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RESEARCH PAPER

Comparing Optimal and Realized Investment Portfolio of Insurance Companies: A Case Study of a High Inflation Environment

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Abstract

This study aims to determine the optimal portfolio of an insurer on six major assets, compare the results with the realized portfolio in a high inflation environment, and finally find the reasons for the differences observed. Using quarterly data from 2008-2020, the optimal portfolio was determined for the insurers of this environment using the Mean-CVaR method and imposing constraints on the regulator. Furthermore, we analyze the deviation and investigate the possible reasons for the gap by holding semi-structured interviews. Results show that the realized portfolio is significantly different from the optimal portfolio. The main reasons for this difference range from misappropriation of accounting standards in an inflationary environment, mass tax-exempt on some significant assets, inadequate knowledge of insurers' investment managers on the existing instruments, and investment mismanagement due to the weakness of the corporate governance structure of insurers, to inadequate development of domestic financial markets.

Keywords: Inflationary Environment, Insurance Companies, Investment Portfolio, Regulatory Restrictions, Value at Risk.
JEL Classification: G11, G22.

1. Introduction

Insurance companies are the main active institutions in the risk coverage market. They compensate for the realized economic and social covered risks and pay for the claims through continuous receiving premiums. As a result, they help in creating a secure environment for productive economic sectors and investment activities.

Receiving premiums and paying claims lead to the formation of continuous streams of revenues and payments for insurance companies. The time interval between premium inflow and paid claims outflow provides the insurers with significant

financial resources. These resources can be optimally, invested and the profits can help in improving the financial strength and competitiveness of the insurance company. However, determining the optimal investment portfolio of insurance companies, with an eye on the limitations caused by regulators concerning the investment regulations, as well as identifying the maturity and volume of future liabilities are the main issues faced by many insurance companies. In recent years, regarding the complexities of moving from a governmental monopoly system to more competitive markets, insurance companies need to emphasize more on the optimization of investment. At the same time, the relatively stable nature of the cash inflow along with the stochastic nature of the claims lead insurance companies to ensure that they have the liquidity necessary to meet their determined insurance liabilities. Therefore, the main objective of the present study is to determine the optimal investment portfolio for insurance companies in the context of regulatory constraints, and then to compare the optimal portfolio with the realized portfolio of status quo of the companies in the high inflationary environment of Iranian economy and finally, to investigate the probable reasons for the observed differences between the two.

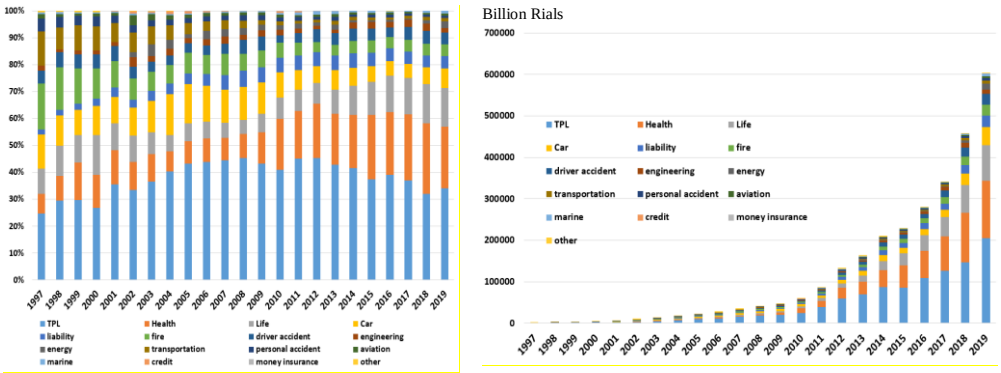


Figure 1. Insurer Underwriting Portfolio of the Iranian Insurance Industry
Source: Iranian Insurance Industry Annual Report (different years).

Life insurance product is the only business line that has a long-term liability and different duration behavior among all insurance lines. Figure 1 shows the proportion of life insurance lines has a slight growth over time after 2007; but the high rate of causation in an inflationary environment (along with having no unit-linked life insurance products (ULIPS) in Iran), causes a shortening in the duration of such liabilities for insurers. The other business lines have less than 1-year contracts and so, are considered short-term products. Since the lion's share of lines (including TPL, Health, car/motor, and driver accident insurance) follow the law of large numbers, the cash outflow of claims would be smoothed within the insurer’s accounts. The cash

flow of other lines would be smoothed through reinsurance contracts. So, we conclude that asset-liability management struggles with matching duration, maturity or currency of assets and liabilities don't matter in Iranian insurance companies; especially when a compulsory rule exists that requires maintaining more than 20% of the portfolio as a bank deposit. Therefore, we can focus on the other targets of portfolio optimization.

There is a big body of empirical literature on determining the optimal investment portfolio. In most previous studies conducted on the optimization of the investment portfolio, only stocks have been considered as investable assets, and other assets were excluded. Additionally, due to the relative economic stability in the countries where these studies have been conducted, some assets such as gold and foreign exchange or real estate have not been generally considered investment options. However, the situation in Iran as an emerging economy is quite different with a long-term inflation of about 20% Therefore, besides stocks, this study considers other assets in which insurance companies mainly invest. Of note, the methods used for portfolio optimization in these studies range from portfolio optimization methods such as Markowitz (Gordon and Bapista, 2002; Setiawan et al., 2019; Abbasian et al., 2013; Rezagholizadeh et al., 2022), single- and multi-factor (Sarlak et al., 2013; Varedi et al., 2016) to more developed and modern methods of portfolio optimization like Mean-CVaR (Boffey et al., 2014; Shi et al., 2019; Asgharpour and Rezazadeh, 2015; Oskooi et al., 2019). In this study, using the Mean-CVaR method and by taking the constraints on investment of the regulator into account, we determine the optimal investment portfolio for the studied insurance company.

The present article is organized as follows: In Section 2, the empirical literature is investigated. In Section 3, the data and research method are described. Section 4 presents the research results and finally, Section 5 provides the concluding remarks.

2. Literature Review

For performing a comprehensive review of the empirical literature, it is appropriate to divide it into the following two parts: studies related to portfolio optimization in general and studies for determining the optimal investment portfolio in insurance companies. Accordingly, the first part includes studies comparing value at risk (VaR) with conditional value at risk (CVaR) methods using the Markowitz method, and those that calculate these risk metrics determine the optimal portfolio.

Regarding the first part, Gordon and Bapista (2002), Abbasi et al. (2009), Fathi and Talebnia (2010), Mehdizadeh and Sabet (2012), Jabal Ameli et al. (2021) and Rezagholizadeh et al. (2022) present different results by comparing the use of Markowitz and VaR methods in identifying the optimal portfolio. Their results depend

on various assumptions such as the form of the return distributions, the degree of risk aversion of investors, etc. Judging based on the return to risk ratio, known as the main criterion for determining the superiority of the model, in some previous studies no difference in results was observed between these methods (e.g., Fathi and Talibnia, 2010); in some other studies, VaR method was superior (e.g., Karimi, 2007; Abbasi et al., 2009), Mehdizadeh and Sabet (2012) and Jabal Ameli et al. (2021)); and in some other studies, Markowitz method was superior as a better portfolio (e.g., Gordon and Bapista, 2002; Rezagholizadeh et al., 2022).

Babaloyan and Chegini (2015) in their study on comparing the efficiencies of CVaR and Markowitz methods in identifying an optimal market portfolio, consider eight major industries of the Tehran Stock Exchange (TSE) during 2011-2014. Their results indicate that CVaR method results are more reasonable compared to those of Markowitz's mean-variance method. Also, to compare the measures of standard deviation and CVaR as a portfolio risk index, Rai et al. (2020) used the daily adjusted price data of 30 listed companies[1] from the beginning of 2005 until August 2015. Their results indicate that the Mean-CVaR method results are more acceptable than those of the standard deviation. Kibzun and Kuznetsov (2006), and Boffey et al. (2014) in their studies compare the potentials of VaR and CVaR methods for determining the optimal portfolio for stocks and finally reach the simplicity of calculations and higher accuracy of the Mean-CVaR method. Overall and based on the results of previous studies, it can be said that the Mean-CVaR method, besides having simplicity of calculation and high accuracy, has provided more reasonable results compared to both standard deviation and VaR methods.

Moreover, some studies have calculated the asset portfolio risk and determined the optimal portfolio using one of the investment portfolio optimization methods. In this regard, Mohammadi et al. (2008), Nikomaram and Zomordian (2014), Abbasi et al. (2017) and Pratiwi (2017) in their studies investigated the possibility of using both VaR and CVaR methods to calculate portfolio risk. The studies by Ghadiri and Rafiei (2010), Asgharpour and Rezazadeh (2015), Oskooi et al. (2015), Jamshidi and Khalouzadeh (2015), Setiawan and Rosadi (2019), and Varedi et al. (2016) are also among the studies with an optimal portfolio using Markowitz, Sharp multivariate, VaR, and CVaR methods. Although these studies differ in their optimal portfolio calculation methodology (e.g., linear, and nonlinear programming, genetic algorithms, particle swarm, etc.), the studied industries, the geographical location of the studied

[1]. Measure of sample selection was profitable (or zero profit) stocks that had been active in TSE in the studied period.

markets, the study period, etc., all of them are similar in terms of focusing solely on stocks as portfolio assets and not paying attention to other investable assets.

The second part includes those studies that investigated the investment conditions and environment for insurance companies. Accordingly, the studies by KarimKhane Zand and Behnam (2013), Shahriar et al. (2017), Sarlak et al. (2013), and Abbasian et al. (2013), consider future obligations, asset management, corporate debt, and financial strength models, and then investigate investment options of Iranian insurance companies. Additionally, Kozlova et al. (2019) for Russia, Mao et al. (2017) for the United States, Chakraboraty and Harper (2017) for India, and Bolos et al. (2019) for Romania, consider the issue of investment of insurance companies following the rules and regulations concerning the investment of insurance companies in those countries. Among the drawbacks of studies conducted on the Iranian insurance industry, the following can be highlighted: use of old optimization methods, using outdated data, lack of comparison of company performance with the calculated optimal portfolio, lack of analysis of the reasons for deviation, and not mentioning all the investment opportunities for companies. The present study attempts to fill the study gaps by resolving these shortcomings.

3. Data and Methodology

3.1 Data

Based on the main investment options of individuals in Iran, we divided the assets that can be invested in the optimal investment portfolio, into six main categories of assets, including gold, foreign exchange, stocks (consisting of both listed and non-listed companies), Islamic bonds, bank deposits, and real estate. According to the existing theoretical principles in the field of investment portfolio optimization, firstly, it is necessary to calculate the return on these assets during the study period. Therefore, the methods used for data gathering and calculation of the return on each one of these assets are as follows:

To calculate the return on gold assets, the change in the Bahare Azadi gold coin's new design (hereafter gold coin) price was considered as an index of the price changes on this asset (implemented for capital gain computation). To calculate the seasonal return on foreign exchange, the change in the price of the US dollar in the open market can be considered as an index for price changes for US dollar returns. The quarterly gold coin and foreign exchange price data during 2008Q2-2021Q1 were obtained from

Ministry of Economic Affairs and Finance formal database website[1]. The annual return on Islamic bonds and bank deposits were also extracted from Central Bank of Iran official website[2]. To convert this annual return to a seasonal return, simply the annual return was divided by four. As well, quarterly data on the price and rent of one square meter of residential unit have been obtained from the Ministry of Roads and Urban Development of Iran's official website[3] from 2008 to 2021 to calculate the quarterly return on real estate. Finally, changes in the TSE Dividend & Price (total return) Index (TEDPIX) are considered to calculate of stock market return quarterly during the studied period. The investment data regarding the insurance company were obtained from the audited financial statements of the insurance company from the Comprehensive Database of All Listed Companies (CODAL) of the TSE website[4].

Table 1. Descriptive Statistics of the Variables

Asset / Descriptive statistics	Real state	Stock	Gold	Foreign Exchange	Deposit	Islamic Bond
Mean	0.065	0.118	0.089	0.088	0.048	0.045
Median	0.038	0.058	0.057	0.020	0.050	0.043
SD	0.080	0.253	0.167	0.287	0.004	0.004
CV	1.231	2.149	1.877	3.259	0.088	0.092
Skew	0.872	3.218	1.794	5.518	-0.864	1.164
Kurt	1.906	15.958	4.582	34.942	1.052	0.084

Source: Research finding.

3.2 Calculation of the Mean Return and Risk of Portfolio

To calculate the portfolio, mean return, first, we calculated the mean return of each asset and then multiplied the "mean return on portfolio assets vector" by the "weight of portfolio assets vector" to form the portfolio mean return. To calculate the risk of a portfolio, the variance-covariance matrix of the "mean return on portfolio assets vector" was calculated at first. Then, by pre-multiplying and post-multiplying the transpose of the "weight of portfolio assets vector" to the variance-covariance matrix, the variance of portfolio return was obtained ($\sigma_p^2 = W^T \sum W$). Subsequently, the

[1]. https://databank.mefa.ir
[2]. https://tsd.cbi.ir
[3]. https://www.mrud.ir
[4]. https://www.codal.ir

standard deviation, as the portfolio risk criterion, was obtained from the square root of the variance.

VaR is known as another common criterion for the risk's assessment. By assuming that the distribution of return on assets is normal, we calculate the portfolio value at risk at a 99% confidence level (α = 1%) as follows:

$$VaR_p = -(\mu_p - \sigma_p Z_{0.01}) \quad (1)$$

where VaR_p is the portfolio value at risk, Z_α is the standard normal distribution, and σ_P and μ_P are the standard deviation and the portfolio mean return, respectively. Therefore, according to the assumption that the return distribution is normal, CVaR was calculated as follows:

$$\mathrm{CVaR}_P = -\left(\mu_P - \sigma_P \frac{\emptyset(Z_{0.01})}{0.01}\right) \quad (2)$$

where CVaR_P is the conditional value at risk of the portfolio, $\emptyset(Z_\alpha)$ is the value of the density function of the probability of the standard normal distribution for the value of Z_α, and σ_P and μ_P are the standard deviation and the mean of portfolio return respectively.

3.3 Determining Structural Breakpoints

The present study was conducted for twelve years. The determination of an optimal portfolio for the entire period will provide a biased estimation for the optimal portfolio (why?). As the markets had no stable trend during this period and experienced volatilities due to the political and economic conditions of the country, to separate the distinct sub-periods during the current study period, the cumulative returns of all six assets were calculated and a structural breakpoint test was then performed[1] (Figure 2). Next, based on the structural breakpoints, the optimal portfolio for the pre-and post-breakpoint periods was separately calculated and analyzed.

[1]. To calculate the cumulative return on these assets, the price changes and dividends of each asset were firstly calculated by following Formula:

$$(P_{t+1} - P_t) + D$$

Thereafter, the calculated values for each period were summed over all the values of the previous periods, and as a result, the cumulative return of each period for the initial value P_0 was obtained. Because P_0 is not the same for all assets, comparing these cumulative returns with each other gives a biased result. Therefore, the initial value of P_0 for all assets was normalized to the initial value of ten million Rials using following formula:

cumulative return of t period / cumulative return of t-1 periods × 1000000

Figure 2. Logarithm of Cumulative Return of Six Assets in Iranian Markets
Source: Research finding.

Figure 2 shows that between 2008 and 2020, the return on assets during different periods failed due to political and business cycles inside and outside the country. The points considered as possible structural breakpoints of the diagram and the result of performing the Chow breakpoint test using Eviews 10 are presented in Table 1.

Table 2. Chow Breakpoint Test Results in Some Probable Points

Asset / Probable breakpoint	USD	Gold	Real Estate	Stock
2013-Q 3	×	×	×	×
2015- Q 4	×	×	×	×
2017- Q 1	×	×	×	×
2018- Q 2	✓	✓	✓	✓
2019- Q 3	×	×	×	✓

Source: Research finding.
Note: (× = isn't breakpoint) & (✓= is breakpoint).

As shown in Table 1, between 2018 and 2020, due to the political event of the US withdrawal from the Joint Comprehensive Plan of Action (JCPOA), a structural break occurred in all the studied markets. In addition, Figure 3 shows the consumer price index, which also indicates a break during this period; therefore, the structural break observed at this point may probably be due to the continuous devaluation of Real and higher inflation that affected the nominal return on all assets. Therefore, we divided the research period into two parts, the last quarter of 2017 and before, and the first quarter of 2018 and after (until the first quarter of 2021).

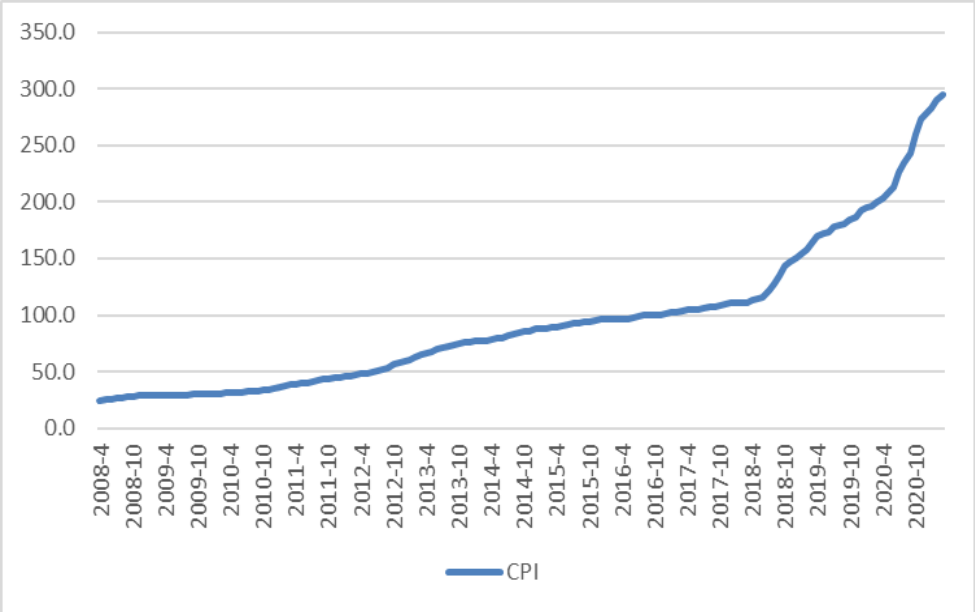


Figure 3. Iranian Monthly Consumer Price Index (2016 = 100)
Source: Statistical Center of Iran website.

3.4 Optimal Portfolio Calculation Method

To determine the optimal investment portfolio of the insurance company, the method of Mean-CVaR optimization was used. The optimal investment portfolio was obtained by solving the optimization problem as follows:

$$Max \sum_{i=1}^{n} W_i R_i \quad (3)$$

$$S.t: \quad CVaR_P = \overline{CVaR} \quad (4)$$

$$\sum_{i=1}^{N} W_i = 1 \quad (5)$$

$$W_i \geq 0 \; \forall i = 1, 2, \dots, 6 \quad (6)$$

where $\sum_{i=1}^{n} W_i R_i$ is the portfolio return and $CVaR_P$ is the portfolio risk. $W_i \geq 0 \; \forall i = 1, 2, \dots, 6$ indicate the absence of short selling.

Besides 3, 4, and 6 restrictions, it is necessary to add the constraints of the investment regulations of insurance companies, to obtain the restricted optimization model faced by insurance companies. Due to the changes in these regulations, during the periods before and after the break, the regulatory restrictions on weights were different in the following order. Usually, corporate investment supervision regulations include the following two parts: quantitative and qualitative supervision. In the

designed model, it was not possible to enter the quality constraints required by the companies. As well, the risk-limiting constraints on asset concentration have not been included in the modeling since these have not been limiting for the above-mentioned optimization problems. The added regulatory constraints were taken from the quantitative constraints of the No. 42, 60, and 97 bylaws passed in High Council of Insurance related to the investment of insurance companies.

During the period before the structural break (from 2008-Q4 to 2018-Q1):

$$20\% \leq W_1 \quad (7)$$

$$W_2 \leq 25\% \quad (8)$$

$$W_3 \leq 40\% \quad (9)$$

$$W_4 \leq 30\% \quad (10)$$

$$W_5 = W_6 = 0 \quad (11)$$

During the period after the structural break (from 2018-Q2 to 2021-Q1):

$$20\% \leq W_1 \leq 70\% \quad (12)$$

$$W_2 \leq 30\% \quad (13)$$

$$W_3 \leq 40\% \quad (14)$$

$$W_4 \leq 25\% \quad (15)$$

$$W_5 = W_6 = 0 \quad (16)$$

where W_1, W_2, W_3, W_4, W_5, and W_6 represent the weight of bank deposits, Islamic bonds, stocks, real estates, gold, and foreign exchange, respectively. Finally, the optimal weights of investment were obtained from maximizing returns for different risks, in terms of the constraints of investment regulations of insurance companies.

After obtaining the optimal weights of the six main assets, the optimal share of different industries from the total equities is obtained. This is the second stage of the optimization process as follows:

$$Max \sum_{i=1}^{n} W_i R_i \quad (17)$$

$$S \cdot t : CVaR_P = \overline{CVaR} \quad (18)$$

$$\sum_{i=1}^{N} W_i = 1 \quad (19)$$

$$W_i \geq 0 \; \forall i = 1.2 \ldots .33 \quad (20)$$

where $\sum_{i=1}^{n} W_i R_i$ is the stock portfolio return and $CVaR_P$ is the portfolio risk.

$W_i \geq 0 \; \forall i = 1.2 \ldots .33$ indicates the absence of short selling for each one of the 33 active stock exchange industries. Once again, optimal investment weights were obtained from maximizing returns for different risks ($\overline{CVaR}$)[1].

In case of significant difference between the optimal portfolio and the realized portfolio of the studied insurance company, both identifying and analyzing this deviation are important to validate the study's results. So, an attempt was made to collect the perceptions of experts and the main investment decision makers of the insurance company regarding the causes of such deviation through conducting a field study based on a semi-structured questionnaire.

4. Results

Calculation of the optimal portfolio is conducted in two statuses including and not including regulatory restrictions on the first stage of optimization for the main six assets for both two periods. Then, they compared it with the realized portfolio. Finally, the second stage of optimization for achieving an optimal stock portfolio is conducted and compared with the realized stock portfolio.

4.1 Results of the Calculation of the Optimal Portfolio of Six Assets

The results of solving the first status[2] optimization model (without regulatory restrictions) for different risks (CVaR) provide us with the efficient frontier[3] obtained from CVaR for each period, as shown in Figure 4. In addition, the results of solving the second status optimization model (with regulatory restrictions) for different risk levels (CVaR) provide the efficient frontier for each period shown in Figure 5.

[1]. Regulatory risk-related constraints are concentrated on the investment of insurance companies on the stock of one company. Since each stock exchange industry includes several companies, so regulatory constraints are not the case for our 2nd stage optimization model.

[2]. This means without applying constraints of the investment regulations of insurance companies.

[3]. Efficient frontier includes a set of investment portfolios providing the highest expected returns at different risk levels or the lowest risk at different return levels.

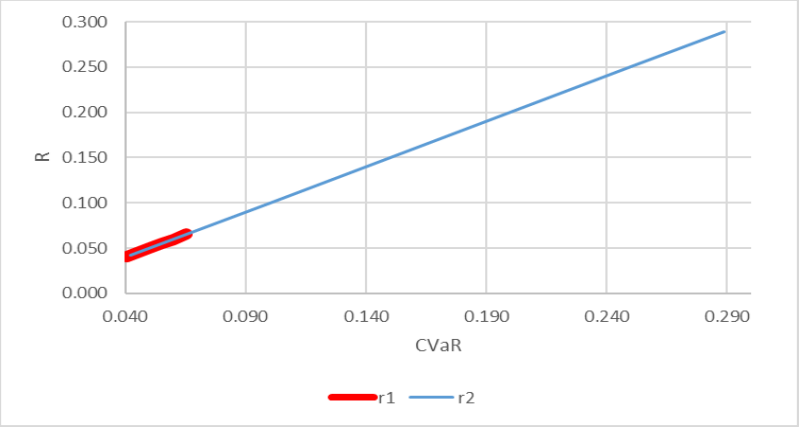


Figure 4. Efficient Frontier of the Optimal Asset Portfolio without Regulatory Restrictions
Source: Research finding.
Note: r1 = the first period; r2 = the second period.

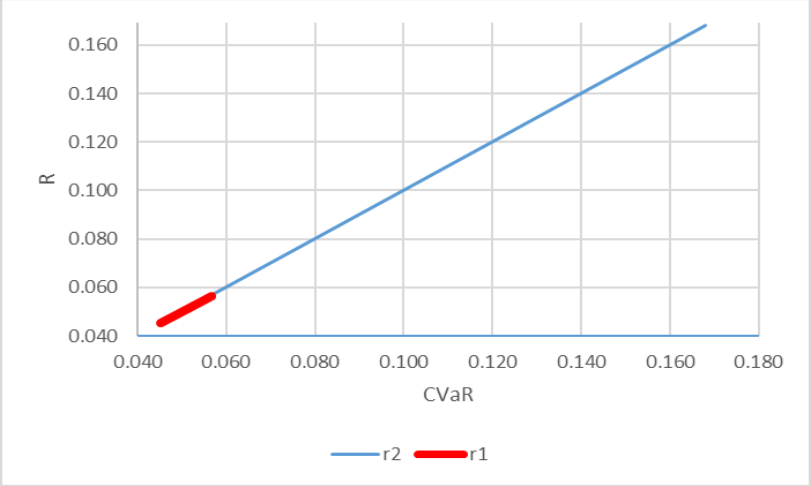


Figure 5. Efficient Frontier of the Optimal Asset Portfolio with Implementation of Regulatory Restrictions
Source: Research finding.
Note: r1 = the first period; r2 = the second period.

the In case of not implementing regulatory restrictions, the lowest risk and return during the two studied periods were 0.042 and 0.042, and the highest risk and return were 0.06 and 0.06, and 0.28 and 0.28, respectively in the 1st and 2nd periods (Figure 4). This implies that many points in the risk & return environment are available in the 2nd period that have a higher level of risk and return compared to 1st period. In other

words, during the second period (after the break) optimal investment portfolios were available with much higher risk and return compared to the first period in both optimal models due to the increased general price level.

In the case of implementing regulatory restrictions (Figure 5), the lowest risk and return during the two periods were 0.045 and 0.045 and the highest risk and return during the first and second periods were 0.056 and 0.056, and 0.168 and 0.168, respectively. Comparing the results of this optimization model with the previous case shows that by adding the constraints of the investment regulations to the model, the available maximum risk point would be lower than the unrestricted status in both two periods. In addition, this comparison shows that the available risk of the portfolio is much more mitigated in the 2nd period by the implementation of the regulation. Although it helps control the risk of the portfolio (as a target of the regulator), it is not necessarily an efficient solution, because the available portfolio return is also restricted significantly (from 0.28 to 0.168).

Given that each one of the points on the efficient frontier (which is a combination of risk and return) refers to a portfolio, these portfolios can be plotted as the share of different assets. It is performed for optimal portfolio without regulatory restrictions in Figure 6 and, for optimal asset portfolio with regulatory restrictions in Figure 7.

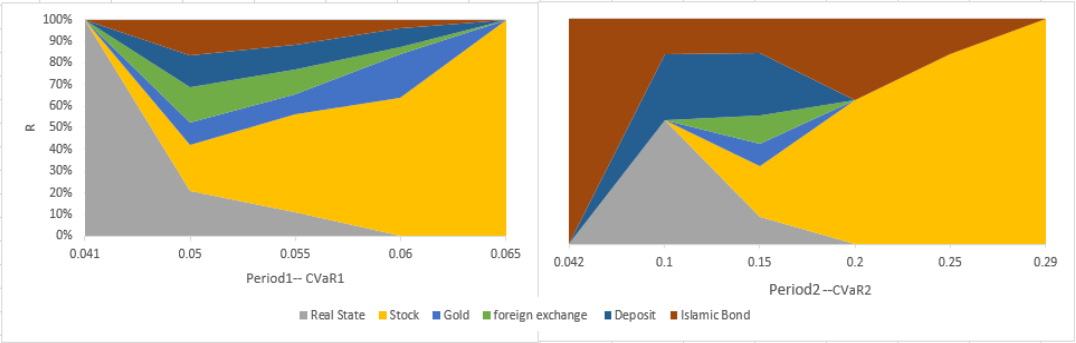


Figure 6. Optimal Investment Weights (without Regulatory Restrictions) for the First and Second Periods
Source: Research finding.
Note: The horizontal axis indicates the risk.

Figure 6 implies that during the first period and at low-risk levels, the model suggests investment in real estate, while the diversification of the portfolio was increased with a little more risk tolerance. At the highest risk levels, investing in stocks has unlimited increasing weight. During the second period and at low-risk levels, investment in debt securities is proposed as the best alternative option, and at high levels of risk, investment in stocks can be considered. Therefore, based on this optimal

model, debt securities are more used as a low-risk investment in the inflationary environment of 2nd period, while this role is played by real state in 1st period. As another result, diversification of optimal portfolio is mitigated with higher level of risk in higher inflation (in 2nd period compared with 1st period).

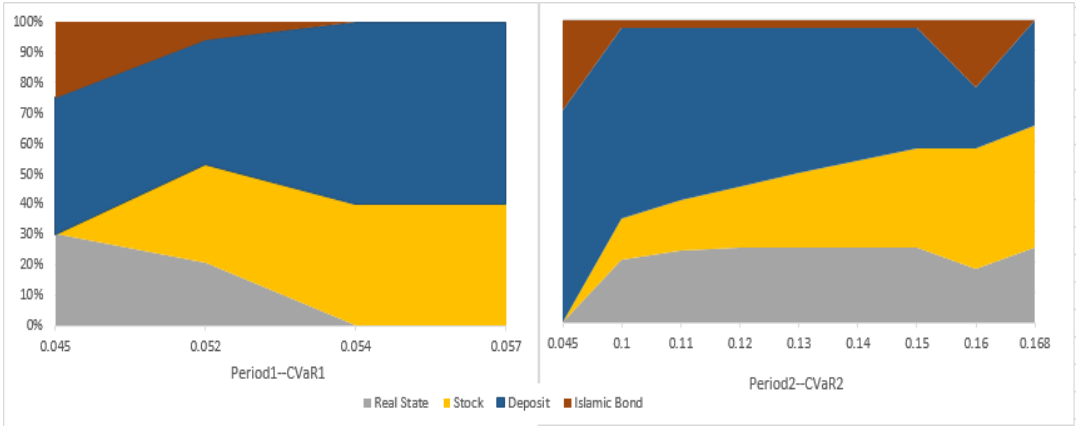


Figure 7. Optimal Weights of Investment (with Regulatory Restrictions) during the First and Second Time Periods of the Investment of Insurance Companies
Source: Research finding.

After imposing regulatory restrictions (Figure 7), gold and foreign exchange were eliminated from the model. In addition, debt securities were substituted by mandatory deposit and had minimal weight. Additionally, stock weight is restricted in both 2 time periods, and seems it is the main item for restriction of available high-risk and high-return portfolios in comparison with Figure 6.

4.2 Results of Calculating the Optimal Stock Portfolio

After calculating the optimal weights of the main portfolio optimization model, to identify the optimal weights of each stock exchange industry in the company's stock portfolio, the results related to solving the second model optimization problem for different risk levels (CVaR) in the efficient frontier of CVaR, are presented in Figure8.

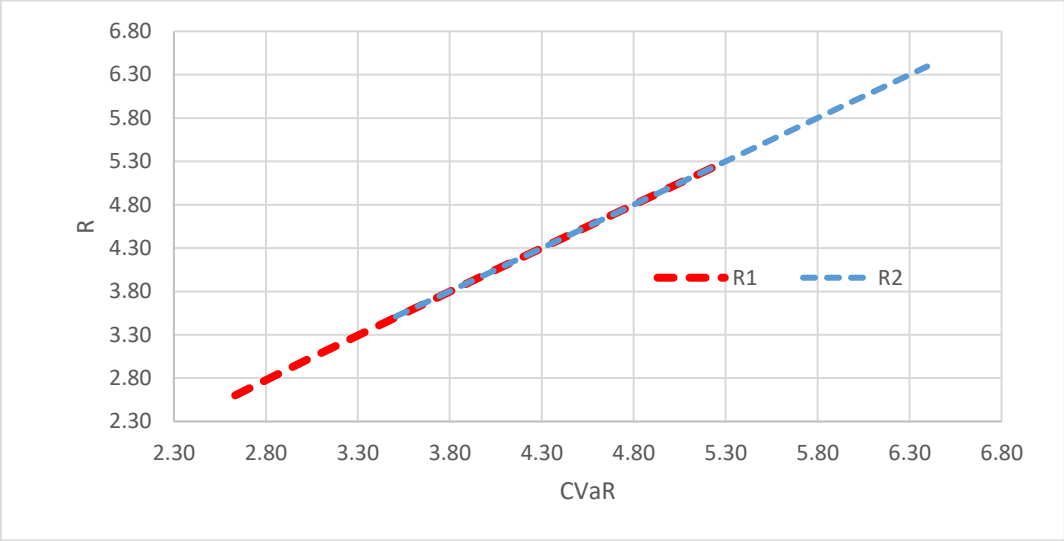


Figure 8. Efficient frontier of the optimal stock portfolio (R1= the first time-period and R2= the second time-period)
Source: Research finding.

Like the previous stage of the asset portfolio optimal model, due to the structural break in returns, optimal portfolios of stock investments in 2nd period have much higher risk and return than those of the 1st period. Of course, in this stock-efficient frontier, the minimum level of risk and return also moved up significantly in 2nd period (figure 8)[1]. It could have stemmed from the stock market bubble due to intense governmental propaganda for the stock market in 2nd period. The optimal weights of the stock portfolio for each available level of risk are plotted in Figure 9.

[1]. The lowest risk and return in the first and second periods were 2.6 and 2.6, and 3.5 and 3.5, respectively. As well, the points of highest risk and return during the first and second periods were 5.25 and 5.25, and 6.4 and 6.4, respectively.

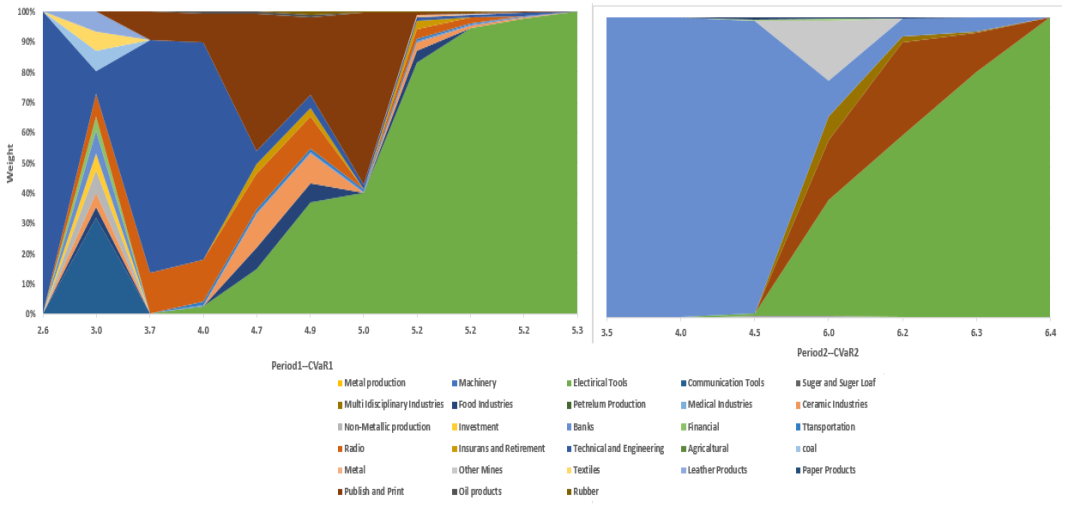
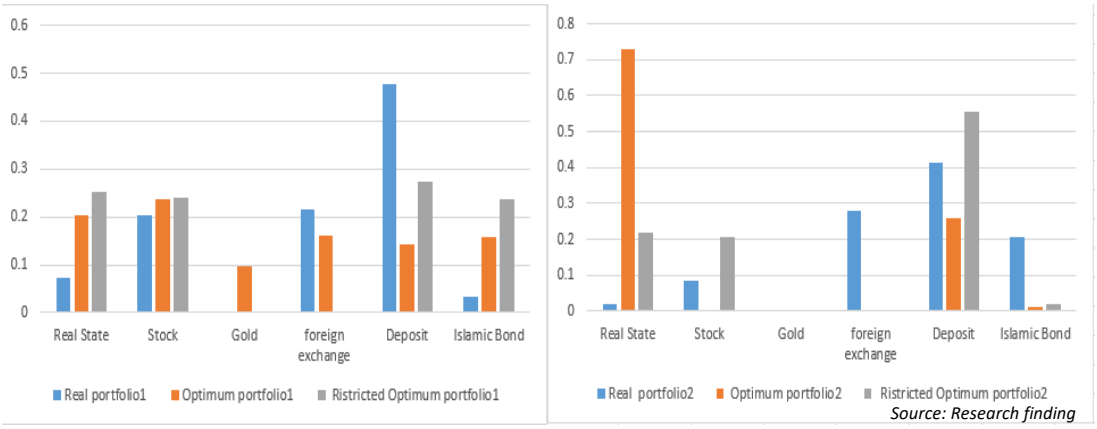


Figure 9. Optimal Weights of Stocks Portfolio for the First and Second Time-Periods
Source: Research finding.

As shown in Figure 9, in the first period, investing in technical and engineering stocks was recommended at low-risk levels, and investing in electrical appliance stocks was recommended at high-risk levels. However, in the second period, at low-risk levels, investment in the banking industry and at high-risk levels, investment in the electrical appliance industry was recommended.

4.3 Comparison of the Optimal and Realized Portfolio of the Company

Realized weights of the asset portfolio for the studied company were obtained from its audited financial statements. It can be claimed that the studied Insurance Company has obtained a mean return of about 0.05048 for risk acceptance of about 0.0587 (CVaR measure) from the first quarter of 2008 to the last quarter of 2017 and it has also obtained a return of about 0.118063 for risk tolerance of about 0.1223 from the first quarter of 2018 to the last quarter of 2020. These combinations of risk and return are not on the efficient frontier, because a higher return would be achievable by the acceptance of the same risk. Based on the amount of investment risk taken by the insurance company, the two optimal portfolios were chosen on the efficient frontiers of Figures 4 and 5 and their optimal asset weights were determined from Figures 6 and 7 for each period.



Source: Research finding

Figure 10. Comparison of the Two Optimal Portfolios of Assets with the Realized Portfolio of the Studied Insurance Company
Source: Research finding.
Note: "Optimum portfolio" refers to optimization without imposing regulatory restrictions and "Restricted optimum" refers to optimization with imposing regulatory restrictions. In addition, the left-hand chart refers to the 1st period and the right-hand chart refers to the 2nd period.

As shown in Figure 10, the company's investment realized weights are different from the optimal weights. Accordingly, in the first period, this company has less invested in the assets of real estates, stocks, and Islamic bonds than what the optimal models suggest. Also, in the second period, deposits replace Islamic bonds, and therefore, the realized deposit is less than the restricted optimum portfolio2 and Islamic bond is more than the corresponding optimal weights.

It should be noted that the realized amount of some assets such as stocks, deposits, and Islamic bonds are calculated from merely investment category in the balance sheet, while the realized amount of gold, foreign exchange, and real estate assets calculated from foreign assets and tangible assets (besides investment) categories in the balance sheet. If we had calculated six assets only based on the investment category of the balance sheet, the realized weight of real estate, gold, and foreign exchange would be estimated at zero. Because investment in these assets is forbidden by regulation. In addition, in this case, the real and optimal portfolios would be different.

The lower realized weight of real estate in the first period may be due to a measurement error that stems from the implementation of finished cost-based accounting standards for an inflationary environment. Furthermore, despite the double-digit inflation of the Iranian economy in the long run, real estate has been

recorded in accounting books based on the purchasing price that can refer to 20 or more years ago. While most of these assets were purchased previously, because they were not traded during this period, their book value was considered as the basis for the calculation. Of note, this leads to much less deviation in valuation for other portfolio assets such as stocks that naturally traded several times per year and as a result, have little difference between market value and book value.

The reason for the high realized weight of foreign exchange during both of these study periods can be explained by the fact that due to the high correlation existing between gold and foreign exchange in the inflationary economy, the company has selected only one of these two for investment. Although keeping gold and foreign exchange as investments are forbidden by the regulation, the company has bought foreign exchange even more than the unrestricted optimization corresponding weights. As a result, if we consider the sum of these two assets as one asset, even though the foreign exchange is more than optimal, the sum of gold and foreign exchange during the first period would be less than the optimal amount, and during the second period, it would be more than the optimal amount.

For the optimal and realized weights of deposits and debt securities, it should be noted that these two assets are very similar in nature (both have guaranteed fixed income and determined value in maturity). Therefore, the company has held one of these two assets. If it is assumed that the company has placed these two assets in the same class, the realized weight of this class of asset during the first period for the company would be 0.51 and the optimal weight would be 0.3. It means that the difference between realized and optimal weight for this aggregated class of asset is mitigated compared to the difference for separated two assets of deposit and bonds individually.

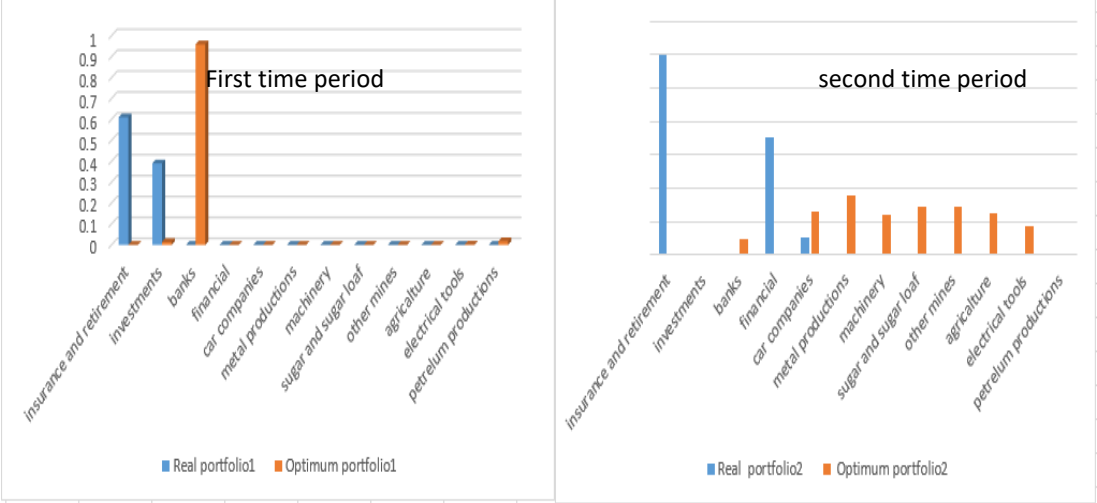


Figure 11. Comparison of the Optimal Stock Portfolio with the Realized Stock Portfolio of the Studied Insurance Company
Source: Research finding.

By examining the company's stock portfolio, it was observed that the insurance company's stock portfolio during the studied period was significantly different from the optimal portfolio, as shown in Figure 11. Investments in industries such as banking, petroleum products, automobiles, metal products, other mines, and agriculture are usually offered by the optimal stock portfolio, while the company's investments are often in other parts such as the insurance & pension industries, and mutual funds. It can be stemmed from that insurer's investment managers do have not enough informational dominancy on all listed businesses and they prefer to concentrate on indirect investment through holding equities of financial institutions and equities of their rivals in the domestic insurance market.

4.4. Reason for Deviation of Realized Portfolio from the Optimal, Semi-Structured Interview

The statistical population of the respondents of the semi-structured interview included CEOs, financial managers, and investment managers of the studied insurance company as well as some other investment decision-makers in the insurance industry (n = 9). Accordingly, among the included respondents, those who participated in completing the questionnaire (n = 7) were selected as eligible samples of this study. The interview questions were designed with the guidance and approval of

knowledgeable and expert people in the field of investment of insurance companies. Main results of the completed questionnaire are summarized as below[1]:

The main part of the insurance undertakings of Iranian insurance companies relates to insurance lines such as private health insurance and Motor Third Party Liability Insurance (MTPL). These lines have a short-term structure for paid claims. Therefore, regarding ALM[2], companies have adjusted their asset composition with more short-term and liquid investments, and less long-term and illiquid investments. For this reason, most insurance companies have invested in bonds and bank deposits and have not sought long-term investments such as stocks and real estate[3].

In the case of real estate, if we calculated the weight of this asset only based on those categorized in investments in the balance sheet, the resources allocated to this asset during both periods would be almost zero. However, considering the tangible fixed assets section on the right hand of the balance sheet, the allocation of resources to this asset is shown in Figure 10. The reason, from the point of view of the interviewees, maybe the severe inflation of the Iranian economy. Because, the real estate that was purchased with the intention of investing, in case of annual revaluation[4], is identified as a capital gain (in legal accounting books), which must be divided between the shareholders and life policyholders. Notably, since this capital gain has not been realized for the company before the sale of the corresponding asset, it is recorded in books as a tangible fixed asset. Therefore, by transferring real estate from the investment category to the fixed asset category in financial statements, insurers evade paying capital gain benefits to the policyholders.

Both gold and foreign exchange are not usually categorized as investments in accounting records due to the legal prohibition. Nevertheless, they are recorded as assets, which are held to procure the liabilities in foreign currency according to ALM principles.[5] Due to this reason, their share is differently evaluated from that of the

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[1]. The questions posed to the respondents included general questions on the reason for the difference between the optimal and realized portfolios. In addition, the company officials were asked about the reasons for the increase or reduction in the share of each asset from the realized portfolio to the optimal portfolio.

[2]. Asset-Liability Management (ALM)

[3]. Because the investigated periods for decision making on stock investments is long-term and they have not a maturity, investment in stocks refers to the long-term portfolio of these assets.

[4]. According to corporate tax regulation, corporations can revaluate assets and record their surplus in financial statements in free tax on surplus one time; but in the case, they must revaluate corresponding assets every three years and their surplus included in tax. Therefore, most of corporations reluctant to asset revaluation.

[5]. Allocation of investment resources to foreign asset had not permitted in previous insurer's investment regulation (no 60 bylaw) which was matter in the 1st time-period. However, it has permitted until 20% cap of investment resources in new regulation (no 96 bylaw) for the 2nd time-period.

optimal share. In fact, foreign exchange assets are intended for both investment purposes and meeting ALM requirements.

Regarding the difference between the optimal and realized weight of the Islamic bonds in company's investment, it is noted that inadequate investment in bonds in the primary years of the first period due to the new launching and introduction of this financial instrument in the Iranian financial market and lacks both knowledge and confidence of corporative investment managers about them. Also, depending on whether the issuer of these securities is an investment bank, commercial bank and/or the central bank, the way they are recorded in the accounting books would be different according to the accounting standards. For example, in the case of securities issued by capital market institutions, they are not recorded as Islamic debt securities, and this is a measurement error that should be corrected in the form of financial statements guides/directives of insurance companies. The third reason can be that although this asset has a lower interest rate risk compared to a bank deposit, it is not as flexible and well-behaved as a bank deposit for insurance companies. At the same time, the possibility of bargaining on interest rates on deposits in the form of providing better banking services consequently increases the tendency to go for banking deposits rather than buying debt securities.

To compare the optimal and realized portfolios in the capital market (equities), it should be noted that investors mainly intend to enter the capital market in both long-term and short-term forms. Therefore, the type of investment of insurance companies in this market is divided into these two parts. Short-term investments, making up at least 5% and at most 30% of the company's stock portfolio, are monitored and changed daily and even hourly and are formed with the intention of noise trading.[1] By contrast, comparing the long-run portfolio of insurance companies, which includes at least 70% and at most 95% of the resources allocated to this asset, with the computed stock portfolio in this research seems more logical. Accordingly, insurance companies are usually investing in industries such as banks, investments, insurance, and pension funds for the long term, which differs from the calculated optimal portfolio. Correspondingly, the reason may be the lack of optimal management of the companies' share portfolios and in some cases, the tendency to hold shares of their own parent companies, to impact their votes on their general assembly, which leads to the difference between the two combinations.

In the present study, the interviewees also stated that some assets such as gold and foreign exchange in terms of liquidity, risk, and return could be considered as good

[1]. Therefore, this is not the case of stock investment in this research.

options for investment. Therefore, if this prohibition converted to a legal permissive percentage (even a small percentage) of the company's investment resources, then insurance companies will possibly achieve higher levels of portfolio returns for each specific level of investment.

5. Conclusion

The current study intends to optimize the investment portfolio of insurance companies on the following six assets: gold, foreign exchange, stocks, Islamic bonds, deposit, and real estate Also the optimal stock portfolio of the company in the shares listed in TSE was calculated and then compared with the realized stock portfolio in the studied company. The comparison indicated a significant difference between the optimal and real investment portfolios of the studied company.

The obtained results show that unlike many previous studies performed in other countries, gold, and foreign exchange have always been considered good assets for investment in Iran, stemming from the fact that Iran's economy has been experiencing instability from the impact of widespread and volatile sanctions and oil price, the resulted foreign exchange shocks and long-term chronic inflation. Additionally, the studied insurance company also had large foreign exchange assets in its asset portfolio. Due to the prohibition of the allocation of investment resources to gold and foreign exchange, the company has justified its foreign exchange purchase by arguing that the volume of foreign exchange liabilities is high to match the foreign exchange of assets and liabilities; however, the result of this legitimized action is the same to forex investment for the company. Another important result of this paper is that legal factors such as accounting standards on valuation and classification of financial instruments, significant and predictable differences in the market value and book value of some long-term assets due to continuous high inflation, could lead to measurement error in financial statements and deviation of the realized portfolio from o the optimal portfolio. Similarly, the basis for the valuation and reporting of capital gain (which requires the sale of assets according to applicable accounting standards), along with constraints of the investment regulations for purchasing real estate, has led the insurance company to buy their properties as fixed assets required for insurance business and to not keeping it as an investment item in financial statements. The high share of tangible fixed assets in the balance sheet as well as the low share of real estate in investments, are the results of these conditions, which are common among Iranian insurance companies.

Lack of dedicated company investment managers and experts, inadequate development of financial markets, lack of diversity in highly liquid financial

instruments (including the lack of long-term bonds), the existence of legal barriers to enter the market of some assets such as gold and foreign exchange, and non-professional investment decisions have also been mentioned as other reasons for the difference observed between the optimal and realized portfolios.

The main problem stemmed from the implementation of the approach for asset valuation that is not valid in an inflationary environment like the case of Iran. Recording of asset values in all years based on the nominal value at the time of buying assets leads to a continuous decrease of book to market value of assets. Since the tax on capital gain is calculated merely based on book value, this framework seduces the insurers to buy and hold long-run assets (such as real estate) and their resistance to selling such assets. It seems that full and accurate implementation of IFRS17 & IFRS9 would help cure this big regulatory distortion for inflationary environments.

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