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Determinants of Profitability of the Insurance Industry: An Application of the TVP-DMA Model

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Abstract:

Today, insurance is an integral part of the financial system of any country. Insurance companies, as important financial institutions in the capital market, in addition to hedging risks, also play the role of financial intermediaries. As for-profit institutions, these companies must achieve profitability by performing these two roles. For this purpose, this study was conducted quarterly using the TVP-DMA model to identify the factors determining the profitability of the Iranian insurance industry during the years 1390 to 1401. The results showed that the variables of financial leverage, exchange rate, and premium growth are the most influential variables affecting the performance of the Iranian insurance industry, respectively. The results also show that the way and probability of affecting the performance of these variables on the performance of the insurance industry is not constant over time and is influenced by factors such as the JCPOA agreement, withdrawal from the JCPOA, the continuation of the privatization process, the elimination of the insurance industry value-added tax and changes in the statutes of insurance companies, the announcement of the formation of the General Fund for Natural Disaster Insurance, and the use of the capital market capacities of the insurance industry.

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1. Introduction

Financial intermediaries, as economic lubricants, keep the economy's engine running. They contribute significantly to the economic prosperity of any country by collecting resources through savings and allocating them to activities with the highest returns (Msomi, 2023; Keshtgar, 2020). In addition, they manage investments, transfer risk, and implement corporate governance principles; moreover, they provide various financial instruments to the market (Kryvoshlyk et al. 2024; Kiptoo et al. 2021). For this reason, financial institutions, especially banks and insurance companies, play a vital role in financing and insuring economic activities and contribute to the financial system's stability and the economy's development (Alsalami et al., 2023; Worku et al., 2024).

The insurance sector in developing and developed countries plays a key role in the financial services industry. Through insurance, economic actors can effectively manage threatening risks (Olarewaju & Msomi, 2022). In addition, these companies contribute to economic development, efficient allocation of resources, facilitating trade and commerce, reducing transaction costs, creating liquidity, reducing financial losses, and investing in vital sectors of the economy (Otonne, 2023; Shiu, 2020).

However, the success of insurance companies in fulfilling these tasks depends on their performance. The performance of any company not only helps to increase the market value of that company but also leads to the growth of the entire industry and, ultimately, to the economy's prosperity. Generally, a company's performance can be measured by its profitability. Profitability is an essential tool for evaluating the internal performance of a company (Jumono et al. 2019; Heryán et al. 2024)،because it indicates the insurer's ability to invest. Observers determine the insurer's survival by relying on profitability-related financial characteristics (Kumar et al., 2023).

Investigating financial health and reliability, recognizing the factors affecting insurers' profitability, and identifying them accurately are essential tasks for researchers and financial analysts. (Susabiyani et al., 2021). Due to the multiplicity and variety of factors and variables affecting profitability and the possibility of influencing variables at different times, the models used to predict or estimate profitability should be sensitive to how explanatory variables are influenced over time. In other words, the models should be able to estimate the coefficients of the variables over time in order to correctly show the effect of changes in explanatory variables on profitability. Since the economy is always exposed to various shocks, and these shocks may impact profitability, identifying the predictors of profitability is important to policymakers and planners and helps them for more efficient management. on the other hand, the results can affect economic enterprises' willingness to invest and households' willingness to predict future incomes (Masoodi et al., 2023). Therefore, the purpose of this study is to predict the effect of factors affecting the profitability of Iran's insurance industry

in the form of Dynamic Model Averaging (TVP_DMA) on a seasonal basis in the period of 2011 to 2022.

This paper is written in five sections. After the introduction, the theoretical frameworks and the literature on the experimental studies in line with the present topic have been examined in the second section. In the third section, research methods and estimation models are analyzed. The fourth section presents the findings of the dynamic model averaging (TVP_DMA). Finally, the results and suggestions for policy are presented in the fifth section.

2. Literature review

Profitability is one of the most important goals of financial management because its primary goal is to maximize the owner's wealth and profitability, which in turn indicates better financial performance. Economists have always focused on investigating the causes and factors of profitability, and several studies have been designed to investigate it. In a study by Olarewaju and Msomi (2022) on the profitability of insurance companies in sub-Saharan Africa during 1991-2020, they found that the profitability of insurance companies is influenced by factors such as gross domestic product (GDP), competition (HHI), overall premium growth, investment strategies, underwriting risk, and operational efficiency. Furthermore, Farhan et al. (2021), in their study concluded that factors such as net premium (profit from investment activity/other incomes) have a direct relationship with profitability; variables such as reinsurance fee, net loss paid, underwriting cost, change Mathematical-reserve value, general and administrative expenses have an inverse relationship with the profitability of insurance companies.

According to the study of Alan and Aybars (2021) and Andoh and Yamoah (2021), the effect of using derivatives and reinsurance for risk coverage purposes is focused on the profitability of companies in the non-life insurance industry. Based on panel data analysis, findings show that using derivatives and reinsurance contributes to firms' financial performance as measured by return on assets (ROA).

In another study, Mitra et al. (2023), through their analysis of the Indian insurance market, found a positive correlation between firm performance and macroeconomic factors. Furthermore, they found that firm performance is influenced by its size, age, leverage, sales growth, and operating profit.

In addition, Upadhyaya et al. (2023) investigated the impact of financial performance indicators on the return on equity (ROE) and return on assets (ROA) of non-life insurance companies. The results show a robust positive relationship between ROA and gross premium, retention ratio, expense ratio, and combined ratio.

The study by Zinyoro and Aziakpono (2023) shows that the literature mainly examines the size, organizational structure, capital mix, diversification, distribution systems, risk management practices, and insurance strategies. This study emphasizes the importance of competition and macroeconomic conditions as commonly discussed external determinants. While a clear relationship between performance and factors such as company size, organizational structure, and risk management practices is evident, the influence of other factors remains inconclusive. Msomi and Nzama (2023) investigated the effect of company-specific factors on the financial performance of South African insurance companies. In this study, return on assets (ROA) was calculated as a function of financial performance. While company size, leverage ratio, premium growth rate, liquidity ratio, and asset tangibility were examined as dependent variables, using the panel data regression technique, premium growth rate, liquidity ratio, and asset tangibility were examined as independent variables.

In sum, these studies contribute to a deeper understanding of the multifaceted dynamicity in the insurance industry. According to the study of Banker et al. (2023), the average technical and output allocative efficiency and managerial ability of Iranian markets fluctuate enormously with high variance. However, there is a positive relationship between the return on equity and managerial ability in the insurance industry of Iran and India. Comparing these two metrics showed relatively little movement in India.

Considering the important role that insurance companies play in the economy, their financial strength and survival are required. Investigating financial health and reliability, knowing the factors affecting insurers' profitability, and identifying them accurately are important tasks for researchers and financial analysts. The multiplicity of potential explanatory variables affecting profitability in the empirical literature indicates that the studies on what variables should be included in the model are not rich enough. Therefore, each researcher can enter different explanatory variables into the model depending on his goal and topic. In this study, based on economic theory in the empirical literature and access to data, the influential variables of profitability, such as gross domestic product, inflation, tax revenues, oil revenues, exchange rate, unemployment rate, underwriting risk, insurance premium growth, financial leverage, capital adequacy ratio, and company size are considered.

3. Data

This study is of applied research, and the research method is scientific in nature. Using library studies, theoretical frameworks were collected, and the required data were extracted from the economic indicators of the Central Bank, Central Insurance Institute, and Stock Exchange. The statistical population of this research is the seasonal data of Iran from 2011-3 to 2022-3 (Equivalent to the solar calendar 1390-1 to 1401-12) Moreover, the model used in the present study

is a time series model with the form of an econometric technique that is a dynamic model averaging with time-variable parameters (TVP - DMA).
The selected variables affecting the profitability (ROA) of the insurance industry are as follows:

Table 1. Selected variables affecting the profitability (ROA) of the insurance industry

Variable	Symbol	Explanation	Source (prediction)
Profitability	ROA	return on assets: profit after tax deduction divided by total assets	Al-Zuhairi,(2024),Bushashe, (2023), Bazhair & Alshareef (2022),Upadhyaya et al. (2023), Al-Omari et al. (2024)
Gross domestic product(1)	GDP	$GDP = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$	Akbary et al., (2024), Trung, (2021), Olarewaju & Msomi (2022) Al-Eitan et al. (2021)
Inflation rate (2)	INF	$INF = \frac{INF_t - INF_{t-1}}{INF_{t-1}}$	Msomi, (2023),Bushashe, (2023), Olarewaju & Msomi (2022) Al-Eitan et al. (2021)
Tax revenues(3)	TAX	Tax revenue growth rate	
Oil revenues (4)	oil	The growth rate of resources due to the sale of oil and oil products	
Exchange rate (5)	EXR		Msomi, (2023),Bushashe, (2023) Olarewaju & Msomi (2022)
Unemployment rate (6)	UNE	Unemployment rate (population aged 15 and over)	Dorofti & Jakubik (2015)
Underwriting risk (7)	UNR	The ratio of claims paid to net insurance premiums received	Msomi, (2023), Olarewaju & Msomi (2022)
Insurance premium growth (8)	PGR	Growth in premium income	Upadhyaya et al. (2023), Olarewaju & Msomi (2022)
Financial leverage (9)	LEV	The ratio of total debt (sum of current and non-current liabilities) to equity	Msomi, (2023),Trung, (2021), Bazhair & Alshareef (2022), Jumono et al. (2019)
Capital adequacy ratio(10)	CAR	The ratio of equity to total assets	Yitayaw, (2021),Bushashe, (2023). Jumono et al. (2019)
Size of the company (11)	SIZ	Logarithm of total assets	Msomi, (2023),Yitayaw, (2021), Bazhair & Alshareef (2022), Olarewaju & Msomi (2022)

4. Research Methodology

This study is of applied research, and the research method is scientific in nature. Using library studies, theoretical frameworks were collected, and the required data were extracted from the economic indicators of the Central Bank, Central Insurance Institute, and Stock Exchange. The statistical population of this research is the seasonal data of Iran from 2011-3 to 2022-3 (Equivalent to the solar calendar 1390-1 to 1401-12) Moreover, the model used in the present study is a time series model with the form of an econometric technique that is a dynamic model averaging with time-variable parameters (TVP - DMA).

Compared to other econometric techniques, TVP - DMA models using Bayesian and TVP models, along with estimating coefficients simultaneously with the possibility of changing the estimated coefficients over time, have economic features in estimating coefficients. As stated above, the most important feature of this model is the possibility of changing the input variables over time. This feature enables the model's flexibility in the conditions of recession or boom and other structural developments for proper estimation. On the other hand, with the increase in the number of variables, the mentioned models provide the possibility of estimating bulky and large models with accurate estimates (Koop & Korobilis, 2014). In addition, one of the important advantages of this method compared to other traditional and conventional time series methods based on classical limiting assumptions such as ordinary least squares (OLS) is that it solves the inability to predict correctly over time and the need to Examining unit root tests is not about time series variables and there is no necessity about variable reliability at the level (Stock & Watson, 2008).

The structure of Bayesian space-state models and its random fluctuations for TVP models are defined by the following two equations:

$$y_t = z_t \theta_t + \varepsilon_t \quad (1)$$

$$\theta_t = \theta_{t-1} + \mu_t \quad (2)$$

where y_t is the dependent variable of the model, $z_t = [1, x_{t-1}, y_{t-1}, ..., y_{t-p}]$ is a vector of m × 1, that estimates intercept elevation and interval of the dependent variable of the model, and $\theta_t = [\varphi_{t-1}, \beta_{t-1}, y_{t-1}, ..., y_{t-p}]$ is a m ×1 vector of coefficients. The values of $\mu_t \sim (0, Q_t)$ and $\varepsilon_t \sim N(0, H_t)$ have a normal distribution with zero mean and variance of Ht and Qt, respectively. This model has many advantages, the main one being the possibility of changing the estimated coefficients at any time. However, the disadvantage of these models is that whenever Z_t becomes too large, the estimations will not be very reliable. The generalized TVP model, like TVP-VAR, also has the same problems. The appropriate development in this model was the introduction of uncertainty caused by the behavior of the estimators, whose model is in the form of equation (3). In this model, Z_{jt} and θ_{jt}, are j^{th} elements of Zt and θt. The point added to their model is the existence of the variable $S_j \in \{0,1\}$ that cannot change over time and only has the status of a permanent variable that can accept the number one or zero for each estimator (Koop & Korobilis, 2012).

$$y_t = \sum_{j=1}^{m} s_j \theta_{jt} z_{jt} + \varepsilon_t \quad (3)$$

Raftery et al. (2012) present the DMA method and remove all the limitations of the previous methods. This method could estimate bulky models at any moment and allow changing the input variables to the model at any moment (Babaei et al., 2018). To describe DMA's method and work process, it is assumed that there are k sub-set models of Zt variables as estimators, and with k=1, 2, ..., K represents K models of the above sub-set. Based on this fact and assuming the existence of K sub-set models at each point of time, the space-state model is described as equations (4) and (5).

$$y_t = z_t^{(k)} \theta_t^{(k)} + \varepsilon_t^{(k)} \quad (4)$$

$$\theta_{t+1}^{(k)} = \theta_t^{(k)} + \mu_t^{(k)} \quad (5)$$

In these equations, $\varepsilon_t^{(k)} \sim N(0, H_t^{(k)})$, $\mu_t^{(k)} \sim (0, Q_t^{(k)})$, and $\theta_t = (\theta_t^{(1)}, ..., \theta_t^{(k)}) L_t \in \{1, 2, ..., k\}$ indicate which point in time is better used in each model of the sub-model K. The method that allows estimating a different model at any moment is called dynamic model averaging.

All in all, DMA has many benefits compared to other predicting methods. The most significant advantage of this method is that it eliminates the weakness of other methods in the small number of equations and variables. In other words, this method can predict many variables and, consequently, estimate more models. DMA and DMS models can reduce the variables and, subsequently, the models because these methods can identify the models that have more weight in the prediction by using the equation (6). Another advantage of this method is that some subsets of estimators provide parsimonious models with few input variables through which, if the DMA model considers more weight for them, it will avoid overfitting problems in estimation (Doojav & Luvsannyam, 2017).

$$\mathrm{E}(\mathrm{size}_t) = \sum_{k=1}^{k} \pi_{t|t-1,k} \, size_{k,t} \quad (6)$$

5. Model estimation and results

After performing the estimation of the model using the intervals of the independent variables of the model, the results of the estimation of the selected dynamic model (DMS), which allows the selection of the best model in the estimation of profitability at any point in time is presented, (among 2 ^11different estimation models in each period which is equal to the number of subsets or situations where 11 independent variables of profitability models can form a separate model together). That is, based on the symbols of the variables listed in Table 2, the input variables to the best model for modeling profitability have been determined at each point in time. Based on this table, it can be seen that, for example, in the summer of 2017, the first and second intervals of asset returns,

economic growth, inflation, exchange rate, oil revenues, and financial leverage were influential on the performance of the insurance industry. Meanwhile, in the spring season of 2017, the first and second intervals of asset returns, oil revenues, financial leverage, underwriting risk, and capital adequacy ratio have the highest impact on the performance of the insurance industry, respectively. Such an analysis can be provided for other periods.

Table 2- Variables affecting the performance of the insurance industry in different time frames

Period		**Variable Name**								
13901*	**c**	**ARY_1**	**ARY_2**	-	-	-	-	-	-	-
13902	c	ARY_1	ARY_2	-	-	-	-	-	-	-
13903	**c**	**ARY_1**	**ARY_2**	-	-	-	-	-	-	-
13904	c	ARY_1	ARY_2	-	-	-	-	-	-	-
13911	**c**	**ARY_1**	**ARY_2**	-	-	-	-	-	-	-
13912	c	ARY_1	ARY_2	-	-	-	-	-	-	-
13913	**c**	**ARY_1**	**ARY_2**	-	-	-	-	-	-	-
13914	c	ARY_1	ARY_2	-	-	-	-	-	-	-
13921	**c**	**ARY_1**	**ARY_2**	-	-	-	-	-	-	-
13922	c	ARY_1	ARY_2	11	-	-	-	-	-	-
13923	**c**	**ARY_1**	**ARY_2**	**11**	-	-	-	-	-	-
13924	c	ARY_1	ARY_2	-	-	-	-	-	-	-
13931	**c**	**ARY_1**	**ARY_2**	**11**	-	-	-	-	-	-
13932	c	ARY_1	ARY_2	1	7	-	-	-	-	-
13933	**c**	**ARY_1**	**ARY_2**	**5**	**7**	-	-	-	-	-
13934	c	ARY_1	ARY_2	5	7	-	-	-	-	-
13941	**c**	**ARY_1**	**ARY_2**	**9**	-	-	-	-	-	-
13942	c	ARY_1	ARY_2	2	9	-	-	-	-	-
13943	**c**	**ARY_1**	**ARY_2**	**2**	**6**	-	-	-	-	-
13944	c	ARY_1	ARY_2	5	9	8	-	-	-	-
13951	**c**	**ARY_1**	**ARY_2**	**5**	**9**	**8**	-	-	-	-
13952	c	ARY_1	ARY_2	5	9	8	-	-	-	-
13953	**c**	**ARY_1**	**ARY_2**	**9**	**8**	-	-	-	-	-
13954	c	ARY_1	ARY_2	5	9	8	-	-	-	-
13961	**c**	**ARY_1**	**ARY_2**	**5**	**9**	**8**	-	-	-	-
13962	c	ARY_1	ARY_2	1	2	5	4	9	-	-
13963	**c**	**ARY_1**	**ARY_2**	**2**	**9**	-	-	-	-	-
13964	c	ARY_1	ARY_2	2	9	-	-	-	-	-
13971	**c**	**ARY_1**	**ARY_2**	**2**	**9**	-	-	-	-	-
13972	c	ARY_1	ARY_2	2	9	-	-	-	-	-
13973	**c**	**ARY_1**	**ARY_2**	**5**	**4**	**3**	**11**	-	-	-
13974	c	ARY_1	ARY_2	3	9	7	-	-	-	-
13981	**c**	**ARY_1**	**ARY_2**	**3**	**9**	**7**	-	-	-	-
13982	c	ARY_1	ARY_2	4	9	7	10	-	-	-
13983	**c**	**ARY_1**	**ARY_2**	**4**	**9**	**7**	**10**	-	-	-
13984	c	ARY_1	ARY_2	4	9	7	10	-	-	-
13991	**c**	**ARY_1**	**ARY_2**	**4**	**9**	**7**	**10**	-	-	-
13992	c	ARY_1	ARY_2	2	5	3	9	10	8	-
13993	**c**	**ARY_1**	**ARY_2**	**2**	**5**	**3**	**9**	**10**	**8**	-
13994	c	ARY_1	ARY_2	2	5	3	9	10	8	-
14001	**c**	**ARY_1**	**ARY_2**	**2**	**5**	**3**	**9**	**10**	**8**	-
14002	c	ARY_1	ARY_2	1	4	3	8	-	-	-

14003	**c**	**ARY_1**	**ARY_2**	**1**	**5**	**6**	**3**	**9**	**10**	**8**
14004	c	ARY_1	ARY_2	1	5	6	3	9	10	**8**
14011	**c**	**ARY_1**	**ARY_2**	**1**	**5**	**6**	**3**	**9**	**10**	**8**
14012	c	ARY_1	ARY_2	1	5	6	3	9	10	**8**
14013	**c**	**ARY_1**	**ARY_2**	**1**	**5**	**6**	**3**	**9**	**10**	**8**
14014**	c	ARY_1	ARY_2	5	-	-	-	-	-	-

Sources: researchers' estimations * Equivalent 2011-3 ** Equivalent 2022-3

Table 2 specifies the contribution of each variable in modeling and the impact of the insurance industry's performance in all periods. The total amount of influence of each variable in the entire period indicates the number of periods that the variable in question affects the insurance industry's performance.

Table 3. Prioritization of variables affecting the performance of the insurance industry

Row	Variable	Symbol	Affecting period	prioritization
1	Gross domestic product	GDP-0	8	7
2	Inflation rate	INF-0	11	6
3	Tax revenues	TAX-0	13	4
4	Oil revenues	oil-0	7	8
5	Exchange rate	EXR-0	19	2
6	Unemployment rate	UNE-0	6	10
7	Underwriting risk	UNR-0	7	9
8	Insurance premium growth	PGR-0	18	3
9	Financial leverage	LEV-0	28	1
10	Capital adequacy ratio	CAR-0	13	5
11	Size of the company	SIZ-0	4	11
12	Profitability(with 1 year interval)	ARY_1	48	
13	Profitability (with 2 year interval	ARY_2	48	

Source: Researcher's estimation

The research results showed that profitability intervals in the entire research period and financial leverage variable, exchange rate, and insurance premium growth have been among the variables affecting the performance of the insurance industry for many years. Accordingly, they are important to consider the variables that influence the performance of the insurance industry in Iran. After these variables, tax revenues, capital adequacy ratio, inflation, economic growth, oil revenues, underwriting risk, unemployment rate, and company size are the most important factors affecting the performance of the insurance industry, respectively. In the following, the best-estimated model, the effectiveness of each variable on the insurance industry's performance, and the probability of occurrence over time are presented.

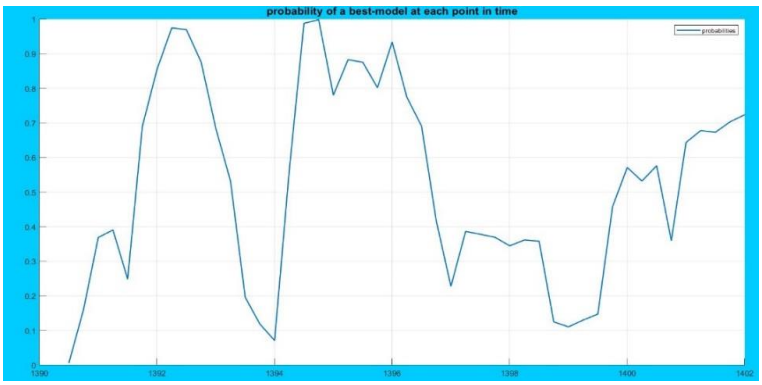


Fig 1. The probability of the best model for predicting the performance of the insurance industry during the period of spring 2011 to Winter 2022

Source: research findings

Figure 1 shows the probability of the best model in predicting the performance of the insurance industry with the presence of the variables included in the model and the proposed alpha and beta from spring 2011 to winter 2022. As can be seen, the probability level of the best-estimated model in some periods is less than 50%; therefore, it can be concluded with doubts that the initial specification has the minimum initial conditions for predicting the performance of the insurance industry. Accordingly, it is better to determine the contribution of each variable to model and predict the insurance industry's performance at all time points. Thus, in the next step, the DMA model, which allows determining the probability of entering the model's independent variables, is estimated. Figures 2 to 12 present the probability of influence of each of the model's independent variables on the insurance industry's performance when the model is estimated with a prediction horizon of one (h=1).

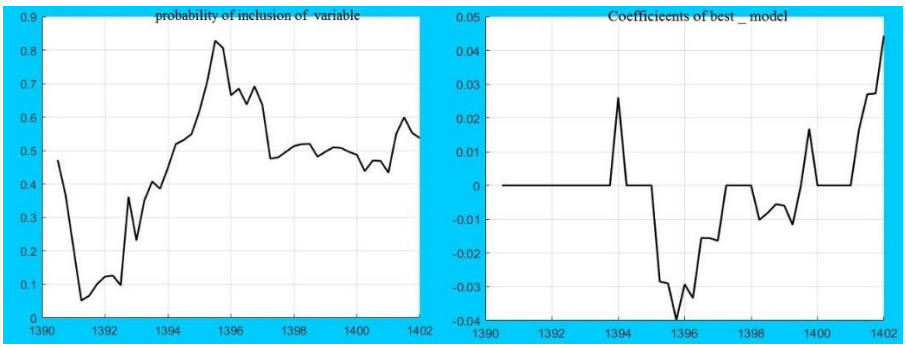


Fig 2. The degree of probability and type of effect of financial leverage on the performance of the insurance industry

Source: Research findings

Figure 2 shows the probability and the kind of effect of financial leverage on the insurance industry's performance from spring 2011 to winter 2022. It can be seen that the influence of financial leverage on the performance of the insurance industry has fluctuated and had positive and negative effects. The probability of its occurrence is less than 50% until 2015; after this year, it is more than 50% in most periods. In 2016, due to the election of Trump and the thought wave of their withdrawal from the JCPOA, it reached its lowest level. In 2017, the insurance industry paid the most significant loss in its history for the Boali Petrochemical fire, as well as losses such as the Kermanshah earthquake, the sinking of the Sanchi oil tanker, etc. However, its growing trend can be attributed to the continuation of the privatization process, the JCPOA agreement, the removal of value-added tax in the insurance industry, and changes in the statutes of insurance companies following corporate governance regulations. In 2019 and 2020, to some extent, there were adverse effects that can be attributed to the spread of coronavirus in these years. In 2020, a positive effect can be seen, which can be attributed to the election of Biden as the President of the United States, the announcement of the establishment of the General Insurance Fund for Natural Disasters, and the insurance industry's use of the capital market. The continuation of this process in 2022 is since insurance was recognized as the leading player in the capital market.

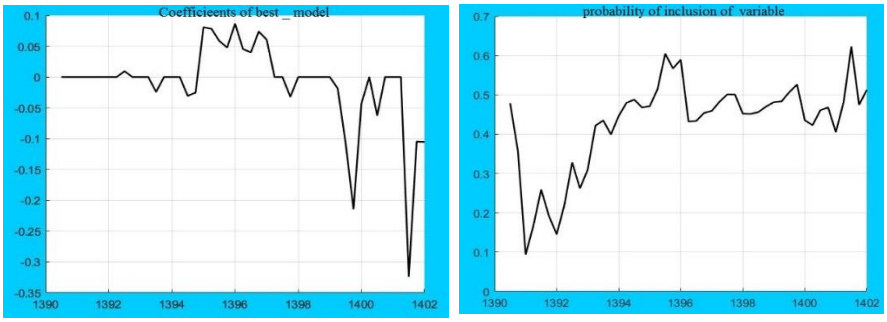


Fig 3. The degree of probability and the type of effect of exchange rate on the performance of the insurance industry

Source: Research findings

According to Figure 3, the effect of the exchange rate on the insurance industry's performance was almost zero or close to zero in the first years of the period. In the following, it was somewhat positive, and at the end of the period, it was either zero or negative. The probability of its effectiveness in most periods is close to 50%. Exchange rate fluctuations in the free market do not significantly impact the insurance industry. However, companies with foreign currency assets benefit from exchange rate appreciation, and those with insurance debt must pay it at a higher rate.

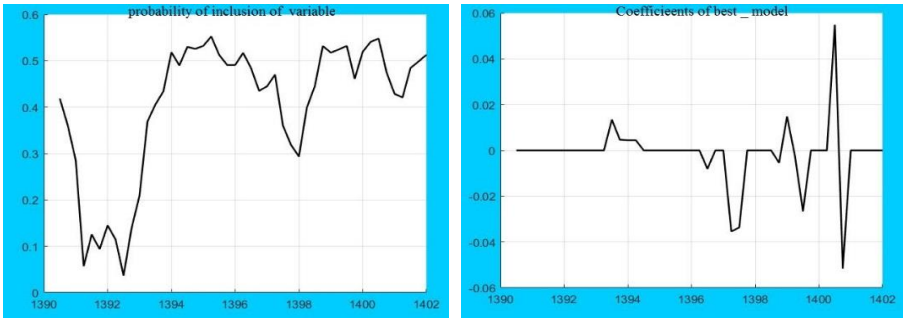


Fig 4. The degree of probability and type of impact of insurance premium growth on the performance of the insurance industry

Source: Research findings

In Figure 4, for most years of the period, the impact of premium growth on the performance of the insurance industry has been almost zero or close to zero. In the following, it has fluctuated and had a positive and negative impact. The probability of its effectiveness at the beginning of the period is low; from 2015 onwards, it is close to 50%. Premium growth is driven by exposure growth (increase in the number of insureds) and rate level growth (increase in the average price per exposure). These two sources of growth have different sustainability and risk implications. Growth is a value exposure if the products are reasonably priced, but in a competitive market, significant growth may be a sign of underpricing. Conversely, premium growth attributable to rate increases may reduce risk if the same customers pay more for the same risk exposure.

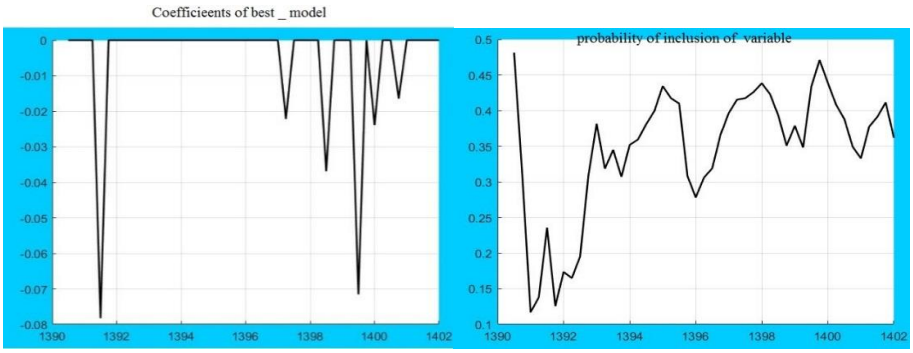


Fig. 5 The degree of probability and type of effect of tax revenue on the performance of the insurance industry

Source:Research findings

Figure 5 shows that, throughout the entire period, the impact of tax revenues on the performance of the insurance industry has been zero or negative. The probability of its effectiveness is less than 50%. Insurance companies are among the biggest taxpayers of the government. In Iran, taxes are collected from the

insurance industry, and many taxes are collected more than other activities, so about 40% of insurance sales and issued insurance premiums are collected as taxes.

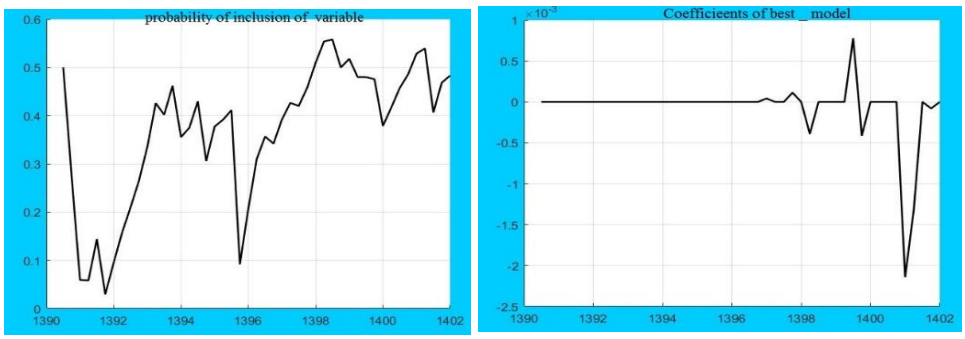


Fig 6. The degree of probability and the type of effect of the capital adequacy ratio on the performance of the insurance industry

Source: Research findings

According to Figure 6, in most of the period, the effect of the capital adequacy ratio on the performance of the insurance industry has been zero or close to zero. In the following, it has fluctuated and had a positive and negative impact. The probability of its effectiveness at the beginning of the period is low; from 2019 onwards, it is close to 50%. The capital adequacy ratio is an essential indicator of the financial health of an insurance company and indicates its ability for long-term survival. Insurance companies with higher solvency margins are considered more financially sound. Financially sound insurance companies are better able to attract potential policyholders and adhere to specified underwriting guidelines.

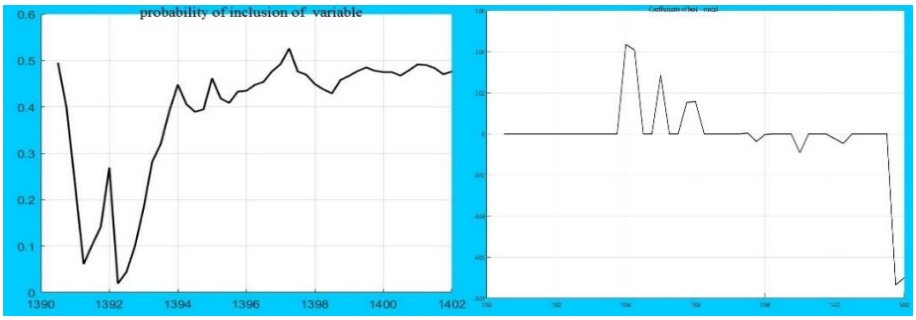


Fig 7.The degree of probability and the type of effect of inflation on the performance of the insurance industry

Source: Research findings

According to Figure 7, during most of the period, the effect of inflation on the performance of the insurance industry was almost zero or close to zero. It fluctuated in some periods and had positive and negative effects. The probability of its effectiveness at the beginning of the period is low; from 2015 onwards, it reaches more than 40%. Suppose we want to imagine the high inflation rate's effect on the atmosphere governing insurance companies or the insurance industry. In that case, we need to look at this issue from an income perspective. In Iran, since people's income is not adjusted according to the inflation rate, even if we consider insurance as a necessary commodity, with the decrease in purchasing power, the demand and, consequently, the insurance premiums received decrease. Thus, the financial prosperity of the insurance company as an indicator of the performance of each company, and in total, the entire industry is demolished. The positive effect of inflation on performance is also due to its unanticipated rates, which affect the company's predictions. Insurance companies invest their funds in growth stocks, and inflation tends to increase the overall value of their investments in real terms.

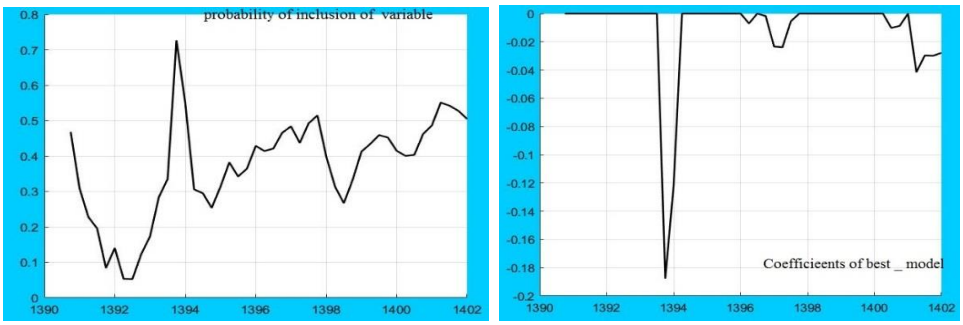


Fig. 8.The degree of probability and the type of effect of GDP on the performance of the insurance industry

Source: Research findings

According to Figure 8, the effect of GDP on the insurance industry's performance has been zero or negative. The probability of its effectiveness has fluctuated. At the end of 2014, 2017, 2018, 2021, and 2022, gross domestic production harmed the insurance industry's performance, and for the rest of the period, it had no effect. The negative effect can be due to the presence of oil revenue in the gross domestic product structure, low awareness of people about insurance, and lack of innovative products or investment opportunities.

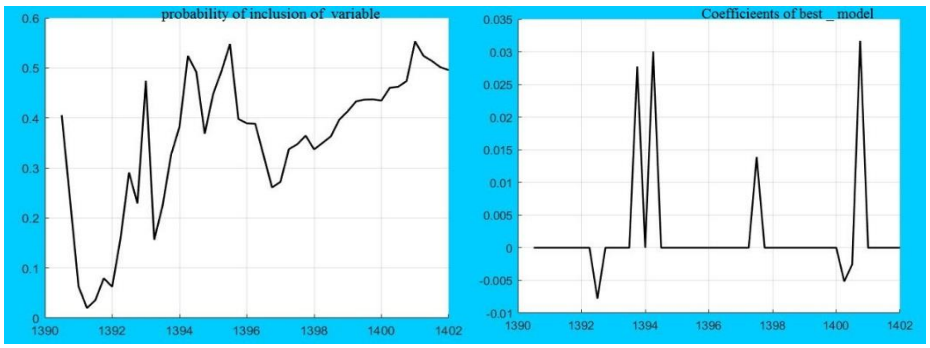


Fig 9.The degree of probability and type of effect of oil revenues on the performance of the insurance industry

Source: Research findings

According to Figure 9, the effect of oil revenues on the performance of the insurance industry was zero in most periods. It fluctuated in some periods and had positive and negative effects. The probability of its effectiveness has fluctuated and is mostly less than 50%. Considering that oil revenues are adequate for economic growth, they can affect the performance of the insurance industry. However, in Iran, it can be said that with the increase in oil revenues, economic growth increases much less than expected. In other words, the structural bottlenecks in Iran's economy have caused the economic growth to be less affected by the growth of oil revenues, and the injection of this revenue has only brought about an increase in prices.

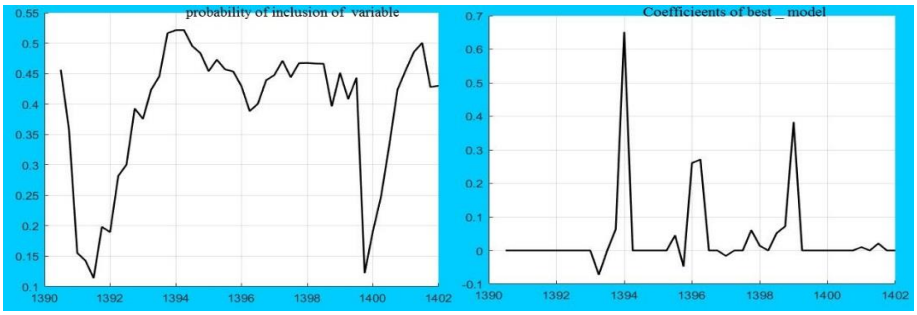


Fig 10.The degree of probability and type of effect of underwriting risk on the performance of the insurance industry

Source: Research findings

According to Figure 10, underwriting risk's effect on the insurance industry's performance was zero in most periods, fluctuated in some periods, and had positive and negative effects. The probability of its effectiveness has fluctuated

and is mostly less than 50%. Underwriting risk shows the adequacy of insurance companies' inventive performance, thus determining their profitability. The strong underwriting of the insurers influences the insurance company's financial success. Therefore, lower underwriting risk is expected to increase insurers' profitability.

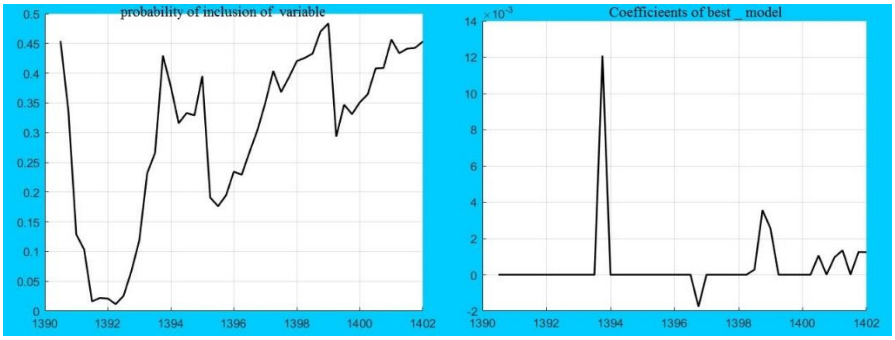


Fig 11.The degree of probability and type of effect of the unemployment rate on the performance of the insurance industry

Source: Research findings

According to Figure 11, the unemployment rate's effect on the insurance industry's performance was zero in most periods. It fluctuated in some periods and had positive and negative effects. The probability of its effect fluctuates by less than 50%. A high unemployment rate makes it more difficult for insurance companies to grow, as households are reluctant to spend their limited income purchasing insurance. In addition, the increase in unemployment figures makes insurers more sensitive to prices and reduces the ability to purchase new properties and goods that usually require insurance coverage. This limits the demand for insurance, and thus, it may also negatively affect overall profitability.

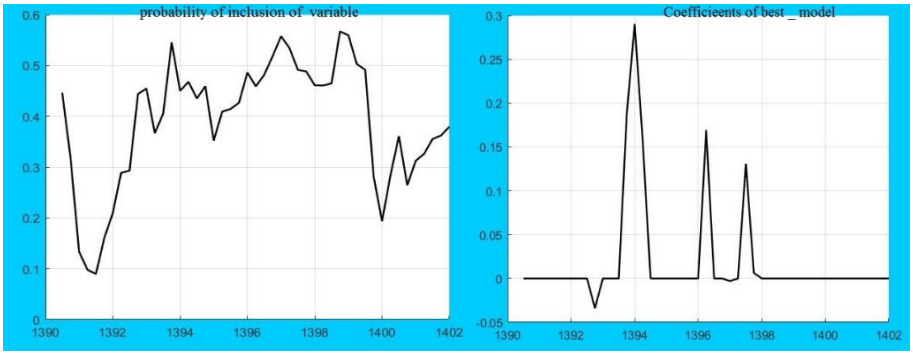


Fig 12. The degree of probability and type of effect of company size on the performance of the insurance industry

Source: Research findings

According to Figure 12, the effect of company size on the insurance industry's performance was zero in most periods. It fluctuated in some periods and had positive and negative effects. The probability of its effectiveness has fluctuated. The lack of effect can indicate that the size of the company or total assets is not an essential variable in the discussion of profitability. A large company may have many problems. For example, a large company with many debts harms profitability.

Table 4 compares and shows the model's accuracy in predicting the insurance industry's performance. It provides the value of MAFE and MSFE of the new models used in experimental studies to predict various variables, including DMA and DMS.

Table 4- Comparison of models

Prediction Method	MAFE	MSFE
DMAα = β = 0.99	0/25	**0/21**
DMSα = β = 0.99	0/37	**0/30**
DMAα = β = 0.95	0/26	**0/24**
DMSα = β = 0.95	0/40	**0/36**
DMA α = 0.99; β = 0.95	0/27	**0/26**
DMS α = 0.99; β = 0.95	0/42	**0/5**
DMA α = 0.95; β = 0.99	0/24	**0/20**
DMS α = 0.95; β = 0.99	0/38	**0/32**

Source: Research findings

The results of the present study show that the DMA model is more accurate in modeling the insurance industry's performance. Compared to the DMS model, the values of MAFE and MSFE of the DMA model with dynamic mode are = 0.95 and = 0.99, respectively, which is less than the DMS model.

6. Conclusion and Recommendations

Profitability is the driving factor of any investment in different projects and the relative success criterion for a business. This research uses TVP - DMA models as nonlinear dynamic models to simulate variables affecting Iran's insurance industry performance. The superiority of the mentioned models over other econometric models is that these models provide the possibility of changing the input variables to the model and the coefficients of the variables in the probability space over time. Therefore, in these models, unlike traditional econometric models, the evolution of relationships over time, which causes the coefficients in the equations to change, is not neglected. Consequently, in the present study, the factors affecting the performance of the insurance industry with variable probability levels have been investigated from spring 2011 to spring 2022. Based on the results, financial leverage variables, exchange rate, and

insurance premium growth are the most influential variables affecting the performance of Iran's insurance industry. The high level of the possibility of variables affecting the performance of the insurance industry in different periods indicates that in each period, different factors have influenced the performance of the insurance industry.

According to the findings, the effect of financial leverage on the performance of the insurance industry fluctuated, had positive and negative effects, and was without effect in most periods. The probability of its occurrence is less until 2015; after that, it is higher than 50 percent in most periods. In 2017, due to the election of Trump and the thought wave of their withdrawal from the JCPOA, it reached its lowest level. In 2017, the insurance industry paid the most significant loss in its history for the Boali petrochemical fire, as well as losses such as the Kermanshah earthquake, the sinking of the Sanchi oil tanker, etc. However, its growing trend can be attributed to the continuation of the privatization process, the JCPOA agreement, the removal of value-added tax in the insurance industry, and changes in the statutes of insurance companies following corporate governance regulations. In 2019 and, to some extent, 2020, it had adverse effects, and the spread of coronavirus in these years can be pointed to as its reason. In 2020, a positive effect can be seen, which can be attributed to the election of Biden as the President of the United States, the announcement of the establishment of the General Natural Disaster Insurance Fund, and the insurance industry's use of the capital market. The continuation of this process in 2022 can be since insurance was recognized as the leading player in the capital market.

In the first years of the period, the effect of the exchange rate on the insurance industry's performance was almost zero or close to zero. In the following, it was somewhat positive, and at the end of the period, it was either zero or negative. The probability of its effectiveness in most periods is close to 50%. Exchange rate fluctuations in the free market do not significantly impact the insurance industry. However, companies with foreign currency assets benefit from exchange rate appreciation, and those with insurance debt must pay it at a higher rate. For most of the period, the impact of premium growth on the performance of the insurance industry has been almost zero or close to zero. In the following, it has fluctuated and had a positive and negative impact. The probability of its effectiveness at the beginning of the period is low; from 2015 onwards, it is close to 50%. Premium growth is caused by exposure growth (increase in the number of insureds) and rate level growth (increase in the average price per exposure). These two sources of growth have different sustainability and risk implications. Growth is a value exposure if the products are reasonably priced, but in a competitive market, significant growth may be a sign of underpricing. Conversely, premium growth attributable to rate increases may reduce risk if the same customers pay more for the same risk exposure. In the entire period, the effect of tax revenues on the performance of the insurance industry has been zero

or negative. The probability of its effectiveness is less than 50%. Insurance companies are among the biggest taxpayers of the government. In Iran, taxes are collected from the insurance industry, and many taxes are collected more than other activities, so about 40% of insurance sales and issued insurance premiums are collected as taxes. For most of the period, the effect of the capital adequacy ratio on insurance industry performance has been almost zero or close to zero. In the following, it has fluctuated and had a positive and negative impact. The probability of its effectiveness at the beginning of the period is low; from 2019 onwards, it is close to 50%. Capital adequacy ratio is an essential indicator of the financial health of an insurance company and indicates its ability for long-term survival. Insurance companies with higher solvency margins are considered more financially sound. Financially sound insurance companies are better able to attract potential insurers and adhere to specified underwriting guidelines. The effect of inflation on the performance of the insurance industry has been zero or close to zero. It fluctuated in some periods and had positive and negative effects. The probability of its effectiveness at the beginning of the period is low; from 2015 onwards, it is more than 40%. Suppose we want to imagine the high inflation rate's effect on the atmosphere governing insurance companies or the insurance industry. In that case, we need to look at this issue from an income perspective. In Iran, since people's income is not adjusted according to the inflation rate, even if we consider insurance as a necessary commodity, with the decrease in purchasing power, the demand and, consequently, the insurance premiums received decreases; as a result, the financial prosperity of the insurance company as an indicator of the performance of each company and in total, the entire industry decrease. The effect of gross domestic product (GDP) on the performance of the insurance industry has been zero or negative. The probability of its effectiveness has fluctuated. It can be seen that at the end of 2014, 2017, 2018, and 2021, the effect of gross domestic product (GDP) harmed the performance of the insurance industry, and it had no effect in the rest of the period. The negative effect can be due to oil revenues in the gross domestic product structure, low awareness of people about insurance, lack of innovative products, or investment opportunities. The effect of oil revenues on the performance of the insurance industry was zero in most periods, fluctuated in some periods, and had positive and negative effects. The probability of its effectiveness has fluctuated and is almost less than 50%. Considering that oil revenues are effective in economic growth, they can affect the performance of the insurance industry. However, in Iran, it can be said that with the increase in oil revenues, economic growth increases much less than expected. In other words, the structural bottlenecks in Iran's economy have caused the economic growth to be less affected by the growth of oil revenues, and the injection of this revenue has only brought about an increase in prices.

Underwriting risk's effect on the insurance industry's performance was zero in most periods, fluctuated in some periods, and had positive and negative effects. The probability of its effectiveness has fluctuated and is mostly less than 50%. Underwriting risk shows the adequacy of the inventive performance of insurance companies. Hence, it determines their profitability. The strong underwriting of the insurers influences the insurance company's financial success. Therefore, lower underwriting risk is expected to increase insurers' profitability. The unemployment rate's effect on the insurance industry's performance was zero in most periods, fluctuated in some periods, and had positive and negative effects. The probability of its effect fluctuates by less than 50%. High unemployment rates make it more difficult for insurance companies to grow, as households are reluctant to spend their limited income to purchase insurance. In addition, the increase in unemployment figures makes insurers more sensitive to prices and reduces the ability to purchase new properties and goods that usually require insurance coverage. This factor limits the demand for insurance. Hence, it may also adversely affect overall profitability. The effect of company size on the performance of the insurance industry was zero in most periods, fluctuated in some periods, and had positive and negative effects. The probability of its effectiveness has fluctuated. The lack of effect can indicate that the size of the company or total assets is not an essential variable in the discussion of profitability. A large company may have many problems; for example, a large company with large debts harms profitability. In order to prevent the manipulation of actual profit activities by opportunistic managers, the main owners of companies, and board members, it is suggested to pay more attention to current debt and use short-term debt contracts to prevent and limit the opportunistic behavior of managers. A suitable combination of short-term and long-term debt can use in the company's capital structure. Moreover, it is necessary for the insurance companies that are members of the Stock Exchange Organization to have an appropriate level of working capital to create and increase added economic value. Since currency shocks affect the profitability of insurance companies, creating a favorable macroeconomic environment can effectively reduce the effect of shocks. On the other hand, reforming the structure of insurance companies can reduce their vulnerability to exchange rate fluctuations. Since the exchange rate affects the stock price of insurance companies, which plays a crucial role in the instability and has unfavorable effects on the macroeconomy, the monetary authorities must avoid hasty and unprofessional instructions and directives. With the cooperation of the relevant economic institutions, they should try to plan precisely and provide suitable policies to reduce the fluctuations of the exchange rate and instability and uncertainty in the economy, which can affect the financial variables of the insurance industry. If the insurer thinks about managing its risks and considers emerging risks, such as the growth of technology, he will find that insurance

tools should be used to control probable risks. On the other hand, with the growth of technology, the insurer will design appropriate tools to control his own and the insured's risks. If this cycle is properly understood and has a precise and scientific implementation, it will eventually lead to something that will be referred to as the risk management cycle. It is recommended that the insurance companies' managers not consider the insurance company's size under their management as an influential factor when planning and evaluating their plans to create profitability and improve efficiency. Considering that insurance companies in the financial market play an essential role in the performance of other economic sectors, strengthening this industry and the optimal use of resources can lead to increased economic stability in this industry and other industries in the financial markets.

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تعیین کننده های سودآوری صنعت بیمه: کاربردی از الگوی TVP-DMA

چکیده

امروزه بیمه جزء لاینفک سیستم مالی هر کشوری محسوب می شود. شرکت های بیمه به عنوان نهادهای مالی مهم در بازار سرمایه، علاوه بر پوشش ریسک، نقش واسطه های مالی را نیز ایفا می کنند. این شرکت ها به عنوان موسسات انتفاعی باید با اجرای این دو نقش به سودآوری دست یابند. برای این منظور، این پژوهش با هدف شناسایی عوامل تعیین کننده سودآوری صنعت بیمه ایران طی سال‌های ۱۳۹۰ تا ۱۴۰۱ به‌صورت فصلی با استفاده از مدل TVP-DMA انجام شده است. نتایج نشان داد که متغیرهای اهرم مالی، نرخ ارز و رشد حق بیمه به ترتیب تأثیرگذارترین متغیرهای تأثیرگذار بر عملکرد صنعت بیمه ایران هستند. همچنین نتایج نشان می‌دهد که نحوه و احتمال تأثیرگذاری این متغیرها بر عملکرد صنعت بیمه در طول زمان ثابت نبوده و تحت تأثیر عواملی مانند توافق برجام، خروج از برجام، ادامه روند خصوصی‌سازی، حذف می‌باشد. مالیات بر ارزش افزوده صنعت بیمه و تغییر اساسنامه شرکت‌های بیمه، ابلاغ تشکیل صندوق عمومی بیمه بلایای طبیعی و استفاده از ظرفیت های بازار سرمایه صنعت بیمه.

کلمات کلیدی: صنعت بیمه، عوامل داخلی، عامل کلان اقتصادی، سودآوری، مدل TVP-DMA .