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Examining the Emigration of Elites from Iran: A System Dynamics Approach

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ABSTRACT

Nowadays, countries are leading in growth and development, with their managers having a systematic approach and perspective toward external phenomena. In the past, the slow pace of changes and transformations in societies made it easier to analyze current and future conditions. However, in today's world, complex phenomena are non-linear and multidimensional. The issue of migration of skilled and educated human resources from developing countries to developed countries is also considered one of these phenomena, which is influenced by numerous variables and factors that change and evolve over different time periods. The dynamic systems approach is a precise modeling method that allows us to simulate complex and dynamic systems computationally, both qualitatively and quantitatively. By utilizing the obtained results, we can design more effective policies and organizations. In this article, the issue of the migration of elites from Iran to developed countries is examined from a dynamic systems perspective. The problem is modeled and simulated using software "VENSIM". Important variables in elite migration are identified and adjusted. The model's outputs indicate the positive impact of the presence of elites in a country on its level of economic development.

Keywords: Elite migration, Dynamic systems, Socio-economic variables, Computer simulation, Scenario analysis.

1. Introduction

The movement and migration of populations across borders has a long history in human civilization. However, this phenomenon has been rapidly increasing in recent years. International migration has been on the rise since 1970, and every year a significant number of individuals migrate from developing countries to industrialized countries. According to the studies by Vakili and Mobini (2023) shown in Figure 1, the number of migrants worldwide approached 300 million in 2020, which accounts for about 4% of the total global population.

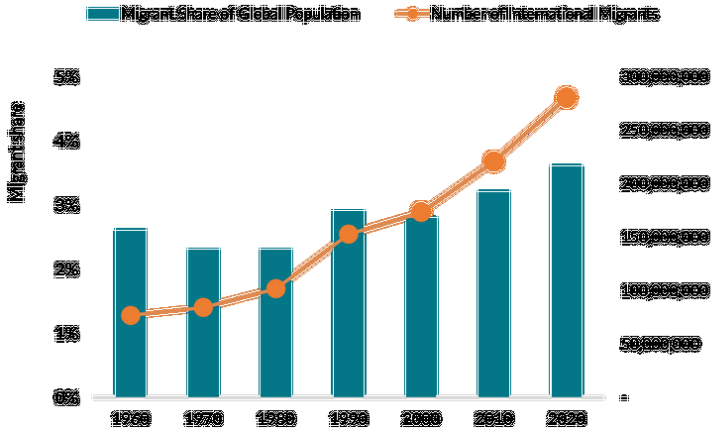

Figure1- The number and share of immigrants worldwide

Throughout its history, Iran has always been famous for its numerous internal and external migrations and immigrations. However, the importance and complexity of international migration have increased in recent decades due to the increasing young population of the country. The Iranian migrant population in the world, based on the latest available and reliable statistics in 2020, is 1.87 million people, which constitutes 2.23% of the Iranian population, as indicated in Table 1. However, according to the Secretariat of the Supreme Council of Iranians Abroad, the estimated population of Iranian migrants outside the country is 4.04 million people, and this figure can be verified based on international sources (Sadeghi & Seyyed Hosseini, 2019).

Table1- The status of Iranian immigrants in domestic and global statistics

Internal Statistics	Statistics Based on International Sources				Annual Population Factors
2020	2020	2010	2000	1990	Year
4.04	1.87	1.49	1.15	0.82	The population of Iranian immigrants in the world (million people)
83.99	83.99	73.8	65.6	56.4	Total population of Iran (million people)
4.81	2.23	2.02	1.75	1.45	The share of Iranian immigrants in the total population of Iran (percentage)

Since most of the emigrants are the elites and the skilled human resources of society, their departure from the countries of origin is often described as "brain drain"; a term that was first coined by the Royal Society of England to describe the migration of scientists from England to North America after World War II (Ha et al, 2016). Migration can lead to a decrease in skilled and educated workforce in the country of origin, and subsequently result in a reduction in economic capabilities and the inability to meet domestic needs, as well as a decrease in industrial competitiveness (Beine et.al, 2001).

Therefore, the emigration of elites at the caliber level can cause the backwardness of the countries of origin and, in addition to being an economic and social issue, it has political and cultural consequences in the country. To examine this issue, it is necessary to use an approach that covers all dimensions of the problem, as these issues are influenced by multiple factors. On the other hand, simple analyses and breakdowns do not provide suitable solutions for this issue because the influential factors change over time. For this reason, a systems dynamics approach is used in this regard, as this approach takes into account the time variable and provides a more realistic view of the problem, and can examine the effects of various factors in different dimensions. Finally, with the presentation of scenarios to improve the current situation, systems dynamics can have a more comprehensive impact on the investigation of the issue of elite emigration.

In this study, after reviewing previous studies and identifying the factors and variables used, as well as the methods employed, the dynamics of the system will be introduced and the advantages of using this approach will be discussed. The issue of elite emigration will be modeled qualitatively and quantitatively, and various scenarios will be implemented to discuss the resulting outputs and provide managerial solutions in this field.

2. Literature Review

According to the definition provided by the United Nations, migration is the act of changing one's country of residence regardless of its nature, motivation, or legal status. However, in general, the goal of a migrant is to achieve better conditions and escape existing problems and challenges in the country of origin. Zackerman also introduces the concept of an elite individual in his book "The Scientific Elite," who is the most successful and powerful person in a society in one or more outstanding and efficient fields.

Vakili and Mobini (2023) found that the outflow of talents from Iran is mainly influenced by external factors (such as attraction factors from developed countries) and internal incapacities (such as push factors). The migration rate is rapidly increasing; therefore, it is necessary to analyze and manage this phenomenon using existing theories in the field of attraction and push factors, Maslow's hierarchy of needs, rational choice theory.

Mozaffari (2023) concluded that the current political atmosphere, economic sanctions, and lack of research opportunities have led to an increase in the emigration of elites and the departure of talented professionals from Iran. With the increase in the number of talented Iranian scientists seeking better opportunities and resources abroad, this trend is expected to continue.

Moftakhari et al. (2021) investigated the impact of social capital on talent outflow in member countries of the Cooperation Organization of Shanghai during the time period from 2009 to 2018. The results indicate that social capital has a non-linear and threshold effect on talent outflow. Given that the coefficient of social capital is positive and the second power coefficient is negative, increasing social capital at lower levels exacerbates talent outflow from the countries under study. However, increasing the level of social capital beyond the threshold level has a negative effect on talent outflow. By determining the threshold level in these societies and striving to enhance social capital to that level, as an effective factor in preventing talent outflow, one can prevent the emigration of elites in these countries.

By examining the situation of Iranian elites' migration, postgraduate students, married individuals, those who were dissatisfied with their income, and individuals with high economic and social status, Derakhshani et al. (2023) found out that the mentioned groups had a greater inclination towards migration. The inclination for migration had an inverse relationship with four dimensions of origin and destination conditions (economic, political, social, and cultural). Important factors that influenced student migration included a wide range of cultural, economic, occupational, and socio-political variables. A significant relationship was found between the inclination for migration and variables such as gender, educational region, educational degree, religion, having relatives and friends abroad, experience of foreign travel, foreign language proficiency, number of published articles, and membership in the National Elite Foundation.

Vedadhir & Eshraghi's (2023) study aimed to explain the inclination for migration and found that migration reasons can be categorized into two main groups: attraction factors of the destination and push factors of the origin. Data analysis resulted in the extraction of two main categories: 1) push factors, which included five subcategories of economic-occupational factors, socio-cultural factors, political-religious factors, educational factors, and personal factors, and 2) attraction factors of the destination, which included five subcategories of legal and relationships, security, welfare-financial conditions, educational and occupational opportunities.

Ghorbanian & Salehi (2021), using a dynamic systems approach, concluded that by implementing policies to reduce tensions in international relations, it is not possible to significantly impact the emigration rate of elites, and their number cannot be reduced. However, implementing policies to improve fair remuneration, job security, and employment status of elites can lead to changes in the rate of elite migration and the number of immigrants. Therefore, implementing these two policies can be effective in preventing the outflow of elites from the country and can strengthen them.

Haji Gholam Saryazdi et al. (2017) modeled the factors of elite migration using a system dynamics approach and by collecting a group of scientific and technological elites to model this phenomenon with a systemic perspective. The current model showed that the main hypothesis of the article, which states that elites themselves play a role in creating the brain drain structure and are also influential in rectifying it, is valid.

Mousavi Rad & Ghodsian (2015) also adopted a dynamic system approach, which, by implementing government policies to support entrepreneurship and increasing the level of cultural education, does not result in a change in the rate of elite formation. The rate of elite development initially decreases, which is due to a decrease in the migration rate in the first few years. Therefore, it cannot be said that the implementation of these two policies has led to the nurturing of elites in the country. Considering that the number of immigrants has also remained insignificant, it can be concluded that these policies have been unsuccessful in reducing the trend of brain drain.

A summary of the above studies can be reviewed in Table 2 in the form of a research background:

Table 2- An overview of the research background

Results	Method	Year	Researchers	Title	
The simultaneous effect of external attractiveness and internal disability	Review	2023	Vakili & Mobini	An overview of brain drains, causes & policy issues in Iran	1
The role of political-economic and scientific parameters	Review	2023	Mozaffari et al.	Science in Iran: A victim of political torn ail	2
The effect of scientific factors such as parent's education level and language proficiency	Review	2023	Derakhshan et al.	Emigration pattern among medical & Non-medical Iranian elite & its associated factors: A review of literature	3
Non-linear effect of social capital variable	Econometrics	2023	Moftakhari et al.	Investigating the effect of social capital on brain drain in the member countries of the Shanghai Cooperation Organization	4
The inverse effect of research and development costs and globalization index on immigration	Statistics	2022	Shahabadi & Pouran	The effect of economic complexity and globalization on elite migration in selected member countries of the Organization of Islamic Cooperation	5
The lack of impact of improving foreign relations on immigration statistics	SD	2021	Ghorbanian & Salehi	Presenting the study model of the phenomenon of elite evasion	6
Explaining the factors of repulsion of the origin and attraction of the destination	Inductive quality	2019	Vedadhir & Eshraghi	Tendency to migrate in Iran's medical community	7
Elites are responsible for increasing or decreasing the rate of immigration	SD	2017	Haji Gholam Saryazdi et al.	Analyzing the dynamics of elite migration using associative modeling	8
Lack of effect of government support policies	SD	2015	Mousavirad & Ghodsian	Analysis of elite immigration and the effect of restrictive policies	9
The influence of income-quality level of life and cultural development	Survey Secondary analysis	2005	Chalabi & Abbasi	Comparative analysis of brain drains at micro and macro levels	10

3. Methodology

In this study, the system dynamics approach is used as a modeling method. One of the basic challenges in the development of human societies is to predict the real world in the future. System dynamics (SD) analysis is a very efficient and well-known method for studying system behavior in this case (Safaie et.al, 2022). System dynamics refers to system changes and behaviors over time under different conditions. Professor Forrester (1961) in the book of industrial dynamics defines system dynamics as the study of information and feedback characteristics of industrial activities to show how

organizational structure, reinforcement (policies), and time delays (in decisions and actions) affect the success of the company. The main features of this method include the existence of a complex system, the change of system behavior over time, and the existence of a closed feedback loop (Langroudi & Amiri, 2016).

The implementation of the system dynamics method in this research, according to Figure 2, has been carried out in five stages and recursively in the Vensim software, version PLE10, in the time frame of 2006 to 2036.

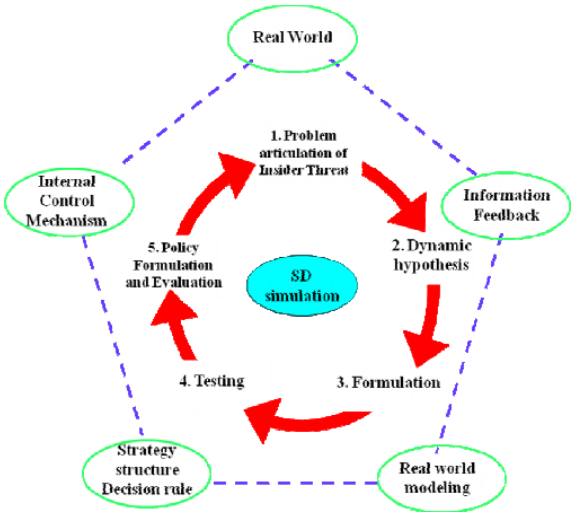

Figure 2- Implementation steps of the system dynamics method

4. Modeling, review and analysis of data

To start the modeling work, after familiarizing yourself with the method and steps of the work, you must collect and categorize the necessary information about the studied problem and form a mental and descriptive model according to the above steps.

4-1. Dynamic hypothesis

In order to implement the elite migration model, the first step is to have a dynamic hypothesis about migration. The elites who intend to migrate, economic, cultural and social factors influence their decision to migrate. If the above factors do not match the individual's wishes, the existing conditions are not completely consistent with the individual's ideals; Therefore, in this hypothesis, the high migration rate is caused by the existence of unfavourable conditions in the country of origin.

4-2. Causal Loop Diagram (CLD)

The causal diagram depicts the cause-and-effect relationships between the various variables in the problem situation and is used to record mental models and the mutual effects of the variables on each other.

The causality structure of a model is shown by a causal diagram, which is shown in figure 3 for the discussed problem:

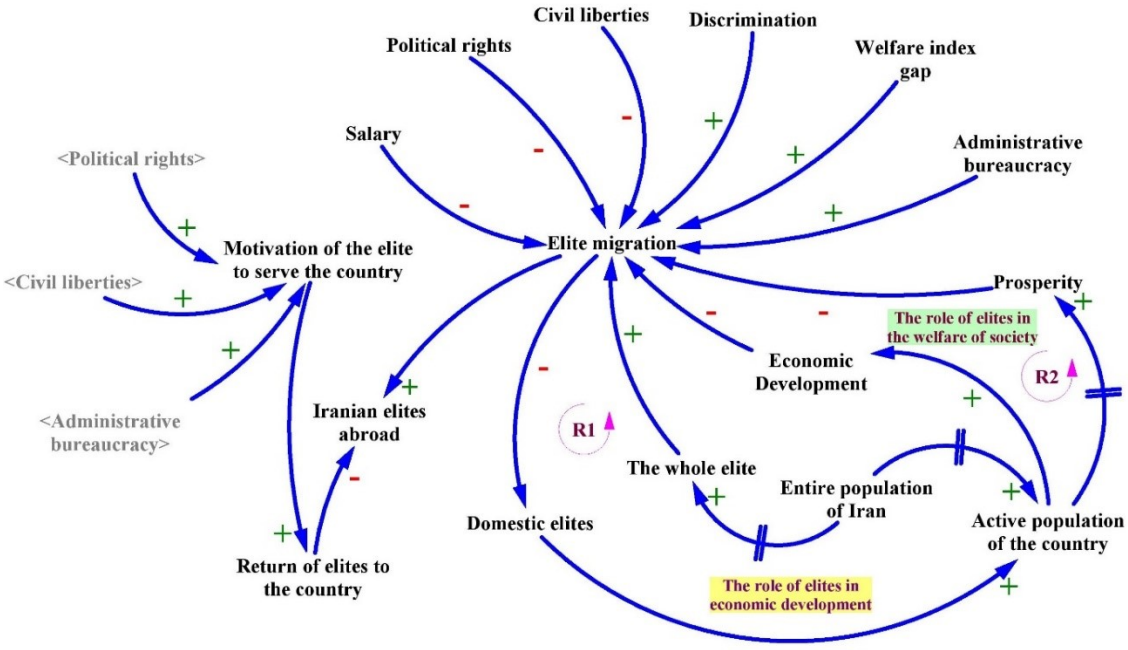

Figure 3- Causal loop diagram of elite migration

Diagram of the causality have 2 feedback loops as follows:

1. The role of elites in economic development (R1): With the reduction of elite immigration, the population of elites inside the country increases and these people become the active population of the country. As a result, with the activity of these people in the economy, the amount of GDP increases and with the improvement of the country's economic situation, the immigration statistics of other elites decreases.

2. The role of elites in society's welfare (R2): With the decrease in the number of immigrant elites and the continued increase in the number of resident elites, their entry and activation in the country's economy has increased per capita income and general well-being, leading to a decrease in their migration statistics.

4-3. Stock-Flow Diagram (SFD)

Causality diagrams are very useful in many situations, but despite these advantages, they have limitations, one of which is their inability to show the change in the state structure and system flow. This problem can be solved by using the flow state diagram, and by displaying the state variables and flows, it is possible to track the state variables along the path (Sterman, 2002).

The state and flow diagram of this problem is designed according to Figure 4:

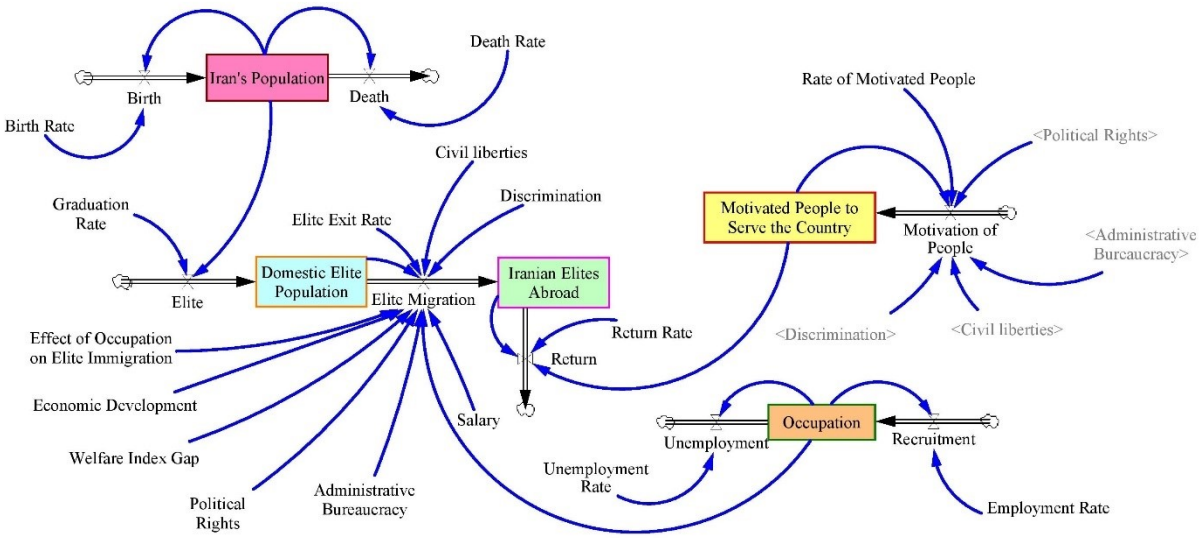

Figure 4 - Stock-Flow diagram of elite migration

4-4. Formulation

The quantification of the model was done based on the stock-flow diagram in the form of mathematical relationships and by separating the variables involved in the problem according to table 3:

Table 3- Mathematical equations of model variables

Type	Unit	Formula	Description	Variable	
State	People	INTEG (7.0496e+07, Birth-Death)	Iranian population in the simulation period	Iran's Population	1
State	People	INTEG (4e+06, Elite Migration -Return)	Total of Iranian elites in other countries	Iranian Elites Abroad	2
State	People	INTEG (220649, Elite - Elite Migration)	Number of elites living inside the country	Domestic Elite Population	3
State	People	INTEG (6619, Motivation of People)	Iranian elites living abroad who decide to return	Motivated People to Serve the Country	4
State	People	INTEG (28414, Recruitment – Unemployment)	Number of working population relative to the total economically active population	Occupation	5
Rate	People/Year	Occupation × Employment Rate	Number of new employees in relation to the total working population	Recruitment	6
Rate	People/Year	Motivated People to Serve the Country × Rate of Motivated People + (Civil Liberties +Political Rights - Discrimination - Administrative Bureaucracy)	People with a positive attitude	Motivation of People	7
Rate	People/Year	Occupation × Unemployment Rate	Number of unemployed populations compared to the total economically active population	Unemployment	8

Table 3- Mathematical equations of model variables (continue)

Type	Unit	Formula	Description	Variable	
Rate	People/Year	(Motivated People to Serve the Country × Return Rate)+(Iranian Elites Abroad × Return Rate)	Number of elites returning to the country	Return	9
Rate	People/Year	Birth Rate × Iran's Population	Number of births per time unit	Birth	10
Rate	People/Year	Death Rate × Iran's Population	Number of deaths per time unit	Death	11
Rate	People/Year	Domestic Elite Population × Elite exit rate – (Occupation × Effect of Occupation on Elite Immigration) – (Economic Development + Political Rights + Civil Liberties + Discrimination) × Domestic Elite Population + (Administrative Bureaucracy + Welfare index gap + Salary) × Domestic Elite Population	Number of immigrant elites per time unit	Elite Migration	12
Rate	People/Year	Graduation Rate ×Iran's Population	Number of new entry elites per time unit	Elites	13
Constant	1/Year	0.0384	Growth rate of working people	Employment Rate	14
Constant	1/Year	0.03	Positive feeling growth in people	Rate of Motivated People	15
Constant	1/Year	0.03	Return of elites to the country	Return Rate	16
Constant	1/Year	0.0108	Amount of people's participation in total production of the country's economy	Unemployment Rate	17
Constant	1/Year	0.1583	Growth of departure of elites from the country	Elite exit rate	18
Constant	1/Year	0.0185	Growth rate of births per total population	Birth Rate	19
Constant	1/Year	0.0057	Growth rate of deaths per total population	Death Rate	20
Constant	1/Year	0.0126	Growth rate of educated people per total population	Graduation rate	21
Constant	1/Year	0.256	People's freedom against unjustified violations by governments	Political Rights	22
Constant	1/Year	0.0096	Qualitative changes in the economic structure of a society	Economic Development	23
Constant	1/Year	0.0044	Realization of social justice	Discrimination	24
Constant	1/Year	0.003	Individual and social freedoms	Civil Liberties	25

Table 3- Mathematical equations of model variables (continue)

Type	Unit	Formula	Description	Variable	
Constant	1/Year	0.001	Impact factor of related occupation on the decision to migrate	Effect of Occupation on Elite Immigration	26
Constant	1/Year	0.011	Income from skills and knowledge	Salary	27
Constant	1/Year	0.13	Difference in the level of prosperity in Iran and developed countries	Welfare index gap	28
Constant	1/Year	0.008	Excessive administrative regulations and formalities	Administrative Bureaucracy	29

4-5. Model validation

After the implementation of the model, to ensure the validity of the proposed model, 3 validation tests are performed on it;

4-5-1. Test of the model structure

This test, as an experimental tool, compares the form of equations and models with the relationships that exist in real systems. This work was done in the Vensim software according to Figure 5.

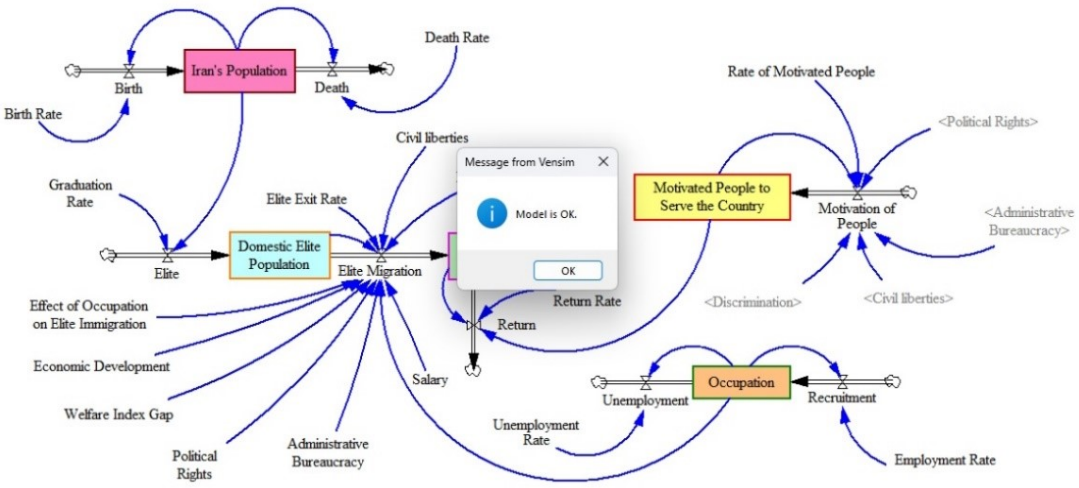

Figure 5 – Model Check

4-5-2. Test of the dimensional consistency

This test includes checking the right and left sides of the equation in terms of the dimensions of the variables, which must be the same; According to the introduction of the unit of all the variables in the model, this test can also be performed in the Vensim software according to Figure 6.

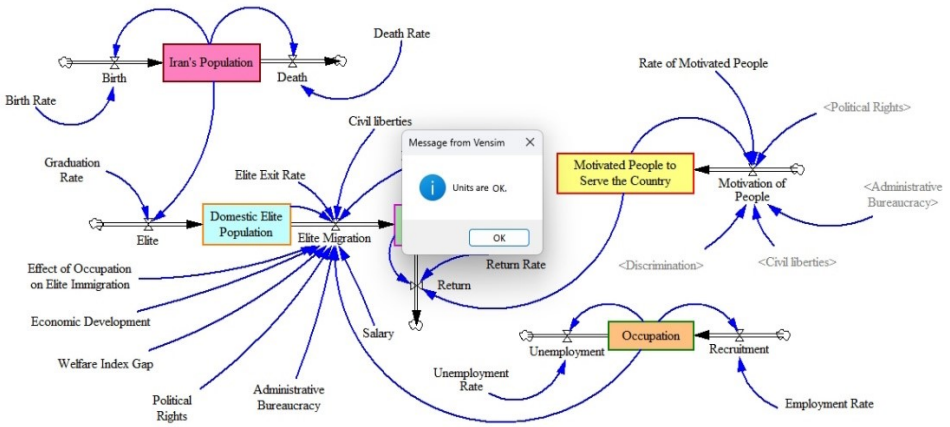

Figure 6 – Units Check

4-5-3. Limit condition test

The purpose of this test is to measure the sensitivity of the model for values far from reality and the limits of model decay. Here, by setting the return rate of the elites to a high value, as shown in figure 7, we see an increase in the number of domestic elites and its gradual equalization with the total elites of the country, which means they all stay.

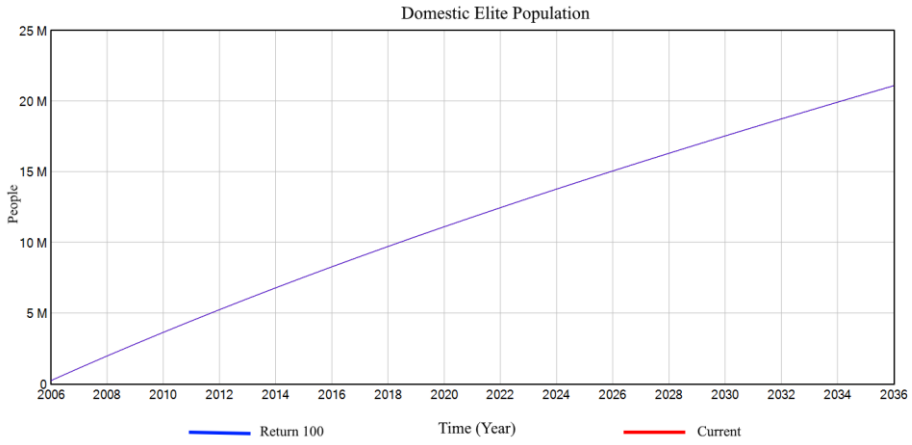

Figure 7 – The boundary condition test in the case of the return of all elites to the country

4-6. Model output detailed analysis

Figure 8 shows the status of foreign elites, which shows that due to the increase in the number of university graduates, especially in the supplementary education courses, as well as the conditions of recent years, the increase in their number can be justified.

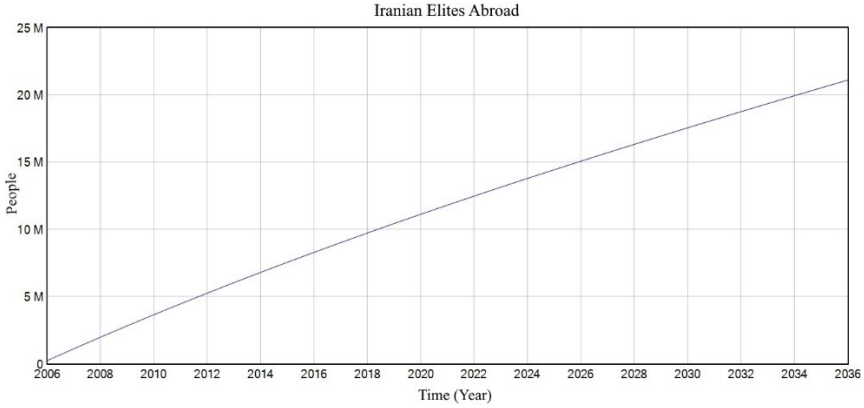

Figure 8 – The elite population living abroad

Figure 9 is the trend of the main flow variable of this model, which clearly shows the alarming situation of elite immigration, if there is no change in the variables related to immigration, the increase will continue.

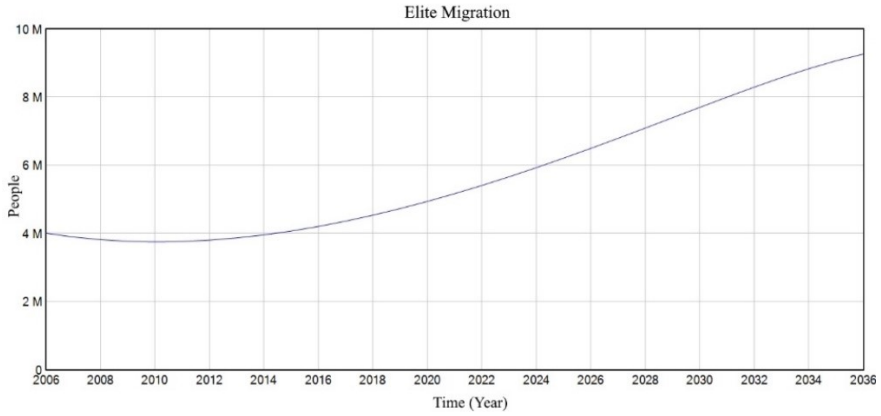

Figure 9 – The process of elite migration in the simulation period

4-7. Assessing policies and scenarios

System dynamics is one of the approaches in simulation methods. The benefits of using simulation models are learning about complex problems and testing different interventions (Beigian et.al, 2022). At this stage, by setting different values to selected variables of the model that are considered close to the economic variables of the 7th development plan, the simulation results are compared with the base state and the most suitable options for management decisions are suggested in this issue.

4-7-1. Salary increases scenario

If we increase the wage index to 65%, according to Figure 10, the rate of elite migration will continue to increase, but it will have a lower slope compared to the current trend.

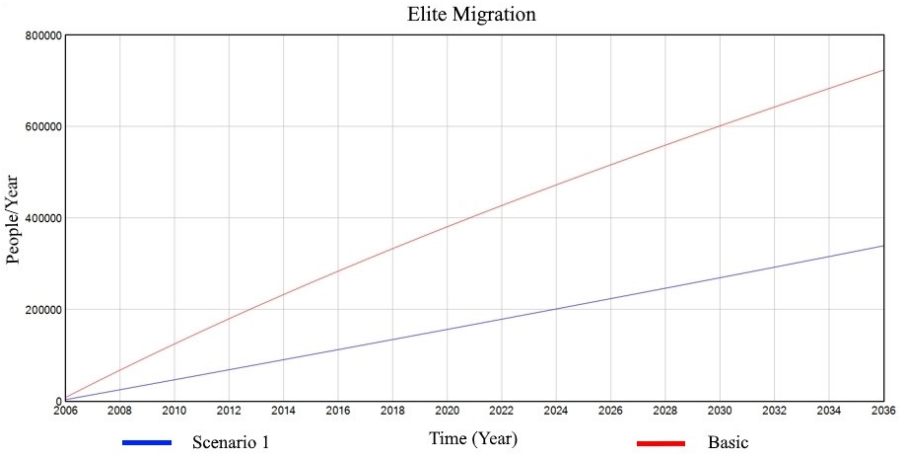

Figure 10 – The rate of elite migration under the wage increase scenario

4-7-2. Economic development scenario

If the rate of economic development increases by 8% (according to the perspective of the seventh development plan of the country), the rate of elite migration will decrease as shown in Figure 11; In other words, we will see reverse migration.

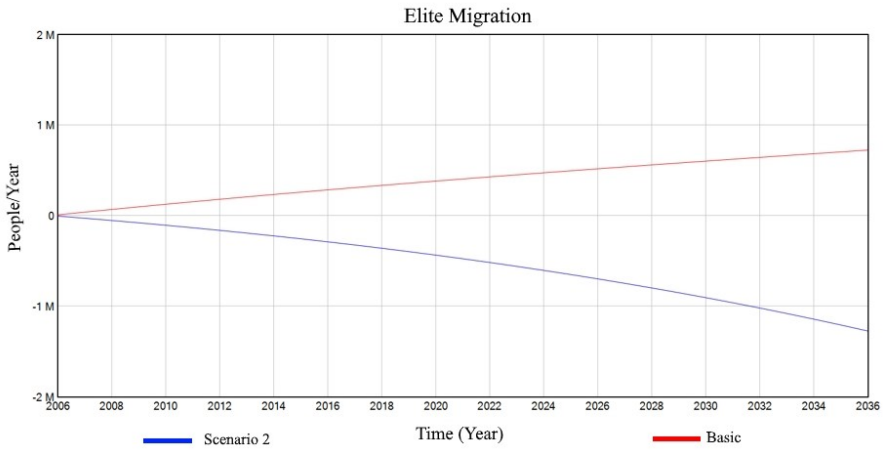

Figure 11 – The rate of elite immigration under the scenario of improving economic development

5. Management recommendations

The scenarios examined in the present study have focused on the economic factors in the issue of elite immigration. Therefore, in this regard, there are several managerial points worth mentioning for policymakers. Given the lower level of service rates and wages within the country, considering the exchange rate parity of the national currency against foreign currencies and comparing it with other countries, especially developed and immigrant-receptive countries, it is necessary to review the pattern of determining salaries and wages, especially for specialists. Despite the possibility that this pattern may lead to an increase in income inequality among other social classes, it is possible to regulate the gap in the welfare level of this group with other income brackets through non-inflationary supportive measures. In this regard, in addition to improving salaries, it is possible to mention the improvement of working conditions ethically by increasing the attractiveness and competitiveness of the domestic job market through providing government incentives, especially for startups and new companies, which are mostly run by educated young forces. Moreover, providing professional and research opportunities for the development of the skills of university elites, alongside cooperation with elites in industrial and technological sectors, as well as scientific and technological collaborations with other countries, can lead to improving the internal migration deterrent indices for elites.

6. Discussion and conclusion

The present research was conducted to simulate a dynamic model for the phenomenon of elite migration; The output of the model shows the undeniable effect of the increase in economic development and the level of public welfare as a result of the role of elites in different fields of the country; the same discussion that is mentioned under the title of meritorious year that has also been mentioned in past studies such as Shahsawaripour et al. (2019). In addition to the components discussed in this research, the influence of social and cultural policies and scenarios as well as non-economic motivational factors in the migration of elites can be investigated by converting them into quantitative parameters.

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