of monopoly and the prohibition of competition in companies. In order to achieve this important point in this study, the estimation of the size of concentration and share of different firms is done through Herfindahl- Hirschman Index, which is stronger than other indicators in terms of theoretical basics [35]. This index uses the information of all industry firms and weighs each firm as much as its market share and is expressed as:

$$HHI = \sum_{i=1}^{N} \left(\frac{TA_i}{\sum_{i=1}^{N} TA_i} \right)^2 \quad (2)$$

In this regard, TA is the total assets or total premiums received by an insurance company and N is the number of insurance companies. This index is ranging 1/n (the position in which all firms in the market are equal in size) and 1 (the position in which one firm operates exclusively in the market).

Table 1: Explain Market Performance by Calculating the Concentration Ratio Index

Main Feature of Market	Herfindahl- Hirschman Index	Market Structure
Perfect competition market	HHI=0	More than 50 competitors, without monopolizing significant share of market
Monopolistic competition market	٠<HHI<0.01	High number of effective competitors, none of which has more than 10% monopoly market.
Weak oligopoly market	0.001≤HHI<0.1	4 Firms have a monopoly of up to 40% of the market.
Hard oligopoly market	0.1≤HHI<0.18	4 firms have a monopoly of at least 40% and at most 100% of the market.
Monopolized market with a dominated firm	0.18≤HHI	A firm alone has monopolized alone 50 to 100% of the market.
monopoly market	HHI=1	A firm has monopolized 100% of the market.

Table 1 summarizes the relationship between the market structure and the number obtained from the calculation of the Herfindahl Index, and the characteristics associated with each market structure. In Herfindahl- Hirschman Index, the share of all firms by squaring is considered, as a result of which, the impact of large firms in the market is higher than other firms, and the index is a convex function of the distribution of the share of companies in the market. Companies with a Herfindahl index of 0.18 or higher resist mergers, but companies with an index of 0.1 or less enter the merger process. This ratio has been revised in the proposed instruction of the competition council and presented with the number 0.2. Therefore, at the time of merger, concentration indicators such as Herfindahl- Hirschman Index should be calculated according to the share of companies in the industry so that competition in the insurance industry does not lead to monopoly.

2.4 Efficiency and Its Components

In order to measure the potential gains from mergers in the input perspective, input-oriented efficiency is calculated for each original DMU and hypothetical DMU. The minimum input vector of each original DMU can be calculated, while maintaining the output vector at the current level I (Y) = min {X ′ | (X ′, Y) ∈ T} [10]. Similarly, the minimum input vector for each hypothetical DMU can be calculated as follows:

$$I_J(Y_J) = min\{ X'_J \mid X'_J, Y_J) \in M^k \},\ J \in \Phi_K \quad (3)$$

Based on the estimated minimum input vector, the efficiency of original DMUs and hypothetical DMUs can be calculated. Therefore, the input efficiency DMUjo producing y_{jo} is calculated as follows:

$$E_{jo} = \frac{I(y_{io})}{x_o} \quad (4)$$

Where x_{jo} is the actual input vector of DMUjo and I (yjo) is calculated by I (yjo) = min {x | (xjo, yjo) ∈ T. Similarly, the hypothetical DMUJ merger efficiency from an input-oriented perspective is defined as the ratio of the minimum input vector and the actual input vector that produces the Y_J output as:

$$E^J = \frac{I(Y_J)}{X_J} \quad (5)$$

According to Bogetoft and Wang [6], the merger efficiency E^J can be decomposed into technical or learning efficiency (LE^J), harmony or scope efficiency (HA^J), and scale or size efficiency (SI^J) as follows:

$$E^J = LE^J * HA^J * SI^J \quad (6)$$

The first source of efficiency is related to technical or learning efficiency. Consider a horizontal merger of A and B as shown in Figure 2.

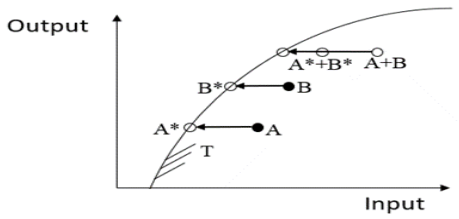

Fig.2: Learning or Technical Efficiency Effect

If organizations merge but continue their activities as they had in the past, the potential for significant resource savings can be seen, which can be observed by the distance from A + B to the possibility of production and so on. However, it can be said that a significant part of this potential for resource savings was also available separately if the business units individually optimized their jobs as A * and B *, and if the jobs A * and B * are integrated, then the potential for resource savings will be significantly less than A + B. This effect is known as the effect of technical or learning efficiency. According to the above explanations and research of Bogetoft and Otto, the calculation of technical or learning efficiency and pure mergers efficiency can be summarized as follows:

$$LE^{J} = \sum_{j \in \varphi_K^J} \frac{I(Y_j)}{X_J}, \qquad J \in \Phi_K \tag{7}$$

$$E^{J*} = \frac{I(Y_J)}{\sum_{j \in \varphi_K^J} C(Y_j)}, \quad J \in \Phi_K \tag{8}$$

Where E^{J*} is the maximum reduction in the aggregated inputs of technically efficient DMUs in $j \in \Psi_K^J$ leading to the production of output Y_j.

Another factor in efficiency is the saving potential in resources that is related with the compound of resources used and a combination of presented services and it is called the scope or harmony effect. To show this, assume two companies with an output level and the required inputs of curve L(x) as shown in Figure 3.

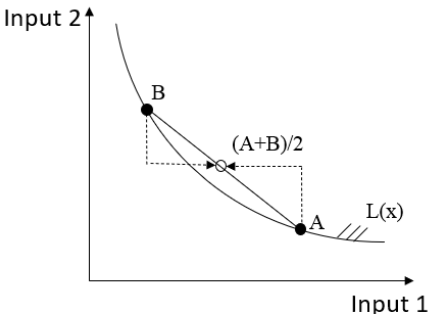

Fig.3: Harmony or Scope Effect

As shown, point A with a dominant input 1 and point B with a dominant input 2 produce the same output. It is clear, however, that none of the consolidations may or may not be optimal at the same time. In fact, the amount of replacement between input 1 and input 2 is different in the two companies. At point A, large amount of input 1 is required to compensate for the loss of input 2, while at point B great values of input 2 are required to compensate for the loss of input 1. This means that it is possible to get better by moving some input 2 from B to A and some input 1 from A to B. If we move the two points as shown by the dashed lines, finally, both of them reach (A + B) / 2 and as the figure shows, there are different opportunities for each company to save resources. In other words, by moving some inputs from A to B and other inputs from B to A, different consolidations of services can be achieved that require less resources to produce or it matches better with the consolidation of the existing points on the path. Therefore, considering the explanations, harmony or scope efficiency can be calculated as follows:

$$HA^{J} = \frac{I(Y_J / N)}{\sum_{j \in J} I(Y_j)/N}, \quad J \in \Phi_K \tag{9}$$

In addition to the above factors, the effects of mergers will also affect the scale of operations, which leads to the scale or size efficiency and is calculated as follows:

$$SI^{J} = \frac{I(Y_J)}{K * I(Y_J / N)}, \quad J \in \Phi_K \tag{10}$$

As a result, in general, the above three effects of learning, harmony, and size determine the consolidated effect of mergers. If each DMU uses the most optimal inputs and is still an independent entity, the LEJ measures the reduction in inputs. The HAJ harmony effect measures the minimum input vector required for the average output vector compared to the modified average input vector for individual learning. The effect of the SIJ scale measures the effect of full-scale (integrated) performance on the average scale of consolidation candidates. If HAJ <1 (SIJ <1), the harmony effect favors the merger (scale effect). If HAJ> 1 (SIJ> 1), the harmony effect (scale effect) works against the merger. Also, according to the theory [5], If the technology used in the consolidation is convex, then the positive harmony effect is weak or in other words HA ≤ 1 while the scale effect may favor or acts against the consolidation but if the scale effect is greater than one, the harmony effect is below 1.

2.5 Research Background

Cummins et al. [12] in a study “Consolidation and efficiency in the US life insurance industry” calculated the cost and revenue efficiency of life insurance companies over the period 1988 - 1995 using DEA method. It was concluded that companies with non-decreasing returns to scale and financial vulnerable firms are more likely to be merger targets. In general, mergers and acquisitions in this industry have a useful effect on efficiency. Cummins and Xie [11] in another study in 2008 investigated the effectiveness and productivity of mergers and acquisitions in the US property - liability insurance industry during the period 1994 - 2003 using DEA technique and the Malmquist index. The results showed that M&A leads to revenue efficiency in the acquiring companies and cost and allocative efficiency in the target companies. Therefore, the consolidations made in the property - liability insurance industry have led to an increase in their value. Shi et al., [42], in a study entitled "Estimation of the potential gains from bank mergers, a new two-stage cost efficiency DEA Model," examined potential gains from mergers, and efficiency with three technical, harmony and size components were assessed. It was found that the potential gains come from the merger of the proposed banks. Also, the main impact of efficiency is from technical efficiency and harmony efficiency, and the size efficiency had the inverse effect on the merger. Bogetoft and Wang [6] in a study “estimating the potential gains from mergers” investigated also efficiency and its components. Sengar et al. [40] in a qualitative study using SWOT analyzed hypothetical mergers and acquisitions in India and concluded that merging banks for a new business unit, shareholders and customers could be profitable. In 2002, Müslümov [29] surveyed 56 US companies to analyze the factors and resources that influenced the merger process during the period 1992-1997. The results of this survey showed synergistic profits through measured mergers with cash flows. Kamal [24] analyzed the financial performance after the merger of Royal Bank of Scotland in Pakistan using 20 accounting ratios. The results of the analysis show that the pre-merger parameters were better and the merger had no improvement in the bank's financial performance. Du and Sim [13] analyzed the effect of M&A in six emerging coun-

tries. The results show that the target banks may have improved their performance, but the acquring banks are still weak in improving their performance. Also, Wanke et al. [44] in a study designed a strategic fit assessment of pre-mergers and acquisitions in African banks and were able to evaluate the resulting virtual banks before the merger and acquisition. Seiford and Zhu [39] also used the output-oriented DEA approach to examine the efficiency of two hypothetical banks from the mergers and acquisitions of two banks. Lozano [28] in his research presented a model of the best potential cost reduction to help decision makers to find the best partner for horizontal merger and acquisition. Halkos and Tzeremes [16] used the bootstrap DEA approach to calculate biased efficiency scores to measure the efficiency gains of 45 possible hypothetical banks.

3. Evaluation Model

The model used in this research is that first the companies are selected and then based on the research of Kao and Hwang [22] "Efficiency decomposition in two-stage data envelopment analysis for Taiwanese non-life insurance companies and research various Cummins's researches computed the efficiency of insurance companies in two stages to identify inefficient companies. Therefore, model 1 is used to calculate the two-stage process as follows:

$$Min\rho = \frac{1-\frac{1}{P}\sum_{t=1}^{p}\frac{L_t^-}{R''_{to}}}{1+\frac{1}{S}\sum_{r=1}^{s}\frac{L_r^+}{R'''_{ro}}} \times \frac{1-\frac{1}{m}\sum_{i=1}^{m}\frac{s_i^-}{R_{io}}}{1+\frac{1}{P}\sum_{t=1}^{p}\frac{s_t^+}{R'_{to}}} \tag{11}$$

st:

$$\sum_{j=1}^{n} z_{tj}\,\lambda_j - S_t^+ = z_{to}(t = 1,2,\dots,p)$$

$$\sum_{j=1}^{n} x_{ij}\,\lambda_j + S_i^- = x_{io}(i = 1,2,\dots,m)$$

$$\sum_{j=1}^{n} y_{rj}\,\mu_j - L_r^+ = y_{ro}(r = 1,2,\dots,s)$$

$$\sum_{j=1}^{n} z_{tj}\,\mu_j + L_t^- = z_{to}(t = 1,2,\dots,p)$$

$$\sum_{j=1}^{n} \lambda_j = 1(j = 1,2,\dots,n)$$

$$\sum_{j=1}^{n} \mu_j = 1(j = 1,2,\dots,n)$$

$$\lambda_i, \mu_i, S_t^+, S_i^-, L_r^+, L_t^- \geq 0$$

Where R_{io} ،R''_{to} ، R'_{to} and R'''_{ro} are as follows:

$$R_{io} = x_{io} - min_j\{x_{ij}\}(i = 1,2,\dots,m)$$

$$R''_{to} = z_{to} - min_j\{x_{ij}\}(t = 1,2,\dots,p)$$

$$R'_{to} = max_j\{z_{tj}\} - z_{to}(t = 1,2,\dots,p)$$

$$R'''_{ro} = max_j\{y_{rj}\} - y_{ro}(r = 1,2,\dots,s)$$

Also, commission costs and benefits commission, administrative and general expenses and market value were considered as primary input and life and non-life insurance premiums as output of the first stage (marketing activity) and the second stage input. Also, the net profit of life and non-life insurance

and the return on invested assets was considered as the output of the second stage (investment activity).

X1: Commission costs and interest fees
X2: General and administrative expenses
X3: Market value
Z1: Life Insurance premium
Z2: Non-life Insurance premium
Y1: Net profit of life insurance
Y2: Net profit of non-life Insurance benefit
Y3: Return on invested assets

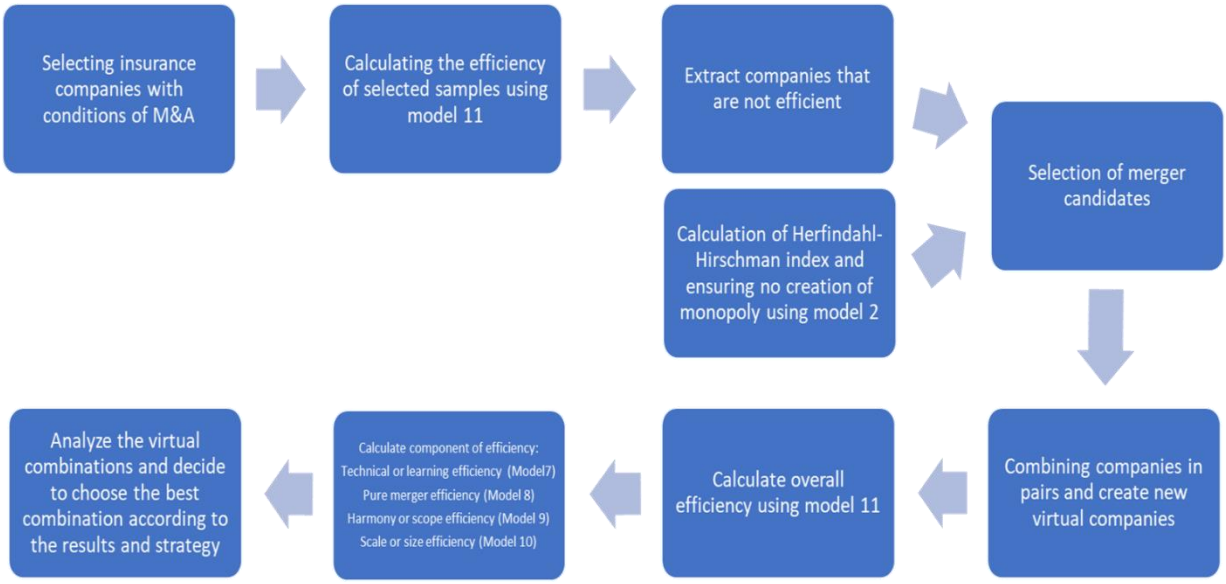

Fig.4: Flowchart to the Article Process

Before any merger, in accordance with Model 2, the Herfindahl- Hirschman Index was calculated to verify that the consolidation does not lead to monopoly and loss of competition among companies. Ensuring that the merger does not conflict with the law, after calculating efficiency, according to the research of Cummins et al. (1999) [12] that companies that are not in a good financial status are the target candidates for merger, the companies with the lowest efficiency were selected for mergers and acquisition and were consolidated. Then, the efficiency of the candidate companies was recalculated based on Model 11 and then its efficiency was analyzed according to Model 6. Based on models 7, 9 and 10, technical efficiency, harmony and scale were also calculated to determine which part of the merger strengthens and weakens the related sections. The steps are given in the above flowchart.

4 Statistical Data and Samples

Now, there are 33 insurance companies working in the country. Iran Insurance Company and Tose'e Insurance Company, due to being governmental and revoking their licenses in car and life insurance, Middle East Insurance Company and Baran Insurance Company, due to their specialization in life insurance field, Hekmat Saba insurance due to its novelty, 6 insurance companies Hafez, Omid, Iran Moein, Moteghabel Kish, Moteghabel Etminan Mottahed Qeshm and Asmari companies for being active in free

and special economic zones and 2 trust insurance companies of Amin and Iranian due to the different types of activities have been excluded from the research. Therefore, in this research, 20 non-governmental insurance companies of Asia, Alborz, Dana, Moallem, Parsian, Razi, Karafarin, Sina, Mellat, Dey, Saman, Novin, Pasargad, Mihan, Kowsar, Ma, Arman, Taavon, Sarmad and Tejarate no were considered as the statistical samples of this research. Input, intermediate and output criteria data, except market value were extracted from the financial statements of the above companies and their market value from the Tehran Stock Exchange (TSE).

5 Analysis of Research Results

5.1 Calculation of Herfindahl- Hirschman Index

Before doing any calculations to merge the selected insurance companies in section 4 of the research, it was permitted to consolidate the companies in terms of observing the principle of competition and prohibition of monopoly. Thus, after extracting the total insurance premiums received by 20 companies according to Model 2, the Herfindahl- Hirschman Index was calculated as follows. As shown in Table 2, this index was equal to 0.08, and according to Table 1, the calculation results indicate that this consolidation does not create a monopoly and the consolidation of selected companies can enter the merger process.

Table 2: Calculation of Herfindahl- Hirschman Index

Premium Insurance	Insurance Life	Insurance Non-Life	Total	Herfindahl Hirschman
Asia Insurance company	4,950,505	53,904,746	58,855,251	0.0218
Alborz Insurance company	1,601,945	29,714,358	31,316,303	0.0062
Dana Insurance company	3,885,940	43,641,026	47,526,966	0.0142
Moallem Insurance company	3,867,091	19,847,535	23,714,626	0.0035
Parsian Insurance company	2,934,500	25,602,187	28,536,687	0.0051
Karafarin Insurance company	6,400,406	5,840,830	12,241,236	0.0009
Razi Insurance company	1,326,305	8,822,496	10,148,801	0.0006
Sina Insurance company	2,612,104	10,779,358	13,391,462	0.0011
Mellat Insurance company	2,298,825	11,968,740	14,267,565	0.0013
Dey Insurance company	252,967	40,844,972	41,097,939	0.0106
Saman Insurance company	4,734,603	8,799,395	13,533,998	0.0012
Novin Insurance company	2,027,342	7,882,737	9,910,079	0.0006
Pasargad Insurance company	20,831,093	11,854,524	32,685,617	0.0067
Mihan Insurance company	188,141	2,845,747	3,033,888	0.0001
Kowsar Insurance company	4,386,820	20,123,318	24,510,138	0.0038
Ma Insurance company	3,108,560	7,085,576	10,194,136	0.0007
Arman Insurance company	192,980	3,885,326	4,078,306	0.0001
Ta'avon Insurance company	566,109	3,232,779	3,798,888	0.0001
Sarmad Insurance company	1,676,559	7,984,209	9,660,768	0.0006
Tejarat-e- No Insurance company	703,998	5,141,737	5,845,735	0.0002
Total	68,546,793	329,801,596	398,348,389	0.08

5.2 Select Companies for Merger

After extracting the data related to the criteria in Section 4, the performance results of 20 insurance companies were extracted using model 11 as follows:

As shown in the above results, 6 insurance companies of Asia, Parsian, Dey, Pasargad, Kowsar and Taavon are efficient in three consecutive periods, so other companies (14 companies) that are inefficient in three consecutive periods are candidates. It is a consolidation and thus the number of virtual companies to

merge and acquire 91 cases ($\frac{14!}{2! \times 12!}$) is considered as follows (Table 4).

Table 3: Efficiency Results of Insurance Companies with Non-Radial MSBM Method

No.	Name of Companies	2017	2018	2019
1	Asia Insurance company	1	1	1
2	Alborz Insurance company	0.35	0.81	0.73
3	Dana Insurance company	0.25	1	1
4	Moallem Insurance company	0.36	0.78	0.87
5	Parsian Insurance company	1	1	1
6	Karafarin Insurance company	0.55	0.04	0.12
7	Razi Insurance company	0.27	0.3	0.7
8	Sina Insurance company	0.53	0.57	0.84
9	Mellat Insurance company	0.28	0.07	0.78
10	Dey Insurance company	1	1	1
11	Saman Insurance company	0.62	0.95	0.67
12	Novin Insurance company	0.28	0.35	0.39
13	Pasargad Insurance company	1	1	1
14	Mihan Insurance company	0.82	1	1
15	Kowsar Insurance company	1	1	1
16	Ma Insurance company	0.43	0.44	0.71
17	Arman Insurance company	0.39	1	1
18	Ta'avon Insurance company	1	1	1
19	Sarmad Insurance company	0.81	0.92	0.88
20	Tejarat-e- No Insurance company	1	1	0.75

Table 4: Virtual Companies for Merger and Acquisition

1	**Dana Insurance company**	**Alborz Insurance company**	47	**Sina Insurance company**	**Razi Insurance company**
2	**Moallem Insurance company**	**Alborz Insurance company**	48	**Mellat Insurance company**	**Razi Insurance company**
3	**Karafarin Insurance company**	**Alborz Insurance company**	49	**Saman Insurance company**	**Razi Insurance company**
4	**Razi Insurance company**	**Alborz Insurance company**	50	**Novin Insurance company**	**Razi Insurance company**
5	**Sina Insurance company**	**Alborz Insurance company**	51	**Mihan Insurance company**	**Razi Insurance company**
6	**Mellat Insurance company**	**Alborz Insurance company**	52	**Ma Insurance company**	**Razi Insurance company**
7	**Saman Insurance company**	**Alborz Insurance company**	53	**Arman Insurance company**	**Razi Insurance company**
8	**Novin Insurance company**	**Alborz Insurance company**	54	**Sarmad Insurance company**	**Razi Insurance company**
9	**Mihan Insurance company**	**Alborz Insurance company**	55	**Tejarat-e- No Insurance company**	**Razi Insurance company**
10	**Ma Insurance company**	**Alborz Insurance company**	56	**Mellat Insurance company**	**Sina Insurance company**
11	**Arman Insurance company**	**Alborz Insurance company**	57	**Saman Insurance company**	**Sina Insurance company**
12	**Sarmad Insurance company**	**Alborz Insurance company**	58	**Novin Insurance company**	**Sina Insurance company**
13	**Tejarat-e- No Insurance compa-ny**	**Alborz Insurance company**	59	**Mihan Insurance company**	**Sina Insurance company**
14	**Moallem Insurance company**	**Dana Insurance company**	60	**Ma Insurance company**	**Sina Insurance company**
15	**Karafarin Insurance company**	**Dana Insurance company**	61	**Arman Insurance company**	**Sina Insurance company**
16	**Razi Insurance company**	**Dana Insurance company**	62	**Sarmad Insurance company**	**Sina Insurance company**
17	**Sina Insurance company**	**Dana Insurance company**	63	**Tejarat-e- No Insurance company**	**Sina Insurance company**
18	**Mellat Insurance company**	**Dana Insurance company**	64	**Saman Insurance company**	**Mellat Insurance company**
19	**Saman Insurance company**	**Dana Insurance company**	65	**Novin Insurance company**	**Mellat Insurance company**
20	**Novin Insurance company**	**Dana Insurance company**	66	**Mihan Insurance company**	**Mellat Insurance company**
21	**Mihan Insurance company**	**Dana Insurance company**	67	**Ma Insurance company**	**Mellat Insurance company**

Table 4: continue

22	**Ma Insurance company**	**Dana Insurance company**	68	**Arman Insurance company**	**Mellat Insurance company**
23	**Arman Insurance company**	**Dana Insurance company**	69	**Sarmad Insurance company**	**Mellat Insurance company**
24	**Sarmad Insurance company**	**Dana Insurance company**	70	**Tejarat-e- No Insurance company**	**Mellat Insurance company**
25	**Tejarat-e- No Insurance company**	**Dana Insurance company**	71	**Novin Insurance company**	**Saman Insurance company**
26	**Karafarin Insurance company**	**Moallem Insurance company**	72	**Mihan Insurance company**	**Saman Insurance company**
27	**Razi Insurance company**	**Moallem Insurance company**	73	**Ma Insurance company**	**Saman Insurance company**
28	**Sina Insurance company**	**Moallem Insurance company**	74	**Arman Insurance company**	**Saman Insurance company**
29	**Mellat Insurance company**	**Moallem Insurance company**	75	**Sarmad Insurance company**	**Saman Insurance company**
30	**Saman Insurance company**	**Moallem Insurance company**	76	**Tejarat-e- No Insurance company**	**Saman Insurance company**
31	**Novin Insurance company**	**Moallem Insurance company**	77	**Mihan Insurance company**	**Novin Insurance company**
32	**Mihan Insurance company**	**Moallem Insurance company**	78	**Ma Insurance company**	**Novin Insurance company**
33	**Ma Insurance company**	**Moallem Insurance company**	79	**Arman Insurance company**	**Novin Insurance company**
34	**Arman Insurance company**	**Moallem Insurance company**	80	**Sarmad Insurance company**	**Novin Insurance company**
35	**Sarmad Insurance company**	**Moallem Insurance company**	81	**Tejarat-e- No Insurance company**	**Novin Insurance company**
36	**Tejarat-e- No Insurance company**	**Moallem Insurance company**	82	**Ma Insurance company**	**Mihan Insurance company**
37	**Razi Insurance company**	**Karafarin Insurance company**	83	**Arman Insurance company**	**Mihan Insurance company**
38	**Sina Insurance company**	**Karafarin Insurance company**	84	**Sarmad Insurance company**	**Mihan Insurance company**
39	**Mellat Insurance company**	**Karafarin Insurance company**	85	**Tejarat-e- No Insurance company**	**Mihan Insurance company**
40	**Saman Insurance company**	**Karafarin Insurance company**	86	**Arman Insurance company**	**Ma Insurance company**
41	**Novin Insurance company**	**Karafarin Insurance company**	87	**Sarmad Insurance company**	**Ma Insurance company**
42	**Mihan Insurance company**	**Karafarin Insurance company**	88	**Tejarat-e- No Insurance company**	**Ma Insurance company**
43	**Ma Insurance company**	**Karafarin Insurance company**	89	**Sarmad Insurance company**	**Arman Insurance company**
44	**Arman Insurance company**	**Karafarin Insurance company**	90	**Tejarat-e- No Insurance company**	**Arman Insurance company**
45	**Sarmad Insurance company**	**Karafarin Insurance company**	91	**Tejarat-e- No Insurance company**	**Sarmad Insurance company**
46	**Tejarat-e- No Insurance company**	**Karafarin Insurance company**			

5.3 Results of Calculating and Examining the Efficiency Components of the Merged Virtual Companies

After identifying the merged virtual companies (Table 4), the overall efficiency and its components were examined. First, the efficiency of all companies was calculated, the results of which are shown in Table 5. According to Table 5, the efficiency distributions of the merged companies are shown in Figure 5.

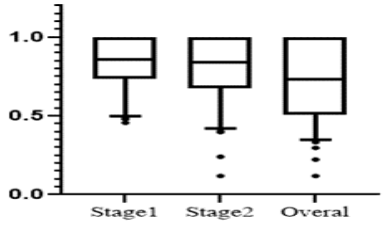

Fig.5: Efficiency of All Merged Virtual Companies

As shown in Figure 5, the consolidation of companies in Stage 1 is more efficient than in Stage 2. In fact, this distribution indicates that in insurance companies, the number of employees and labor costs, general and administrative costs, fixed assets and even wages can be more easily than Life-insurance and non-life insurance premiums for a certain level of pure life and non-life insurance profits and returns on invested assets. Based on Table 4, the consolidation of 29 companies (Alborz-Dana, Alborz-Karafarin, Alborz-Sina, Alborz-Ma, Alborz-Tejarate no, Dana-Moallem, Dana-Karafarin, Dana-Sina, Dana-Mellat, Dana-Mihan, Moallem - Arman, Moallem – Tejarate no, Karafarin - Razi, Karafarin - Sina, Karafarin - Mellat, Karafarin - Saman, Karafarin - Novin, Karafarin - Mihan, Karafarin - Ma, Karafarin - Arman, Karafarin - Sarmad, Razi - Sina, Sina-Saman, Mellat-Sarmad, Saman-Novin, Saman-Mihan, Saman-Ma, Saman-Arman and Saman-Sarmad Kara and two companies (Razi-Novin, Mellat-Tejarate no) are almost efficient. As the consolidations were made based on the information of 2019 and the three insurance companies of Dana, Mihan and Arman were inefficient in 2017 and fully efficient in the two years 2018 and 2019, so, mostly the consolidation of these three companies with other companies was efficient. If the consolidations of Dana, Mihan and Arman Insurance companies are not considered with other companies, we have 18 efficient consolidations and 2 nearly- efficient companies, and the three consolidations of Alborz-Mellat, Sina-Arman and Sina-Sarmad create the lowest efficiency. If in the insurance industry it is possible to improve efficiency by changing input and intermediate variables, then these three consolidations have the greatest potential for improvement. Also, if it is possible in any company to use the results of calculating the efficiency and identifying the strengths and weaknesses, this brings the companies closer to the optimal and efficient points of the market and then consolidate the companies. Then, before merging, the companies will have the potential to improve efficiency technically. Now, when the companies are consolidated, the efficiency of consolidations should be compared with efficient companies (Model 7). Therefore, with this assumption, the pure merger efficiency is obtained as shown in Table 6. If EJ * <1 then technically the inputs can be reduced by merging and if EJ *> 1 , the inputs cannot be technically reduced by merging . Figure 6 shows the distribution of pure merger efficiency. As show in this Figure, some of consolidations have a efficiency of more than 1, so with some of these mergers, we cannot reduce the inputs. This distribution also shows that more EJ *> 1 occurs in stage 2 than in stage 1, and that the median is almost the same in 1, 2, and overall stages. Table 6 also shows that the best merger that can lead to increased synergy is the merger of companies of Alborz-Razi, Alborz-Saman, Dana-Moallem, Dana-Sina, Dana-Saman, Dana-Mihan, Sina-Mellat , Mellat-Arman, Saman-Tejarate no, Novin-Mihan and Novin-Ma.

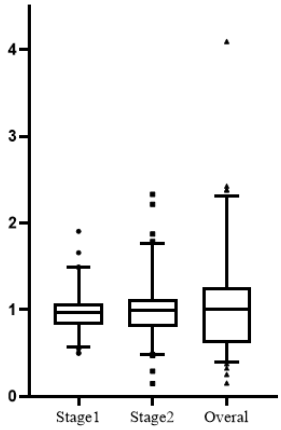

Fig.6: Pure Merger Efficiency

Comparing the output of overall efficiency and pure merger efficiency, it can be seen that except for two consolidations (Dana-Sina and Dana-Mihan), other consolidations that were efficient in overall efficiency calculations are not efficient in the pure merger efficiency stage. Mihan and Dana Insurance companies were also efficient before merger, but Sina insurance company had an efficiency of 0.84 before merger, which after merging with Dana insurance is in a good position in terms of both overall efficiency and pure merger efficiency. Also, the three Alborz-Mellat, Sina-Arman and Sina-Sarmad consolidations still have the lowest pure merger efficiency.

In order to understand which factor favors or works against the consolidation, the efficiency components of the consolidations were examined and the results are as follows. The first factor is the technical or learning efficiency of the merged companies, which is calculated according to Model 7 (Table 7) and its estimated distribution is as depicted in Figure 7:

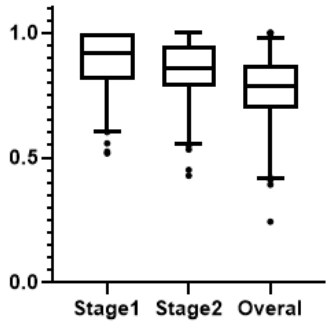

Fig.7: Technical or Learning Efficiency of Merged Virtual Companies

As can be found from the technical efficiency distribution table, the technical efficiency distribution is similar to the overall efficiency distribution, and in this type of efficiency, stage 1 has higher efficiency than stage 2 (median of first stage 0.92 and middle of the second stage is 0.85). Also, the distribution of technical efficiency indicates that although the complete efficiency obtained from the consolidation in the general stage includes only 3 consolidations (Dana-Mihan, Dana-Arman, Mihan-Arman), the distribution of technical efficiency is better than the overall efficiency. Out of 91 consolidations resulting from mergers and acquisitions in this type of efficiency, 68 consolidations have technical efficiency higher than 0.7, while in the overall efficiency of 49 consolidations, the overall efficiency is higher than 0.7. Also, according to the expectations of the two companies, Karafarin insurance and Novin insurance companies, which had the lowest performance, their consolidation also had the lowest technical efficiency. Also, the consolidations of these two companies with other companies also provide low technical efficiency. Another important point in technical efficiency is that the consolidation of companies whose overall efficiency was low is not lower than the average in technical efficiency, so it can be said that the reason for their reduced efficiency is in the two areas of harmony and scale. In other words, except for Karafarin and Novin consolidations, the reduced efficiency reductions is related to two factors of harmony and scale.

Table 5: Overall Efficiency

Companies	Stage1	Stage2	Overall	Companies	Stage1	Stage2	Overall
1	1	1	1	47	0.7282	1	1
2	1	0.7279	0.7279	48	1	0.8498	0.8498
3	1	1	1	49	1	0.8307	0.8307
4	1	0.7331	0.7331	50	0.771	0.9993	0.9993
5	1	1	1	51	0.8542	0.7456	0.6368
6	1	0.1185	0.1185	52	0.8999	0.753	0.6776
7	0.4837	1	0.6955	53	0.7142	0.6261	0.4518
8	1	0.7716	0.7716	54	1	0.8617	0.8617
9	1	0.8166	0.8166	55	1	0.828	0.828
10	1	1	1	56	0.8928	0.9021	0.8055
11	0.5552	0.9251	0.6248	57	0.7585	1	1
12	0.5625	0.7003	0.3939	58	1	0.5274	0.5274
13	1	1	1	59	0.9114	0.5309	0.5054
14	1	1	1	60	0.7215	0.5937	0.3776
15	1	1	1	61	0.8302	0.5467	0.2963
16	0.7149	1	0.7149	62	0.8867	0.2409	0.2227
17	1	1	1	63	0.5816	0.4328	0.3857
18	1	1	1	64	0.8633	0.4274	0.3945
19	1	0.8819	0.8825	65	1	0.3977	0.3977
20	0.8955	1	0.8955	66	0.9095	0.4015	0.3605
21	1	1	1	67	0.6706	0.9633	0.8734
22	1	0.6168	0.6168	68	0.5044	0.9121	0.8823
23	0.7702	0.4926	0.3794	69	0.4979	1	1
24	0.7523	0.8436	0.6969	70	0.6611	0.9608	0.9651
25	0.9666	0.62	0.5994	71	0.4791	1	1
26	1	0.6421	0.6421	72	0.4566	1	1
27	0.7563	0.6553	0.4964	73	0.5296	1	1
28	0.7329	0.6433	0.4712	74	0.5674	1	1
29	0.8884	0.7498	0.6661	75	0.5025	1	1
30	0.7539	0.6204	0.4621	76	0.675	0.7684	0.6888
31	0.8677	0.6825	0.5922	77	0.7267	0.8984	0.6894
32	0.8549	0.6327	0.5406	78	0.7118	0.7182	0.6087
33	0.8394	0.7045	0.5096	79	0.9468	0.7562	0.7158
34	1	1	1	80	0.6652	0.6183	0.4113
35	0.7976	0.6779	0.6825	81	1	0.7918	0.7918
36	0.7539	1	1	82	1	0.7529	0.7529
37	1	1	1	83	0.9375	0.8352	0.7829
38	0.8947	1	1	84	0.7486	1	0.4965
39	0.7591	1	1	85	0.753	0.7562	0.3992
40	0.7403	1	1	86	0.8121	0.7819	0.4631
41	0.9178	1	1	87	0.7427	0.6397	0.332
42	0.752	1	1	88	0.8062	0.8356	0.4943
43	1	1	1	89	0.8573	0.7803	0.4731
44	0.9633	1	1	90	0.8163	1	0.5897
45	0.8514	1	1	91	0.6643	0.8401	0.417
46	1	0.547	0.547				

Table 6: Pure Merger Efficiency

Companies	Stage1	Stage2	Overall	Companies	Stage1	Stage2	Overall
1	1	1.1264	1.115	47	0.9715	1.1413	1.2951
2	1	0.9942	0.9237	48	1.1764	0.9386	1.1232
3	1	1.5492	1.8347	49	1.9047	0.864	1.2235
4	1.1796	0.8195	1.0187	50	1.4886	1.1281	1.7127
5	1	1.3151	1.3043	51	1.2934	0.7456	0.7963
6	1	0.1512	0.1568	52	1.4932	0.753	0.9605
7	0.5772	1.1441	0.9844	53	1.0697	0.6261	0.5619
8	1.0949	1.067	1.1635	54	1.2133	0.9104	1.0519
9	1	1.0467	1.0496	55	1.6591	0.828	1.149
10	1.0721	1.2576	1.377	56	0.8928	1.134	0.9866
11	0.5552	1.0965	0.7951	57	1.0121	1.1793	1.3442
12	0.5625	0.8347	0.4934	58	1.1855	0.6998	0.7719
13	1.0337	1.1778	1.36	59	0.9114	0.6482	0.5643
14	1	1.0884	1.0398	60	0.82	0.6882	0.4781
15	1	1.0955	1.2283	61	0.8302	0.6507	0.3293
16	0.8094	1	0.7677	62	0.8867	0.2925	0.2562
17	1	1.0441	1.0278	63	0.6346	0.5129	0.4742
18	1	1.0389	1.0435	64	1.0275	0.483	0.533
19	1.1412	0.8932	0.9728	65	1.0932	0.5136	0.5633
20	0.9736	1.0398	1.0074	66	0.9095	0.4717	0.4246
21	1	1	1	67	0.7339	1.0892	1.1471
22	1.0529	0.6168	0.6494	68	0.5044	1.0453	1.0137
23	0.7702	0.4926	0.3794	69	0.4979	1.168	1.1949
24	0.7523	0.8575	0.7084	70	0.7003	1.0972	1.2454
25	0.9926	0.62	0.6155	71	0.8588	1.152	1.7122
26	1	1.0528	1.1123	72	0.6737	1.0615	1.3191
27	0.9579	0.8046	0.6212	73	0.8475	1.045	1.4548
28	0.7329	0.8593	0.5459	74	0.8263	1.0533	1.3075
29	0.8884	0.9814	0.7946	75	0.616	1.1035	1.2608
30	0.9527	0.766	0.5967	76	1.0754	0.8083	0.9872
31	1.0069	0.9387	0.8228	77	0.947	1.1416	1.0172
32	0.8549	0.827	0.591	78	1.0779	0.8427	1.0146
33	0.9189	0.879	0.6191	79	1.2696	0.9113	1.1051
34	1	1.2792	1.1032	80	0.741	0.7429	0.5351
35	0.7976	0.8591	0.7767	81	1.4895	0.9475	1.3206
36	0.7884	1.2742	1.1772	82	1.236	0.7529	0.9306
37	1.3384	1.4721	2.3819	83	0.9375	0.8352	0.7829
38	0.8947	1.7894	2.0058	84	0.7486	1.0939	0.5428
39	0.7591	1.6455	1.7145	85	0.8809	0.7562	0.467
40	0.99	1.5562	2.2631	86	0.9695	0.7819	0.5528
41	1.0904	2.2162	4.0949	87	0.826	0.681	0.4031
42	0.752	2.3319	2.4266	88	1.1031	0.8356	0.6763
43	1.126	1.5908	2.3856	89	0.8573	0.8419	0.5112
44	0.9633	1.8748	2.2181	90	0.9265	1	0.6693
45	0.8514	1.7545	1.6246	91	0.716	0.9044	0.4936
46	1.0635	0.9947	1.3916				

Table 7: Technical or Learning Efficiency

Companies	Stage1	Stage2	Overall	Companies	Stage1	Stage2	Overall
1	1	0.8878	0.8968	47	0.7495	0.8762	0.7722
2	1	0.7321	0.788	48	0.85	0.9053	0.7566
3	1	0.6455	0.5451	49	0.525	0.9614	0.679
4	0.8478	0.8946	0.7196	50	0.5179	0.8858	0.5835
5	1	0.7604	0.7667	51	0.6604	1	0.7997
6	1	0.7836	0.7559	52	0.6026	1	0.7055
7	0.8381	0.874	0.7065	53	0.6677	1	0.804
8	0.9133	0.7231	0.6632	54	0.8242	0.9465	0.8192
9	1	0.7802	0.778	55	0.6027	1	0.7206
10	0.9327	0.7952	0.7262	56	1	0.7955	0.8164
11	1	0.8437	0.7858	57	0.7494	0.8479	0.744
12	1	0.839	0.7983	58	0.8435	0.7537	0.6833
13	0.9674	0.849	0.7353	59	1	0.8191	0.8956
14	1	0.9188	0.9618	60	0.8799	0.8627	0.7898
15	1	0.9129	0.8141	61	1	0.8402	0.8997
16	0.8833	1	0.9312	62	1	0.8237	0.8693
17	1	0.9577	0.973	63	0.9165	0.8439	0.8133
18	1	0.9625	0.9583	64	0.8402	0.8849	0.7401
19	0.8763	0.9873	0.9071	65	0.9148	0.7744	0.7061
20	0.9198	0.9617	0.8889	66	1	0.8511	0.849
21	1	1	1	67	0.9137	0.8844	0.7614
22	0.9498	1	0.9498	68	1	0.8726	0.8704
23	1	1	1	69	1	0.8561	0.8369
24	1	0.9838	0.9838	70	0.944	0.8757	0.7749
25	0.9738	1	0.9738	71	0.5579	0.8681	0.584
26	1	0.6099	0.5772	72	0.6777	0.9421	0.7581
27	0.7895	0.8144	0.799	73	0.6249	0.957	0.6874
28	1	0.7486	0.8632	74	0.6867	0.9494	0.7648
29	1	0.764	0.8383	75	0.8158	0.9062	0.7932
30	0.7913	0.8099	0.7745	76	0.6277	0.9506	0.6977
31	0.8618	0.727	0.7198	77	0.7674	0.787	0.6777
32	1	0.7651	0.9147	78	0.6603	0.8522	0.6
33	0.9135	0.8015	0.8231	79	0.7457	0.8298	0.6477
34	1	0.7818	0.9065	80	0.8977	0.8323	0.7687
35	1	0.7891	0.8787	81	0.6714	0.8357	0.5996
36	0.9563	0.7848	0.8495	82	0.8091	1	0.8091
37	0.7472	0.6793	0.4198	83	1	1	1
38	1	0.5588	0.4985	84	1	0.9141	0.9148
39	1	0.6077	0.5833	85	0.8548	1	0.8548
40	0.7478	0.6426	0.4419	86	0.8377	1	0.8377
41	0.8417	0.4512	0.2442	87	0.8992	0.9394	0.8236
42	1	0.4288	0.4121	88	0.7309	1	0.7309
43	0.8881	0.6286	0.4192	89	1	0.9268	0.9255
44	1	0.5334	0.4508	90	0.8811	1	0.8811
45	1	0.57	0.6155	91	0.9277	0.929	0.8448
46	0.9403	0.5499	0.3931				

Then, according to Model 9, the harmony efficiency of the merged companies is calculated (Table 8), the estimated distribution of which is as shown in Figure 8:

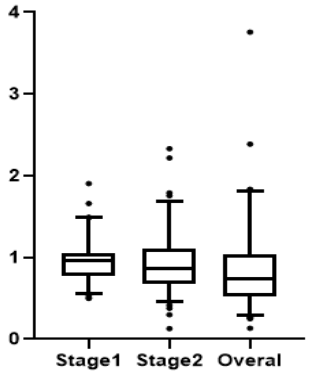

Fig.8: Harmony or Scope Efficiency of Merged Virtual Companies

As mentioned in section 3, if the coordination efficiency is higher than 1, the consolidation eliminates the resource allocation, and if it is less than 1, the merger is in favor of the harmony effect. As shown in Table 8, in the stages 1,2 and overall, 27, 36 and 26 consolidations, respectively led into the 36 and 26 consolidations lead to a elimination of resource allocation. In other words, in the second stage, more consolidations than in the first stage lead to the neutralization of the harmony effect, but, the median in the second stage (0.86) is lower than that of the first stage (0.96). Also, out of 29 fully efficient consolidations and 2 relatively efficient consolidations in the calculated overall efficiency, 16 consolidations (Alborz-Dana, Alborz-Karafarin, Alborz-Sina, Alborz-Ma, Alborz-Tejarate no, Moallem-Arman, Karafarin-Razi, Karafarin - Sina, Karafarin-Mellat, Karafarin -Saman, Karafarin -Novin, Karafarin -Mihan, Karafarin -Ma, Karafarin -Arman, Karafarin -Sarmad, Razi-Novin) deteriorated the allocation of resources and consolidations (Dana- Karafarin, Moalem-Tejarate no, Razi-Mellat, Sina-Saman, Mellat-Sarmad, Mellat-Tejarate no, Saman-Novin, Saman-Mihan, Saman-Ma, Saman-Arman, Saman-Sarmad, Dana-Mihan, Dana-Moallem, Dana-Sina , Dana-Mellat) are in favor of merger, of which out of 15 consolidations, 1 consolidation (Dana-Mihan) is fully efficient and 3 consolidations (Dana-Moalem, Dana-Sina, Dana-Mellat) are relatively efficient and 11 consolidations have the potential to improve. They have this area. On the other hand, 6 other consolidations (Alborz-Razi, Alborz-Novin, Sarmad-Razi, Mellat-Sina, Arman-Tejarat-e-No, Novin-Arman) despite being in the inefficient section in the calculation of overall efficiency, but in terms of the harmony effect is in good condition. Also, the three Alborz-Mellat, Sina-Arman and Sina-Sarmad consolidations, which had the lowest efficiency, are also among the lowest efficiencies in terms of resource allocation.

Finally, according to Model 10, the scale or size efficiency of the merged companies was calculated (Table 9), the estimated distribution of which is as illustrated in Figure 9:

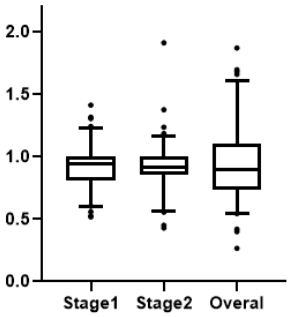

Fig. 9: Scale or Size Efficiency of Merged Virtual Companies

Table 8: Harmony or Scope Efficiency

Companies	Stage1	Stage2	Overall	Companies	Stage1	Stage2	Overall
1	1	1.1264	1.115	47	0.9715	1.1413	0.9431
2	1	0.757	0.7033	48	1.1764	0.9375	1.1219
3	1	1.5492	1.8347	49	1.9047	0.8493	1.2027
4	1.1796	0.7342	0.9148	50	1.4886	1.1289	1.3214
5	1	1.3151	1.3043	51	1.2934	0.6921	0.7391
6	1	0.1293	0.134	52	1.4846	0.7045	0.8985
7	0.5772	1.1441	0.6846	53	1.0697	0.5956	0.5291
8	1.0949	0.8607	0.9364	54	1.2133	0.9105	1.0521
9	1	0.7368	0.7388	55	1.6591	0.8285	1.1497
10	1.0721	1.2576	1.377	56	0.8928	1.1359	0.9882
11	0.5552	0.8584	0.5144	57	1.0121	0.5227	0.5344
12	0.5625	0.6641	0.3926	58	1.1855	0.6228	0.5266
13	1.0337	1.1778	1.36	59	0.9114	0.5808	0.3316
14	1	1.0884	1.0398	60	0.82	0.5978	0.3859
15	1	1.0955	0.9054	61	0.7958	0.5062	0.2677
16	0.8094	1	0.5436	62	0.7744	0.2974	0.2607
17	1	1.0441	1.0278	63	0.6346	0.3766	0.3155
18	1	1.0389	1.0435	64	1.0275	0.4821	0.513
19	1.1412	0.641	0.6977	65	1.0932	0.4799	0.5263
20	0.8177	1.0398	0.8461	66	0.8978	0.5677	0.5158
21	1	1	1	67	0.8656	1.0149	0.8074
22	1.0529	0.6727	0.7083	68	0.5044	1.028	0.5198
23	0.7702	0.4157	0.2499	69	0.4979	1.168	0.5949
24	0.7523	0.8001	0.4557	70	0.7003	0.9369	0.7001
25	0.9926	0.5931	0.4498	71	0.8588	1.152	0.8203
26	1	1.0056	0.8303	72	0.6737	1.0615	0.6023
27	0.9579	0.7615	0.4776	73	0.8475	1.045	0.7704
28	0.7329	0.7481	0.3523	74	0.8263	1.0533	0.7419
29	0.8884	0.8165	0.4738	75	0.616	1.1035	0.6335
30	0.9405	0.6232	0.4278	76	1.0756	0.7633	0.702
31	0.9415	0.8543	0.6626	77	0.9277	1.0064	0.8489
32	0.6495	0.7778	0.417	78	1.0726	0.7596	0.768
33	0.8666	0.8108	0.5516	79	1.2694	0.8073	1.0199
34	1	1.2792	1.1032	80	0.7214	0.6419	0.4501
35	0.7188	0.6266	0.4489	81	1.4895	0.9072	1.2645
36	0.7362	1.2742	0.8875	82	1.236	0.7011	0.8665
37	1.3384	1.1081	1.7928	83	0.9375	0.7784	0.7385
38	0.6855	1.7894	1.7992	84	0.7486	1.0939	0.7984
39	0.6813	1.6455	1.3244	85	0.8809	0.6113	0.5875
40	0.9899	1.1534	1.2418	86	0.9695	0.6788	0.658
41	1.0904	2.2162	3.7583	87	0.8216	0.6277	0.5301
42	0.752	2.3319	1.8248	88	0.8094	0.7859	0.8651
43	1.126	1.5908	2.3856	89	0.6064	0.7846	0.6737
44	0.9633	1.3902	1.5844	90	0.6693	1	0.9265
45	0.8514	1.7545	1.3832	91	0.535	0.7402	0.5407
46	1.0635	0.9787	1.3692				

Table 9: Scale or Size Efficiency

Compa-nies	Stage1	Stage2	Overall	Compa-nies	Stage1	Stage2	Overall
1	1	0.8878	0.8968	47	0.7495	0.8762	1.0604
2	1	0.9616	1.035	48	0.85	0.9064	0.7575
3	1	0.6455	0.5451	49	0.525	0.978	0.6907
4	0.8478	0.9985	0.8014	50	0.5179	0.8852	0.7562
5	1	0.7604	0.7667	51	0.6604	1.0773	0.8616
6	1	0.9166	0.8843	52	0.6062	1.0688	0.7541
7	0.8381	0.874	1.0159	53	0.6677	1.0512	0.8539
8	0.9133	0.8965	0.824	54	0.8242	0.9464	0.8191
9	1	1.1084	1.1053	55	0.6027	0.9994	0.7202
10	0.9327	0.7952	0.7262	56	1	0.7942	0.8151
11	1	1.0778	1.2147	57	0.7494	1.9132	1.8711
12	1	1.0544	1.0033	58	0.8435	0.8468	1.0015
13	0.9674	0.849	0.7353	59	1	0.9141	1.524
14	1	0.9188	0.9618	60	0.8799	0.9932	0.9785
15	1	0.9129	1.1045	61	1.0432	1.0801	1.107
16	0.8833	1	1.3151	62	1.145	0.8099	0.8544
17	1	0.9577	0.973	63	0.9165	1.1493	1.2225
18	1	0.9625	0.9583	64	0.8402	0.8865	0.769
19	0.8763	1.3758	1.2649	65	0.9148	0.8287	0.7557
20	1.0952	0.9617	1.0584	66	1.013	0.7072	0.699
21	1	1	1	67	0.7748	0.9491	1.0817
22	0.9498	0.9169	0.8709	68	1	0.8873	1.6974
23	1	1.185	1.5182	69	1	0.8561	1.6808
24	1	1.0543	1.5294	70	0.944	1.0255	1.3786
25	0.9738	1.0454	1.3327	71	0.5579	0.8681	1.219
26	1	0.6385	0.7733	72	0.6777	0.9421	1.6603
27	0.7895	0.8605	1.0394	73	0.6249	0.957	1.2979
28	1	0.86	1.3374	74	0.6867	0.9494	1.3479
29	1	0.9183	1.4058	75	0.8158	0.9062	1.5785
30	0.8016	0.9956	1.0803	76	0.6276	1.0067	0.9812
31	0.9217	0.7989	0.8938	77	0.7833	0.8927	0.8121
32	1.3162	0.8134	1.2965	78	0.6636	0.9454	0.7925
33	0.9686	0.8689	0.9239	79	0.7459	0.9368	0.7019
34	1	0.7818	0.9065	80	0.9221	0.9633	0.9137
35	1.1096	1.0819	1.5205	81	0.6714	0.8727	0.6262
36	1.0241	0.7848	1.1267	82	0.8091	1.0739	0.8689
37	0.7472	0.9025	0.5578	83	1	1.073	1.0601
38	1.3052	0.5588	0.5558	84	1	0.9141	0.6219
39	1.1142	0.6077	0.755	85	0.8548	1.237	0.6795
40	0.7479	0.867	0.8053	86	0.8377	1.1519	0.7038
41	0.8417	0.4512	0.2661	87	0.9039	1.0191	0.6262
42	1	0.4288	0.548	88	0.996	1.0632	0.5714
43	0.8881	0.6286	0.4192	89	1.4138	0.9945	0.7023
44	1	0.7193	0.6311	90	1.2196	1	0.6365
45	1	0.57	0.723	91	1.2418	1.135	0.7712
46	0.9403	0.5589	0.3995				

As shown in Figure 8, in stages 1 and 2, most consolidations have increasing returns to scale efficiencies. In stage 1, about 12 companies have a return to scale of above 1, the highest of which is 1.4 (Arman-

Sarmad) and only 54 companies (Moalem-Mihan, Karafarin -Sina, Arman-Tejarate no, Sarmad-Tejarate no) have scale efficiency between 1.2 and 1.4. In stage 2, about 23 companies have returns to scale of over 1, the highest of which is 1.9 (Sina-Saman) and only 2 companies (Dana-Saman and Mihan-Tejarate no) have scale efficiency ranging between 1.2 and 1.9. But in the overall stage, about 35 consolidations lead to the oversizing of companies, the highest of which is 1.9 (Sina-Saman) and 8 of its consolidations (Dana-Arman, Dana-Sarmad, Moallem-Sarmad, Sina-Mihan, Mellat-Arman, Mellat-Sarmad, Saman-Mihan, Saman-Sarmad) have returns to scale of above 1.5, and the Dana-Mihan consolidation has a fixed returns to scale, and 8 companies have relatively fixed returns to scale. 3 consolidations of Alborz-Mellat, Sina-Sarmad and Sina-Arman, which have the lowest overall efficiency and low harmony efficiency, are about 0.8 in terms of scale efficiency of the first two consolidations and 1.1 in the last consolidation. As shown in Table 8 and Table 9, according to Bogetoft and Otto [5], it can be seen that if the technology used in their consolidation is convex, then the positive harmony effect is weak or in other words $HA \leq 1$, but the scale effect may favor or acts against the consolidation, if the scale effect is greater than one, the harmony effect is below 1.

6 Conclusions and Suggestions

This paper makes it possible to evaluate the performance of insurance companies before mergers and acquisitions, and to identify the appropriate strategy between the two potential candidates for the merger. For this purpose, first, by non-radial MSBM model, the efficiency of insurance companies in the three periods of 2017, 2018 and 2019 was calculated, and then the companies that were efficient in three consecutive periods and had a good position in terms of efficiency were excluded from the process and the rest were considered as consolidate candidates. Before any action to ensure that the resulting consolidation does not create a monopoly in the industry, Herfindahl- Hirschman Index was used, the results of calculations showed that the merger and acquisition in this industry is in accordance with the principle of competition. Therefore, according to the selected candidate, the different consolidations of this merger and acquisition are defined and virtual companies are created. Then, the efficiency of these virtual companies was calculated and the performance components of this process including technical or learning efficiency (LE), harmony or scope efficiency (HA) and scale or size efficiency (SI) were also calculated. In each consolidation, depending on the nature of the inputs, the type of component efficiency favors or acts against the consolidation performed, which before this process, the proposed models provide predictability. The calculations performed in this research showed that the best consolidation is Dana-Mihan and Dana-Sina and the 3 consolidations of Alborz-Mellat, Sina-Arman and Sina-Sarmad have the lowest efficiency, so these 3 consolidations have higher improvement potential. The components of these three consolidations showed that the harmony effect in this merger and acquisition is to the detriment of the process and that the greatest focus should be on this area. The calculations also showed that if the effect of scale in the consolidation is greater than one, then the effect of harmony is less than one and the inverse relation is not necessarily satisfied. Finally, according to the strategy of consolidating its agents, the best and most appropriate consolidation can be selected, and also before doing any consolidation, its strengths and weaknesses can be identified and, if possible, the best consolidation can be achieved.

In order to further improve research in this field, the followings are recommended to the researchers:

- Solvency criteria should also be used in calculating efficiency.
- Identification of the consolidate candidate can also be done by the method of Wanke et al. [44].
- To establish virtual companies, use consolidations of 3 or above insurance companies.

Acknowledgments

We would like to express our very great appreciation to Mr. Yousef Moghadami, Advisor to supervision vice presidency of Central Insurance of the Islamic Republic of Iran for his valuable and constructive suggestions during this research work. His willingness to give his time so generously has been very much appreciated.

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