Journal of Systems Thinking in Practice
JSTINP, *QUARTERLY*
Homepage: jstinp.um.ac.ir
Online ISSN: 2821-1669, Print ISSN: 2980-9460
Research Article
DOI: 10.22067/JSTINP.2024.89580.1117
JSTINP 2025; Vol. 4, No. 1

Modeling Customer Purchase Behavior in the Insurance Industry Using System Dynamics

Shabnam Jalalat[a], Kambiz Shahroodi[a]*, Mehdi Fadaei[b], Mahdi Homayounfar[b]

[a]*Department of Business Administration , Rasht Branch, Islamic Azad University, Rasht, Iran.*
[b]*Department of Industrial Management, Rasht Branch, Islamic Azad University, Rasht, Iran.*

How to cite this article

Jalalat, S., Shahroodi, K., Fadaei, M., Homayounfar, M. 2024. Modeling Customer Purchase Behavior in the Insurance Industry Using System Dynamics, *Journal of Systems Thinking in Practice*, *4*(1), pp.44-69. doi: 10.22067/jstinp.2024.89580.1117.

URL: https://jstinp.um.ac.ir/article_46017.html.

ABSTRACT

The Iranian insurance industry is a system in which each of the population segments, customers and their types, revenue management, various investment methods, and advertising methods have nonlinear and bidirectional relationships with each other. Analyzing this industry requires a tool to consider all the essential variables and incorporate the relationships between them in the analysis and simulation. System dynamics is a powerful approach for modeling and simulation that has shown its applicability in analyzing and predicting the behavior of complex systems. Therefore, this article used this tool to model and simulate the impact of advertising on the behavior of life insurance customers and its relationship with revenue and asset management. The system dynamics model was drawn, formulated, and validated with the help of the Vensim software. The model extraction process consisted of a comprehensive review of existing studies on customer behavior, identification of key variables related to life insurance purchasing behavior, consulting with insurance industry experts to validate the initial variables and identify factors specific to the Iranian context, drawing causal loop diagrams, and converting them into stock and flow diagrams. Statistical data were collected using the annual reports of the Iran Insurance Company, the Statistical Center of Iran, the statistical yearbooks of the Central Insurance of Iran, and semi-structured interviews with experts. After optimizing the structure and parameters of the model, simulation was performed over a 10-year horizon, and the results were analyzed in three scenarios. The first scenario showed that of continuing the current conditions would lead to an increase in the gap between life insurance expenses and revenue. In the second scenario, the effect of increasing the advertising budget was examined, which prevented the increase in this gap but the existence of a difference. The third scenario showed that a 10% improvement in the rate of word-of-mouth advertising dissemination, while compensating for the costs, will lead to the company's profitability.

Keywords

Modeling, Customer purchase behavior, System dynamics, Life insurance.

Article history

Received: 2024-08-25
Revised: 2024-11-16
Accepted: 2024-11-27
Published (Online): 2025-03-17

Number of Figures: 21 **Number of Tables: 2** **Number of Pages: 26** **Number of References:24**

**Corresponding author*
Email: shahroudi@iaurasht.ac.ir

1. Introduction

According to Kotler and Keller (2009), purchase behavior is the study of how individuals or groups buy, use, and dispose of goods, services, ideas, or experiences to satisfy their needs and wants. A customer decides to purchase in response to the imbalance caused by unmet needs and wants. Typically, a customer undergoes five stages of purchase behavior: need recognition, information search, evaluation of alternatives, purchase decision, and post-purchase behavior (Shah et al., 2019). The development of new technologies (such as the Internet of Things, artificial intelligence, machine learning, digital currencies, blockchain, cloud computing, mobile devices, and cognitive systems) is transforming the competitive landscape in various ways and at different levels. Organizations increasingly use new strategies, data, and business models developed or derived from new technologies to understand consumer choices and behavior and gain a competitive advantage.

In this context, the insurance industry, like many other markets and financial sectors, faces increased competition and complexities in understanding customer purchase behavior. In the insurance industry, one of the critical studies is understanding the behavior and motivations of individuals inclined to purchase insurance (Chen et al., 2022). The insurance industry is considered a development indicator and plays a crucial role in supporting other institutions within the economy. Therefore, the significantly impact the industry's growth and development and, consequently, the country's economic growth and development. However, research shows that one of the gaps in the Iranian insurance industry is the lack of specialists who are simultaneously educated, specialized, and experienced in insurance and marketing. The technical managers of insurance companies are primarily experts in insurance matters, while marketing specialists lack sufficient knowledge of insurance technicalities. This weakness is more pronounced in non-life insurance sales, such as life insurance. Everyone faces risks in life. Since risk is almost always present, it must be properly and adequately. One way to mitigate this risk is by purchasing insurance from an insurance company (Alfiero et al., 2022). Life insurance is a type of insurance that provides services to manage risks related to an individual's life or death (Sukmaningrum et al., 2023). With the increasing number of deaths and life-threatening diseases, the importance of life insurance as a necessity for protecting individuals is becoming more evident (Keat et al., 2020). Life insurance is one of the most common financial tools for households to compensate for the loss of assets due to premature death caused by severe illness or significant health issues (Chen et al., 2022).

In Iran, life insurance constitutes a small share of the insurance industry's activities compared to the global average and other regional countries, indicating the presence of barriers and issues in this process. The low penetration rate and lack of development of life insurance in our country highlight the need to study the demand for life insurance despite its benefits and potential. The insurance industry faces complex challenges in understanding and predicting customer purchasing behavior .The intention to purchase a life insurance policy can be influenced by various economic, social, cultural, and individual factors. Numerous studies have been conducted on the reasons for the underdevelopment of life insurance in Iran, most of which focus on the factors affecting the demand for these policies. However, what is lacking is a comprehensive examination of this issue with a dynamic approach, modeling the relationships between the contributing factors while considering interactions and maximum realistic considerations.

Therefore, the present research addresses several critical research gaps in the customer behavior literature in the insurance industry. One gap is the insufficient use of system dynamics: While many studies have examined the fixed factors affecting the purchase of insurance, there is a need for more studies that demonstrate the dynamic and evolving nature of customer behavior over time. Another gap is the lack of a comprehensive model. Existing research often focuses on separate aspects of the insurance industry. More comprehensive models are needed that integrate factors related to demographic variables, customer acquisition, advertising effectiveness, financial resources, and investment strategies. Additionally, few studies have determined the long-term effects of different advertising strategies on customer acquisition and profitability in the insurance sector. It can also be noted that the comparison of the relative effectiveness of traditional advertising methods versus word-of-mouth marketing has been limited, particularly in the field of insurance, and over extended periods, sufficient studies do not exist. By addressing the aforementioned gaps, this study aims to develop a more comprehensive and dynamic understanding of customer behavior in the insurance industry and provide theoretical insights and practical tools for decision-makers.

Today, advanced technologies enable the development of new methods and support for software tools that can assist the insurance sector. System dynamics (SD) analysis is a very efficient and well-known method for studying system behavior. System dynamics refers to system changes and behaviors over time under different conditions (Safaie et al., 2023). Hence, utilizing the SD approach, the behavior of variables is displayed concerning each other over time, and the effect of variables on each other is well-reflected in simulating the behavior

(Modares et al., 2023). Also, system dynamics is an evaluation method to increase learning in complex systems and designing effective policies. Recording and investigating the critical functional points of the systems is one of the best ways of organizing the correct and rapid reactions to the issues related to the systems; it takes the form of a prospective scenario that takes as its criterion the past and the present behavior of the system's environment. Recording this scenario entails applying the knowledge and technique that correctly identifies the problem by taking advantage of a systematic method and presenting the fastest and most proper reaction to overcome the created challenges .This knowledge is the system dynamics(Amiri, 2023).

Given the topic's significance, this study aims to enrich the scientific literature on customer purchase behavior in the insurance industry by designing an appropriate model. This model seeks to provide a practical tool for effective use by insurers and insureds, allowing for the analysis and evaluation of various policies, including advertising and educational policies, under different market risk conditions .This study develops a comprehensive and dynamic model of the life insurance industry that illustrates the feedback loops and time delays between demographic variables, customers, revenue management, investment strategies, and advertising effectiveness in Iran's life insurance market. The present model provides a framework for policymakers and industry leaders to understand the long-term impacts of different strategies on Iran's life insurance market and determines the magnitude of the long-term effects of advertising strategies on customer acquisition and company profitability. Additionally, analyzing various scenarios provides practical insights for insurance companies to optimize advertising strategies and improve profitability. It demonstrates the potential of system dynamics as a decision-support tool for insurance companies to evaluate policies and strategies under defined scenarios.

This article is organized as follows: First, the system dynamics approach is briefly explained. Then, with the help of subsystem diagrams, an overview of the system under study is presented. Next, the involved variables are introduced, and the relationships between them are defined in causal loop diagrams and stock-and-flow diagrams. Subsequently, the mathematical relationships between the variables are determined, and the simulation is conducted using Vensim software. Finally, the results of various scenario analyses over a ten-year horizon are presented after ensuring the model's validity through conventional system dynamics validation methods.

2. Literature review

Numerous studies have explored the factors influencing customer behavior, with some specifically focusing on the insurance industry.

Zhao et al. (2023) conducted a study to investigate the impact of multi-level factors on the purchase decisions of green housing (GH) customers in China using a system dynamics approach. Despite being recognized as a key approach to addressing environmental issues and enhancing human life quality, green housing faces marketing and sales policy challenges in China due to limited market demand. This study proposed a system dynamics model to explore the interactions between producers, residents, governments, the social environment, and product features and to examine the dynamic impact mechanisms on purchase decisions. The results indicated that GH purchase decisions are influenced by a complex interplay of factors at various levels that dynamically interact. Specifically, advertising and education effectively increase perceived benefits, administrative regulations effectively reduce perceived risks, and economic incentives have minimal impact on perceived benefits. This study provides a new systematic and dynamic perspective on the interdependent structure of multi-level factors influencing buyer decisions, offering enlightening implications for policymakers and business decision-makers to jointly promote GH development.

Teixeira et al. (2024) conducted a review study on consumer purchasing behavior. The results show that the number of citations on this topic has increased more than 2.5 times in the past two decades and is predicted to double in future decades. Jacobs et al. (2021) studied dynamic customer purchasing behavior. They propose a new model linking purchase motivation with product and customer characteristics and frequency. This model even considers the interdependence of motivations, which can lead to better prediction performance and provides deep insights into purchasing behavior that was not possible using standard models. Managers can use such insights to create more intuitive, informed, and effective marketing actions.

In another study, Nursiana et al. (2021) aimed to examine the fundamental variables influencing customer purchase behavior in the insurance industry. The results showed that product quality positively and significantly impacted purchase intention, company reputation, and perceived risk. Company reputation had a positive and significant effect on purchase intention and a minor positive effect on service quality. Product quality had a positive but insignificant impact on service quality, while service quality had a positive and significant effect on purchase intention. Perceived risk had a negative and significant impact on purchase

intention, a positive and significant effect on service quality, and a positive and significant impact on company reputation.

A study on factors influencing the intention to purchase life insurance found that having previous negative health experiences motivates individuals to purchase insurance to reduce the risks of income loss due to illnesses and disabilities. A survey conducted in Australia, Brazil, Germany, Hong Kong, Italy, Spain, Mexico, the UK, Sweden, and the USA showed that those with negative health experiences were 25% more likely to intend to purchase health insurance compared to others (Innocenti et al., 2019). The perception of risk has long been studied in research, such as psychological or psychometric approaches. Kunreuther and Michel-Kerjan (2015) indicated that risk perception is a process describing the subjective evaluation of an imminent event. Research by Yang and Peng (2020) on the impact of risk perception on insurance purchase intention showed that fear of natural disasters leads individuals to lower their risk assessment when purchasing insurance, prompting quicker purchases of natural disaster insurance.

A study on the journey from intention to decision in life insurance purchase, conducted by Dragos et al. (2020), revealed that besides the strong positive relationship between insurance education and insurance demand, specific behavioral factors such as trust and previous experience influence insurance purchase decisions. Additionally, Ulbinaite et al. (2014), in their study on "The complexity of the insurance purchase decision-making process," stated that capitalizing on the benefits of growing insurance markets, particularly in Asia, requires improving the understanding of relevant consumer expectations and behaviors. In this regard, they present an approach for modeling and analyzing how consumers decide to purchase insurance services. This model includes various consumer characteristics such as quality of life, risk exposure, perception of security needs, insurance usage culture, and affordability. Danaye Nematabad et al. (2017) conducted a study to present a system dynamics model for analyzing consumer preferences, showing that social influence and environmental conditions impact preferences and, sometimes, shift individuals' preferential behavior from one product to another.

3. Research methodology

This research is applied in terms of purpose, descriptive, and based on mathematical separation in nature. Data collection was done through library and field methods. The secondary statistical data included historical data on life insurance sales, customer numbers, and financial

performance, which were obtained from the annual reports of the Iran Insurance Company (2011-2022). Demographic data were also extracted from the Statistical Center of Iran, and industry data were collected from the statistical yearbooks of the Central Insurance of Iran. In order to collect primary data, semi-structured interviews were conducted with seven experts selected using the Delphi technique. These included two senior managers from Iran Insurance Company, three university finance specialists, and two active life insurance sales representatives. Then, through an iterative testing process and consulting with experts and professors, the model's structure and parameters were optimized.

The research is based on the methodology of system dynamics (Sterman, 2000). Accordingly, Figure 1 shows the research steps.

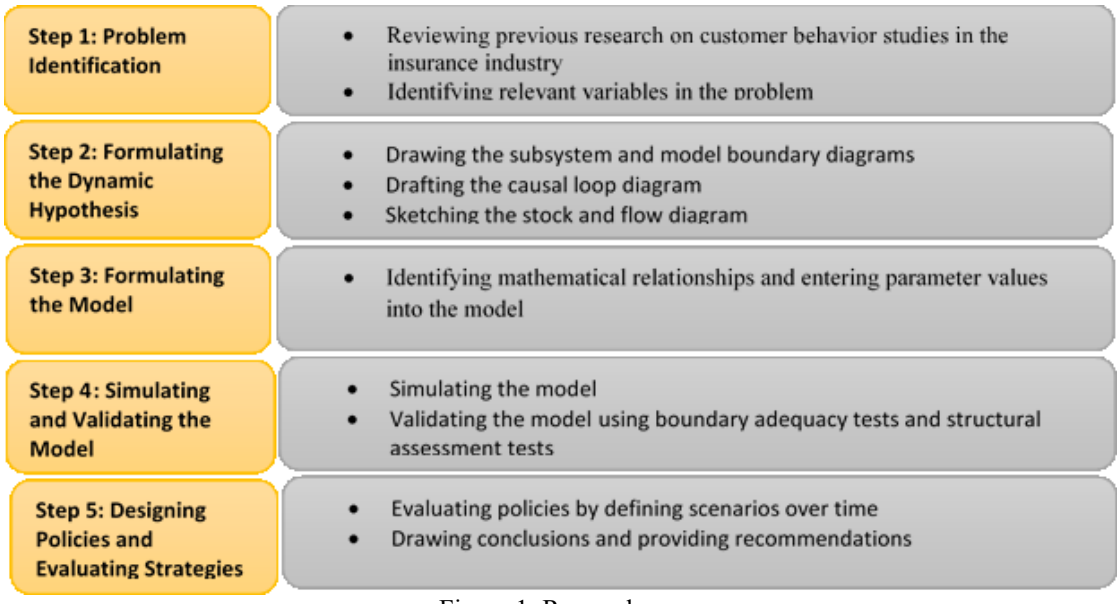


Figure 1. Research process

In the first step of the above figure, the literature on customer behavior in the insurance industry is reviewed, followed by identifying research gaps. In the second step, the subsystem diagram is presented, and the variables and dynamic assumptions of the research are formulated in a causal loop diagram. In this step, loops and feedback are shown with positive and negative signs, and the arrows are marked based on their positive or negative impact. In the third step, after identifying the stock and flow variables, the stock and flow diagram is drawn, and the mathematical relationships between the variables are determined using the logic of relationships, existing data, and expert opinions. In the fourth step, the mathematical model is simulated using software designed for system dynamics modeling. Vensim PLE software is used. Validation is performed to ensure that the model accurately represents the realities within the system in this research,. Validation involves structural assessment tests, extreme condition

tests, dimensional consistency tests, integration error tests, and boundary adequacy tests, confirming the model's validity. The fifth step tests strategies by quantifying their impact using the model. It is noteworthy that in the process of developing the research model, field data were collected through interviews and expert opinions. The expert statistical population consisted of university professors, insurance industry specialists, and managers employed in the Insurance Company.

4. Model development

4.1. Subsystem diagram

Figure 2 represents a broad picture of the system under study. The model presented in this research generally includes the population and potential customers, actual customers, advertising, the insurance company's financial resources, and investment. External factors affecting this system pertain to investment risks in various markets.

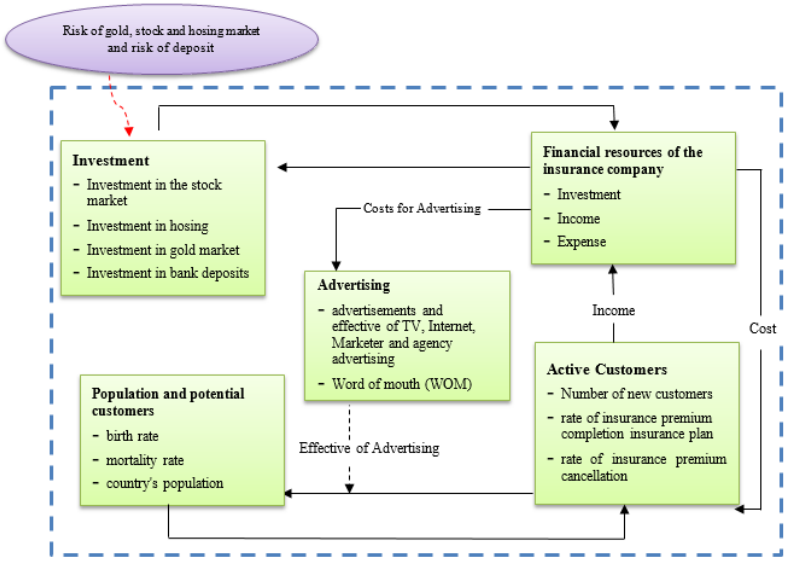


Figure 2. Diagram of research subsystems

4.2. Dynamic hypotheses

The dynamic hypotheses of the research are presented in the causal loop diagram shown in Figure 3. The positive loop R1 and the negative loop B1 shape the behavior of the population variable. As the population increases, it exhibits a growing behavior due to higher birth rates, which is controlled by the loop related to mortality. The positive loop R2 indicates the impact of word-of-mouth advertising; as the number of actual customers of a business, such as the insurance industry, increases, this self-reinforcing loop converts potential customers into actual ones. Another control loop, modeled in the form of loop B2, shows that as the number of actual

customers increases, the rate at which these customers retire increases with a delay, thus controlling their numbers.

The third reinforcing loop, R3, relates to the impact of other advertising methods (television, internet, marketers, and insurance agents). The more actual customers the insurance industry has, the more advertising budget will be allocated due to higher revenue. Consequently, the number of actual customers will increase if the advertising is effective. In the control loop B3, as the financial resources of the insurance industry increase, the conversion rate to assets such as stocks, housing, gold, and bank deposits will rise, ultimately controlling the financial resources available to the industry. Additionally, the reinforcing loop R4 indicates the impact of the profit from each type of asset on the amount of assets, where the profit itself is influenced by risks such as those in the housing market, stock market, and gold market, including risks from recession, price changes, central bank regulations, and more.

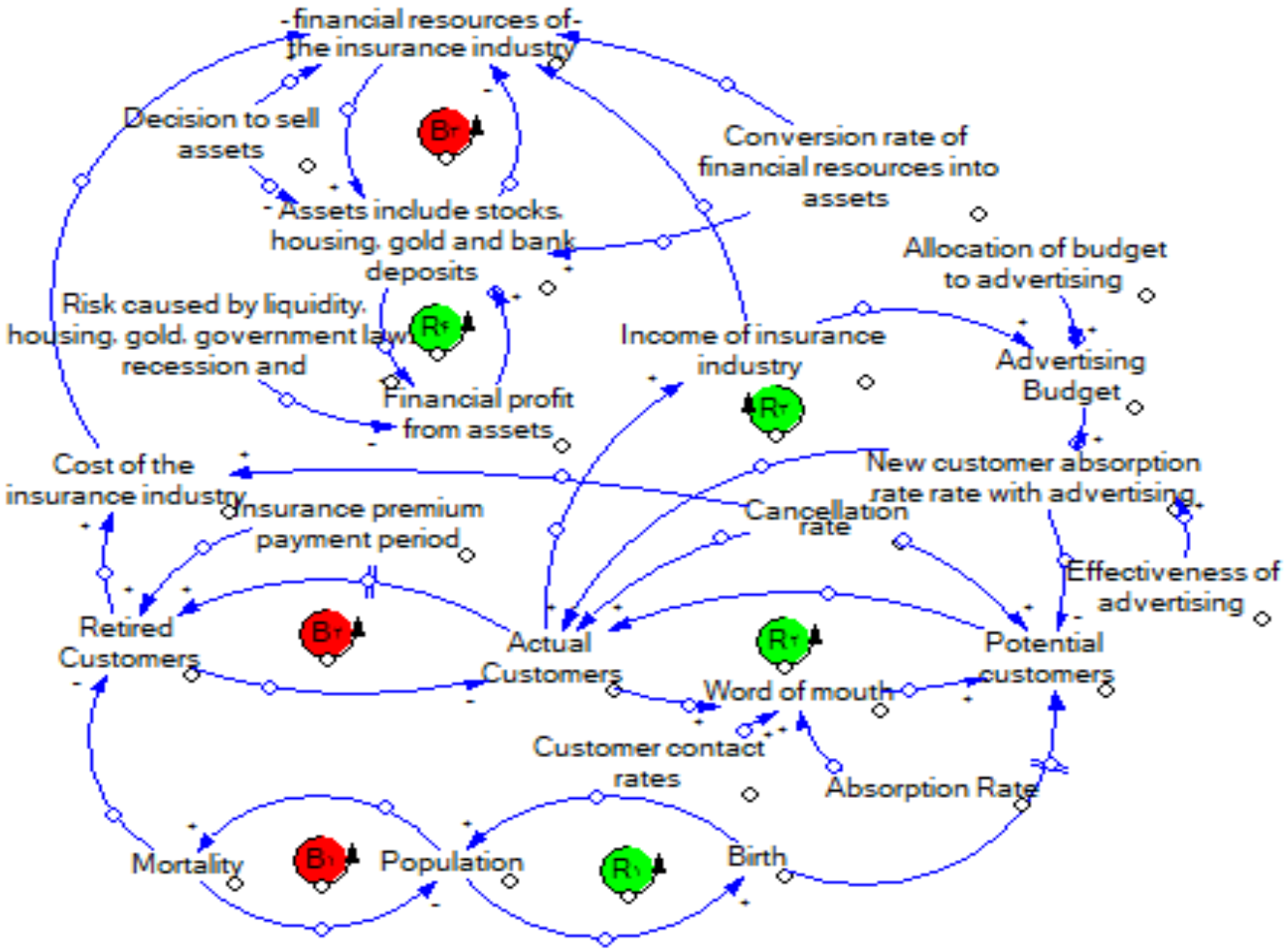


Figure 3. General cause and effect diagram of the research

4.3. Stock-Flow diagram

The key variables used in the stock-flow diagram include 104 auxiliary, flow, and stock variables, with the most important ones, along with their type, unit, and source, presented in Table 1. It is worth noting that the variables related to the risks impacting the insurance industry, advertising (through word-of-mouth, television, internet, marketing, and insurance agents), and assets (in the domains of housing, gold, stock market, bonds, and bank deposits) have been merged for simplification in the table below.

Table 1. Key variables defined in the model

No	Variable name	Persian equivalent	Type	Unit
1	Potential customers	Potential customers	Endogenous	People
2	Actual customers	Actual customers	Endogenous	People
3	Averagely income from each customer	Averagely income from each customer	Endogenous	Rial/(People*Year)
4	Finished customers with 40<life<70 life<40 and life>70	Finished customers by age group	Endogenous	People
5	New customers	New customers	Endogenous	People/Year
6	Adoption fraction	Adoption fraction in word-of-mouth advertising	Exogenous	DMNL
7	TV internet marketer and agency Advertising budget	Advertising budget by four methods	Endogenous	Rial/Year
8	TV internet marketer and agency Advertising effectiveness	Advertising effectiveness by four methods	Endogenous	DMNL
9	Adoption from TV internet marketer agency Advertising and words of mouth Advertising	New customers acquired through advertising	Endogenous	People/Year
10	Risks from: Bankruptcy; Business; Central bank policy; Cyber attack; Demand; Deposit market; Depreciation; Dollar; Gold market; Gold ounce; Gold tax; Governmental; Holding; Housing market; Law; Liquidity; Real stock market; Tax	Risks affecting the insurance industry	Exogenous	DMNL
11	Governmental support	Government support for the stock market	Endogenous	DMNL
12	Expected profit of gold deposit housing and stock market	Expected profit from four assets	Exogenous	1/Year
13	Real profit of gold deposit housing and stock market	Actual profit from four assets	Endogenous	1/Year
14	Decision to sell gold, housing stock and deposit	Decision to sell four assets	Endogenous	Rial/Year
15	Investment in Gold Stock housing market and deposit	Increase in investment in four assets	Endogenous	Rial/Year
16	Average cost of canceling	Average cost paid for policy cancellation by customers	Exogenous	Rial/People
17	Averagely cost per finish	Average cost paid to each customer after insurance ends	Exogenous	Rial/(People*Year)
18	Birth rate	Birth rate	Endogenous	People/Year
19	Country population	Country population	Endogenous	People
20	Canceling rate	Insurance cancellation rate	Endogenous	People/Year
21	Contact rate	Contact rate in word-of-mouth advertising	Exogenous	1/Year

No	Variable name	Persian equivalent	Type	Unit
22	Cost of insurance finish	Cost paid to each customer after insurance period ends	Exogenous	Rial/Year
23	Cost of insurance canceling	Cost paid to each customer after cancellation	Exogenous	Rial/Year
24	Deposit to funds	Rate of converting deposits to available liquidity	Endogenous	Rial/Year
25	Cost to funds	Average annual cost ratio to available liquidity	Exogenous	1/Year
26	Desired cost to funds proportion	Expected average annual cost ratio to available liquidity	Endogenous	1/Year
27	Funds	Financial resources	Endogenous	Rial
28	Income rate	Income rate	Endogenous	Rial/Year

Taking into account variables such as financial resources, stock market assets, housing market assets, gold market assets, and company deposits in banks, potential customers, actual customers, and customers whose insurance policies have expired, divided by age groups under 40, between 40 to 70, and over 70 years old as stock variables, the stock-flow diagram has been created and is shown in Figure 3.

4.4. Formulating the model

After drawing the stock-flow diagram, it is necessary to define the mathematical relationships between the variables. The most important relationships are provided below, illustrating the number of assets divided by housing, gold, stock market, and bank deposits considered as stock at the start of the simulation period.

$$P_K = \int I_k + B_k - S_k + P_0 \qquad (1)$$

$K\epsilon$ Housing, gold, stock market and deposits

The company's financial resources (F) are also calculated based on variables such as revenue (RI), current expenses (C), the amount of sales, and investment in each type of asset.

$$F = \int (RI + S_k - C - I_k) + F_0 \qquad (2)$$

The profitability of each of the four markets is calculated similarly to the relationship presented in Equation 3, which is used for the housing market. In this equation, the actual profit (AP) is calculated from the product of the expected profit (EP) and the risks affecting the housing market (R_i), such as demand risk, tax risk, regulatory risk, and depreciation risk.

$$AP = EP \times (1 - \sum R_i) \qquad (3)$$

$i\epsilon$ Demand, tax, law and depreciation risks

 DOI: 10.22067/JSTINP.2024.89580.1117

The impact of advertising in the model is based on four types of advertising: television, internet, marketers, and insurance agents. Word-of-mouth advertising is calculated based on the diffusion model from Sterman's book (2000) and Equation 4. In this equation, the number of customers attracted through word-of-mouth advertising (AW) is calculated based on the number of actual customers (AC), potential customers (PC), total population (TP), the impact of this type of advertising (AF), and the contact rate (CR).

$$AW = \frac{PC \times AF \times CR \times AC}{TP} \quad (4)$$

The number of individuals attracted through television, internet, marketer, and insurance agent advertising is calculated according to Equation 5. In this equation, the number of individuals attracted through this type of advertising (Atv) is calculated based on the effectiveness of the advertising budget (AE - lookup function) and the allocated budget amount (ABtv).

$$Atv = AE(ABtv) \quad (5)$$

The values of the lookup function AE, which indicates the number of individuals attracted for each budget amount allocated to advertising, are determined using a questionnaire distribution based on the prices of the year 2022 and presented in Table 2.

Table 2. Data used in the lookup function regarding the effectiveness of advertising based on expert opinion

Budget (Rials per year)	**1,000,000,000**	**5,000,000,000**	**10,000,000,000**	**50,000,000,000**
Number of individuals attracted	0 to 1,000	1,000 to 10,000	10,000 to 20,000	20,000 to 50,000

An age chain model is used to determine the number of individuals whose insurance premium payment is due since individuals in each group have different mortality rates. That includes individuals under 40, between 40 and 70, and over 70. According to insurance industry statistics, the mortality rates for these individuals are 2%, 10%, and 30%, respectively. Additionally, the transition rate from one stock to another takes an average of 15 years.

4.5. Simulating and validating the model

After determining the mathematical relationships of the model, validation is performed from 2011 and scenario analysis is carried out until 2031 with a time step of 0.03 years. The simulation model is shown in Figure 4.

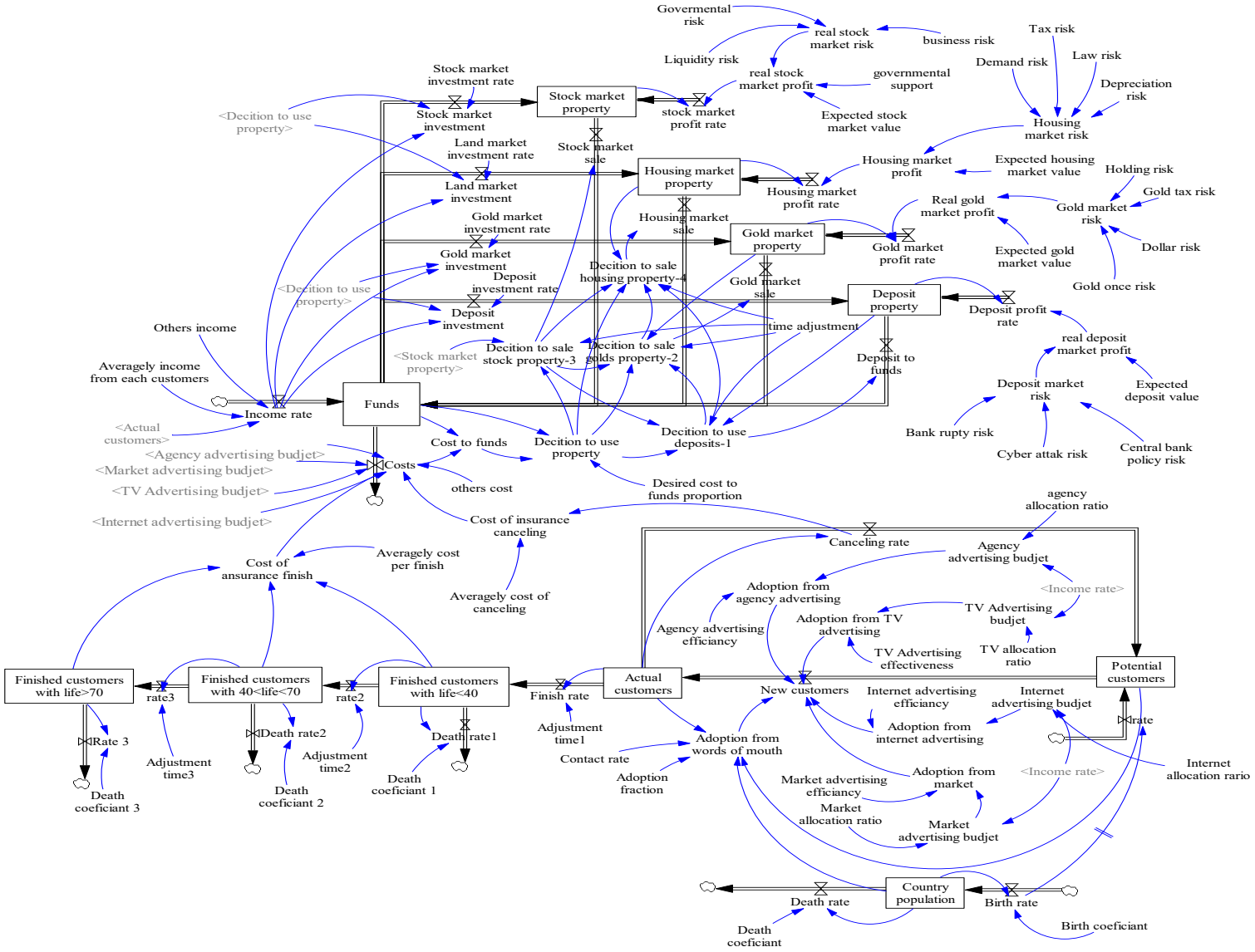


Figure 4. Stock flow diagram containing influential variables in the insurance industry

After simulating the model, its validation is carried out. In this study, the model's validity was assessed using various methods, including structural assessment, extreme condition tests, dimensional consistency tests, integral error tests, sensitivity analysis tests, and boundary adequacy tests, as Sterman (2000) introduced. The structural assessment of the model was evaluated using Vensim PLE software, and the model's validity was confirmed using this method (Fig.5).

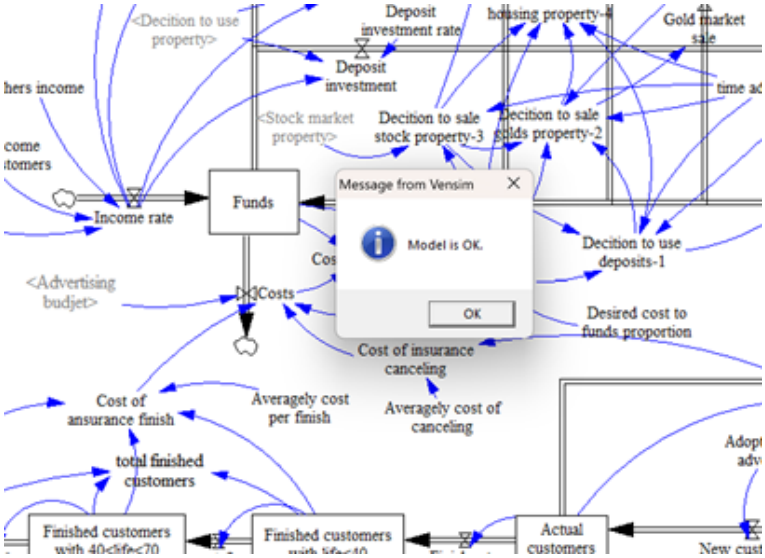


Figure 5. Structural evaluation of the model in Vensim software

Additionally, reducing the time step did not affect the model's outputs, and the model was validated in terms of integration error tests. For instance, Figure 6 illustrates the numerical results obtained from reducing the time step from 0.030 to 0.015 and its effect on the behavior of actual customers.

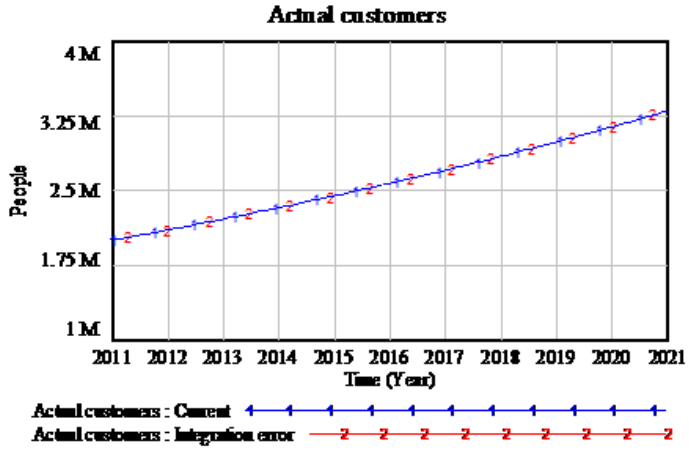
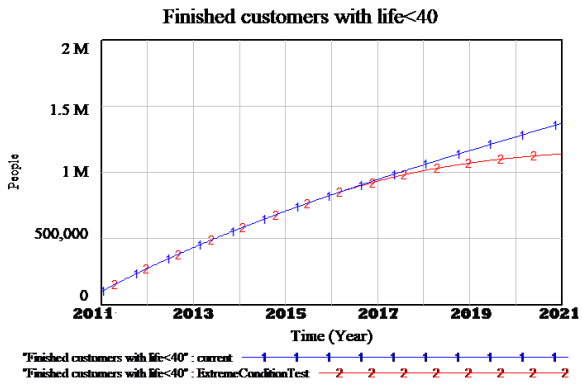
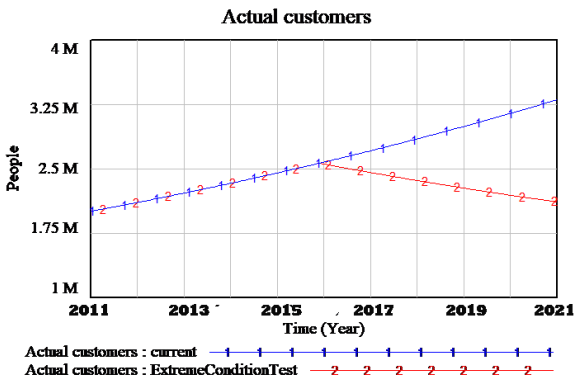


Figure 6. Behavior of the actual customers in the integration error test

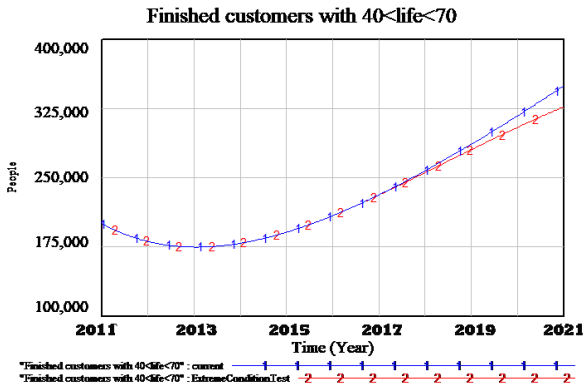
For the extreme condition test, many of the model's exogenous parameters were set to their extreme values, but the model did not exhibit any unreasonable or unexpected behavior. Therefore, the model's validity was also confirmed in terms of the extreme condition test. For example, assuming the insurance service withdrawal rate parameter increases tenfold from 2016 onwards, the behavior of variables such as the number of actual customers (Fig.5), policy expirations at different ages, and revenue and expenses are as follows. Figures 7 to 10 show, no unreasonable or uncontrolled behavior occurs in the model variables. This test was also applied to other model parameters, and the results confirmed the model's validity in other tests.



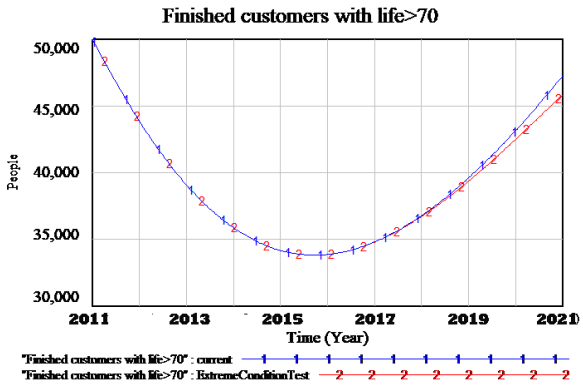
a: In the extreme test



b: With insurance policies completed before the age of 40 in the extreme test



c: With insurance policies completed between the ages of 40 and 70 in the extreme test



d: With insurance policies completed after the age of 70 in the extreme test

Figure 7. Behavior of the number of customers

The results from the sensitivity analysis test also confirmed the validity of the model. For example, Figure 8 illustrates the behavior of the company's financial inventory in response to a change in the parameter "Desired Cost to Funds Proportion." The value and behavior of this variable significantly change with variations in the specified parameter.

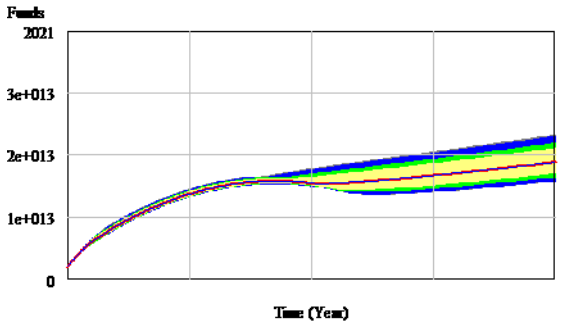


Figure 8. The result of sensitivity analysis test on the financial inventory

In the model boundary adequacy test, the question is whether the model's level of comprehensiveness is appropriate and includes all related structures, variables, and feedback effects necessary to examine the issue and align with the research objectives. The expert group's

response to this question was satisfactory, considering the dynamic hypothesis, the research objectives, and the results obtained from model execution.

4.6. Designing policies and scenarios

For the model analysis, three scenarios have been designed to examine various aspects of life insurance market dynamics in Iran, chosen based on the following criteria:

- Relevance to current industry discussions and strategies
- Potential for significant impact on market dynamics
- Feasibility of implementation within the Iranian context
- Ability to provide practical insights for policymakers and industry leaders

Analyzing these diverse scenarios leads to providing a comprehensive understanding of potential strategies for improving life insurance market performance in Iran

4.6.1. Scenario one: Continuation of current trends until 1410 (Base scenario)

The first scenario is crucial for identifying potential issues should current strategies remain unchanged. Its purpose is to establish a baseline for comparison and understanding the long-term implications of current strategies.

In this scenariothe model that was run until 2031 without changing the parameters. In this scenario, the rate of customer increase based on word-of-mouth advertising and other advertising methods (television, internet, marketing, and insurance agents) is presented as shown in Figure 9. As observed, the customer increase rate based on word-of-mouth advertising is significantly higher than that of other advertising methods.

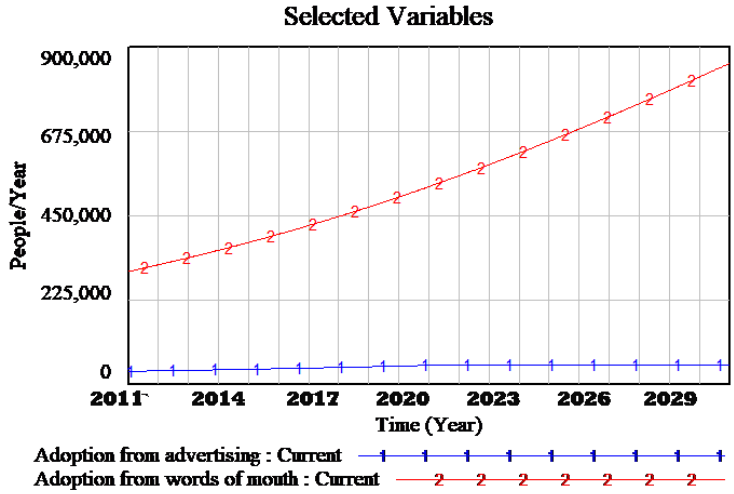


Figure 9. Rate of increase in actual customers through word-of-mouth advertising and other advertising methods

The rate of customers whose policies have expired is shown in Figure 10.

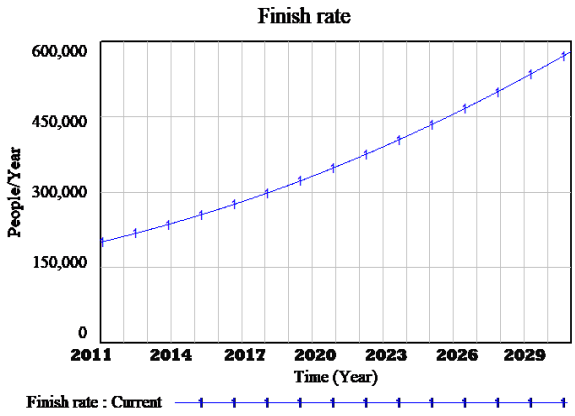


Figure 10. Rate of customers with completed insurance policies

Additionally, the number of actual customers compared to the total number of customers whose policies have expired is depicted in Figure 11.

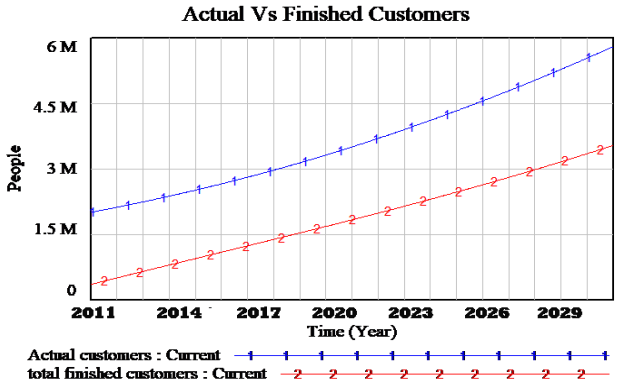


Figure 11. Trend of the number of actual customers and individuals with completed insurance policies

The chart below (Figure 15) also shows the behavior of revenue and expense variables. If current conditions continue similar to the trend that started in 2020, expenses will surpass revenue, leading to increased company losses.

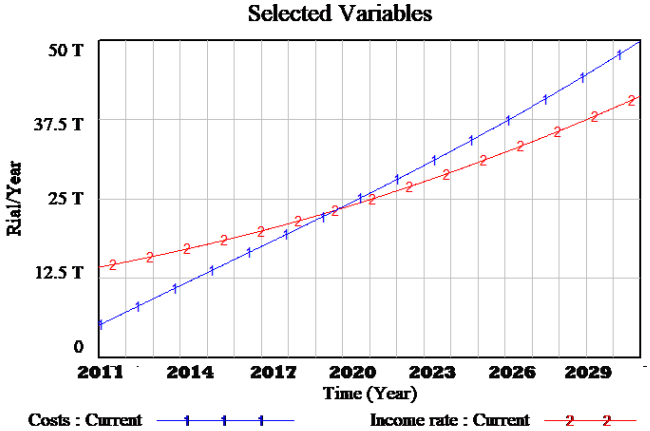


Figure 12. Comparison of costs and revenues in the first scenario

Given the increasing trend of expenses surpassing revenue (as shown in Figure 12), the behavior of the company's bank deposits, gold assets, housing assets, and stock market assets will also lose their growth trend to cover expenses. It will decrease accordingly, which is depicted in Figure 13.

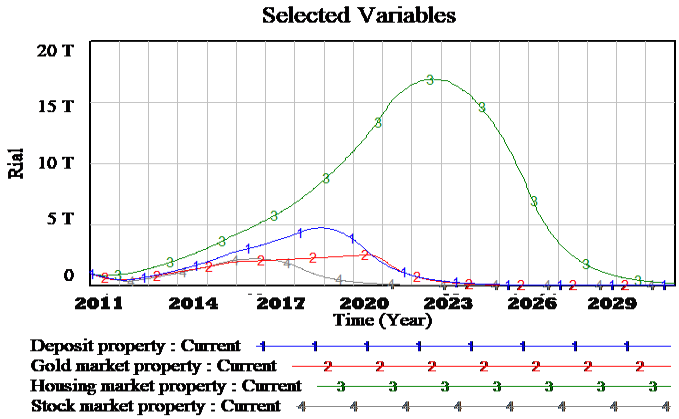


Figure 13. The behavior of various company assets in the first scenario

4.6.2. Scenario two: Impact assessment of increased advertising budget

This scenario is vital for industry decision-makers in determining advertising budget increases, and its objective is to examine the impact of intensive efforts on customer acquisition and revenue growth.

In the second scenario, it is assumed that the percentage of revenue allocated to the advertising budget will increase significantly from 2023 onwards, tripling the budget. Although the allocation percentage triples in this scenario, the advertising budget amount will increase more than threefold over time. This is because with increased advertising, the number of actual customers will increase, leading to higher revenue, and thus the advertising budget, according to Figure 14, will increase more than threefold through this feedback loop.

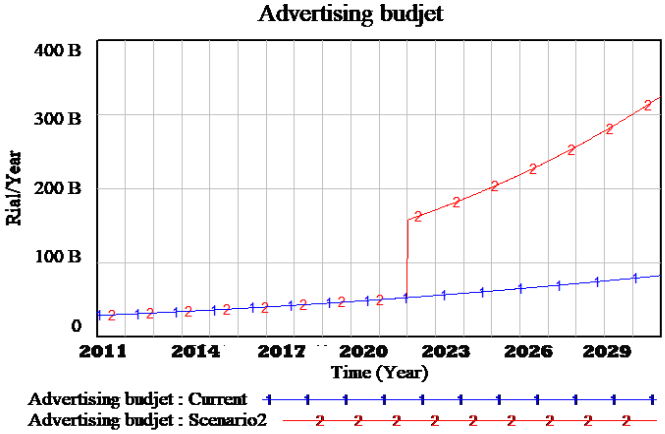


Figure 14. The advertising budget is allocated as a percentage of revenue

Implementing this scenario, the number of individuals attracted through advertising will increase, as shown in Figure 15.

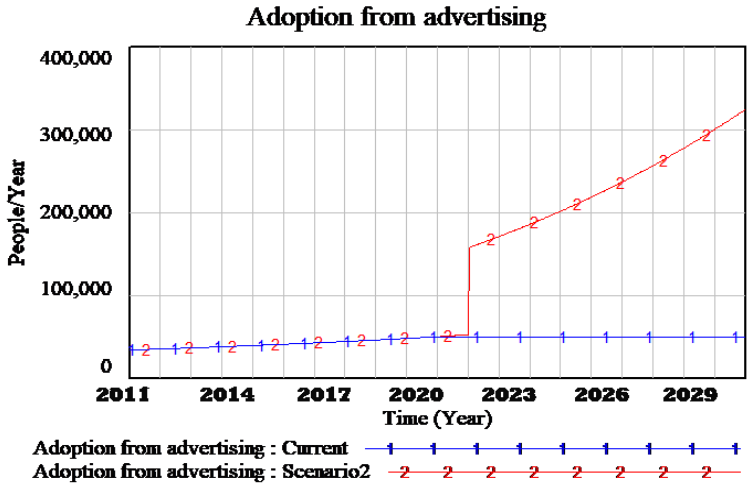


Figure 15. Rate of customers acquired through other advertising methods in the second scenario

Moreover, the increase in individuals attracted through this type of advertising will positively impact word-of-mouth advertising, increasing the number of individuals attracted through this method. This increase is due to the higher number of actual customers, which enhances the effectiveness of word-of-mouth advertising. In other words, according to Figure 16, with increased advertising through other methods, the word-of-mouth advertising loop is strengthened, attracting more customers.

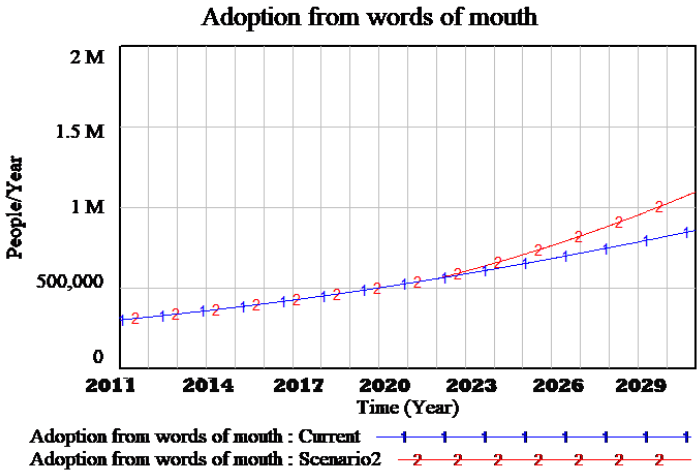


Figure 16. The rate of customers acquired through word-of-mouth advertising in the second scenario

The overall number of customers will follow the trend shown in Figure 17.

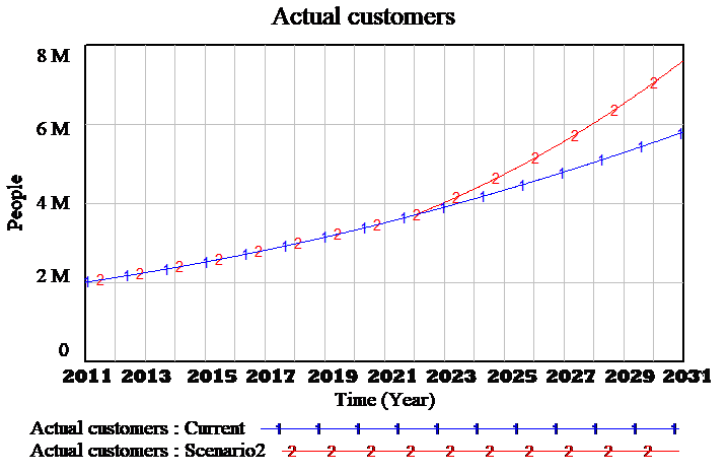


Figure 17. Number of actual customers in the second scenario

If the second scenario is implemented, the gap between revenue and expenses that emerged from 2020 in continuing current conditions will be somewhat mitigated with the increase in actual customers from 2023 onwards, reducing the company's life insurance losses observed in Figure 18.

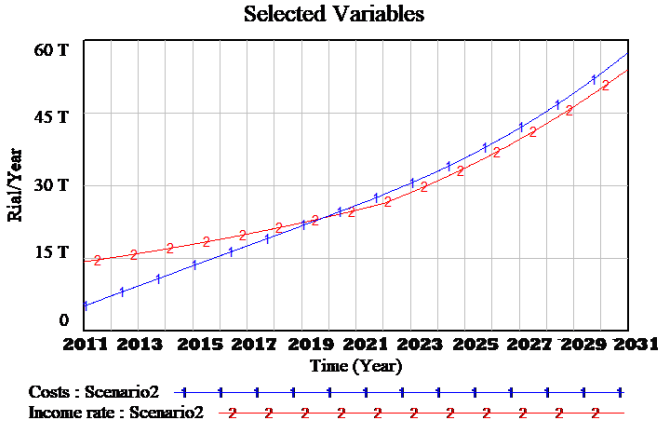


Figure 18. Comparison of costs and revenues in the second scenario

4.6.3. Scenario three: Customer acquisition through word-of-mouth advertising

Word-of-mouth advertising is a powerful yet often overlooked factor in the Iranian market. This scenario helps quantify its potential effects and examines the potential for improving customer satisfaction and referral rates. In this scenario, in addition to increasing the advertising budget, policies are implemented to improve the contagion rate parameter in word-of-mouth advertising by 10%. Under these conditions, the rate of individuals attracted through word-of-mouth advertising will follow the trend shown in Figure 19.

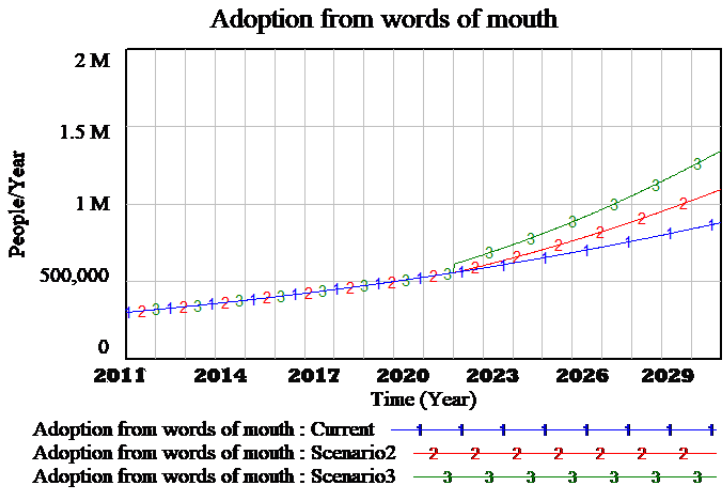


Figure 19. The number of individuals acquired through word-of-mouth advertising in the third scenario

Considering the increased number of individuals attracted through word-of-mouth and other advertising methods, Figure 20 shows the company's revenue and expense trend. As observed, only by increasing advertising can the revenue deficit be compensated, and even profitability can be achieved with more advertising.

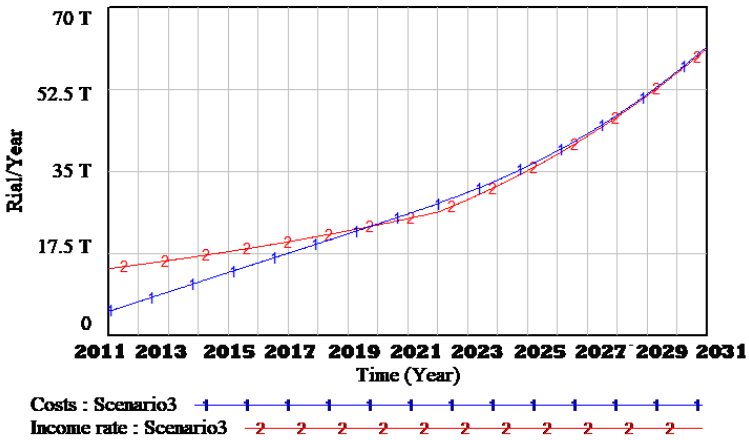


Figure 20. Comparison of costs and revenues in the third scenario

Figure 21 also compares the number of actual customers in the three scenarios. The results show that implementing different advertising scenarios will increase actual customers by 27% and 44%, respectively, by 2031, demonstrating the high impact of advertising on customer numbers and profitability.

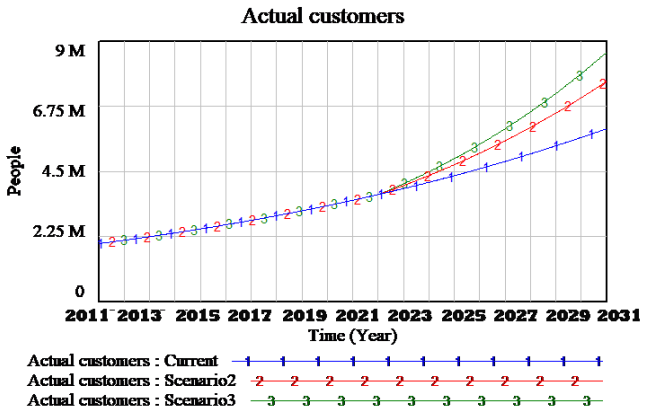


Figure 21. Comparison of the number of actual customers in all three scenarios

5. Conclusion

This article examines the application of system dynamics in the insurance industry. Given the complexity of insurance systems and the nonlinear, bidirectional interactions between various variables, system dynamics is introduced as a powerful method for modeling and simulating these systems. It addresses specific challenges faced by insurance systems, including risk management, adapting to changing market conditions, and, precisely, the impact of advertising on customer purchase behavior and its relationship with revenue and asset management.

The model presented in this research includes subsystems of the population, actual customers, financial resources, investments in various domains, and associated risks. The primary focus is on the impact of advertising, categorized into conventional advertising methods such as television, the internet, marketers, insurance agents, and word-of-mouth advertising. Simulation results suggest that increasing the advertising budget and employing customer-driven acquisition methods can help insurance companies make their advertising more targeted and effective, potentially leading to greater profitability. It aligns with broader marketing research that emphasizes the importance of strategic advertising in influencing consumer behavior.

Three scenarios were analyzed. The first scenario, based on the continuation of current trends until 2031, indicated that expenses would surpass revenue, increasing the company's losses. This underscores the importance of proactive strategy adjustment in changing market dynamics. The second scenario demonstrated that allocating a fixed percentage of revenue to conventional advertising methods could reduce the gap between expenses and revenue over time as customer numbers increase, thus potentially reducing the company's losses. The third scenario showed that combining a fixed percentage allocation to conventional advertising with a 10% increase in the diffusion parameter in word-of-mouth advertising could in the number of actual customers over a ten-year horizon. This scenario suggested eliminating the gap between

expenses and revenue and achieving profitability. The substantial impact of word-of-mouth advertising in this scenario aligns with general marketing principles that highlight the power of customer referrals and positive experiences.

This study indicates that system dynamics can help insurers achieve a shared mental model regarding the industry's variables, better assess the impact of policies and decisions through scenario analysis, and potentially enhance their market competitiveness. The model's ability to simulate different scenarios provides valuable insights for strategic decision-making, allowing insurance companies to test various strategies in a virtual environment before implementation. In addition, the present study offers a more comprehensive approach and precise modeling compared to previous research. For instance, Zhao et al. (2023) employed system dynamics in analyzing purchase decisions to examine the multi-level effects of factors such as advertising and government regulations. They demonstrated the effectiveness of advertising and education in enhancing customer understanding and purchasing behavior, which aligns with our research findings regarding advertising's key role in customer acquisition. However, unlike the present study, they did not address financial issues and specific risks in the insurance industry.

While utilizing system dynamics, this study confirms the effectiveness of word-of-mouth (WOM) advertising, similar to the research of England et al. (2022), which demonstrated WOM's crucial role in the insurance market. Moreover, our results align with the study by Kurnianingtyas et al. (2020), as both models indicate financial sustainability and the impact of long-term policies. Nevertheless, the present research addressing further addresses the complex interaction between advertising budgets and financial variables. Notably, our findings regarding WOM advertising effectiveness parallel the work of Yang and Peng (2020), who analyzed the impact of fear and natural risks on insurance purchases, as they also demonstrated that indirect motivations (such as personal advertising) could be influential. The research by Parviero et al. (2022) and Olmez et al. (2023) emphasizes the importance of social network effects and operational risks. Still, their focus is primarily on individual-oriented simulations and specialized functions.

In comparison, our research provides a more comprehensive analysis by integrating marketing and financial aspects, which is innovative and effective in a long-term simulation of life insurance customer behavior. The study by Nursiana et al. (2021) assessed the impact of product quality, company reputation, and perceived risk on insurance purchase decisions. Still, it did not analyze feedback dynamics and cumulative advertising effects. However, they showed that company reputation and service quality positively influence purchase decisions, which

aligns with our model, confirming customer increase through advertising strategies and improved customer experience.

Nevertheless, our distinction lies in analyzing complex feedback between advertising, financial management, and external variables, which previous studies have not comprehensively examined. This analytical integration introduces our use of system dynamics in Iran's insurance industry as an innovative approach that aids in evaluating long-term strategies while identifying findings and key distinctions similar to those of previous research.

Based on the presented model and scenario analysis, practical Suggestions can be provided that could benefit the life insurance market. According to the simulation model results, one of the influential variables is the cancellation of policies by existing customers. Therefore, reducing the life insurance policy cancellation rate is a significant challenge for industry players. Thus, customer retention is of great importance. Implementing a robust customer relationship management system can decrease policy cancellation rates and encourage customer loyalty, motivating them to retain their policies in the long term.

The low penetration rate of life insurance, often caused by a lack of public awareness about its benefits or immediate intangibility, reveals the need to implement product and market development activities. To this end, offering more diverse product combinations of life insurance with other financial products is recommended to increase the perceived value. Additionally, investing in training programs for insurance agents can improve their ability to explain the benefits of products. Furthermore, developing educational content for potential customers can increase awareness of life insurance benefits. From a macro perspective, engaging with regulatory bodies could also be considered to explore policy changes that could foster market growth, such as tax incentives for life insurance purchases, leading to increased market penetration. Developing a multi-company model to investigate competitive dynamics in the insurance industry is recommended for future research. The model could include more detailed customer segmentation to examine how different demographic groups respond to various marketing strategies. Conducting a comparative study that applies this model in other developing markets to identify common patterns and unique characteristics could also be, valuable and practical. Our model is based on the assumption of stability for certain macroeconomic variables, which may change in reality. Additionally, it does not fully cover external risks such as regulatory changes. Modeling these changes could be considered in future research. By implementing these suggestions and pursuing the mentioned research paths,

stakeholders in Iran's life insurance industry can move towards increasing market penetration, improving customer satisfaction, and ensuring long-term sustainability.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Alfiero, S., Battisti, E. and Hadjielias, E., 2022. Black box technology, usage-based insurance, and prediction of purchase behavior: Evidence from the auto insurance sector. *Technological Forecasting and Social Change*, *183*, p.121896. https://doi.org/10.1016/j.techfore.2022.121896.

Amiri, F., 2023. Designing a Model and Simulating the Production Chain of the Metal Industries in a System Dynamics Approach (Case Study: Shablon Tajhiz Company). *Journal of Systems Thinking in Practice*, *2*(4), pp.1-16. https://doi.org/10.22067/jstinp.2023.85540.1079.

Chen, C.C., Chang, C.C., Sun, E.W. and Yu, M.T., 2022. Optimal decision of dynamic wealth allocation with life insurance for mitigating health risk under market incompleteness. *European Journal of Operational Research*, *300*(2), pp.727-742. https://doi.org/10.1016/j.ejor.2021.10.016.

Danaye Nematabad , N., Bafandeh Zendeh, A. and Mirzaei Daryani, S., 2017. A system dynamics model for analyzing consumer preferences. In: First National Conference of Iranian Association of System Dynamics. Tehran: Sharif University of Technology. [in Persian]

Dragos, S.L., Dragos, C.M. and Muresan, G.M., 2020. From intention to decision in purchasing life insurance and private pensions: different effects of knowledge and behavioural factors. *Journal of Behavioral and Experimental Economics*, *87*, p.101555. https://doi.org/10.1016/j.socec.2020.101555.

England, R., Owadally, I. and Wright, D., 2022. An agent-based model of motor insurance customer behaviour in the UK with word of mouth. *Journal of Artificial Societies and Social Simulation*, *25*(2), p.2. https://doi.org/10.18564/jasss.4768.

Jacobs, B., Fok, D. and Donkers, B., 2021. Understanding large-scale dynamic purchase behavior. *Marketing Science*, *40*(5), pp.844-870. https://doi.org/10.1287/mksc.2020.1279.

Innocenti, S., Clark, G.L., McGill, S. and Cuñado, J., 2019. The effect of past health events on intentions to purchase insurance: Evidence from 11 countries. *Journal of Economic Psychology*, *74*, p.102204. https://doi.org/10.1016/j.joep.2019.102204.

Keat, P.T.B., Zakaria, W.N.W. and Mohdali, R., 2020. Factors influencing purchase intention of life insurance among engineering students. *Open International Journal of Informatics*, *8*(1), pp.1-9. Retrieved from https://oiji.utm.my/index.php/oiji/article/view/32.

Kotler, P. and Keller, K.L., 2009. *Marketing Management*. Jakarta: Erlangga. . Like. Dawn Translation.

Kunreuther, H. and Michel-Kerjan, E., 2015. Demand for fixed-price multi-year contracts: Experimental evidence from insurance decisions. *Journal of Risk and Uncertainty*, *51*, pp.171-194. https://doi.org/10.1007/s11166-015-9225-4.

Kurnianingtyas, D., Santosa, B. and Siswanto, N. 2020. A system dynamics for financial strategy model assessment in national health insurance system. *In MSIE 2020: 2020 2nd International Conference on Management Science and Industrial Engineering*, pp.1-6. https://doi.org/10.1145/3396743.3396754.

Modares, A., Motahari Farimani, N. and Abdari, K., 2023. Evaluating the implementation cost of blockchain in organizations through system dynamics. *Journal of Systems Thinking in Practice*, *2*(4), pp.78-104. https://doi.org/10.22067/jstinp.2023.85842.1084.

Nursiana, A., Budhijono, F. and Fuad, M., 2021. Critical factors affecting customers' purchase intention of insurance policies in Indonesia. *The Journal of Asian Finance, Economics and Business*, *8*(2), pp.123-133. https://doi.org/10.13106.

Olmez, S., Ahmed, A., Kam, K., Feng, Z. and Tua, A., 2023. Exploring the Dynamics of the Specialty Insurance Market Using a Novel Discrete Event Simulation Framework: a Lloyd's of London Case Study. *arXiv preprint arXiv:2307.05581*. https://doi.org/10.48550/arXiv.2307.05581.

Parviero, R., Hellton, K.H., Haug, O., Engø-Monsen, K., Rognebakke, H., Canright, G., Frigessi, A. and Scheel, I., 2022. An agent-based model with social interactions for scalable probabilistic prediction of performance of a new product. *International Journal of Information Management Data Insights*, *2*(2), p.100127. https://doi.org/10.1016/j.jjimei.2022.100127.

Safaie, N., Chakmehchi Khiavi, F. and Shahsavar, M.S., 2023. Examining the Emigration of Elites from Iran: A System Dynamics Approach. *Journal of Systems Thinking in Practice*, *2*(4), pp.17-32. https://doi.org/10.22067/jstinp.2023.85830.1083.

Shah, A.M., Zahoor, S.Z. and Qureshi, I.H., 2019. Social media and purchasing behavior: A study of the mediating effect of customer relationships. *Journal of Global Marketing*, *32*(2), pp.93-115. https://doi.org/10.1080/08911762.2018.1497243

Sterman, J., 2000. Business dynamics: systems thinking and modeling for a complex world. Translated by M. Majdfar and H. Haghi. Tehran: Daneshgahi Press. [in Persian]

Sukmaningrum, P.S., Hendratmi, A., Putri, M.R. and Gusti, R.P., 2023. Determinants of sharia life insurance productivity in Indonesia. *Heliyon*, *9*(6). https://doi.org/10.1016/j.heliyon.2023.e16605.

Teixeira, Teixeira, E.A., Kallas, R.M. and de Oliveira Dias, M., 2024. Consumer Purchase Behavior: A Systematic Literature Review. *British Journal of Multidisciplinary and Advanced Studies*, *5*(2), pp.121-131. https://doi.org/10.37745/bjmas.2022.0472.

Ulbinaite, A., Kucinskiene, M. and Le Moullec, Y. 2014. The complexity of the insurance purchase decision making process. *Transformations in Business & Economics*, *13*(3), pp.19-33. http://www.transformations.khf.vu.lt/33.

Yang, F., Tan, J. and Peng, L., 2020. The effect of risk perception on the willingness to purchase hazard insurance—A case study in the Three Gorges Reservoir region, China. *International Journal of Disaster Risk Reduction*, *45*, p.101379. https://doi.org/10.1016/j.ijdrr.2019.101379.

Zhao, S., Huo, T. and Chen, L., 2023. The influence of multi-level factors on Chinese residents' purchase decisions of green housing: A system dynamics approach. *Sustainable Cities and Society*, *99*, p.105001. https://doi.org/10.1016/j.scs.2023.105001.