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Using a Multi-Criteria Decision-making Mathematical Technique for the Influential and Interaction Factors in Pension Fund

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ARTICLE INFO	ABSTRACT
	Pension funds are major concerns and future threats to the economy of developing countries. In general, pension funds are among the most sensitive and complicated modern financial institutions in today's world, as well as an important component of the national economy to achieve the goals of the social security system. The present study was only focused on the dimensions and prioritization of the influential factors in evaluating the impact of pension funds. This could be an important step toward accurate policymaking in this regard within a shorter period and with decreased costs by recognizing the important factors. This was an applied research in terms of the objectives and involved a mixed method in terms of the design. Data were collected in two consecutive stages using the descriptive survey method. The first stage involved a qualitative assessment using the content analysis method, and the second stage was carried out using a decision-making mathematical model known as the fuzzy DEMATEL method. The two stages facilitated the identification of the influence and interaction of the factors and prioritized the identified indexes. The fuzzy DEMATEL technique is a simple and efficient model applied to recognize and rank the most important factors. The factors were calculated based on the opinions of experts using the fuzzy DEMATEL method. According to the results, the three most important factors in this regard were upstream rules and regulations, inflation, and investment strategies.

1 Introduction

In the modern era, many individuals join a pension foundation via a contract or a law and pay a specific amount of money to the fund as a premium for the employees' share to enjoy its benefits in retirement. The premium shares that are paid by an employee create their acquired right, which must be respected in international documents [1]. Therefore, the full respect of this right and decent enjoyment of retirement benefits depend on the favorable performance of pension funds. A pension fund is defined

as a financial institution or a legal person established to organize the funds raised by employees and employers with the aim of developing sustainable and long-term growth in the value of assets. At the end of the working years, employees receive retirement pension based on a specific procedure [2]. In every country, pension funds are so important that the crisis related to these funds is considered along with other crises related to the environment, water, and banking systems as the main challenges nationwide as they may be a significant threat to the political, economic, and social stability of the country in the near future.

Today, more than half of the nation in every country is affected by the activities of pension funds, and the crisis of public pension funds will have devastating effects on their current and future lives. After studying the pension funds in Iran, the global bank warned that Iran must improve the situation of its pension funds by 2030 and make the necessary corrections; otherwise, the dire situation of pension funds will become even more critical [3]. Therefore, it seems that a series of factors have complicated the situation, thereby leading to the lack of the financial sustainability of these funds, the adverse effects of which have resulted in liquidity deficits and gaps, inability to pay obligations without the help of the government, and overflow of pressure on governmental decisions and the national economy. Ultimately, the pressure caused by the dependence of pension funds will affect the economy of the country, and the imbalance between the government revenues and expenditure leads to an economic crisis. The impact of the crisis is contrary to the main information of the 20-year vision document of Iran on the horizon of 2025 and the strategy of the document of resistance economy, which emphasizes the importance of becoming the first regional economic power. The ideal keywords in the vision plan of the Islamic Republic of Iran include social justice, preservation of the human dignity and rights, social welfare and security, proper income distribution, health, and social security, the realization of which requires the formation of an independent and powerful social system [4].

Focus on the important influential factors in pension funds is a fundamental issue for these organizations, which may lead to the adoption of appropriate policies and strategies for the funds within a shorter period with decreased costs. In fact, the rank of the factors identified in the model should be determined using scientific methods and mathematical techniques, so that an important step could be taken toward illustrating the priorities for accurate policymaking and decision-making by focusing on the research question regarding the influence, interaction, and prioritization of these factors. The present study has a novel topic and method, and such comprehensive research has not been focused on pension funds to date. Researchers have used limited indexes for the assessment of pension funds in the case studies in this regard. The present study aimed to propose a proper ranking for the influential factors in pension funds based on the previous case studies, opinions of experts, and scientific mathematical methods.

2 Theoretical Foundations and Research Background

Research is scarce regarding the identification of the components of pension funds and use of mathematical techniques for their prioritization in Iran. The studies performed inside and outside the country to evaluate the critical factors associated with pension funds have been discussed in the following section to explain the most important components of the models. In [5], the researchers focused on the crisis of pension funds and reported an imbalance in fund resources and expenditures, population growth, laws and regulations, economic environment, and discrimination and inequality in salaries and pensions, each of which alone could lead to the bankruptcy of a fund and eventually the country. In [6], the main emphasis was on the pension governance factors of investment funds and

designing an appropriate governance structure. The mentioned research also presented solutions for the accountability, transparency, and bailment of pension funds to achieve the goals of social security, securing the interests of pension fund stakeholders, and optimally managing their funds. In a research entitled "The Comparison of the Management Structure and Managers' Scope of Authority in National Pension Funds and Joint-stock Companies", the researchers compared the method of governing and leading the national pension fund and joint-stock companies with an effort to identify factors such as compensation for legislative shortcomings and their completion [7]. In [8], the scholars evaluated the assets and liabilities of a pension fund under fixed and variable interest rates by recognizing the influential factors using a simulation method. In [9], the researchers aimed to optimize factors such as the assets and liabilities of pension funds using stochastic planning based on a scenario and robust optimization. All the components of a pension fund should be identified in order to design an efficient model. Therefore, the most important influential factors in the status of a pension fund have been identified and discussed in the following section for a more comprehensive identification.

3 Upstream Rules and Regulations

An important influential factor in the general condition of a pension fund is its interaction with the legislative environment of the country. In Iran, using the resources that are the share of future generations for the needs of today is not limited to natural resources and the environment only, and it is constantly observed in the pension funds in almost all the governments. The establishment of various laws to please different strata based on the suggestion of the government or the parliament, which has a direct and undeniable influence on the financial sustainability of pension funds, and lack of the required resources despite the inclusion of materials or notes in the same rules have caused the speed of reaching the critical point in these financial institutions to double. Some examples of these regulations are as follows:

1. Exemptions for small workshops with less than five workers were related to 1983, and the trend continued until the approval of the early retirement of the members of the social insurance fund for farmers, villagers, and nomads during the review of the Budget Law of 2018 in the Islamic Consultative Assembly, which led to the reduction of the early retirement age in the fund from 75 years to 61 years [5].

2. National funds are managed in accordance with the define benefit system. Since the average pension paid is determined by the rules of the last two years of service, the individual may take a managerial position at the end of service or have an academic degree upgrade to increase their average pension compared to another person with the same work experience. As such, the payments in these funds are unfair [15].

3. In Iran, the two categories of social insurance and government support are combined, and the government often sets out laws in line with the government's support in order to protect certain segments of the society, the resources of which are provided through social insurance. Nonetheless, this issue does not comply with insurance and actuarial principles [16].

4 Inflation Rate

Inflation is an important influential factor in funds, which could positively influence the economy with through proper policies or vice versa. In addition, the inflationary policies of the economy could

have positive or negative effects on funds. Inflation rate is the rate of change in the price index in each periods compared to the previous period. In Iran, inflation affects various sectors disproportionately, causing relative price changes (Fig 1 [13]). As an economic phenomenon, inflation has always been a concern of authorities and economic experts. Moreover, the anticipation of inflation in economic policymaking is an extremely sensitive subject. Therefore, increasing the accuracy of quantitative predictions and their integration into judicial criteria is essential to economic investment. Most governments and central banks formulate and implement their fiscal and monetary policies not solely based on the status quo, but also based on the short-term and long-term forecasts of key economic variables, such as inflation. Evidently, the predictive accuracy of these variables plays a key role in the success of the related policies regardless of the correctness of fiscal and monetary policies and their relevance to the existing conditions [14].

Fig. 1: Diagram of Iran's Inflation Rate During 1984-2016 [13]

5 Investment Strategies (How to Invest)

Over the past decades, there has been a rapid growth in the assets of pension funds, as well as signs for the continuation of its trend. However, one of the problems caused in countries due to the growth and accumulation of such a large volume of assets is their investment methods [2]. Today, pension funds consider investment as an important revenue-generating source, and the International Social Security Association (ISSA) has considered investment as an inherent element of the management areas of insurance funds, along with strategic planning and insurance computations [10] and the illustration of investment principles in the approved documents of pension funds. In the legal system of Iran, the investment of pension funds has been pinpointed in various rules and regulations. In addition, the Law on the Structure of the Comprehensive Welfare and Social Security System (2004) considers the income from the investments and management of active funds in various areas of the social security system to represent the stability of the financial resources of pension funds [11].

In addition to the provision of insurance and accepting the risk, insurance companies and pension funds should consider investment as a basic and significant responsibility through which they could greatly contribute to the dynamism of the national economics and development. Notably, the goal of investment by pension funds is not merely earning a profit. In fact, a fund should invest to meet its obligations in the future, maintain its credibility among the clients and shareholders, and survive in the competitive market. In other words, correct investment is a vital component for the survival and success of funds [12].

6 Research Methodology

This was an applied research in terms of the design. In general, scientific goals cannot be achieved without an accurate methodology, and a research becomes valid based on its methodology. Most of the studies in the field of social and management sciences use descriptive methods, which describe the characteristics of a subject or situation objectively, realistically, and systematically. This descriptive survey aimed to evaluate the research problem in an exploratory manner. Notably, the resources and research background in this regard are limited. In order to address the research question (What is the correlation between the influence and interaction of the influential factors in pension funds?), data had to be collected using a combination of library and field techniques. The library method was selected for the literature review of the research subject and assessment of the research background and opinions currently available on the subject, and the field method was exploited to collect data by questionnaires and interviews. The results were obtained after the analysis of the collected data. Considering that the present study was interdisciplinary and a combination of qualitative and quantitative methods, the mixed technique applied two communities.

The first section (qualitative) was performed using the non-probabilistic purposive sampling method or convenience method due to the qualitative nature of the study; this method is mostly used for a sample population with the same occupation, skills or knowledge, and the number of these individuals is relatively low [17]. To select the research samples, a list of experts in pension funds in the country was initially prepared, including university professors, managers, and experts in pension funds and economic, social areas (i.e., fund stakeholders). Following that, in-depth interviews were performed with these individuals. After the interviews, the interviewees were asked to introduce other experts in the field of pension funds to the researcher, and the process continued until reaching saturation in the area of research components and interviewing all those who were introduced by the experts. In total, 10 experts of national pension funds were interviewed in the current research. The second section (quantitative) involved the multi-criteria group decision-making method and survey of the community of the pension fund experts. In such research, the level of expertise and experience of experts regarding the subject matter is significantly more important than their number [18-21]. Therefore, the experts in the present study were selected based on the criteria of experience, organizational work experience, expertise in economic and social affairs, education level, and number of studies in the field of study. Therefore, there was no need for sampling operations in our research, and the sampling process was purposive. Table 1 shows the characteristics of the experts evaluated in the current research.

Table 1: Characteristics of Experts in Field of Solving Fuzzy DEMATEL Method

Mean number of articles, books and research activities of pension fund experts	11.88 %
Mean number of articles, books and research activities of experts in economic management	11.44 %
Mean activity history and work experience in pension fund affairs per year	12.66 %
Mean work experience and experience in economic management	8.7 %
Percentage of experts with a PhD	33 %
Percentage of experts with a master's degree	44 %
Percentage of experts with a bachelor's degree	11 %
The number of experts in the quantitative section	12 %

In the present study, the initial model of pension funds based on the influential components was extracted using the content analysis method to analyse the data in the first (qualitative) section of the research. Ultimately, 19 important and influential factors were identified after the stages of coding, conceptualization, and categorization and presented in the form of a model (Table 2).

Table 2: Model of Influential Factors in Pension Funds

	Factor	Description
1	Upstream rules and regulations	Influence of rules and regulations of government groups (e.g., parliament). The rules have doubled the speed of reaching the critical point in these funds
2	Retirement period	Number of elapsed years from retirement age to life expectancy. As life expectancy increases in a country, the gap between retirement age and the end of life naturally increases, and this equates to an increase in pension fund commitments
3	Population growth	Rate of increase in number of individuals in community Due to the increase in population, the elderly will significantly increase the cash flow out of pension funds in the near future to pay pensions
4	Country-based salary payment system	Stability mechanism of fund to receive appropriate and timely premiums based on replacement rate and support ratio
5	Actuarial assessment and insurance calculations	Accurate calculations of fund input source and output obligations Actuarial calculations in social security insurance is a science that indicates the existence or non-existence of equality between assets and liabilities of the pension fund.
6	Investment strategies	Necessity of clear dynamic strategies with expected long-term rate of return for development of national infrastructures by pension funds Pension Funds Look at investing as one of your most important sources of income
7	Appointment of qualified managers	Competence and capability of appointed individuals in fund business processes
8	Using information technology	Using information technology in providing integrated, accurate, in-person, and electronic services
9	Process improvement in fund services	Agility of efficient office structure and providing quality and standard services
10	Regulatory body for monitoring	Establishing an institution for policymaking and monitoring of fund operations
11	Expectations and beliefs of society	Beliefs and expectations of community members from the pension fund (social capital)
12	Creating transparency and fighting corruption	Transparency as an accurate anti-corruption solution
13	Exchange rate	Role in function of value of foreign investment or exports Effects of changes in the funds' foreign assets portfolio due to exchange rate changes
14	Interest rate	Capital return rate and percentage of reward paid on money
15	Inflation rate	A consumer price index influential in receiving more expensive services and increasing investment value of funds with inflationary economic policies, you can have a positive and negative impact on the fund
16	Economic growth rate	Increased per capita income (GDP) to increases welfare and improves quality of life
17	Budget deficit	Lack of fund liquidity of funds due to untimely fulfilment of government obligations for payments

Table 2: Model of Influential Factors in Pension Funds

	Factor	Description
		Failure to meet commitments by the government on time increases the liquidity problems of the funds.
18	Political interventions	Government interventions in fund management Many of the problems in investing in pension funds also have to do with government performance. Because pension funds are part of the country's economic system, whose policy is made by the government.
19	Sanction shock	Influence of international sanctions and economic impairment of funds This, together with the extensive investment activities of the pension fund, had a tremendous impact on the reserve value of pension funds.

In the second (quantitative) section of the present study, we employed the fuzzy group multi-criteria decision-making method, also known as the fuzzy DEMATEL technique.

6.1 Fuzzy DEMATEL Technique

The DEMATEL method was first proposed by Fontela and Gabus in 1976. The method is based on paired comparisons, decision-making tools, and the graph theory. DEMATEL may confirm the correlations between variables or limit the correlations through a developmental and systematic process [22]. In fact, the technique has proven effective in determining the appropriate and possible hierarchy of the influence of factors or assumed indicators on the purpose of a system, thereby establishing a structural model of the discussed issue graphically.

Furthermore, DEMATEL could be easily implemented in evaluating a group of experts using a committee of 10-12 [23]. Solving an issue by the fuzzy DEMATEL technique requires determining the criteria for decision-making. To resolve the uncertainty, we should provide these criteria to the decision-maker in accordance with the language criteria (Table 3), so that the indicators could be compared accordingly. The scale of Table 3 is based on the current research [25].

Table 3: Linguistic Scales for Paired Comparisons

Linguistic Variables/Corresponding Numbers	Equivalent Value of Language Variables
0-(No) No Influence	(0,0,0.25)
1-(VL)Very Small Influence	(0, 0.25,0.5)
2- (L) Small Influence	(0.25,0.5,0.75)
3-(H) Large Influence	(0.5,0.75,1)
4-(VH) Very Large Influence	(0.75,1,1)

6.2 Solving by the Fuzzy DEMATEL Method

In this section, we applied a group decision-making approach using the fuzzy DEMATEL method to address the research question, which was related to the ranking of the influential components in pension funds. The method has been used in the previous studies in this regard [21, 24-28] with an ultimate focus on de-fuzzy operations. If $\tilde{Z}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ is a fuzzy triangular number assuming that the

research model includes $= (C_i|i = 1,2, \ldots, n)$, the n indexes, and p experts, the solution will be as follows [21, 24-28-34-35]:

1) Calculation of the initial direct relation fuzzy matrix
Initially, we calculated the mean expert opinions based on the arithmetic mean:

$$\tilde{Z} = \left(\frac{\tilde{Z}^1 + \tilde{Z}^2 + \cdots + \tilde{Z}^p}{p}\right) \tag{2}$$

The result was the P fuz

zy matrix, as follows:

$$\tilde{Z}^{(1)}, \tilde{Z}^{(2)}, \ldots, \tilde{Z}^{(p)} \tag{3}$$

In addition, the initial fuzzy direct relations matrix was as follows:

$$\tilde{Z} = \begin{bmatrix} 0 & \tilde{Z}_{12} & \cdots & \tilde{Z}_{1n} \\ \tilde{Z}_{21} & 0 & \cdots & \tilde{Z}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{Z}_{n1} & \tilde{Z}_{n2} & \cdots & 0 \end{bmatrix} \tag{4}$$

2) Calculation of the normalized direct-relation fuzzy matrix

$$\tilde{a}_{ij} = \sum_{j=1}^{n} \tilde{Z}_{ij} = \left(\sum_{j=1}^{n} l_{ij}, \sum_{j=1}^{n} m_{ij}, \sum_{j=1}^{n} u_{ij}\right) \tag{5}$$

$$s = \max_{1 \le i \le n}\left(\sum_{j=1}^{n} u_{ij}\right) \tag{6}$$

The normalized fuzzy matrix of the direct relations was as follows:

$$\tilde{X} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \tilde{x}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{x}_{n1} & \tilde{x}_{n2} & \cdots & \tilde{x}_{nn} \end{bmatrix} = \tilde{X}_{ij} = \frac{\tilde{z}_{ij}}{s} = \left(\frac{l_{ij}}{s}, \frac{m_{ij}}{s}, \frac{u_{ij}}{s}\right) \tag{7}$$

3) Total-relation fuzzy matrix

$$\tilde{T} = \lim_{Z \to \infty}(\tilde{X}^1 + \tilde{X}^2 + \ldots + \tilde{X}^z) \tag{8}$$

$$\tilde{T} = \begin{bmatrix} \tilde{t}_{11} & \tilde{t}_{12} & \cdots & \tilde{t}_{1n} \\ \tilde{t}_{21} & \tilde{t}_{22} & \cdots & \tilde{t}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{t}_{n1} & \tilde{t}_{n2} & \cdots & \tilde{t}_{nn} \end{bmatrix} \tag{9}$$

And $\quad \tilde{t}_{ij} = (\acute{l}_{ij}, \acute{m}_{ij}, \acute{u}_{ij}) \tag{10}$

$$[\acute{l}_{ij}] = X_l \times (I - X_l)^{-1} \quad (18\text{–}3) \tag{11}$$

$$[\acute{m}_{ij}] = X_m \times (I - X_m)^{-1} \tag{12}$$
$$[\acute{u}_{ij}] = X_u \times (I - X_u)^{-1} \tag{13}$$

4) Calculating values

$$D = \left[\sum_{j=1}^{n} \tilde{t}_{ij} \right]_{n \times 1} \tag{14}$$

$$R = \left[\sum_{i=1}^{n} \tilde{t}_{ij} \right]_{1 \times n} \tag{15}$$

5) Calculating the values of $\left(\widetilde{D_\iota} - \widetilde{R_\iota} \right)^{def}$ *and* $\left(\widetilde{D_\iota} + \widetilde{R_\iota} \right)^{def}$

In this step, the defuzzification of the fuzzy numbers was carried out. The values of $\left(\widetilde{D_\iota} + \widetilde{R_\iota} \right)^{def}$ expressed the degree and importance of the indicators, and $\left(\widetilde{D_\iota} - \widetilde{R_\iota} \right)^{def}$ showed its level of influence and interaction. When $\left(\widetilde{D_\iota} - \widetilde{R_\iota} \right)^{def}$ is positive, the index is classified as an influencer, and if the mentioned value is negative, the index considered to be interactive.

$$v = \left(\frac{l + 4\,m + u}{6} \right) \tag{16}$$

6.3 Validity and Reliability of the Questionnaire

Validity is a feature of a data collection tool, which determines the categories for which it is intended [29]. Validity is an important parameter since inappropriate and inadequate measurements may decrease the value and adequacy of scientific research [30]. In other words, the validity of research shows the compatibility level of the measurement tool with the research objectives and determines whether the tool is actually assessing the supposed variables. The higher validity of research is indicative of higher credibility [31]. In the present study, we applied the opinions of the pension fund experts, respected university professors, and researchers in the relevant field to confirm the validity of the conceptual model and applied questionnaire. The conceptual model of the research was developed based on the opinions of the experts in the field of pension funds, who were asked to eliminate the unfavourable indexes from the model by determining the appropriateness and importance of the indicators. Notably, all the stages of the research were approved by respected professors and experts. The indexes presented in the current research were extracted from multiple scientific and valid articles, the references of which have been provided.

Reliability is another important feature of data collection tool, which maintains its stability over time [29]. In fact, the purpose of reliability is to obtain very close results after using measurement tools by a single group several times within a short period [30]. Notably, solving a problem with the fuzzy DEMATEL method does not require the estimation of the Cronbach's alpha. As such, none of the authoritative foreign researches and articles that have used this method have examined and calculated the Cronbach's alpha.

7 Data Analysis

Analysis guides the entire research process from the problem selection to obtaining the results [29]. In the present study, the identified factors were evaluated and prioritized based on the questionnaires distributed among the experts (n=12) using the fuzzy DEMATEL method. The mentioned linguistic variables quantitatively evaluated the level of influence and interaction of the indexes. The experts included researchers in the field of economic, university professors, experts, and specialists in the field of fund mission.

Table 4: Questionnaire Completed by First Expert

	A₁	A₂	A₃	A₄	A₅	A₆	A₇	A₈	A₉	A₁₀	A₁₁	A₁₂	A₁₃	A₁₄	A₁₅	A₁₆	A₁₇	A₁₈	A₁₉
A₁	0	4	0	3	4	3	4	0	2	3	2	4	2	4	3	4	4	4	1
A₂	4	0	1	0	0	3	2	3	4	2	1	0	2	1	3	2	4	1	3
A₃	0	1	0	0	0	1	1	0	0	0	2	1	0	0	2	2	1	0	2
A₄	3	0	0	0	3	2	1	4	3	3	2	3	2	2	3	2	0	0	1
A₅	4	0	0	3	0	2	2	4	2	3	0	0	0	1	1	1	1	0	1
A₆	3	3	1	2	2	0	3	3	2	1	3	4	2	1	3	2	2	1	3
A₇	4	2	1	1	2	3	0	1	2	2	0	3	0	0	2	3	2	4	1
A₈	0	3	0	4	4	3	1	0	2	3	2	4	0	0	0	1	3	2	3
A₉	2	4	0	3	2	2	2	2	0	3	2	1	1	2	3	2	4	1	3
A₁₀	3	2	0	3	3	1	2	3	3	0	2	1	0	0	0	0	0	1	2
A₁₁	2	1	2	2	2	0	3	0	2	2	0	4	3	3	2	2	2	2	0
A₁₂	4	0	1	3	0	4	3	1	1	1	4	0	0	0	0	0	0	0	0
A₁₃	2	2	0	2	0	2	0	1	1	0	3	0	0	0	4	3	1	1	4
A₁₄	4	1	0	2	1	1	0	2	2	0	3	0	0	0	2	1	1	1	1
A₁₅	3	3	2	3	1	3	2	3	3	0	2	0	4	2	0	4	3	4	4
A₁₆	4	2	2	2	1	2	3	2	2	0	2	0	3	1	4	0	3	1	3
A₁₇	4	4	1	0	1	2	2	4	4	0	2	0	1	1	3	3	0	2	2
A₁₈	4	1	0	0	0	1	4	2	1	1	2	0	1	1	4	1	2	0	4
A₁₉	1	3	2	1	1	3	1	3	3	2	0	0	4	1	4	3	2	4	0

An example of the questionnaire, which was completed based on the opinion of the first expert, was converted into fuzzy numbers in accordance with the mentioned language variables.

Table 5: Questionnaire of First Expert Converted into Fuzzy Numbers in Solving Problem by Fuzzy DEMATEL Approach

	A₁			A₂			A₃			A₄			A₅			A₆			A₇		
A₁	0	0	0.25	0.75	1	1	0	0	0.25	0.5	0.75	1	0.75	1	1	0.5	0.75	1	0.75	1	1
A₂	0.75	1	1	0	0	0.25	0	0.25	0.5	0	0	0.25	0	0	0.25	0.5	0.75	1	0.25	0.5	0.75
A₃	0	0	0.25	0	0.25	0.5	0	0	0.25	0	0	0.25	0	0	0.25	0	0.25	0.5	0	0.25	0.5
A₄	0.5	0.75	1	0	0	0.25	0	0	0.25	0	0	0.25	0.5	0.75	1	0.25	0.5	0.75	0	0.25	0.5
A₅	0.75	1	1	0	0	0.25	0	0	0.25	0.5	0.75	1	0	0	0.25	0.25	0.5	0.75	0.25	0.5	0.75
A₆	0.5	0.75	1	0.5	0.75	1	0	0.25	0.5	0.25	0.5	0.75	0.25	0.5	0.75	0	0	0.25	0.5	0.75	1
A₇	0.75	1	1	0.25	0.5	0.75	0	0.25	0.5	0	0.25	0.5	0.25	0.5	0.75	0.5	0.75	1	0	0	0.25
A₈	0	0	0.25	0.5	0.75	1	0	0	0.25	0.75	1	1	0.75	1	1	0.5	0.75	1	0	0.25	0.5
A₉	0.25	0.5	0.75	0.75	1	1	0	0	0.25	0.5	0.75	1	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75
A₁₀	0.5	0.75	1	0.25	0.5	0.75	0	0	0.25	0.5	0.75	1	0.5	0.75	1	0	0.25	0.5	0.25	0.5	0.75
A₁₁	0.25	0.5	0.75	0	0.25	0.5	0.25	0.5	0.75	0.25	0.5	0.75	0	0	0.25	0.5	0.75	1	0	0	0.25
A₁₂	0.75	1	1	0	0	0.25	0	0.25	0.5	0.5	0.75	1	0	0	0.25	0.75	1	1	0.5	0.75	1
A₁₃	0.25	0.5	0.75	0.25	0.5	0.75	0	0	0.25	0.25	0.5	0.75	0	0	0.25	0.25	0.5	0.75	0	0	0.25
A₁₄	0.75	1	1	0	0.25	0.5	0	0	0.25	0.25	0.5	0.75	0	0.25	0.5	0	0.25	0.5	0	0	0.25
A₁₅	0.5	0.75	1	0.5	0.75	1	0.25	0.5	0.75	0.5	0.75	1	0	0.25	0.5	0.5	0.75	1	0.25	0.5	0.75
A₁₆	0.75	1	1	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0	0.25	0.5	0.25	0.5	0.75	0.5	0.75	1
A₁₇	0.75	1	1	0.75	1	1	0	0.25	0.5	0	0	0.25	0	0.25	0.5	0.25	0.5	0.75	0.25	0.5	0.75
A₁₈	0.75	1	1	0	0.25	0.5	0	0	0.25	0	0	0.25	0	0	0.25	0	0.25	0.5	0.75	1	1
A₁₉	0	0.25	0.5	0.5	0.75	1	0.25	0.5	0.75	0	0.25	0.5	0	0.25	0.5	0.5	0.75	1	0	0.25	0.5

In the current research, the fuzzy direct relation matrix was developed based on equations 2-4. Afterwards, the *S* value was calculated using Equations 5 and 6 in order to determine the normalized fuzzy direct relation matrix based on Equation 7. Furthermore, the final fuzzy relation matrix was developed by initially considering the normalized fuzzy direct relation matrix for each fuzzy component separately and operating based on Equations 8-13. At the next stage, the final fuzzy relation matrix was

developed between the indexes. Finally, the values of *D*, *R*, *D+R*, *D-R*, *(D-R) def*, and *(D+R) def* were calculated based on Equations 14-16.

Table 6. Table of D, R, D+R, D-R, (D-R) def, and (D+R) def Values in Solving Problem by Fuzzy DEMATEL Method

	D			R			D-R			D+R			(D-R)def	(D+R)def
	l	m	u	l	m	u	l	m	u	l	m	u		
A1	0.728	2.010	10.041	0.618	1.786	9.312	0.111	0.224	0.730	1.346	3.797	19.353	0.2893	5.9808
A2	0.505	1.501	8.331	0.606	1.748	9.199	-0.101	-0.248	-0.867	1.110	3.249	17.530	-0.327	5.2727
A3	0.396	1.349	8.020	0.432	1.376	8.091	-0.036	-0.027	-0.072	0.828	2.725	16.111	-0.036	4.6396
A4	0.597	1.752	9.303	0.592	1.727	9.223	0.005	0.025	0.080	1.189	3.478	18.526	0.0309	5.6046
A5	0.590	1.731	9.190	0.545	1.629	8.959	0.045	0.102	0.231	1.134	3.360	18.150	0.1139	5.4542
A6	0.602	1.746	9.283	0.723	1.949	9.818	-0.122	-0.203	-0.535	1.325	3.695	19.101	-0.245	5.8766
A7	0.551	1.663	9.215	0.454	1.447	8.355	0.098	0.216	0.860	1.005	3.109	17.570	0.3037	5.1688
A8	0.410	1.401	8.185	0.548	1.636	8.885	-0.139	-0.235	-0.700	0.958	3.037	17.070	-0.296	5.0295
A9	0.471	1.502	8.626	0.577	1.716	9.312	-0.105	-0.215	-0.686	1.048	3.218	17.938	-0.275	5.3097
A10	0.656	1.806	9.264	0.561	1.632	8.983	0.095	0.175	0.282	1.217	3.438	18.247	0.1792	5.5358
A11	0.501	1.588	8.962	0.616	1.793	9.530	-0.115	-0.205	-0.568	1.116	3.381	18.491	-0.25	5.5219
A12	0.596	1.710	9.177	0.632	1.767	9.213	-0.036	-0.057	-0.036	1.227	3.477	18.390	-0.05	5.5876
A13	0.602	1.723	9.068	0.494	1.498	8.418	0.108	0.225	0.650	1.096	3.221	17.486	0.276	5.2443
A14	0.468	1.470	8.386	0.538	1.596	8.817	-0.071	-0.126	-0.431	1.006	3.065	17.204	-0.167	5.0785
A15	0.742	1.982	9.784	0.647	1.801	9.345	0.096	0.181	0.439	1.389	3.782	19.128	0.2096	5.941
A16	0.717	1.940	9.843	0.624	1.767	9.248	0.094	0.172	0.595	1.341	3.707	19.091	0.2297	5.8674
A17	0.578	1.686	9.105	0.629	1.789	9.323	-0.051	-0.103	-0.219	1.206	3.475	18.428	-0.114	5.5893
A18	0.628	1.753	9.221	0.532	1.639	8.902	0.096	0.114	0.319	1.160	3.392	18.123	0.1453	5.4753
A19	0.571	1.649	8.822	0.542	1.665	8.892	0.029	-0.016	-0.070	1.114	3.314	17.714	-0.017	5.3474

It is worth repeating that the total *D* row shows an order of the elements that strongly affected the other components, and the total *R* column indicated the interaction elements. Therefore, if the value of *(D-R)* is positive, the index is definitely an influencer, and if the value is negative, the index is definitely interactive. Moreover, (D+R) shows the total intensity of an element (along the length axis) both in terms of influence and interaction; in other words, it shows the degree of importance of the element [23-26].

As is observed, the indexes were divided into two categories of influence and interaction based on the positive and negative *D-R* values. Finally, the indexes were prioritized as shown in Table 8. According to the calculations, the first three prioritized indexes were upstream rules and regulations, inflation rate, and investment strategies.

Table 7. Influence and Interaction of Indexes in Fuzzy DEMATEL Method

Factor	Effective	Influential	(D-R)	Factor	Effective	Influential	(D-R)
Upstream rules and regulations	✓	-	0.2893	Expectations and beliefs of society	–	✓	-0.25
Retirement period	-	✓	-0.327	Creating transparency and fighting corruption	-	✓	-0.05
Population growth	-	✓	-0.036	Exchange rate	✓	-	0.276
Country-based salary payment system	✓	-	0.0309	Interest rate	-	✓	-0.167
Actuarial assessment and insurance calculations	✓	-	0.1139	Inflation rate	✓	-	0.2096
Investment strategies	–	✓	-0.245	Economic growth rate	✓	-	0.2297
Appointment of qualified managers	✓	-	0.3037	Budget deficit	-	✓	-0.114
Using information technology	-	✓	-0.296	Political interventions	✓	-	0.1453
Process improvement in fund services	-	✓	-0.275	Sanction shock	–	✓	-0.017
Regulatory body for monitoring	✓	-	0.1792				

Table 8. Prioritization of Indexes in Solving Problem by Fuzzy DEMATEL Method

Factor	(D+R)	Factor	(D+R)
Upstream rules and regulations	5.980832	Expectations and beliefs of society	5.521917
Retirement period	5.27271	Creating transparency and fighting corruption	5.587558
Population growth	4.639557	Exchange rate	5.24427
Country-based salary payment system	5.604576	Interest rate	5.078473
Actuarial assessment and insurance calculations	5.454177	Inflation rate	5.940977
Investment strategies	5.876627	Economic growth rate	5.867486
Appointment of qualified managers	5.168804	Budget deficit	5.589263
Using information technology	5.029467	Political interventions	5.475344
Process improvement in fund services	5.309662	Sanction shock	5.347381
Regulatory body for monitoring	5.535842		

8 Conclusion

Selecting the most important and proper component for a pension fund is sensitive step that should be taken before a crisis emerges and leads to the bankruptcy of the fund. Inattention to this issue threatens the fund status, and the budget deficit of funds leads to the pressure overflow of the government's decision-making and national economy. The dependence of such fund pressure on the government causes an imbalance between the government revenues and expenditures, thereby giving rise to an economic crisis in the country. According to [32] Given the large number of influence indexes

in the process of selection and the fact that numerous qualitative and quantitative factors should be considered for the fund, selecting the appropriate factors was challenging our study. On the other hand, previous studies have mainly been focused on executive levels and crisis in funds, overlooking the importance of the identification and selection of proper factors for the fund. As such, the present study used the fuzzy DEMATEL technique and other new methods to rank the influential factors in pension funds.

According to the results, upstream rules and regulations was identified as the foremost index, followed by inflation and investment strategies as the second and third indexes, respectively. According to [33], the 80-20 rule was used to propose a proper policy based on scientific and mathematical techniques for the studied pension fund. The rule indicated that if the fund achieves a favorable influence on the national economy, it should strongly avoid doing the tasks that are among the 80% low-value ones, especially in the case of the delayed tasks that are among the 20% valuable ones. Therefore, pension funds and the policymakers should make a firm decision to allocate more time to the important activities that could make a real difference in their business ventures and spend less time on unimportant activities. Our findings indicated the components of funds in terms of the main factors, only some of which have been considered in previous studies. Compared to the previous studies in this regard, our research prioritized the comprehensive factors in terms of ranking the influential factors that could be considered as a theoretical model.
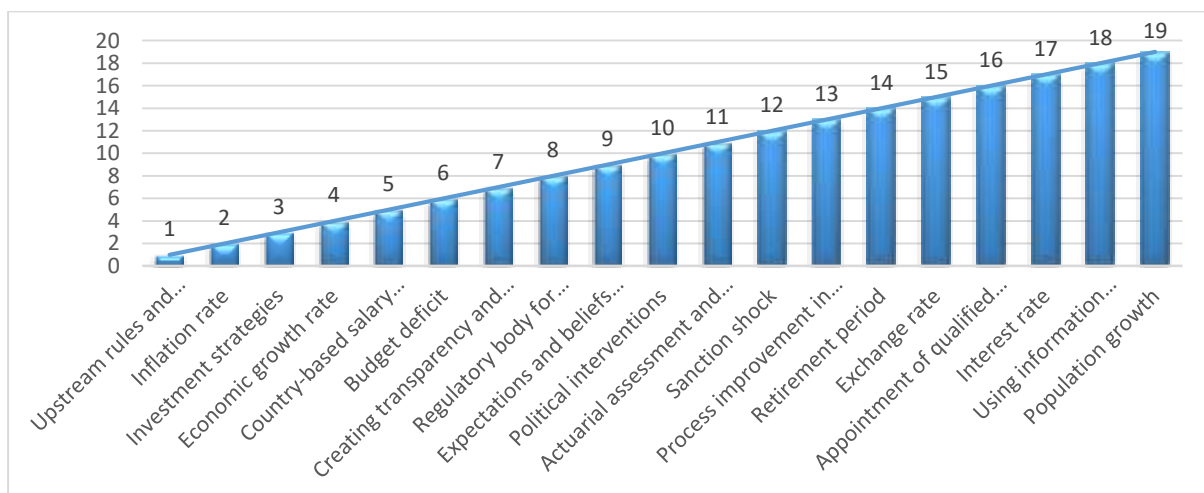

Fig. 2: Ranking of Factors Based on Fuzzy Demitel Method

Implications for Practice are stated as follows:
- Improvement of the conceptual model of the current research by adding new variables at specific times;
- Use of other multi-criteria group decision-making methods with statistical methods;
- Research in the field of private pension funds and benefiting from the experts in other countries

Limitations of the Study can be summarized as follows:
- Limited cooperation of the managers of some pension funds in the interviews and distribution and collection of the questionnaires;
- Limited cooperation of the faculty members in the interviews and collecting the questionnaires, especially due to the corona outbreak;

- Relatively limited sources of information on the subject matter

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