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The Effect of Government Support Policies on the Export of Iranian Food Industry Products Using the System Dynamics-Agent Base Approch

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Abstract--- *Theoretically, increase in the export rates could improve economic growth. Therefore, export development, as one of the strategies of economic development, is the main determinant in order to increase production capacity, employment, and provide foreign exchange earnings for investment in new technologies. On the other hand, achieving a high economic growth rate is the economic goal of all countries, which guarantees the implementation of appropriate economic policies, especially government support policies in the field of tax, subsidy, consumption, production and global trade policies. Iran's position in the food industry, given the high potential in this field in the country, has caused it not to have a proper position in the huge food market and international trade. Therefore, in this study, the effect of government support policies on the export of Iranian food industry products has been investigated using the system dynamics-agent base approach. After designing causal-Loop diagrams and Stock-flow, the equations are written and simulation model for the period of 2017-2035 were performed. The results of the simulation showed that with the continuation of the current trend and the lack of change in conditions, the export of Iranian food industry products in the last year of the simulation (2035) will not be significant and will be only 3.8 billion dollars. In the following scenario, it was assumed that if the government's supportive policies to help export food industry products experience growth and improvement conditions (policies such as customs, tax, production, etc.), in these circumstances, food industry exports are expected to increase by $ 1.2 billion compared to the base model. In other words, improving government policies will make the export of food industry products reach $ 5 billion by the end of the simulation year (2035). The variable of efficient government policies is also considered as a factor in this research. If it is assumed that the efficiency index of government policies changes behavior and takes an upward trend, the export of Iranian food products will be established to 5.3 in the final year of simulation in the system dynamics-Agent base model.*

Keywords--- *Exports, Food industry products, Government support policies, Simulation, System dynamics.*

I. INTRODUCTION

According to theories of international development and trade, since exports are part of GDP, export growth can have a positive impact on economic growth. Most countries also want to improve their balance of payments and create new job opportunities by expanding the volume and diversification of their exports, while thinking about technology transfer and

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the positive effects of trade. These benefits have led some schools to attribute economic growth and development to trade expansion (Motevaseli, 2001). In other words, export development provides foreign exchange resources for economic development and can play a decisive role in the formation of economic structures, optimal allocation of resources, use of economies of scale, production of international expertise, etc. In this regard, the agricultural sector through Agricultural exports are involved in foreign trade, and the export of its products is more stable than in other sectors; Therefore, relying on this sector and developing and expanding its exports can provide the ground for presence in global markets and the use of its benefits. For this reason, it is necessary to pay attention to the development and trade of the agricultural sector as a precondition for economic development (Pakravan and Gilanpour, 2014). Iran's food industry has made significant progress in the last two or three decades, and its products have been able to enter export markets. However, despite the development of the food industry in the country and the influence of the products of this industry on some neighboring markets, it seems that the high potential of this industry has not been used for a large and stable presence in the world markets. According to the latest statistics, the active units of the food and beverage industry in the country have been 5,258 units, with an investment of 27,732 billion rials, an added value of 189,000 billion rials and the creation of 301,359 people. Iran's food industry accounts for about 16.7 percent of industrial workshops, 16.8 percent of industrial workshops' employment, 12 percent of value added of industrial workshops, 11.8 percent of investment in industrial workshops and 6.89 percent of non-oil exports in 2016. On the other hand, in the Sixth Economic Development Plan (2016-2021), the development and support of conversion and complementary industries, packaging and storage of agricultural products from 35 million tons in the base year to 47 million tons by the end of the program, which shows the importance of this The sector is in the development of the country (Table No. 9 of Article 31, sub-section 7-Agriculture, Sixth Development Plan). Therefore, the implementation of government supportive economic policies such as monetary, financial, foreign exchange, trade and other policies has a very important role in the export development programs of agricultural products, especially food products in the country. In this study, the impact of government support policies on the export of food industry products through the design of a dynamic simulation model as a system consisting of factors and variables affecting it will be examined. Here are some of the most important studies on the subject. Mohammadi and Rasoulizadeh (2018) in their study entitled The Effects of Currency and Commercial Policies on the Export of Garden Products in Iran examined the impact of foreign exchange and commercial policies on the export of garden products in Iran. In the field of exchange rate policies, exchange rate volatility index and imaginary exchange rate exchange rate policy were considered in relation to trade policies, trade deviation index and economic recovery index and estimated long-term and short-term relationship between model variables during the years 1997-2015 using the logarithmic form of the export supply function based on the authoritarian pattern with distributive interruptions and error correction models. The results showed that in the long run, the variables of trade deviation, exchange rate instability, economic volatility, value of export of nuclear fruits in previous years, variable domestic price of products and imaginary variable of exchange rate unification policy have a positive effect on export of nuclear fruits in Iran. Khaliqi and Shaukat Fadaei (2017) examined the impact of exchange rates and foreign policies on Iran's date exports in 2011-1991. The results showed that the exchange rate is an important factor for the export of dates as well as exporters. In addition, other factors, especially government policies, are on the export model. In this regard, the short-term outsourcing of foreign policy has reduced the value of exports. The results also showed that the use of exchange rate unification policy, without a proper exchange rate to encourage exporters, has a negative impact on date exports. Azizi et al. (2016) examined the role of supportive policies in the development of agricultural exports. According to the results, the indicators of the ratio of export price, agricultural value added and the general criterion of support affect the pattern and have a positive relationship with the supply of exports in the short and long term. On the other hand, exchange rates, private sector consumption and war have no effect on the supply of exports. The error correction coefficient showed that in each period, 52% of the imbalance is eliminated and long-term adjustment

is made. Safari et al. (2015) examined the effect of exchange rate fluctuations on agricultural exports in line with the second paragraph of general agricultural policies using self-explanatory model with distributed interruptions in the period 1981-2011. The results showed an inverse relationship between exchange rate fluctuations and agricultural exports. Qaderpour et al (2015) in a study entitled The effect of government support policies on the supply of products of agricultural conversion industry units examined the impact of government support policies on the supply of products of agricultural conversion industry units. For this purpose, the combined data of the units of Iran's agricultural conversion industries were used during the years 2001-2010 and the supply function was estimated. Government supportive policies were divided into two parts: subsidizing energy and banking facilities. The findings showed that a 10 percent increase in government support in the form of subsidy payments to energy and banking facilities would increase supply by 2.1 and 4.3 percent, respectively. Azimi and Yahya Zadehfar (2015) examined the impact of export incentive programs on agricultural trade. In this study, 24 agricultural products were divided into three groups; The first group included products and when the prize was not paid. The second group received subsidies of 1.5 percent and less, and finally the third group received more than 1.5 percent subsidies. The results of multiple variance analysis showed that there was no significant difference between the first and second groups, but there was a statistically significant difference between the third group and the first and second groups. In other words, to be effective in exporting awards and incentives, the amount of rewards must be greater than one threshold.

II. MATERIALS AND METHODS

System dyamic

The method of system dynamics was founded in the late 1950s by Jay Forster at MIT and was used for various systems, including economic and social systems. System dynamics is a way to understand the behaviors of a complex system over time. In this method, by focusing on the feedback loops within the system, the nonlinear effects and time delays among the variables, as well as the accumulative nature or flow of the variables, examine the behavior of a system. Given the numerical nature of the system dynamics method, it is possible to simulate models based on this method using a computer and predict the state of the system for a period of time in the future with a set of different parameters and variables (Wikipedia). System dynamics is a method for studying and managing complex systems in different fields such as business, economics, urban issues and technical fields, etc. (Rajaian, 2009). Problem (border selection), formulating a dynamic hypothesis, formulating, testing the model and designing and evaluating the policy: The first step - problem statement (border selection): The most important step in modeling is problem statement. Having a clear goal is the most important part of successful modeling. What is our goal? What are the key variables in the model? Step 2: Develop a Dynamic Hypothesis: Once the problem has been identified and identified over a reasonable time horizon, model builders should begin to formulate a theory called Dynamic Hypothesis for description. The hypothesis should provide an explanation of the dynamics of the problem in terms of important feedback and the structure of accumulation and flow of the system. Step 3: Formulate: As soon as the initial dynamics hypothesis, model boundary, and conceptual model are developed, it should be tested. Before testing the model, it is necessary to determine the formulas and equations related to the accumulation variables and flow variables and other model variables in order to simulate the model in order to test the model based on these equations. Fourth step-model testing: After converting the mental model into causal-circular form and then converting them into accumulation-flow and formulating it and simulating it with computer software, the desired analyzes on the face model Accepted and the results obtained. Step 5 - Policy Design and Evaluation: Once the model and employer trust in the model, it can be used to design and evaluate policies to improve the system. (Sterman, 2007) After identifying the system and its elements, we consider changing them over time and determine the feedback between the elements in the system. In the meantime, when an element of the system is indirectly affected by the path in which other

elements and the feedback between them are affected, it forms a causal or feedback loop. (Kirkwood, 1998) After determining the causal-cyclic charts, the flow forms take the necessary details to write the equations. In these forms, variables are divided into types of state variables, rate variables, and auxiliary variables, and values are defined based on constants and parameters. (Sushil, 2008) Accumulation-flow forms include special signs and details to show the structure of the system. In these forms, some variables are identified as reserves and others as current variables (Rouhi, 2011). The following figure shows the process of modeling the dynamics of the system.

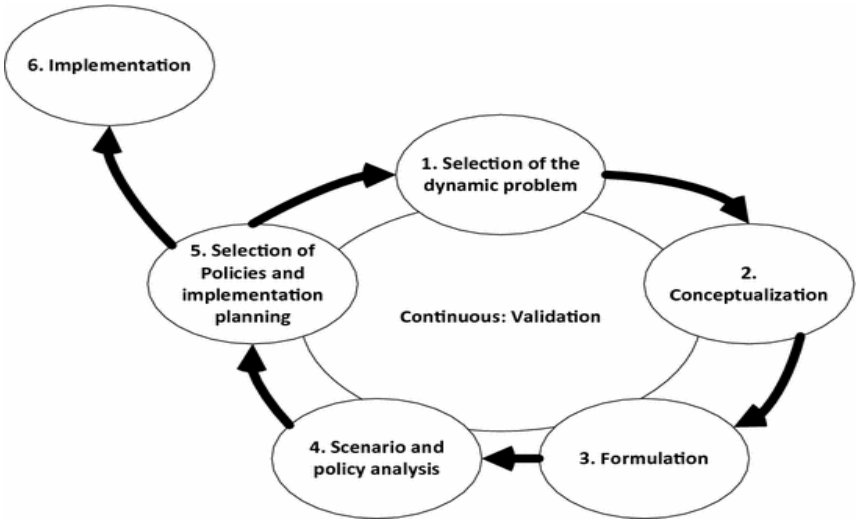

Figure 1- System dynamics modeling process

Agent-base Modeling

Agent-based modeling is based on the framework of complex adaptive systems. According to the definition of the Miller (1991), systems are composed of a large number of components called agents. These factors will interact, adapt or learn with each other. In this context, control is decentralized and the behaviors resulting from the system are the result of many interactions between actors or agents and decisions are made by them. The basis of Agent-based modeling is based on a state diagram in which a factor or variable moves from one state to another based on a specific and defined event. In Agent-based modeling, members of a community, such as firms in an economy, are explicitly modeled rather than presented as a whole.

Combining system dynamics-Agent base approach

Combining a system dynamics approach that follows the framework of systems thinking with a partisan approach such as Agent-based can analyze complex behaviors with greater accuracy. This combination can be done in two ways.

In the first case, producers, consumers and other existing factors can be defined as a factor and then their behavior can be examined with the model of system dynamics.

In the second case, in the system dynamics model, some parameters or model variables that take different positions during the simulation years are entered in the form of a status diagram in the model. This can significantly increase the dynamics of the designed pattern. In the present study, the second case is used.(_Block, 2017, Martin & Schulter, 2015, Jang et.al, 2016, Shafiei et.al, 2012)

III. DISCUSSION

In the present study, system dynamics modeling has been used to model the effect of government support policies on food industry exports. Using this technique, a dynamic model of the relationships between the effective components is given. First, in order to develop the system dynamics model, a causal-disability graph is presented, which is the basis of the flow chart and simulation model. In the following, the developed flow chart is used as a simulation of the system to test different scenarios for analyzing and selecting the best factor and solutions for modeling the export of food industry products. As can be seen in Figure 2, the effectiveness of government policies is the result of factors influencing policies and supportive policies. Government support policies based on the modeling of this research include tax policies, export policies (export subsidies), global trade policies (WTO), production policies and consumer policies. On the other hand, factors affecting policies include competitiveness indicators, business environment, the internal factors of companies exporting and producing food industry products, exchange rates, GDP per capita, inflation and environmental indicators.

After identifying the factors affecting government support policies and its impact on food industry exports, modeling and problem analysis are performed. Using the causal-loop diagram, the relationships between the variables are easily shown. After preparing the causal diagram, the flow diagram prepared for the research problem is shown in Figure (2). Although causal diagrams illustrate the feedback structure well, they are not suitable for computer simulation. Flow diagrams are a tool for modeling the assumptions made in causal diagrams. There are various methods for finding equations in a dynamic system problem, which are: 1) the use of existing laws and physical theories between factors 2) the use of statistical information among model factors 3) the use of expert opinion 4) the use of public opinion Rule 5) Use the opinion of the model Maker

In determining the equations of this model in terms of experts, modeling and similar relationships that have been used in other studies, has been used. Some of the equation coefficients have been estimated based on the experience and opinion of supervisors and consultants, as well as the researcher (model) himself, and other relationships have been determined based on interviews with experts and other studies. Figure 2 shows the accumulation-modeling model of government support policies and its impact on food industry exports, Which is part of the model of export modeling of Iranian food industry products.

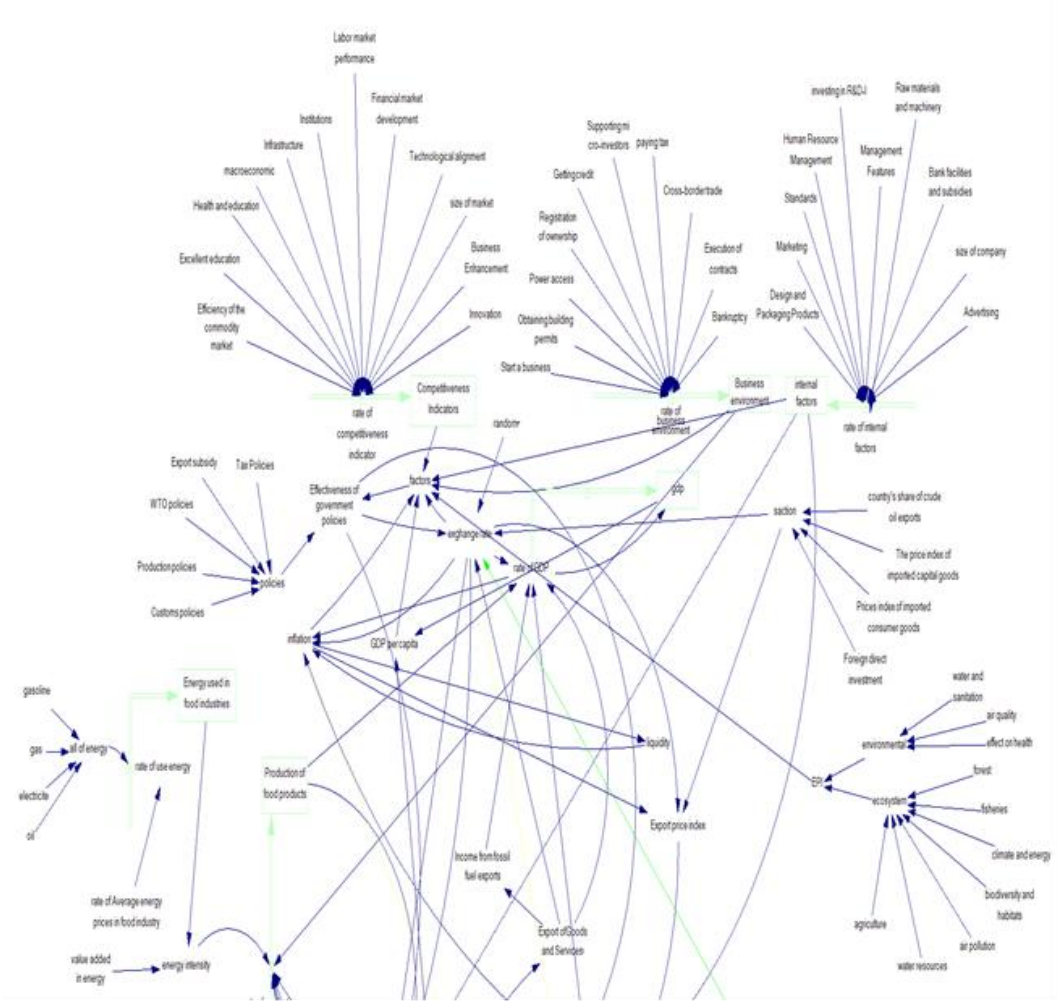

Figure 2- Modeling variables affecting government policy efficiency

- **Statistics and data**

After designing the causal-Loop diagram and the accumulation and flow mentioned in the previous sections, the relationships between the variables should be modeled and the statistics and information of the variables should be included in the equations. The variables of this research are classified into two categories: quantitative and qualitative variables, statistics and information of quantitative variables such as exchange rate, export rate, etc. based on the latest statistics and information published in the Central Bank, Statistics Center of Iran, Ministry of Economic Affairs and Assets, publications, etc. have been collected. The coefficients related to qualitative variables have been collected based on the information of a questionnaire from experts (university professors, exporters, etc.)

- **Simulation**

There are many definitions of simulation. According to ICAF's definition, using a model to gain experience instead of reality is called simulation. In other words, models represent the real system and simulate imitation or exchange of reality using the model. According to Shannon's definition, simulation is the process of designing a model of a real system and conducting experiments with this model with the aim of realizing the behavior of the system or evaluating various strategies for system operation. In this definition, simulation involves modeling and using the model. (Sharafat and Moshrafi, 2011) Simulation of a model is used to analyze the effects of decisions on a system or to predict the future behavior of systems. With the help of simulation, real-world issues can be experienced in the virtual world, without the

costs and waste of real-time being limited, and experiments can be repeated under different circumstances to examine different policies. (samadi and eydizadeh, 2013) The main infrastructure of system dynamics modeling is based on quantitative differential equations and the mentioned symbols are the only tools to simplify the development of mathematical models. To calculate the integral in the system dynamics analysis, the multi-point Uller integration method is used. Of course, Oller's integration method is more practical due to its greater flexibility in using mathematical and conditional functions, and the technique of integrating the present study is based on this method. The method of integrating Uller is as follows.

$$\int_{t}^{t\times\Delta T} I(x)dx = DT.I(t) + \frac{DT^2}{2}I'(\mu)$$

$$t \leq \mu \leq t \times \Delta T$$

Since the function I (t × ΔT) is usually unknown and is not available for calculating ∫_t ^ (t × ΔT) I (x) dx, this type of integral is designed to solve numerical differential equations. . In the above statement, ΔT is the time step for performing calculations and some time between time intervals. (Sharafat and Moshrafi, 2011) The main reason for using the system dynamics modeling method to simulate the products of Iran's food industry is to consider the continuous interaction of all sub-sectors simultaneously with each other. On the other hand, the system dynamics method provides extensive capabilities for the sensitivity test. It is easy to analyze the estimated values of the variables in the system. Simulation of variables in the current dynamic system begins with basic simulation. Base simulation is a situation where there is no change in the condition of the model variables. In fact, the basic simulation shows the basic behaviors of the model variables using the initial values given to it. While in simulation with different scenarios, the behavior of the model variables is examined when the situation changes.

The following are some of the assumptions made in the simulation of Iranian food industry products:

1- The simulation period is 216 months (from 1396-1414)

2. The time and storage step in this model is 0.125.

3. The type of integration in this simulation is the Oler integration, and the time for simulation is considered on a monthly basis.

4. All statistics and information used in this simulation are taken from reliable sources and references.

Some of the most important equations used in the model are:

Policies= (Customs policies+Export subsidy+Production policies+Tax Policies+WTO policies)/5

Effectiveness of government policies=SIMULTANEOUS((policies/factors),0.05)

Competitiveness Indicators= INTEG (rate of competitiveness indicator, 4.27)

Rate of competitiveness indicator= (Business Enhancement + Efficiency of the commodity market + Excellent education + Financial market development + Health and education + Infrastructure + Innovation + Institutions + Labor market performance + macroeconomic + size of market + Technological alignment)/ 12

Business environment= INTEG (rate of business environment,56.48)

rate of business environment= (Bankruptcy + "Cross-border trade" + Execution of contracts + Getting credit + Obtaining building permits + paying tax + Power access + Registration of ownership + Start a business + "Supporting micro-investors")/10

internal factors= INTEG (rate of internal factors,0.4)

rate of internal factors=(Advertising + Bank facilities and subsidies + Design and Packaging Products + Human Resource Management + "investing in R&D-I" + Management Features + Marketing + Raw materials and machinery + size of company+Standards)/10

saction=country's share of crude oil exports + Foreign direct investment + Prices index of imported consumer goods + The price index of imported capital goods

and……

IV. Simulation Results

In this study, the simulation period was 18 years (1394-1414) and the repetition period was 0.125. In other words, simulation has been performed for 72 seasons and for all level variables and some auxiliary variables that needed initial values, the values of 1396 were considered. However, for all rate variables and other auxiliary variables in the model, the results of the estimate and the questionnaire mentioned earlier were used. In the following, the results of solving the basic model and simulation are presented in the form of various scenarios.

The results of simulation of the designed model show that with the continuation of the current situation, the export of food industry products will increase from 2.2 billion $ in the base year of 1396 to 3.8 billion$ in the last year of the simulation (1414).

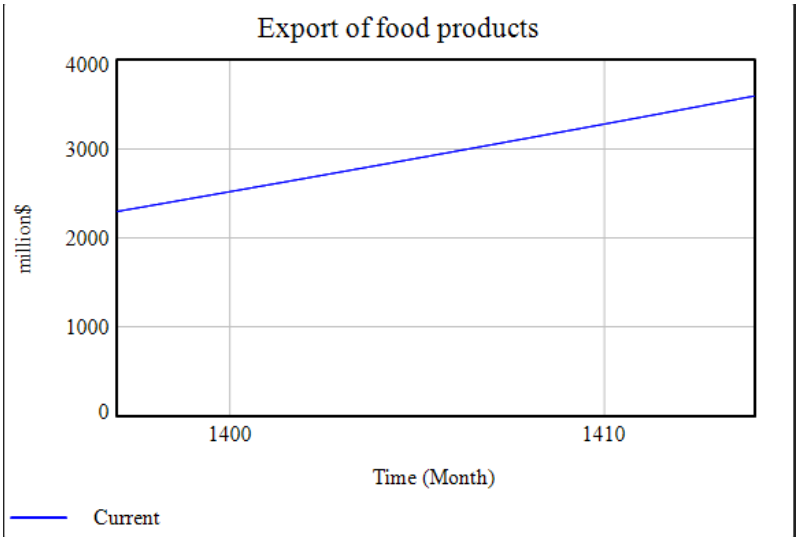

Figure 3- Simulation of the export of food industry products in the basic model

If the government's supportive policies improved (tax, production, export subsidies, global trade policies, etc), the export of food industry products will increase by 1.2 billion$ compared to the base model at the end of the simulation year. In other words, improving government policies will make the export of food industry products reach 5 billion $ by the end of the simulation year (1414).

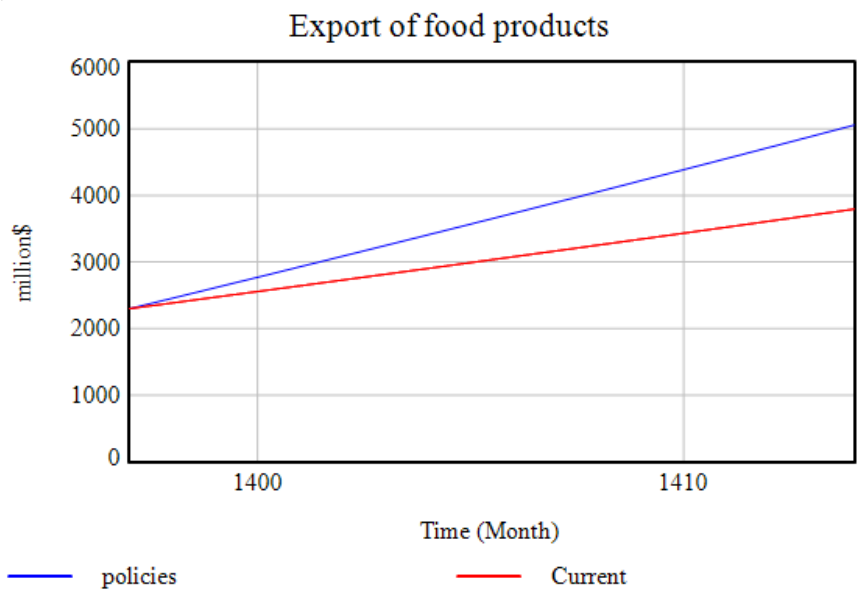

Figure 4- The results of simulating the export of food industry products, taking into account government support policies

The variable of efficiency of government policies is also considered as a factor in this research. If it is assumed that the efficiency index of government policies in 1400 changes behavior and takes an upward trend, the export of Iranian food products will be established from 3.6 in the final year of simulation in the system dynamics model to 5.3 in the final year of simulation in The system dynamics-Agent base model.

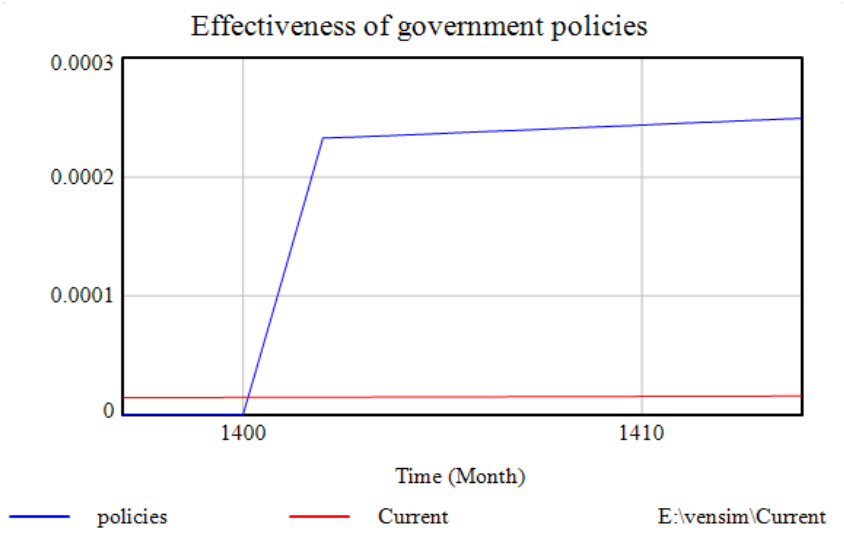

Figure 5- The results of System Dynamics-Agent based model in government policy efficiency variables

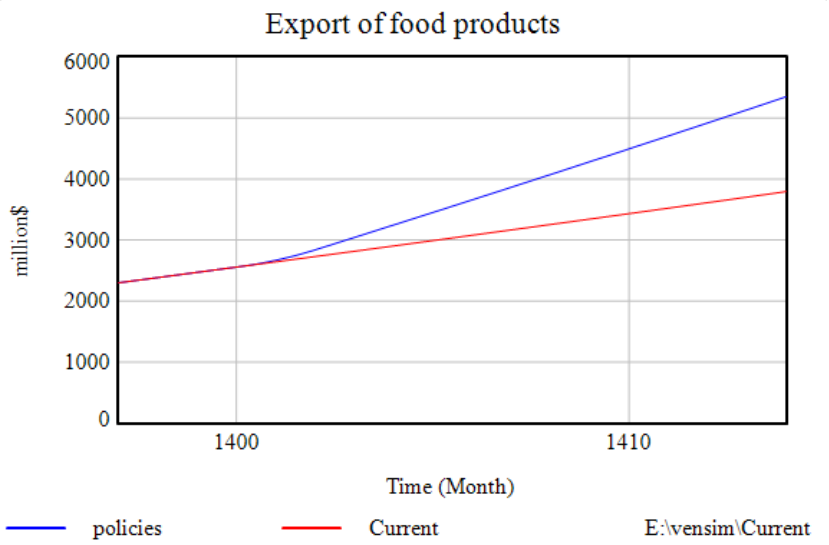

Figure 6- The results of simulating the export of food industry products by using system dynamics-Agent base model

V. Conclusion

Export of agricultural products has a major role in non-oil exports and the export of this sector is more stable than other sectors. Therefore, relying on the agricultural sector and the development and expansion of exports in this sector can provide a suitable condition for the country's presence in global markets and use its benefits. In this study, the possibility of increasing the export of the country's food industry products by designing a dynamic model that can be simulated for the export of Iranian food industry products as a system consisting of effective factors and variables was studied. The results of the research showed that by the continuation of the current situation (without changing the situation), the export of food industry products will increase from $ 2.2 billion in 1396 to $ 3.8 billion in 1414, which is not a significant number. Following the scenario, it was assumed that if the government's supportive policies on the export of food industry products (such as tax, consumer, production, customs, etc.) improve, the amount of exports of food industry products by applying these conditions to the extent $ 1.2 billion will increase to $ 5 billion at the end of the simulation year compared to the base model, The variable of efficiency of government policies is also considered as a factor in this research. If it is assumed that the efficiency index of government policies in 1400 changes behavior and takes an upward trend, the export of Iranian food products will be established from 3.6 in the final year of simulation in the system dynamics model to 5.3 in the final year of simulation in The system dynamics-Agent base model.

VI. Aknowlegment

The present article is extracted from a doctoral dissertation by Mr. Shahram Eidizadeh, with the guidance of Dr. Hossein Mohammadi and Dr. Mohammad Reza Kohansal, entitled "Modeling of Exports of Iranian Food Products Products in the Framework of Bayesian Random-Dynamic Operating System to Horizon 1404".

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