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Original Research

Determinants and Outcomes of Ecological Behaviors of Young Consumers in Iran

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Abstract

Ecological behavior is defined as actions which contribute towards environmental preservation and/or conservation. Owing to an increasing awareness in environmental crises, consumers are more sensitive towards green products when making their purchasing decisions. The young generation seems to have a different attitude and belief which enables them to reflect on their choice of green products. The aim of this study is to investigating the determinants and outcomes of ecological behaviors of young consumers in Iran. The population of this study consisted of all students of the main universities of Ardabil city in Iran including University of Mohaghegh Ardabili, Islamic Azad University of Ardabil, New Novin Institution of Higher Education and Moghadas Ardabili Institution of Higher Education. According to the unlimited population, the sample size was determined 379 based on the Morgan table, that using non-probability sampling method was selected. Standard questionnaires have been used to measure the research variables. Smart PLS software was used for data analysis. According to the results, environmental knowledge, healthy food and healthy lifestyle have a positive effect on the ecological behaviors of the consumers. Moreover, ecological behaviors of the consumers have a positive effect on green purchase behavior and green purchase intention. This research is one of the few studies that has been conducted on green consumer behavior in developing countries and can provide practical implications for promoting such behaviors in the society.

Keywords: Ecological Behavior, Environmental Knowledge, Healthy Food, Healthy Lifestyle, Green Purchase Behavior, Green Purchase Intention.

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Introduction

There have been many claims during the last decades that environmental problems in overall bring forward a constantly worsening ecological crisis (Tilikidou & Delistavrou, 2008) The marketing principles known as green marketing e.g., (Stavros P, Michael , Robert , & Markos H. , 1999); (McDonagh & Clark, 1995); (Ottman, Stafford, & Hartman, 2006); (Peattie & Charter, 1997); (Peattie & Crane, Green marketing: legend, myth, farce or prophesy?, 2005) have evolved over recent decades and will continue to do so as a large number of consumers worldwide become more concerned about the importance of protecting the natural environment (Álvarez-González, López-Miguens, & Caba, 2014).

Ecological behavior of consumer is related to the sensitivity of the consumer, the vigilance, and the responsiveness of consumers towards ecological concerns, environmental forces and ecologically healthy products, such as healthy food. Responsible businesses and organizations play their outstanding role through producing, improving, packaging and delivering products in a way that does not harm humans and the natural environment (Smith & Paladino, 2010) . The factors determining ecological behavior of consumers can be as follows: 1) Environmental knowledge 2) Healthy food and 3) healthy lifestyle (Fryxel, 2003)

Green purchasing refers to the purchase of environmentally friendly products and avoiding products that harm the environment. (Chan R. Y., 2001) Green purchasing is most often measured as green purchase intention and behavior. Green purchase intention is related to an individual's inclination to buy and use products with eco-friendly features when purchase considerations are based on the product features and source country of the product (Joshi & Rahman, 2015) Green purchase behavior represents a complex form of ethical decision-making behavior and is considered a type of socially responsible behavior. As a socially responsible consumer, the green consumer "takes into account the public consequences of his or her private consumption and attempts to use his or her purchasing power to bring about social change" (Mostafa, 2007).

Environmental pollution resulting from human production and human consumption is one of the issues that has been widely reported by active organizations in this area as a threat to humankind. In this regard, some industries have taken measures to reduce the final impacts they might have on the environmental. Like many countries in the world, Iran also suffers from high levels of air pollution, low water quality, high levels of traffic-based noise pollution, high rates of non-recoverable waste and rapid reduction of energy supplies. Environmental problems are mainly caused by maladaptive consumption and unstable activities. Changing one's lifestyle and consumption habits, one can participate in the elimination of this issue. The Iranian government can adopt different strategies to encourage sustainable consumption and develop green behavior. Given the increasing environmental issues and the adverse effects of consumerism on the physical and mental health of humans, it is inevitable to consider green products (Hamdi & Karim , 1390)

The young generation has a considerably different concept and attitude comparing to other generations. They tend to react more flexibly than others, and enjoy collaboration

and innovation fosters their consideration of society. Young buyers tend to search for more information before making an actual purchase. Moreover, they do not only consider the present, but are also concerned about the future effect of their present actions, preferring to become lifelong customers of the green market (Kanchanapibul, Lacka, Wang, & Chan, 2014) As such, the aim of this study is to investigate the determinants and consequences of ecological behaviors of young Iranian consumers.

Literature review

Ecological behavior

Green marketing is defined as "the effort by a company to design, promote, price and distribute products in a manner which promotes environmental protection" (Suki, Suki, & Azman, 2016). The literature contains numerous proposed definitions for green marketing, the most widely-used one being suggested by Peattie (1995), who defines it as "the holistic management process responsible for identifying, anticipating and satisfying the needs of customers and society, in a profitable and sustainable way". This new way of understanding marketing implies incorporating environmental aspects into proposals and decisions related with the product design and production process, pricing, the type of communication conducted in relation with these products, and distribution policies in the target markets (Wells, 2012) The purchase of green products is one of the items in the environmentally friendly behavior scale. However, researchers have not yet ascertained how environmentally friendly behavior could be related to the purchase behavior. Practically, if people behave more environmentally friendly, they should buy more environmentally friendly products as well (Liobikiene, Grincevičienė, & Bernatoniene, 2017) Ecological Behavior is defined as "actions which contribute towards environmental preservation and/or conservation" (Chan, Hon, Chan, & Okumus, 2014)

From early 1990s, the ecological marketing research – reflecting the mounting of public concerns – began to expand (Schlegelmilch, Bohlen, & Diamantopoulos, 1996). During the 1970s, pro-environmental consumers were being understood as ecologically concerned consumers while in the 1990s they were renamed to ecologically conscious (not just concerned) consumers. After 2000, the main research direction was to examine not only concerns but actual behaviors, mostly pro-environmental purchasing behavior. In fact, there are very few researchers, who investigated other behaviors besides green buying, for example, non-purchasing behaviors (Tilikidou & Delistavrou, 2008). The analysis of the ecological behavior concept includes different approaches. Some researchers studied it as the level of environmental responsibility (Stavros P, Michael, Robert, & Markos H., 1999) and as the level of ecological awareness. Likewise, more recent studies have analysed the consumers' environmental commitment degree considering their active or passive contribution to the environmental improvement. Moreover, some other works assess the consumer's commitment through their active and positive attitude towards recycling and towards the purchase of less polluting products (Fraj-Andrés & Martínez-Salinas, 2007)

Among the determinants of ecological behavior of consumers three factors can be referred: 1) Environmental knowledge; 2) Healthy food and 3) Healthy lifestyle (Fryxel, 2003). Each one of these factors will be described in continue.

Environment knowledge

Environmental knowledge has become one of the most important intangible assets for organizations in the current competitive environment. Environmental knowledge can be defined as the degree to which an individual or organization becomes aware of and concerned with ecological issues (Martinez-Martinez & Cegarra-Navarro, 2015). Environmental knowledge is defined as "a general knowledge of facts, concepts and relationships concerning the natural environment and its major ecosystems" (Fryxel, 2003). It represents the state of knowledge or what customers know about the environment, awareness of the environment problems, emotional involvement in environmental issues, and consequences of human actions on the environment. Additionally, it involves customers' holistic views of the ecological system as well as awareness of responsibilities towards sustainable environmental development (Goh & Balaji, 2016). Today, environmental knowledge is not only an ideology but also an important issue in market competition which influences consumer behavior (Nakhaei & Khayeri, 2012). Previous Studies in this area have examined different factors that influence one's ecological behavior, such as environmental knowledge. In this regard, Kaplan (1991) Argued that the state of one's knowledge about an issue influences one's decision making significantly. Generally, People tend to keep away from situations where there is not enough knowledge to guide their behavior, and situations where the possibility of uncertainty is greater. Amyx et al. (1994) Stated that people who are extremely knowledgeable about environmental issues are more eager to pay extra money to buy environmentally friendly products (Chan, Hon, Chan, & Okumus, 2014). Existing research studies suggest that environmental knowledge plays a key role in the customers' decision to purchase green products. This has been supported by (Mostafa, 2007) and (Bamberg & Möser, 2007), who emphasized the role of knowledge in determining the customers' attitude and intentions towards organic Products and pro-environmental behaviors. (Smith & Paladino, 2010) found that environmental knowledge will enhance the customers' positive attitudes and intentions towards organic produce. (Paul & Rana, 2012). demonstrated that demographics, health benefits, and availability increase the ecological awareness of customers, which in turn positively influence the purchase intentions and satisfaction from organic food. (Suki N. M., 2013). concluded that environmental knowledge significantly impacted young customers' ecological behaviors such as recycling and purchasing organic food. More recently, (Chang & Wu, 2015) showed that environmental knowledge impacts the message framing of the green advertisements in influencing the customers' pro-environmental behaviors. These studies indicate that customers' environmental knowledge enables them to differentiate the attributes of environmentally friendly products from conventional products and this leads to the formation of positive, favorable attitudes towards the green products (Goh & Balaji, 2016). Recent decades have witnessed a dramatic increase in environmental awareness around the world, and behavioral literature suggests that there is a positive relationship between knowledge and behavior (Chan R. Y., 2001). In addition, many studies have shown that environmental awareness and knowledge is directly related to many consumer behaviors (Barber, Taylor, & Strick, 2009). Increased environmental awareness has a profound effect on consumer behavior and the expansion of the green products market (Schlegelmilch , Bohlen, & Diamantopoulos , 1996). A large number of customers show their increased environmental awareness and their preferences for green company products through their

willingness for green purchase intention and paying more for environmentally friendly products and services (Kamalipourazad, Sharifi, Maivan, Behmanesh, & Chashmi, 2016). Additionally, existing theories in this regard show that consumers who are aware of environmental problems are more likely to have intention for green purchase (D'Souza, Taghian, & Khosla, 2007). Thus, the first hypothesis is as follows:

H1: Environmental knowledge affects young consumer ecological behaviors.

Healthy food

Healthy food normalizes the biological body, physiological functions or maintains the well-being of human bodies (Suki N. M., 2013). Inappropriate nutrition plays an important role in the development of non-communicable diseases (Variyan JN, 1998). As has been shown, some dietary patterns are associated with 4 out of 10 death causes (cardiovascular disease, certain types of cancers, stroke, and type 2 diabetes). A healthy diet plays an important role in reducing the risk factors of non-communicable diseases such as obesity, hypertension and hypercholesterolemia (Mirmiran, Azadbakht, & Esmailzadeh, 2004). Ahmad and Juhdi (2008) noted that perception towards organic food affects consumers' pro-environmental behavior (Suki N. M., 2013). Thus, the second hypothesis is as follows:

H2: Healthy food affects young consumers' ecological behaviors.

Healthy lifestyle

Lifestyle can be interpreted as a set of behaviors that one uses to not only take into account his current needs, but also envisage the particular narrative he chooses for his personal identity (Rahmat Abadi & Aghabakhshi, 2006). Lifestyle as an important component is closely related to different aspects of health, including quality of life (Feizi, Aliyari, & Roohafza, 2012); so that, marketing people's way of life, their individual and social successes can be evaluated in their lives (Cockerham, 2005). Way of life has two positive and negative aspects (healthy and risky aspects). Many studies have shown that those who choose a healthy way of life have less risky behaviors. Cockerham defines a healthy way of life as follows: way of life refers to collective patterns of healthy behaviors which are based on people's choices and according to their position of life. Activities such as alcohol use, smoking, fasten seat belts, etc. can strengthen or weaken the position of a person's life. In other words, a healthy way of life is a collection of choices by people that fit their positions of life. These choices affect health-related behaviors (Cockerham W. C., 1997). Previous research (Wertenbroch, 1998) noted that restrained eaters make a choice to purchase small packaged foods at a premium price to help them reduce caloric intake in order to have a healthy way of life. Catoi et al. (2010) confirmed that price fairness in business practices has a direct influence on perceived value and on buying intentions (Suki N. M., 2013). Thus, the third hypothesis is as follows:

H3: A healthy way of life affects young consumers' ecological behaviors.

Green purchase behavior

Green purchase behavior of consumer refers to a behavior by which the consumer is looking for products that do not have a detrimental effect on the health of the environment and society and the materials used in the production of these products are environmentally friendly. Consumers with environmental concerns purchase products and services they think have a positive (or less negative) effect on the environment. Green purchase behavior involves endeavor to save energy and refuse to buy products with inappropriate packaging. These behaviors include buying standard sprays, purchasing drinks in biodegradable containers, purchasing and consuming products made from recyclable plastic and paper, energy-efficient light bulbs and detergents made of eco-friendly materials (Maroofi, Sadeghi, & Mojoodi, 2011). Other green behaviors include the purchase of products made of or packed with recyclable materials and the purchase of products with refillable packaging (Mohammadian & Khataei, 2011). Green purchase behavior refers to products that are environmentally friendly, useful, recyclable or protected, and responsive and sensitive to environmental concerns (Mostafa, 2007). In a study, Boztepe (2012) concluded that environmental awareness, green product features, green promotion, and green price have a positive impact on consumer purchase behavior. In an attempt to explain consumer green purchase behavior, previous studies have focused on describing the underlying values, attitude and behavioral intentions toward environmentally friendly products (Davies, Foxall, & Pallister, 2002); (Vermeir & Verbeke, 2006); (Wheale & Hinton, 2007); (Joshi & Rahman, 2015)). (Mas'od & Chin, 2014) concluded in their research that consumer ecological behaviors have a positive impact on the behavior of purchasing green products. Thus, the fourth hypothesis is as follows:

H4: Consumer ecological behaviors affect the behavior of purchasing green products.

Green purchase intention

Consumers choose products based on a combination of product features that best meet their needs in terms of value, cost, and satisfaction. It is important for green customers that their money does not boost, promote, or support a normal and non-green product; doing so, they protect the environment and develop renewable resources. Green purchase intention has been defined in different ways. Green purchase intention refers to the desire of a person to prefer a product with favorable environmental characteristics to an ordinary product. In purchasing based on the theory of rational action, the only major factor before a real behavior is the intention or willingness of an individual to perform a job or behavior through which it is possible to predict real behavior at a very high level (Abbasi, Enayati, & Leadership, 2011). (Rashid, Jusoff, & Kassim, 2009) defined green purchase intention as the probability and the willingness of individuals in their purchase consideration to give preference to green products compared to conventional products. The green purchase intention is described as a distinct kind of environmentally friendly behavior that individuals perform to express their concern to the environment. Furthermore, green purchase intention is confirmed as a proxy for the actual green purchase behavior and an accurate measure of future sales compared to other sales forecasting tools. Thus, since purchase intention finally leads to purchase behavior, Follows and Jobber (2000) have recommended it as a main predictive component (Chekima, Wafa,

Igau, Chekima, & Sondoh, 2016) A green consumer is individual consumer who links their purchasing behavior towards acts that will preserve Mother Nature. Green purchase intention refers to consumers' willingness to purchase green products; intentions capture the motivational factors that influence green purchase behavior of consumers (Joshi & Rahman, 2015). However, majority of the studies observed a weak relationship between the expressed positive attitude of consumers toward purchasing green products and their actual purchase behavior, generally referred to as the attitude–behavior gap (Tanner & Wölfling Kast, 2003); (Vermeir & Verbeke, Sustainable food consumption among young adults in Belgium: Theory of planned behaviour and the role of confidence and values., 2008); (Webster Jr, 1975); (Wheale & Hinton, 2007); (Joshi & Rahman, 2015)). (Smith & Paladino, 2010) concluded that not only the individual effects of a product, but also environmental outcomes of it, are effective in the prediction of purchasing green products. (Hamdi, K; Ghafarirs, A, 1390) concluded in their study that green products are more prevalent among young Tehrani consumers. They showed that factors such as social effects, environmental attitude, environmental concern, understanding the importance of environmental issues, individuals' perception of social responsibility, understanding the effectiveness of environmental behavior, and individuals' concerns about personal perception have effect on the green purchase intention of young people. (Mas'od & Chin, 2014) concluded in their research that consumer ecological behaviors had an impact on the intention of purchasing green products. Thus, the fifth hypothesis is as follows:

H5: Consumer ecological behaviors affect the intention of purchasing green products.

Given the effect of the variables of environmental knowledge, healthy food, and healthy way of life on informed environmental consumer behavior and the effect of this variable on GPB and GPI, the model of the current research, based on the research of (Suki N. M., 2013) and (Mas'od & Chin, 2014), is illustrated below. Figure 1 shows the conceptual model of the research.

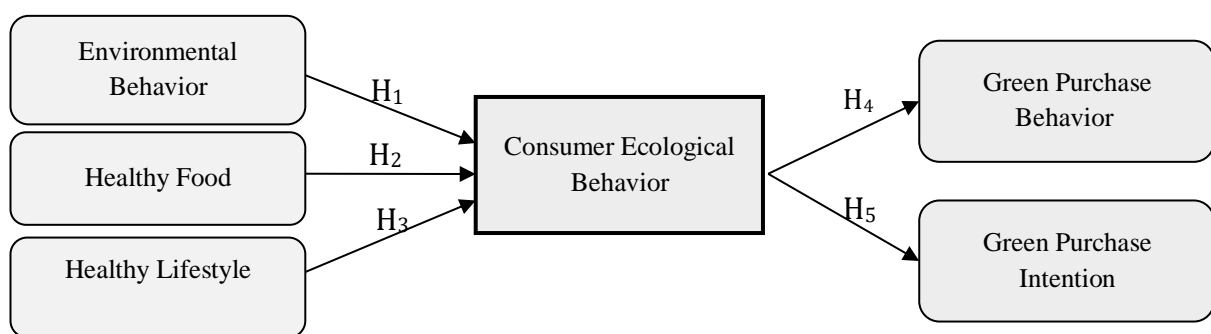


Figure 1. Conceptual Model of the Research (Suki N. M., 2013); (Mas'od & Chin, 2014))

Methodology

Since this research describes and studies what is present, it is a descriptive-survey research. In other words, in this research the researcher tries to analyze events and occurrences as they are, without any interference or conclusion. Moreover, since the

present research is aimed at solving a problem and its results can be used practically, it is an applied one.

Population and sampling

The statistical population of this research consisted of young consumers in Ardabil city as one of the metropolises in Iran. Studies show that young people often reflect their powerful consumer innovations on others. Moreover, consumer innovation, in addition to education, age, and income, is also related to factors such as culture, values, and customer personality (Lao, 2014). Students of the main universities of Ardabil including University of Mohaghegh Ardabili, Islamic Azad University of Ardabil, Ardabil New non-profit institution of higher education and Moghaddas Ardabili University were used as the sample of the study. It should be noted that a large number of the young population of Ardebil are studying at these universities and thus they are a good place for the easy access to young people. The sample size was determined using the Morgan table. When it is impossible to use statistical formulas to estimate sample size, the Morgan table is used to determine the maximum number of a sample. In addition, when the variance of the statistical population is not clear, this table can be used to estimate the sample size (Krejcie & Morgan, 1970). Given that the total number of students at the mentioned universities was approximately 30,000 (15,000 from Islamic Azad University of Ardabil, 10,000 from University of Mohaghegh Ardabili, 2000 from Moghaddas Ardabili University and 3000 from Ardabil New non-profit institution of higher education), using Morgan's table, the sample size was finally determined to be 379 subjects. Convenience sampling method was used to select the respondents. This means that through several visits to different faculties of selected universities in the city of Ardabil, a team of researchers asked students who were available and willing to cooperate in the study to answer the questions of the questionnaire. Accordingly, 379 questionnaires were distributed.

Variables measurement

In this research, data collection was done using library and field methods. In the first step, library method was used to study the theoretical literature and experimental background of the research; that is, referring to scientific resources, especially international databases, studies related to the subject of the research were identified and theoretical and empirical framework of the research was formulated. In the second step, to complete the questionnaires to collect the required data, field method was used.

The questionnaire used in this research had three parts. The first part contained some of the most important demographic characteristics of age, gender, marital status, educational level and income; the second part included 2 questions to measure environmental knowledge using the standard questionnaires of (Suki N. M., 2013), 5 questions to measure healthy food using the standard questionnaires of (Suki N. M., 2013), 4 questions to measure healthy ways of life using the standard questionnaires of (Suki N. M., 2013), 3 questions for measuring the goal of purchasing green products using the standard questionnaire of (Chan R. Y., 2001), 3 questions for measuring the behavior of purchasing green products using the standard questionnaire of (Chan R. Y., 2001), 29 questions for measuring conscious consumer behavior using the standard questionnaire

of (Straughan & Roberts, 1999). All the variables were in the domain of "totally agree," "agree," "no idea," "disagree," "totally disagree". As such, respondents were asked to answer the questionnaire questions by selecting one of five-point Likert scale options. Table 1 shows the combination of questions and the resources used for developing a standard questionnaire.

Table 1. Combination of the questions and resources of the questionnaire

Variable	Number of questions	Resource
Environmental knowledge	2	(Suki N. M., 2013))
Healthy food	5	(Suki N. M., 2013))
Healthy way of life	4	(Suki N. M., 2013))
Green purchasing intention	3	(Chan R. Y., 2001)
Green purchasing behavior	3	(Chan R. Y., 2001)
Environmental conscious behavior of consumer	29	(Straughan & Roberts, 1999)

Data analysis methods

For data analysis, in the first step, normal distribution of data was examined based on Kolmogorov-Smirnov test (Bruce, Green, & Georgeson, 2003) Kolmogorov-Smirnov test is non-parametric statistical tests. Moreover, for the conformation of the distribution, the Kolmogorov-Smirnov test compares the cumulative probabilities of the values in the data set with the cumulative probabilities of the same values in a given theoretical distribution. If the difference between them is large enough, this test will show that the data is not consistent with one of the intended theoretical distributions. In this test, if the decision criterion (significance level) is less than 0.5 the null hypothesis is rejected; that is, the data cannot follow a particular distribution, such as normal, Poisson, exponential, or uniform (Hassani & Silva, 2015).

After determining the distribution of data, in order to test the conceptual model for testing the research model, Partial Least Squares (PLS) and Smart PLS software were used. This method is used for univariate and multivariate regressions. Therefore, it may have several dependent variables. To create a relationship between dependent and independent variables, PLS creates new explanatory (independent) variables. Unlike the covariance-based structural equation modeling, Partial Least Squares (PLS) focus on the highest variance of dependent variables explained by independent variables instead of the re-production of the empirical covariance matrix. Similar to any structural equation modeling, Partial Least Squares model has been composed of a structural part which shows the relationship between the latent variables and a measurement component that reflects how the latent variables are related with their markers. There are various methods for examining the fit of the measurement model; however, the method used in this study

for examining the fit of the measurement model includes three criteria of construct validity, discriminant validity and convergent validity, as well as reliability. Construct validity is a complex concept which requires multi-stage investigation and is evaluated using criterion validity including concurrent validity, predictive validity, distinction validity, and convergence validity. Construct validity refers to the degree of the scale accuracy in measuring the theoretical construct or the intended feature (Ghahramani, Mohammadbeigi, & Mohammadsalehi, 2006). To verify the construct validity of the questionnaire, confirmatory factor analysis was used. To evaluate discriminant validity, discriminant function analysis was used. In this method, there is a primary grouping of subjects, and the purpose of this analysis is to confirm the primary grouping on the basis of other data (Mesrabadi, Jafariyan, & Ostovar, 2013). Finally, convergent validity is a relatively strong correlation between the question and the main variable, and the acceptable value for it should be considered a greater than 0.4 Pearson correlation coefficient (Ghahramani, Mohammadbeigi, & Mohammadsalehi, 2006). After ensuring the proper fit for the measurement model, in the next step, the structural model for examining the relationships between the variables based on the research model and finally the conclusion about confirming or rejecting the hypotheses will be investigated using the partial least squares (PLS) and Smart PLS software.

Results

Demographic characteristics of the respondents

The results of examining the demographic characteristics of the sample members are shown in Table 2.

Table 2. Demographic characteristics of the sample members

Demographic characteristics	Classes	No.	%
Gender	Male	167	43.9
	Female	213	56.1
Marital status	Single	257	67.6
	Married	123	32.4
Age	18 to 22	222	58.4
	22 to 27	87	22.9
	27 to 30	37	9.7
	Above 30	34	8.9
Income level	Under 100\$	35	9.2
	100 to 300\$	210	55.3
	300 to 500\$	99	26.1
	More than 500\$	36	9.5
Education level	Associate degree	104	27.4
	Bachelor's degree	206	54.2
	Master's degree	48	12.6
	Ph.D degree	22	5.8

As Table 2 shows, 77% of the respondents are female and 23% are male. Age of 10% of the respondents is under 30 years old, 48% are between 30 to 40, 35% are between 40 to 50 and 7% are above than 50. In terms of experience, 11% of the respondents have less than 5 years of experience, 32% have between 5 to 10 years of experience, 17% between 10 to 15, and 40% have more than 15 years of experience. In terms of education level, 6% of the respondents have school diplomas, 18% associate degree, 46% bachelor's degree and 30% master's degree and higher.

Then, in order to test the research hypotheses, first, using the Kolmogorov-Smirnov test, the normal distribution of the data was examined. The hypotheses of the research were tested using the structural equation modeling and, finally, the fit index of the whole conceptual model of the research was estimated.

Kolmogorov-Smirnov test

With regard to the claims for data distribution of a quantitative variable, the Kolmogorov-Smirnov test was used. In this test, null hypothesis represents the claim that the data distribution has been normal. Table 3 shows the results of this test.

Table 3. Kolmogorov-Smirnov test

Variable	Mean	Standard deviation	Significance level
Environmental knowledge	3.4013	0.93742	0.000
Healthy food	3.6871	0.72955	0.009
Healthy way of life	3.8816	0.69425	0.000
Green purchase intention	3.6965	0.77277	0.001
Green purchase behavior	3.3671	0.84027	0.000
Environmental Conscious behavior of consumer	3.6821	0.54108	0.288

The results in table 3 show that all variables, except environmental conscious behavior, do not follow the normal distribution; because, the significance level of these variables is less than 5% and the null hypothesis is rejected for them. Therefore, nonparametric methods will be used for data analysis.

Evaluation of construct, discriminant and convergent validities, and reliability

The complete structural equation modeling consists of two components of the measurement model and the structural model. Before entering the test phase of the conceptual model of the research, first, it is necessary to ensure the accuracy of the

measurement model. In the measurement model, the relationship between the latent and observed variables is investigated. There are several methods for checking the fit of the measurement model. But the method that examines the fit of the model of measurement comprehensively involves the use of partial least squares method in which three criteria of construct validity, discriminant validity and convergent validity as well as reliability are used to examine the fit of the measurement. Construct validity refers to the measurability of the research variables by means of the questionnaire's questions, and is tested using confirmatory factor analysis method. In addition to construct validity, the discriminant validity has also been investigated. Discriminant validity means that the items of each construct become appropriately discriminated from other constructs of the model in terms of measurement. This validity is measured using the average variance extracted. The average variance extracted shows the correlation of a construct with its indices and the greater the correlation, the better will be the fit of the model. In addition, reliability was also measured using Cronbach's alpha coefficient. The partial least squares method, compared with the Cronbach's alpha coefficient, offers a more modern criterion called composite reliability, that is, the reliability of the construct is not calculated in absolute terms but in relation to the correlation of constructs with each other. In this research, for the evaluation of the convergent validity, composite reliability index was used (Davari & Rezazadeh, 2013). The results of the evaluation of different variables of validity and reliability are shown in Table 4.

Table 4. The results of construct validity, discriminant validity, convergent validity, and reliability

Latent variable	Observed variable/ question	Factor loadings	t-value	p-value	Average variance extracted (AVE)	Composite reliability (CR)	Cronbach's alpha coefficients
Environmental knowledge	I always update my knowledge about green products.	0.9301	89.4681	<0.05	0.8608	0.9252	0.8383
	I am very interested to know how green products work.	0.9255	75.4551	<0.05			
Healthy food	I control the salt intake.	0.647	15.4197	<0.05	0.5778	0.8203	0.7272
	I try not to eat fast food.	0.7459	24.3057	<0.05			
	I try to use foods without preservatives.	0.6934	18.7677	<0.05			
	I use red meat very moderately.	0.6912	18.5445	<0.05			
	I check my health voluntarily.	0.6747	18.8351	<0.05			

Latent variable	Observed variable/ question	Factor loadings	t-value	p-value	Average variance extracted (AVE)	Composite reliability (CR)	Cronbach's alpha coefficients
Healthy way of life	I try to reduce my stress.	0.7135	19.0697	<0.05	0.5944	0.7957	0.7098
	I often go to the dentist.	0.6277	12.0506	<0.05			
	I try to have a regular and normal life.	0.757	196901	<0.05			
	I try to make a balance between my work and life.	0.7081	16.9748	<0.05			
Green purchase intention	I purchase green products because they have less pollution.	0.8296	38.4525	<0.05	0.7146	0.8825	0.8001
	I prefer green products to other products for ecological (environmental) reasons.	0.8653	42.9605	<0.05			
	When purchasing I give priority to green products.	0.8407	36.5555	<0.05			
Green purchase behavior	I've used green products many times in the past.	0.7876	24.3407	<0.05	0.6718	0.8598	0.7556
	To buy green products, I am ready to pay a large amount.	0.821	30.5562	<0.05			
	Using green products is one of my main priorities.	0.849	45.8742	<0.05			
Environmental Conscious behavior of consumer	I usually purchase products made from recycled materials.	0.5601	12.5204	<0.05	0.5069	0.9261	0.9172
	I usually purchase products made	0.5412	12.5475	<0.05			

Latent variable	Observed variable/ question	Factor loadings	t-value	p-value	Average variance extracted (AVE)	Composite reliability (CR)	Cronbach's alpha coefficients
	from waste paper.						
	To save energy, I try to use my car as less as possible.	0.5383	13.4163	<0.05			
	Because of the lack of confidence in the gasoline produced outside my country, I use my car less.	0.5345	13.2195	<0.05			
	I use recyclable products most of the time.	0.6424	18.0403	<0.05			
	I always try to buy products made from recycled materials.	0.6212	17.5191	<0.05			
	I use low phosphate detergents to wash my clothes.	0.54	12.0484	<0.05			
	I convinced my family members that they would not buy products that are harmful to the environment.	0.5361	13.2106	<0.05			
	Whenever it happens, I buy the products packaged in reusable containers.	0.5158	10.453	<0.05			
	I try to buy only the products that can be recycled.	0.5799	16.7524	<0.05			
	I usually try to decrease my use	0.5803	15.3443	<0.05			

Latent variable	Observed variable/ question	Factor loadings	t-value	p-value	Average variance extracted (AVE)	Composite reliability (CR)	Cronbach's alpha coefficients
	of products made from scarce resources.						
	I do not buy products that have extra packing.	0.5836	19.0581	<0.05			
	I always choose products to buy that have less pollution.	0.5789	16.3858	<0.05			
	If I know about possible damage to the environment that some products can cause, I will not buy those products.	0.5216	13.9587	<0.05			
	Because of some ecological reasons, I have changed my idea about buying previous products.	0.6002	15.219	<0.05			
	I purchase green products as they are less polluting to the environment.	0.5823	18.0607	<0.05			
	Buying products, I always try to buy those products that have less pollution than others.	0.614	16.9112	<0.05			
	I do not buy products in spray containers.	0.5581	14.9673	<0.05			
	When I choose between two similar products, I	0.5925	17.411	<0.05			

Latent variable	Observed variable/ question	Factor loadings	t-value	p-value	Average variance extracted (AVE)	Composite reliability (CR)	Cronbach's alpha coefficients
	always buy the one that is less harmful to the environment.						
	I usually do not buy products of companies that are not responsible for the society.	0.512	12.5715	<0.05			
	I usually buy products with the lowest prices, regardless of their impact on the society.	0.1318	2.0878	<0.05			
	I do not buy household appliances that are harmful to the environment.	0/5023	11/5027	<0.05			
	I try to buy energy-efficient appliances.	0/5787	13/2609	<0.05			
	I usually try not to use electrical appliances (dishwashers, etc.) at peak times.	0/5166	12/0625	<0.05			
	I try to reduce the amount of electricity I use.	0/5803	15/1732	<0.05			
	I buy energy efficient bulbs to save energy.	0/5694	12/3135	<0.05			
	I buy appliances that consume less electricity than other brands.	0/6263	19/07	<0.05			
	I buy bulbs that are more expensive but save more energy.	0/5333	14/3521	<0.05			

Latent variable	Observed variable/ question	Factor loadings	t-value	p-value	Average variance extracted (AVE)	Composite reliability (CR)	Cronbach's alpha coefficients
	I have replaced the house lamps with energy-efficient ones.	0/4947	11/2751	<0.05			

Factor loadings coefficients indicate that the variance between the construct and its indices is greater than the variance of the measurement error of that construct and the reliability of the measurement model is acceptable (Davari & Rezazadeh, 2013). Two values of 0.4 (Hulland, 1999) and 0.5 (Rivard & Huff, 1988) are considered for the acceptance of factor loading. In this study, the standard value for factor loading is considered to be 0.5. The results of Table 3 show that, for all items, the factor loadings values are greater than the standard level of 0.5 and the values of the Student's t-test, at confidence level of 95%, are obtained to be greater than 1.96. Therefore, according to the reported values, the appropriateness of the questions and their ability to measure the variables of the research is confirmed, and it can be claimed that the questions in the research questionnaire have construct validity.

The discriminant validity will be established if the mean value of the variance extracted is greater than the critical value of 0.5. There are also three necessary conditions for the realization of convergent validity which are as follows: 1) the composite reliability value is greater than 0.7; 2) the value of the average variance extracted is greater than 0.5; 3) the composite reliability value is greater than the average variance extracted. If the composite reliability value for each construct is higher than 0.7, it indicates the internal stability for the measurement models, and a value of 0.6 is indicative of the lack of reliability. Finally, experts have considered that the standard value for Cronbach's alpha coefficient is 0.7 (Davari & Rezazadeh, 2013). Thus, according to Table 5 and the standard values for the intended indices, it can be concluded that discriminant validity, convergent validity and reliability there exist for the all variables of environmental knowledge, healthy foods, healthy way of life, green purchase intention, green purchase behavior and environmental conscious behavior of consumer. In general, research measurement models are in a desirable and appropriate situation.

Estimation the conceptual model

Testing the research model was performed using the partial least squares method. Figures 2 and 3 show the research model with the latent and observed variables in the form of reflective measurement models. In this model, the variables of green purchase intention and green purchase behavior are only in the role of dependent variables, environmental conscious behavior of consumer in the role of independent-dependent variable, and the variables of environmental knowledge, healthy food and healthy way of life only as independent variables.

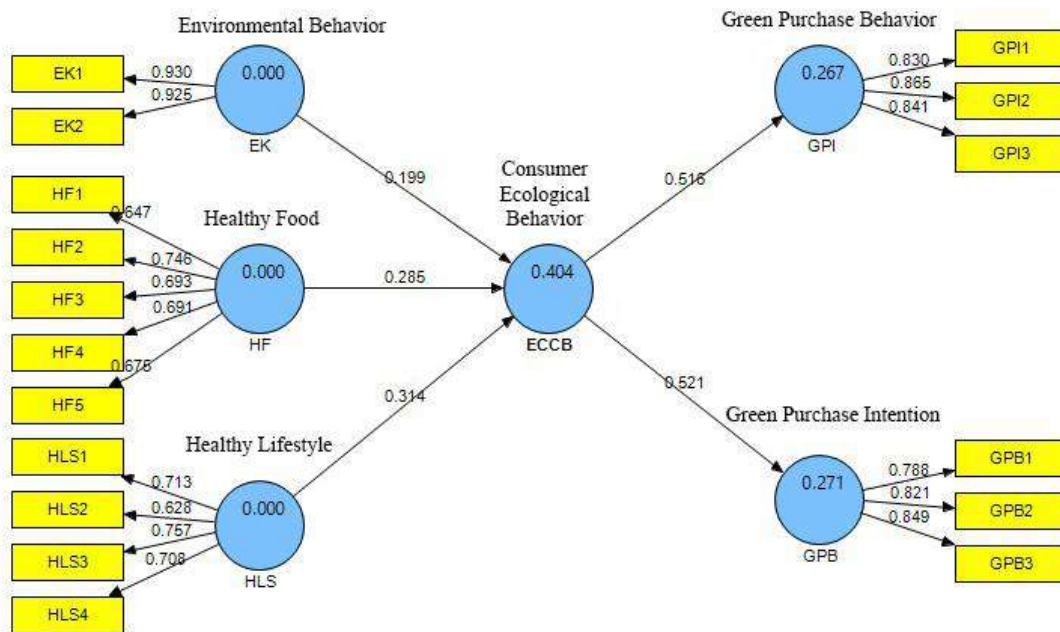


Fig. 2. Path coefficients and the values of the R²

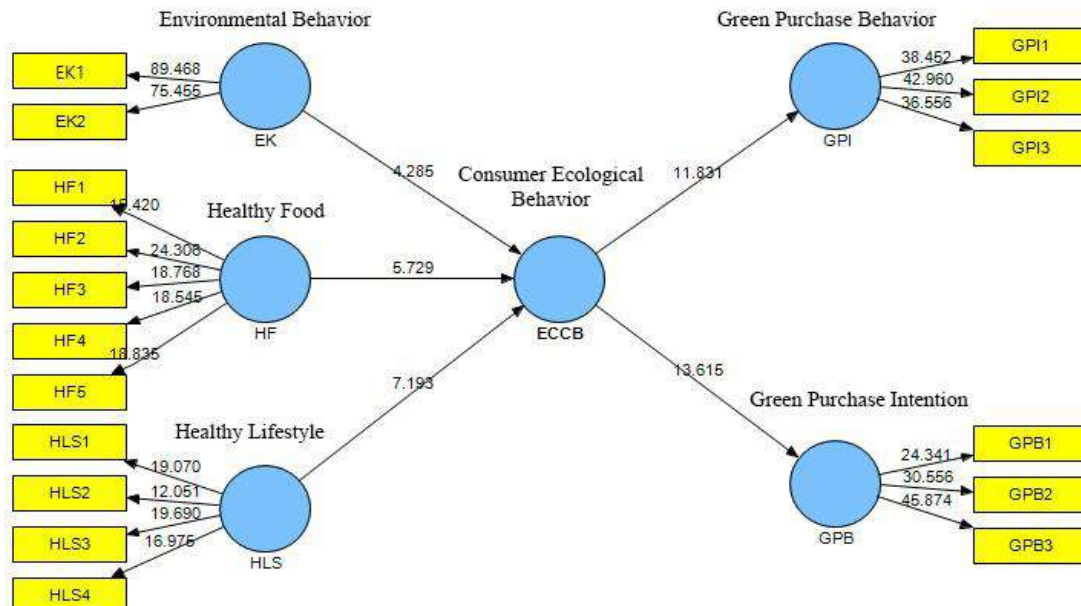


Fig. 3. T values

In the partial least squares method, after examining the fit of the measurement models, the fit of the structural model is examined in the next step. One of the most important criteria for examining the fit of the structural model is the coefficient of determination criterion (R^2). R^2 is a criterion that shows the effect of an exogenous variable on an endogenous one and its value is calculated only for the endogenous constructs of the model. In the case of exogenous constructs, the value of this criterion is zero. Three values of 0.19, 0.33 and 0.67 are considered as the criterion value for weak, moderate and strong R^2 (Gye-Soo, 2016). According to Fig. 1, the value of R^2 for the endogenous variables of the model including green purchase behavior, green purchase intention, environmentally conscious behavior of consumer, environmental knowledge, healthy food, and healthy way of life is equal to 0.217, 0.267, 0.404, 0.0, 0.0 and 0.0 respectively. Therefore, with respect to the criterion values, the model has a relatively good structural fit. Accordingly, 21.7% of green purchase behavior is explained by environmentally conscious behaviors. The variable of environmentally conscious behaviors explains 26.7% of the change in green purchase intention. 40.4% of the variables of environmentally conscious behaviors are related to environmental knowledge, healthy food and healthy way of life. The results of the path coefficients along with the values of the Student's t-value and the significance level are shown in Table 5.

Table 5. The path coefficients of the research model

Hypothesis	Independent variable	Dependent variable	Path coefficient	S.E	t-value	Sig
H1	Environmental knowledge	Environmentally conscious behavior	0/1993	0/0465	4/2855	< 0.05
H2	Healthy food	Environmentally conscious behavior	0/2853	0/0498	5/7288	< 0.05
H3	Healthy way of life	Environmentally conscious behavior	0/3142	0/0437	7/1933	< 0.05
H4	Environmentally conscious behavior	Green purchase behavior	0/5207	0/0382	13/615	< 0.05
H5	Environmentally conscious behavior	Green purchase intention	0/5163	0/0436	11/8308	< 0.05

The results show that environmental knowledge, with the standard error of 0.1993, has a positive and significant effect on the environmentally conscious behavior. Thus, the first hypothesis was confirmed. Healthy food, with the standard error of 0.2853, has a positive and significant effect on the environmentally conscious behavior. Therefore, the second hypothesis was confirmed. Healthy way of life, with the standard error of 0.3142, has a positive and significant effect on the environmentally conscious behavior. Therefore, the third hypothesis was confirmed. Environmentally conscious behavior, with the standard error of 0.5207, has a positive and significant effect on green purchase behavior. Therefore, the fourth hypothesis is confirmed. Moreover, environmentally

conscious behavior, with the standard error of 0.5163, has a positive and significant effect on green purchase intention. Therefore, the fifth hypothesis is confirmed. In a nutshell, based on the results of Table 5, all research hypotheses were approved.

Conclusion, Recommendations, and Limitations

This study aimed at investigating the determinants and consequences of ecological behaviors of young Iranian consumers. In recent years, environmental degradation has raised awareness in society about environmental protection and conservation. Consequently, the concept of "ecological consumers" has appeared along with the need for a clear understanding of the antecedents for their responsible behavior (López-Miguens, González-Vázquez, García-Rodríguez, & Álvarez-González, 2014). Green marketing is part of the key movements in modern business sustainability though their primary concern has always been revenues and profits. Companies focusing on the natural ecological balance in their entire operation are more environmentally friendly while maximizing profits; they reduce environmental pollution, conserve natural resources and protect the environment. (Suki, Suki, & Azman, 2016). A green product is one which satisfies consumers' needs without damaging the environment and contributes towards a more sustainable world. These products are environmentally superior and have low environmental impact. Green products use material safer to the environment, are recyclable and require less packaging (Joshi & Rahman, 2015). Similarly, Bamberg (2003) demonstrated that customers with high environmental concerns are likely to engage in environmental behaviors because of their favorable evaluation and beliefs towards green behaviors. It was observed that customers with high environmental concern were better informed about the green products and green technology, highly conscious about purchasing bad environmental products, and better informed about the reliability and security of green products. Moreover, they exhibited high levels of behavioral beliefs, which have a significant influence on attitude towards environmentally friendly behaviors. Barber, Taylor, and Strick (2009) provide empirical evidence for the mediating role of environmental knowledge (Goh & Balaji, 2016).

Today, environmental knowledge is not only an ideology but also an important issue in market competition, which affects consumer behavior. Environmental knowledge is defined as general knowledge about the facts, concepts and relationships of the natural environment and its ecosystems (Mostafa, 2007). Among the most important variables for predicting human behavior is the individual's knowledge of environmental issues. Knowledge is considered a necessity for the successful pursuit of activities. Knowledge is, in fact, used as a tool to overcome psychological barriers such as ignorance or misinformation. Although knowledge does not always have a direct impact on behavior, it reinforces other mechanisms that facilitate the change of behavior (Fryxel, 2003). Green purchase intention refers to the desire or intention of a person to prefer a product with favorable environmental characteristics to an ordinary product (Abbasi, Enayati, & Leadership, 2011). According to Morison and Netimger (2012), green purchase intention refers to the intention of a buyer for a particular product that is the result of his environmental needs. (Chenl, Woolleyl, Forghamz, & Jones, 2012). Young people will be an imperative target group for each and every industry and in order for every organization to sustain a competitive advantage. This young generation has become a

challenge for businesses because they have greater disposable income and can consider spending it on a variety of products. They are a large powerful target customer group with complex behavioral intentions, outstanding lifestyles and sensational practices for disposable purchases. Furthermore, they are mostly educated and informed well-versed in a sustainable approach. Arguably, there is a strong association between the young generation and their intention to purchase green products (Kanchanapibul, Lacka, Wang, & Chan, 2014).

Therefore, this research investigates the determinants and consequences of ecological behaviors of young Iranian consumers. The analysis of the first hypothesis of the research shows that the values of the path coefficient and t have been 0.1993 and 4.2855 respectively. Therefore, it can be stated that the environmental knowledge variable has a positive effect on the ecological behavior variable. These results are consistent with the results of (Kaplan, 1991); (Schlegelmilch, Bohlen, & Diamantopoulos, 1996), (Mostafa, 2007), (D'Souza, Taghian, & Khosla, 2007), (Barber, Taylor, & Strick, 2009) (Smith & Paladino, 2010), (Suki N. M., 2013), (Chang & Wu, 2015) (Goh & Balaji, 2016) The analysis of the second hypothesis of the research shows that the values of the path coefficient and t have been 0.2853 and 5.7288 respectively. Therefore, it can be said that healthy food variable has a positive effect on the variable of ecological behaviors. These results are in line with the results obtained by (Ahmad & Juhdi, N, 2008), and (Suki N. M., 2013) The analysis of the third hypothesis of the research shows that the values of the path coefficient and t have been 0.3142 and 7.1933 respectively. Therefore, it can be stated that healthy way of life has a positive effect on the variable of ecological behaviors. These results are in line with the research findings of Cocker (Hamdi, K; Ghafarirs, A, 1390), and (Suki N. M., 2013) The analysis of the fourth hypothesis of the research shows that the values of the path coefficient and t have been 0.5207 and 13.615 respectively. Therefore, it can be concluded that the variable of ecological behaviors has a positive effect on the green purchase behavior. These results are in line with the results obtained by (Boztepe, 2012) and (Fryxel, 2003) and (Vermeir & Verbeke, Sustainable food consumption: Exploring the consumer "attitude-behavioral intention" gap, 2006) and (Watson, et al., 2009) and (Joshi & Rahman, 2015) and (Mas'od & Chin, 2014) The analysis of the fifth hypothesis of the research shows that the values of the path coefficient and t have been 0.5163 and 11.8308 respectively. Therefore, it can be said that the environmentally conscious behavior variable has a positive effect on the green purchase intention. These results are consistent with the results of (Mas'od & Chin, 2014). (2009), (Hamdi, K; Ghafarirs, A, 1390).

The demand for ecological products and sustainable business activities has been determined by increasing awareness of consumers about environmental issues and by declaring more stringent laws by national governments, especially in developed industrial countries. On the other hand, various environmental groups, such as the media, monitor the company's compliance with ecological principles closely. Another pressure and awareness in the business environment with regard to the environmental issues is the issue of green marketing. Based on the results of this research, it is suggested that by holding training classes in schools, informing the public in public media, setting up placards with proper slogans about the environment on public roads and creating campaigns will increase the environmental knowledge of individuals. Schools are encouraged to promote the use of healthy diets, as education, through parents and schools, and the content of the

classes, can have a very positive impact on this issue. The officials of the related institutes such as the Physical Education, broadcasting, and healthcare network are recommended to try their best in providing a healthier lifestyle. Manufacturers are encouraged to produce high-quality green products which can compete with ordinary products. Legislators and authorities have to work out programs to maintain natural resources and reduce the environmental consequences of the products which do not comply with the environmental. It is suggested to marketers that through advertising or labeling their products, try to reinforce the issue that the environmental behavior of individuals together with their green purchases is a positive step towards protecting and conserving the environment. Governments, businesses and environmental groups need to demonstrate that environmental problems can be controlled by changes in consumer purchase behavior.

It is suggested to future researchers that the research model used in this research be used in other classes of society, such as employees. It is suggested that a similar research be conducted in other cities to ensure the generalization of the results. It is also suggested that this research be carried out in longer periods of time and also a higher sample size in order to increase the validity of the research results. It is suggested that other dimensions and variables such as the impact of cultural factors, the effect of education and general information, the impact of the culture of the cities be examined.

One of the main limitations of the research was the lack of enough studies at the national and international levels. Another limitation was the low motivation of some respondents in answering the questions. Among other limitations of the research mention may be made of the use of the questionnaire as the only tool for collecting information and not return of all questionnaires, low access to library resources because of limited resources in the university's repositories, the limited scope of the research, which only included the students of the Ardabil city, and the lack of detailed and accurate information of some respondents about green products in answering questions of the questionnaire.

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Original Research

Developing an Agility Model Focusing on Delivering Products to the Customers in the Supply Chain of Perishable Goods

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Abstract

The producer can warehouse the perishable items and reuse them in the production line by creating an appropriate cooperation relationship and sharing information related to demand and stocks in order to provide the field to save money, reduce the environmental population, and use natural resources less. Therefore, it is also necessary to use the concept of the supply chain of perishable items in the supply chain. In this study a new approach will be provided to develop the agility of the supply chain to establish an integrated and agile supply chain to create an informational and operational linking bridge between different sections of the supply chain. Hence, a multi-objective mathematical model will be presented considering the maximization of the level of agility, the minimization of the perishing of goods, minimization of the time of distributing goods by systemizing the retail distribution system and since the agile supply chain model is considered as difficult problems, Epsilon- Constraint method and Benders Exact Solution method will be used to develop this research. Benders method is a decomposition algorithm that creates smaller sections of agility in solving the model by decomposing the mathematical model. First, the model is evaluated, and a problem is designed to assess the performance of the proposed model, and it is solved by using GAMS and CPLEX solver. Then the validity of the provided model is analyzed by the approach of the meta-heuristic algorithm Moka.

Keywords: Agility Model, Supply Chain, Perishable Goods.

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Introduction

The philosophy of supply chain management is to increase the cooperation and improve the communication between the internal sections of organizations, as well as the companies and organizations as the chain loops. The inconsistency and lack of integration are considered as one of the main reasons for the decreased supply chain performance, especially for the core supply chain companies (Horvath, 2001). The agile supply chain is one of the main and important parts of the economy of every country, and its related costs are among the important constitutive costs of the prime cost of final products. Today, due to the more competitive business market, organizations need to decrease some costs, including transportation costs in the goods distribution system and their supply chain, in order to lower the prime cost of final products. Also, the need for systems that can carry out agile transportation operations as efficiently as possible attracts more attention because of a growing trend of civilization and industrialization. Also, according to the reduction of fuel reserves in the world and the growing need for optimizing energy consumption in all organizations, planning transportation is important to reduce energy consumption and costs and also reduce the population, followed by reducing health spending and social problems (Tapia-Ubeda et al., 2018). In addition to mentioned reason, pro-environmental organizations legislate laws based on reducing carbon emissions because of global warming; therefore, reducing the consumption of fossil fuel should be considered as a basic goal, especially in the field of transportation planning, and attract more attention than other goals including the minimization of the total time of transportation (lead time) and mileage (Neves Almeida & Marques, 2021). The mentioned reason causes all organizations all over the world to consider the improvement of their transportation planning as the most important executive program, and accordingly, many researchers study and investigate mentioned problems in this field. One of the most influential components in the supply chain to which paying attention causes agility in the supply chain in the field of retail distribution is the reduction of lead time to costumers. One of the challenges ahead is in lead time to customers recently, which lead in destroying and perishing of products due to latency in delivery lead time also has a key role in the supply chain of perishable products. The delivery of products at an appropriate timing satisfies customers for their purchase of perishable goods, and the development of costumers to the supply chain is stated by the definition of the soft and hard time window of this topic. Therefore, the development of an agile supply chain has a key role in on time delivery, the delivery of high-quality products and customers' satisfaction. According to what mentioned above, new approach will be provided to develop the agility of supply chain in this paper to establish an integrated and agile in supply chain to create information and operational linking bridge between different sections of supply chain. Hence, a multi-objective mathematical model will be presented in this paper considering the maximization the level of agility, the minimization of the perishing of goods, minimization of the time of distributing goods by systemizing the retail distribution system. Therefore, because the agile supply chain model is considered as difficult problems, Epsilon- Constraint method, for assessing the Pareto frontier of optimized responses, and Benders Exact Solution method, because studied supply chain is NP-HARD, will be used to develop this research. As we know, Benders method is a decomposition algorithm which creates smaller sections of agility in solving the model by decomposing the mathematic model.

Literature Review

Mirzabaghi et al. (2021) introduces the problem of sustainable routing of heterogeneous vehicle in a network with direct and reverse flows where different economic, environmental and social factors are considered as a two-objective mixed integer linear programming mathematical model. The aim of the problem is to design serviceability routs and determine transportations' vehicle velocity so that minimizes fuel-consumption rate as well as pollution arising from transportation and, on the other hand, balances the workload of different transportation vehicles in terms of active lead time to satisfy drivers. A comprehensive function has been used to estimate the fuel-consumption rate in which the fuel-consumption rate is a function of departed distance as well as velocity, the amount of load, and technical characteristics of transportation vehicles. The exact form of an augmented constraint method is used to solve the problem and also to solve the problem in large dimensions, and two multi-objective meta-heuristic algorithms based on the Genetic algorithm and Fireworks Algorithm have been developed. The results of solving different examples indicate better performance of the Fireworks algorithm. The analysis of Pareto points also shows that the longest tour can be reduced even up to 20%, and the spread between the working lives of different vehicles can be reduced to 15% by increasing by about 1% of fuel costs. Also, this spread can be reduced to 25% by increasing by about 3% of fuel costs.

Seif Barghi (2020) stated in his research that numerous studies were conducted about touring-locating according to the intense competition of companies for serviceability and intense competition in the global market. The problem of routing-locating with the reduction of pollution produced by vehicles for order fulfillment in multigraph networks and the possibility of comprehensive disturbance has not been seen. Every problem has been investigated separately, and no locating problem with multi-graphs has been seen. In this paper, a new routing-locating model has been introduced, considering the pollution of vehicles in multigraph networks and the possibility of disturbance. In this model, vehicle maneuver depends on the time and traffic conditions. The aimed function is the model of the minimization amount of produced population by vehicles and the reduction of operational costs such as purchasing vehicles, constructing a store, and the salary of drivers according to the duration of travel. The model is provided as Two-Stage Stochastic Optimization to consider disturbance. At the end of the paper, a Genetic algorithm has been used to solve the model on a large scale, and the response and time of solving in exact mode have been compared to assess the accuracy of the meta-heuristic algorithm. According to the results of solving, the model tries to reduce the produced pollution and operational costs simultaneously, such as not constructing warehouses in crowded places and not traveling vehicles in peak traffic time.

Bolvardi et al. (2020) stated that planning business traveling is one of the basic problems for urban planners in developed and even developing countries. The importance of this planning is that this problem deals with three factors, including costs, time, and individuals' security, and also has a high portion in the total travels in peak times. On the other hand, this planning has a direct relationship with the satisfaction degree of employers, and due to this point, planners are going to do it as well as possible. Current research studies the cases of the transportation system of Iranian Butia Steel Company's employers to provide a method for optimizing this system. In this research, the economic

productivity of the plan and the increasing satisfaction of employers are considered the goals of the research. In this research, implementing existing information of transportation systems, developing a mathematical model for locating stations, developing a routing model to determine optimum routes, and finally solving and assessing these models by the employers' information in a sample working shift of the company have been conducted.

Hosein Pour and Bagheri, (2020) inventory routing plan (IRP) is one kind of routing that determines existing strategies and transportation planning simultaneously. We introduce a green inventory routing with a heterogeneous fleet and concerning random demand in which we consider a united supplier and several retailers that the supplier requires to meet the demands of retailers. The problem has a comprehensive goal which is to minimize the costs of routing and the costs of inventory in; which the costs of routing include drivers' salary, fixed costs of vehicles, fuel, and the costs of CO2 emission that the costs of fuel and CO2 emission are determined by loads, speed and the type of vehicle. Two Stage Stochastic Optimization is considered, and the Two-objective problem is solved by the Epsilon Constraint method, and then the numerical example is solved, and the advantages of using the stochastic method are determined.

Etebari and Dashtian (2020) stated that the routing-inventory problem is a useful problem in the field of distributing goods. This problem is the result of integrating two classic problems. The first problem is related to routing, which determines the routes of vehicles' maneuvers between several locations. The next problem is inventory which plans and determines inventory policy according to the maintenance cost and shortage. One of the characteristics of this problem is its dynamics which indicates the intense related decisions to time, and it should be repeated several times according to horizon time. On the other hand, today, using vehicles with electronic fuel and hybrid vehicles has a special position in the green systems of distribution. In this research, we try to compose two above approaches; the problem of routing-inventory is developed by concerning hybrid fleet. In order to do this, first, the mathematical model of the problem of routing-inventory is presented by considering hybrid fleets, and then a large neighborhood search algorithm is used to solve this model on a real scale. GAMS software has been used to investigate the correctness of the presented mathematical model, and the results of the proposed algorithm are compared to the results of the exact method in order to evaluate the algorithm. Then the results of the meta-heuristic algorithm are presented and analyzed for the sample of produced problems. The reported results confirm the appropriate performance of the proposed algorithm. Finally, the Sensitivity analysis is implemented on the parameters of the problem.

Sadat Ghiasi and Etebari (2020) stated that one of the important problems in the management of the supply chain is the problem of routing vehicles and optimizing transportation, and its useful assessment leads to a significant reduction in the costs of distribution. In the current research, a model is proposed to solve the problem of routing heterogeneous vehicles according to the existing situations in some distribution companies concerning sending different kinds of goods to customers, including medical and consuming goods, which considers existing standards of distributions process by separating heterogeneous fleets and accordance with the type of distributing goods. The presented mathematical model in this paper is resulted from the process of distributing

goods in Alborz Distribution Company (distributing company of medical and consuming goods). Moreover, using electronic vehicles is added to it in order to avoid increasing pollution. According to the NP-Hard problem of routing to solve the proposed model on a large scale, the meta-heuristic algorithm of simulated annealing (SA) has been used, and the Taguchi method has been applied to set the parameters of SA up. Then, numerical examples are investigated to show the validity of the mixed integer mathematical model and solving approach. Finally, the trend of changings function of assessing goals and influencing parameters on the management of network costs has been determined by sensitivity analyses on two parameters of the model.

HoseinZade Saljoghi (2020) stated that the obvious presence of different areas of engineering in the transportation field shows its importance as a lifeline. The importance of its other and current aspects is the concern about its environmental consequences. Meanwhile, the Biotechnology approach is lighting for using green vehicles with the ability to repletion of energy sources which makes the environment healthy. The environmental necessitate of using these vehicles, in the time of their comparability to fossil vehicles, is a problem that is solved based on the procedures of improving productivity and efficiency rather than depending on the capability of equipment. Also, this research has been conducted for appropriate routing with energy resources of these vehicles in order to cover the demands of services and continue such an operation and investigate the performance of the method by researchers and sometimes by sampling real cases. Correspondence with the optimized amounts and, of course, the excellence in the number of vehicles and increase in productivity are the consequences of this method.

Nosrati and Arshadi Khamse (2020) provided and solved the problem of integrated vehicles in the situation of the presence of substitute routs and as two-objective. This problem is the development of green vehicle problems. The function of the first goal is the minimization of the total costs of the system and, therefore, the reduction of fuel consumption and the emission of greenhouse gases. The function of the second goal is related to the optimization of the reliability of the whole system. The presence of substitute routes can lead to increasing the quality of responses to this problem. This model originated from a mixed integer nonlinear type. To solve this problem efficiently, the exact method, as well as the multi-objective meta-heuristic algorithm of simulated annealing (SA), has been used. Examples in different scales are constructed and compared to compare the results of these two solving methods. Obtained results show the acceptable ability of the proposed algorithm to solve this problem.

Mousa Zade et al., (2020) stated that the importance of home health care is increasing rapidly because the population of developed societies and even developing countries are getting older, and the number of hospitals, retirement homes, and the staff of medical departments is not increasing by the same amount. Therefore, home health care has become more important. Medical staffs provide concentrated service to different costumers in home health care. Since a combination of routing and timing is often required to provide service, the problems of its optimization are too complicated. In this paper, we try to provide a one-objective mathematical model for routing and timing of vehicles, collecting biological samples in home health care in order to minimize the costs of transportation concerning the special condition and tome of maintaining each biological sample. A case study in the real world has been used to assess the efficiency

of the mathematical model. The results show that the presented mathematical model can calculate the optimum response in small and medium scales in reasoning time duration.

Bastani Katoli and Noudehi (2020) stated that transportation has a significant position in economic systems such as production and service. The routing of vehicles for serviceability to customers is one of the important topics in the last decades and leads in increasing the efficiency and productivity of the transportation system. This problem helps in reducing the consumption of fuel and delivery time duration to the customers, which are important. The routing of vehicles has different types, and the form of the problem changes according to the different limitations. Since this problem is in the group of NP-hard problems, using approximate solutions is appropriate for them. One approximate algorithm is the algorithm of simulated annealing, which is efficient in this type of problem. In this paper, we investigated the function of the algorithm of simulated annealing in different models of vehicles' routing problems. Finally, it is suggested that the routing of vehicles can be solved by integrating the algorithm of simulated annealing with other algorithms.

Mardan, Soltanzadeh, and KamranRad (2019) in his research, has modeled a two-part supply chain including the number of warehouses as the center of distribution and a number of retailers as customers in the form of routing problems along with inventory routing; so that perishable products, which has usable life, are distributed to retailers from their warehouses. Also, expired products are ruined at a cost. Retailors have limited capacity. The problem is modeled based on two-stage stochastic decision models with several scenarios. In the first stage, decisions about the stores are made, and in the second stage, they make decisions about routing. The transportation fleet is homogenous and has a determined capacity. A number of check problems are designed to investigate the influence of some parameters.

Ansari and AkhwanNiaki (2018) stated in their paper that the attempt to achieve sustainable management of the supply chain has new important logistics along with the traditional goal of minimizing costs. The managers and members of supply chains cannot make appropriate decisions because of the constraints and traditional assumptions and sometimes unreal about supply chains, such as the certainty of demands, not perishing goods, and.... Moreover, increasing concerns about the environment, increasing awareness of consumers about health and safety, demands for high-quality products, constraints in natural resources, and ... make the problem of inventory management and routing more complicated and face more challenges. This research provides a model of green inventory management for perishable goods by the seller and routing under demand uncertainty considering the requirements of managers and decision-makers of supply chains for efficient models to make accurate and on-time decisions and existing complications in the problems of novel inventory management in which the routing is conducted in order to minimize the emission of Carbon pollution in two levels by assuming possible demands. In other words, the proposed model of this research introduces a mode according to the assumption of demand uncertainty in which forced costs, such as ordering costs, maintenance, the fuel consumption of vehicles, the salary of drivers, perishing of goods, and shortages, are minimized as well as meet possible demands appropriately.

Hamze Pour et al. (2017) investigated the routing-inventory problem in a three-level supply chain. These three levels are producer, wholesaler, and retailer. The problem of routing-inventory is aimed at minimizing the total costs of the system, including the costs of production, initiation, distribution, shortage, and the maintenance of inventory has been modeled in such a way that the fixed costs of initiation are considered stochastic. The products are delivered to wholesalers and retailers by the same vehicles with limited capacity. Also, production capacity and limited maintenance and shortage are assumed as allowed. The presented mathematical model is a scenario-based stochastic model. It means that the possibility of each scenario occurring is different from another scenario. The initiation cost is different in each scenario. We solved it with Lingo software.

Rabiei and Etebari (2017) stated that the concepts of integrated logistics systems and integrated decision-making become one of the most important aspects of the supply chain. In this paper, a routing model of green multi-warehouse vehicles has been studied, which was for multi-product perishable nutrition products in the distribution network of the cold supply chain, including potential distribution (storage area), costumers and transportation fleet. So, the problem has been formulated as an integer linear programming considering the perishability of products in the process of distribution and using refrigerator-equipped vehicles in order to maintain the freshness by depending on the fuel consumption on the load carried between nodes. In the proposed mathematical model, we try to make the problem closer to the real world by considering the constraints of capacity for warehouses and vehicles, associating the fuel consumption to load carried between nodes and the model has been tested by solving numerical examples in Gam's software.

Pilevar et al. (2017) in his article stated that one of the significant problems in logistics problems and the supply chain of perishable goods is the problem of routing and distribution networks which can reduce costs significantly. Different constraints such as the perishability of goods, expiration date of goods, the capacity of the warehouse, and service constraints to customers make the problem becoming a real-world problem. This paper is a mathematical model to solve dynamic capacitated routing-locating problems with simultaneous delivery and withdrawal, which provides constraints, including perishability of goods that exist in practice that can point out to the distribution system of drinks and foods. The aim of this paper is to choose an appropriate storage area and minimize the total costs of reopening facilities, fixed costs of vehicles, costs of routs of vehicles, assigning costumers to each storage area, and determining the sequence of service routes to costumers. At last, the presentation of a numerical example shows the efficiency and the goals of this article.

Seyyed Hosseini and Mohammadzadeh (2017) state that today, the importance of the management of the supply chain and optimum decision-making in decision-making levels in the chain cannot be ignored. On the other hand, sustainable development based on public awareness, governmental requirements and motivations, and sometimes economic savings, the management of supply chain in management literature has become more important recently. The problem of routing is the main part of distribution activities in industrial chains and has a significant background in research background. The problem of routing has a 50-year background and has developed much over time. On the other hand, a one-level traditional system for distributing goods in towns is in contrast with the requirements of sustainable development. In this research, the problem of two-level

routing has been modeled according to environmental goals along with economic goals as well as the social validity of costumers. The purpose of this research is to present a two-level routing model of the sustainable vehicle based on the novel models of fuel consumption which succeeded in achieving the goals of sustainable development and yet being practical in active industries in the field of practical distribution. The presented results and model in this paper can be used for food industries, automotive industries, and other related industries. Several numerical examples based on valid papers in the literature on the topic have been composed at the end of this paper and are solved to evaluate this model. The results of solving this model show the usability of this model and the rationality of considered assumptions in the two-level routing programming of the supply chain.

Mehranjoo and Behnamian (2017) state that transportation in producing-economic and service systems is important and assigns a significant part of the Gross National Products (GNP) of every country to itself. Because of it, researchers begin to improve routes, omit unnecessary travel or establish short substitute routes. Some topics have been developed in this regard, including traveling salesmen, vehicle routing problem (VRP), and Generally, the routing of facilities are assumed that there is a monopoly in the environment, and there is no attention to the impact of appropriate routing on competence. The routing problem is included in the NP-hard problem. This problem is going to act with mathematical and optimization models so that the traveled distance, total time of travel, the number of vehicles, payment penalty, and finally, the minimized function of transportation costs finally maximize the satisfaction of costumers. Due to the too-difficult structure of the VRP problem, exact algorithms have been rarely used for this problem, but heuristic and meta-heuristic algorithms have been successful in this field. For example, the column generation algorithm can be pointed to as a high-quality algorithm that has been used in this research. Column generation algorithm is the solving method of nonlinear programming for practical programs (with high demands) and rounding to an integer with satisfying results.

Zohrevand and BidhendiMohammadi (2017) presented a routing problem of heterogeneous vehicles with a time window considering the satisfaction of customers in a transitory warehousing system. A heterogeneous fleet of vehicles collects products from suppliers and, after integrating them in the transitory warehouse, delivers them to customers as soon as possible. Each customer has their own time window but tends to take service in a certain time interval of that time window. A mixed integer linear programming model has been presented for the problem, which tends to minimize fixed costs and variables of transportation and the earliness and tardiness of good delivery to costumers as well as appropriate timing of vehicles in order to increase customers' satisfaction. Also, a two-phase genetic meta-heuristic algorithm has been provided to solve this problem. Obtained results confirm that a higher level of customer satisfaction can be achieved by using a proposed approach in comparison with the classic model. Also, obtained numerical results show better performance and efficiency of the proposed algorithm in comparison with the classic genetic and simulated annealing algorithm.

Shen (2020) investigated a closed-loop supply chain network for the production and recovery of button cells under uncertainty. In conducted modeling, the environmental impacts of button cells in designing of supply chain network have been included. Since

there are many uncertainties in real, demand, cost and capacity are considered uncertain variables. Two multi-objective mixed integer programming models under uncertainty, i.e., the expected value model and the Chance-Constrained model, are created to study the influence of this uncertainty on the supply chain network. The purpose of the created model is to reduce numerous environmental impacts on the sum of costs as well as test the positive and negative aspects. A method based on assessing the life cycle to assess the environmental influences in the supply chain network has been presented. These two models can be converted to crisp models by uncertainty theory. In the end, numerical experiments are used to investigate the possibility of proposed models and methods.

Chernonog (2020) studied a two-class supply chain that includes a producer and a retailer and cooperates in the Stackelberg game, which determines the contracts of wholesaling costs for perishable products. Demands for a product depend on the purchasing price, investment in the advertisement, and time duration of not using a product before sale. Investment in advertisement can be conducted by the producer, retailer, or a sharing way. The parties of a policy use the amount of economic order in which the duration of the cycle has been determined by the leader of the supply chain inherently. The decision of parties about pricing, investing in the advertisement, and the duration of the cycle were modeled, and also they investigated how the balance of different forces between parties affected their decisions and other actions of the supply chain balance. They analyzed two cases especially: producer- leader and retailer-leader. For each one, the balance is achieved from demand (One in which the influence of price and advertising on demand are growing (the sum of influences) and the other in which they are the product of influences). The author stated that for a type of determining advertising investment (cooperative/non-cooperative) and determined duration of the cycle, the variable profit of each party is only determined according to their role (leader/follower) and not according to their identity (producer/retailer). This result is valid for formulating the function of advertising costs and demand. It is interesting that the type of advertising investment (cooperative/non-cooperative) depends on a series of decisions, whereas in balance, the cooperation of each party in advertising investment is only determined by its channel of force.

Ashtineh and Pishvae (2019) stated that according to the current and growing trend of environmental concerns, transportation companies face internal and external forces, like other big sections consuming energy, to meet exact regulatory requirements. This study has been conducted to investigate the economic and environmental performance of substitute fuels in vehicle routing problems by measuring and determining the quantity of possible adverse impacts of emitted pollutants on human health and the quality of the ecosystem. Greenhouse gas emissions especially concerning pollutants (for example, NO_x , HC , and CO) and greenhouse gas emissions (for example, CO_2 , N_2O) in production, distribution, and combustion phases, several mixed integer programming models were conducted based on well-analyzed to wheel and wheel to the tank. Beyond factors like distance, load, and speed, the proposed models consider the transmission gear ratio as the main influential factor in traveled distance and greenhouse gas emissions. Several numerical experiments were conducted to investigate the influences in the type of fuel and selecting gear and the intense of pollutants. The results show that although net biodiesel combustion has a negative effect on air quality, more analysis according to the total activities of the fuel chain leads to producing and consuming the product but shows

a reduction of 37% in greenhouse gas production with normal diesel based on measures equal to CO₂.

Bottani et al. (2018) presented routing & locating (R&L) to design reverse logistics channels for food wastes according to the produced wastes in the retailing stage of the food supply chain (FSC). This model is built in Microsoft excel with its application in the Emilia-Romagna region of Italy, which is assessed as a research site for finding substitute ways of food recycling rather than destroying them in landfills. Multiple analyses are conducted by using this model to find some findings related to economic profitability creating a reverse logistics channel for food waste recycling in the target region and leading them to substitute usages. As there is no study that pays attention to investigating the problem of food waste disposal in Italy, this research is expected to show this case in addition to the details of the literature.

Rivera et al., (2016) conducted research in which they studied the problem of multi-travel routing-locating of collective capacities in single-vehicle mode. A vehicle can travel many successful travels to cover a set of under-influence regions and minimize the total time crisis of arriving vehicles by using logistics in a crisis time in this problem. They used two mixed numerical programming with 20 sites in their model, and then considered an exact algorithm for larger cases in the mode of limited resources in the problem of the shortest time between two nodes. The results showed that this problem could be solved by the Bellman-Ford algorithm.

Song and Ko (2016) conducted their research in this field and concluded that: they investigated the problem of transportation vehicle routing, including two types of public transportation vehicles with the refrigerator for multiple perishable food delivery. Also, they assumed that the place and the volume of demand for ordering products are determined for every costumer. However, the maximum capacity of delivery time and the number of both types of vehicles has been determined before. According to their characteristic, a non-linear model and a meta-heuristic algorithm were provided to increase customer satisfaction which has been depend on the freshness of delivered products.

Soysal (2016) conducted research in which they considered transferring the management of a sustainable supply chain as one of the main goals of logistics in addition to minimizing traditional costs of the supply chain, reducing wasting foods and environmental impacts on the supply chain. The traditional costs of the supply chain included the fixed cost of distribution between nodes, warehousing unlimited duration, and certain demands used in this inventory routing problem.

Ren et al. (2016) conducted a research that concluded: they conducted their research according to the optimum approach of robust in routing problems which we are facing daily maintenance problems of road. They considered uncertainty in service time. Then they solved their problem by using the branch and cut method. Calculating results analyzed robust solutions and their performance by Monte Carlo simulation. Analyzing observations created a management attitude to make decisions and seal appropriate routing strategies.

Research Methodology

A supply chain can be introduced as a set of activities of different facilities in order to prepare materials and goods, produce products, transfer between different sections and distribute the final product between consumers. In addition, the management of the supply chain is the management of all considerations of different sections in the supply chain, like moving and substituting raw materials and final products, along with transportation decisions. Using this concept has significant competitive advantages for all participants in the supply chain. Designing a supply chain network provides strategic decisions which have an important role in the performance of the supply chain and its competitive advantages, as well as other decisions at an operational and tactical level of the supply chain over time. Choosing appropriate facilities from potential places, along with determining the number and their capacity, are the most important considerations and decisions in designing a supply chain network. These decisions are the most important components in the management of the supply chain because any kind of small and huge change in such an important and vital decision in each network affects lower levels directly or indirectly and therefore creates many costs in the whole chain. So, logistics is the process of strategic management, purchasing, moving, and restoring materials, parts, and final inventory and related information flows through its marketing organizations and channels through which current and future profitability maximize by doing optimized orders. Basically, logistics is the orientation and framework of programming, which searches for a united program for the flow of products and information through business. The management of the supply chain is built beyond this framework and seeks to achieve a link and coordination between the processes of other sections, such as suppliers and customers, and the organization itself. In this paper, a supply chain will be introduced and provided based on multi-objective modeling in the fields of financial risk, purchasing cost, transportation, maintenance, and lost sales and establishing warehouse and routing in an agile supply chain for perishable goods and at the end, a four-level model is designed.

Stable and Fuzzy Design of Supply Chain

In this paper, a robust (uncertainty in demand) and fuzzy (cost parameters) mathematical model will be presented according to existing real space in problems related to the supply chain and uncertainty in this space.

Benders Solving Approach

According to conducted investigations in the literature reviews of most researches, heuristic and meta-heuristic algorithms were used because the supply chain models were NP-HARD which is inefficient due to the approximation of optimal responses in this field. On the one hand, the approach of the Benders algorithm will be used to solve the mathematical model to improve the time duration of solving the model as well as provide exact responses.

Robust Mathematical Model

In the recent four decades, many studies provided methods to enter risk in stochastic models. A solution is robust in that the response of the model doesn't change by creating small changes in its basic data. Robust optimization integrates target function to input data based on scenario base and includes two separate adverbs: structural adverb and control adverb. Structural adverbs are formulated by using linear programming, and their input data has no disturbance. At the same time, control adverbs are considered auxiliary adverbs which deal with uncertain data. Stochastic Optimization is answered by considering the distribution function for the noise variables, which optimizes the expected amount or other criteria like this. Robust optimization usually has no assumption about the distribution function of noise variables. It searches for a response that has acceptable performance for all modes of noise variable. Typically obtained responses are too conservative (worst case). Meanwhile, Bertsimas and Sim brought an evolution in robust optimization by providing a model that is conservative and can be arranged, and the robust peer of a linear problem is a linear programming problem. This model is able to be applied to optimization problems with discrete variables (Bertsimas et al., 2004). Robust optimization is included among approaches that are so efficient in situations in which there are uncertainties. Robust optimization was introduced by Soyster in 1973. The presented model by Soyster performs too conservatively, and it is the most pessimistic approach. In the last two decades, they attempted too much to provide appropriate controllable robust models to solve different types of optimizing problems with uncertain data. These models are less conservative and provide better responses.

Problems are usually solved presupposing that the data is certain in advance in mathematical programming, while most of the data are uncertain in the real world. The main presupposition of mathematical programming is the development of a model based on explicitly determined data equal to a nominal amount. However, in this kind of model, the effect of data uncertainty has no effect on the quality and feasibility of the responses. Therefore, in real-world problems, a large number of constraints may be contravened by changing one of the data, and obtained response may be non-optimal or even impossible. According to this discussion, the main question of building a response for the problem that is resistant to this uncertainty of the data, so-called these responses are robust, and this type of optimization is called robust optimization (Bertsimas et al., 2004).

The primary idea in robust optimization is considering the worst scenario possible and optimization based on the worst scenario. For instance, assume that the coefficient can change in one of the constraints. In robust optimization, the worst situation which may occur for a constraint is considered according to the change in coefficient, and optimization is conducted based on it. The most important shortage of this method is its conservative performance. This method may not have much practical application, but it will be very useful as a tool for decision-making. The optimization word has its especial concept in mathematics, and it is used in different fields, including energy in Iran. Energy consumption optimization for a process can be conducted locally or comprehensively for a system that includes several processes. Since this paper is in the main branch of the perishable goods supply chain, which will be developed based on an agile supply chain and has built the new problem of the agility model of perishable products supply chain focusing on the delay time of order, so the problem hypotheses are:

1. Supply chain problem is a multi-commodity.
2. Modelling is multi-period.
3. Customers demand has the uncertainty of robust.
4. Cost parameters have fuzzy trapezoidal uncertainty.
5. Vehicles are homogeneous.
6. Vehicles have limited capacity.
7. The number of vehicles is limited.
8. Storing goods are perishable.
9. Lost sale is allowed in every period.
10. The inventory of products in the warehouse of the company is not allowed.

The following symbols are used to develop a mathematical model.

Indices:

$i=1,2,\dots,I$	production locations
$j=1,2,\dots,J$	candidate points and distribution location constant
$k=1,2,\dots,K$	customers' location
$l=1,2,\dots,L$	candidate points and recycle location constant
$t=1,\dots,t',\dots,T$	time periods
$o=1,2,\dots,O$	recycle customers' location

Parameters:

f_i	fixed costs of establishing distribution center j
f_l	fixed costs of establishing recycle center l
C_{xij}	transportation cost from producer i to distributor j
P_i	sale price of every unit of product i
C_{sik}	transportation cost from producer i to customer k
$C_{u_{jk}}$	transportation cost from distributor j to customer k

Ce_{kl}	transportation cost from producer k to recycle center l
Cq_{jl}	transportation cost from distributor j to recycle center l
Cv_{il}	transportation cost from producer i to recycle center l
Cf_{lo}	transportation cost from recycling center l to compost market
Ch_t	maintaining the cost of the product by the distributor in period t
Cp_t	processing and packing cost by the distributor in period t
Cr_t	recycle cost by recycling center in period t
Cp'	advertisement cost and producing product by the producer
d_{kt}	the demand of costumer k in period t
λc_{it}	maximum capacity of producer i in period t
λh_j	maintenance capacity of distributor j in period t
λr_l	production capacity and storage of recycling center l
α_t	waste percentage of produced products in period t
θ_t	waste percentage of stored products of the costumer in period t
β_t	waste percentage of the stored product of the distributor in period t
d'_{ot}	reprocessed product demand (compost) by costumer of compost o in period t
ρ	financial risk for response in forward flows
$\rho-1$	financial risk (importance) for response in recycling flows of perishable products
φ	conversion factor of waste product to processed product
M	extra large positive number

Decision variables:

X_{ijt}	The amount of product which is sent from producer i to distributor j in period t
-----------	----------------------------------------------------------------------------------

λ_{it}	Production amount by a producer I in period t
S_{ikt}	The amount of product which is sent from producer i to costumer k in period t
U_{jkt}	The amount of product which is sent from distributor j to costumer k in period t
E_{klt}	The amount of waste (perished) product which is sent from costumer k to recycle center l in period t
Q_{jlt}	The amount of waste (perished) product which is sent from distributor j to recycle center l in period t
V_{ilt}	The amount of waste (perished) product which is sent from producer i to recycle center l in period t
Ih_{jt}	The amount of processed product which is kept from the warehouse of distributor j in period t
$W_j \begin{cases} 1 \\ 0 \end{cases}$	If distributing center is established in candidate place j, otherwise it is zero.
$Y_l \begin{cases} 1 \\ 0 \end{cases}$	If the recycling center is established in candidate place l, otherwise it is zero.
F_{lot}	The amount of compost which is sent from recycling center l to compost market o in period t.

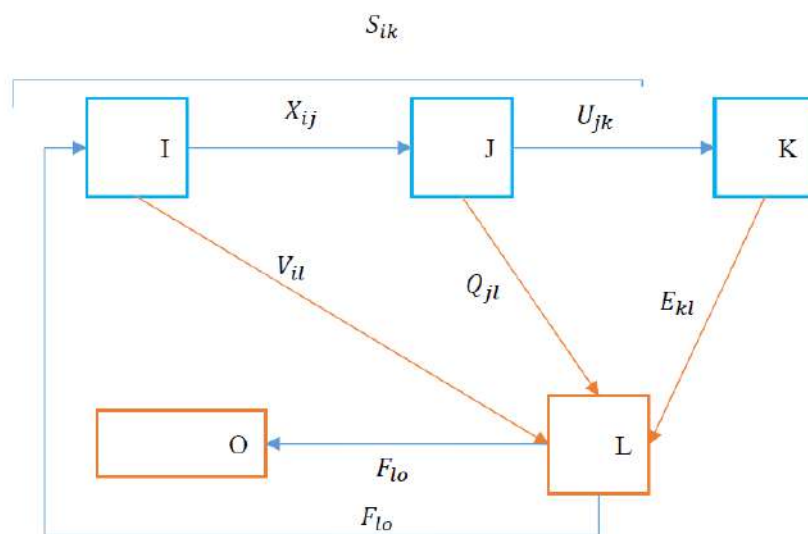


Figure 1. A scheme of the proposed network along with decision variables.

Proposed Model

According to the definition of the problem and considering the assumptions, the mathematical model is designed to maximize the obtained profit from selling products detracted from the costs of the supply chain, including transportation costs, the costs of constructing potential places of distributing center, the costs of maintenance inventory and production cost and risk and processing and minimizing financial risk.

Target functions:

This model has included two target functions maximizing profit and minimizing financial risk.

$$\text{Max } z = z - z1 - z2 - z3 - z4$$

$$z = \sum_{i=1}^I \sum_{j=1}^J \sum_{t=1}^{t'} x_{ijt} * p_i + \sum_{i=1}^I \sum_{k=1}^K \sum_{t=1}^T S_{ikt} * p_i \quad (1)$$

$$z_1 = \sum_{j=1}^J f_j \times W_j + \sum_{l=1}^L f_l \times Y_l \quad (2)$$

$$\begin{aligned} z_2 = & \sum_{i=1}^I \sum_{j=1}^J \sum_{t=1}^{t'} Cx_{ij} \times X_{ijt} + \sum_{j=1}^J \sum_{k=1}^K \sum_{t=1}^T Cu_{jk} \times U_{jkt} + \sum_{i=1}^I \sum_{k=1}^K \sum_{t=1}^{t'} Cs_{ik} \times S_{ikt} \\ & + \sum_{i=1}^I \sum_{l=1}^L \sum_{t=1}^{t'} Cv_{il} \times V_{ilt} + \sum_{j=1}^J \sum_{l=1}^L \sum_{t=1}^T Cq_{jl} \times Q_{jlt} + \sum_{k=1}^K \sum_{l=1}^L \sum_{t=1}^T Ce_{kl} \times E_{klt} \\ & + \sum_{l=1}^L \sum_{t=1}^T \sum_{o=1}^O Cf_{lt} \times F_{lot} \end{aligned} \quad (3)$$

$$z_3 = \sum_{j=1}^J \sum_{t=1}^T Ih_{jt} * Ch_t \quad (4)$$

$$z_4 = \sum_{i=1}^I \sum_{j=1}^J \sum_{t=1}^T X_{ijt} \times Cp_t + \sum_{l=1}^L \sum_{t=1}^T \sum_{o=1}^O F_{lot} \times Cr_t + \sum_{i=1}^I \sum_{t=1}^{t'} \lambda_{it} \times Cp' \quad (5)$$

Equation (1-3) is the minimization of costs as the sum of four kinds of presented costs in equations (2-3) to (3-5). Equations (2-3) is included the fixed costs of establishment and recycling. It should be mentioned that centers of distribution and recycling can be both existing points and potential points that we consider the establishment costs of existed points zero in parameters rather than adding indices. In equations (3-3), transportation costs, including forwarding costs and perishable recycling products, and in equations (3-4), maintenance costs of processed products are included. In equation (5-3),

operational costs include processing costs and packing and advertising, and reprocessing costs.

$$\begin{aligned} \text{Min } Z = \rho \times & \left(\sum_i \sum_j \sum_k s_{ikt} + \sum_t \sum_j \sum_k u_{jkt} \right) / \sum_t \sum_k d_{kt} + (1 \\ & - \rho) \times \sum_t \sum_l \sum_o f_{lot} / \sum_t \sum_o d_{ot} \end{aligned} \quad (6)$$

Equation (6) describes the second objective function, which is the minimization of the financial risk level. The response is divided into two parts of the customers of main products and the customers of reprocessed products that the responsiveness of each section is equal to dividing the amount of entered products to the target customer market by the amount of each market's demand.

Limitations:

There are 12 limitations in this mathematical model, as follows:

$$\lambda_{it} \times (1 - \alpha_t) = \sum_{j=1}^J X_{ijt} + \sum_{k=1}^K S_{ikt} \quad \forall i \in I, \forall t \in t' \quad (7)$$

Equation (7) indicates the amount of production by producers by deducting equal to the amount of transferring from producers to distributors and target market.

$$\sum_{i=1}^I \sum_{t=1}^{T=t'} X_{ijt} \leq M \times W_j \quad \forall j \in J \quad (8)$$

Also, equation (8) is the limitation related to equation (7-3) which emphasizes that sending load to potential distributors occurs if that place establishes.

$$\lambda_{it} \leq \lambda c_{it} \quad (9)$$

Equation (9) indicates that the amount of producing a product by smaller producers is equal to their maximum capacity.

$$Ih_{j(t-1)} + \sum_{i=1}^I X_{ijt} = Ih_{jt} + \sum_{k=1}^K U_{jkt} + \sum_{l=1}^L Q_{jlt} \quad \forall j \in J, \forall t \in T \quad (10)$$

Equation (10) shows that the warehouse inventory of distributors in every period is equal to the inventory of previous inventory deducted by the wastes of the previous period in addition to new products entered into the warehouse and deducted by exited products from the warehouse to processing and packing lines.

$$Ih_{jt} \leq \lambda h_j \quad \forall j \in J, \forall t \in T \quad (11)$$

Equation (11) indicates the fact that the maximum inventory of a smaller distributor warehouse is equal to the capacity of the warehouse.

$$\sum_{j=1}^J U_{jkt} + \sum_{i=1}^I S_{ikt} \leq d_{kt} \quad \forall k \in K, \forall t \in T \quad (12)$$

Equation (12) means that market demand in each period is more than or equal to entered products from producers and distributors.

$$\sum_{l=1}^L V_{ilt} \leq \alpha_t \times \lambda_{it} \quad \forall i \in I, \forall t \in t' \quad (13)$$

$$\sum_{t=1}^{T=t'} \sum_{i=1}^I V_{ilt} \leq M \times Y_l \quad \forall l \in L \quad (14)$$

$$\sum_{l=1}^L Q_{jlt} \leq \beta_t \times Ih_{j(t-1)} \quad \forall j \in J, \forall t \in T \quad (15)$$

$$\sum_{t=1}^T \sum_{j=1}^J Q_{jlt} \leq M \times Y_l \quad \forall l \in L \quad (16)$$

$$\sum_{l=1}^L E_{klt} \leq \theta_t \times d_{kt} \quad \forall k \in K, \forall t \in T \quad (17)$$

$$\sum_{t=1}^T \sum_{k=1}^K E_{klt} \leq M \times Y_l \quad \forall l \in L \quad (18)$$

Equations (13) and (18) show that the amounts of waste in every section appear for the flow of perishable products in the case of establishing recycle centers.

$$\left(\sum_{i=1}^I V_{ilt} + \sum_{j=1}^J Q_{ilt} + \sum_{k=1}^K E_{ilt} \right) \times \varphi = \sum_{o=1}^O F_{lot} \quad \forall l \in L, \forall t \in T \quad (19)$$

Equation (19) shows that the total sum of sending waste to recycle centers from producers, distributor, and customers multiplied by the transfer rate of waste products to compost is equal to the total sending recycled to the markets and costumers of compost.

$$\sum_{o=1}^O F_{lot} \leq \lambda r_l \quad \forall l \in L, \forall t \in T \quad (20)$$

Equation (20) indicates that the total compost sent to the market and costumers of compost is less than or equal to the production capacity of the recycling center.

$$\sum_{l=1}^L F_{lot} \leq d'_{ot} \quad \forall o \in O, t \in T \quad (21)$$

Equation (21) indicates that the total compost sent to the market and costumers of compost is less than or equal to the demand of compost costumer.

$$Y_l, W_j \in \{0,1\} \quad \forall l \in L, \forall j \in J \quad (22)$$

$$X_{ijt}, S_{ikt}, U_{jkt}, V_{ilt}, Q_{jlt}, E_{klt}, F_{lot} \geq 0 \quad \forall o \in O, \forall i \in I, \forall j \in J, \forall k \in K, \forall t \in T, \forall l \in L \quad (23)$$

$$Ih_{jt} \geq 0 \quad \forall j \in J, \forall t \in T \quad (24)$$

Equations (22) to (24) indicate sign variables or their being one or zero variable and being positiveness.

Considering Uncertainty

As we know, investigating the reason for uncertainty in the components of the supply chain in optimistic, medium, and pessimistic modes to analyze the opinions of experts on real environment situation in the supply chain since the theoretical dimensions of the topic has an approach toward the amounts of the fuzzy problem; therefore, the environmental situation of the chance-constraint fuzzy algorithm will be used. On the other hand, On the other hand, according to the accuracy of comment evaluation in trapezoidal fuzzy rather than triangular fuzzy possibilistic-robust, therefore this theory has been used.

In this section, a fuzzy possibilistic-robust programming model with constraint chance is presented for the research problem in order to deal with uncertainty in the parameter of the amounts of demand (Dkt). The used fuzzy possibilistic-robust programming model in this research is a common method that depends on mathematical concepts such as the expected value of fuzzy numbers and possible measurements (POS) and necessity measurements and allows decision makers to control the level of satisfying conservativeness of constraints and also, this supports the different forms of fuzzy as triangular and trapezoidal completely. First, consider mathematical programming problem for further introduction and for simplification:

$$\text{Min } Z = f.y + \tilde{c}.x \quad (25)$$

$$A.x \geq \tilde{d}$$

$$B.x = 0$$

$$s.x \leq N.y$$

Assume that f is the vector of certain parameters and c is the vector of uncertain parameters of the problem. Also, x is the vector of continuous variables, and y is the vector of zero and one variables. Also, A , d , B , and N is the technical coefficient of the problem. Assume that considering uncertain parameters (c and d) –according to this fact that the demand of consumer is considered as uncertain- as trapezoidal fuzzy numbers ($\theta = \theta_1, \theta_2, \theta_3, \theta_4$), the above model can be written as:

$$\text{Min } E[Z] \quad (26)$$

$$\text{Pos}\{A.x \geq \tilde{d}\} \geq \alpha_m \quad (27)$$

$$B.x = 0 \quad (28)$$

$$s.x \leq N.y \quad (29)$$

$$0.5 \leq \alpha_m \leq 1$$

$$x \geq 0 \quad (30)$$

$$y \in \{0,1\}$$

According to the research of Inuiguchi and Ramik (2000), the above model can be written as follows:

$$\text{Min } Z = f.y + \left(\frac{c_{(1)} + c_{(2)} + c_{(3)} + c_{(4)}}{4} \right).x \quad (31)$$

$$A.x \geq (1 - \alpha_m).d_{(1)} + \alpha_m.d_{(2)} \quad \forall m \quad (32)$$

$$B.x = 0 \quad (33)$$

$$s.x \leq N.y \quad (34)$$

$$0.5 \leq \alpha_m \leq 1$$

$$x \geq 0 \quad \forall m \quad (35)$$

$$y \in \{0,1\}$$

Therefore, the first target function of the possibilistic-robust programming model of the research problem is presented as follows.

The modified target function is:

$$\begin{aligned} & \text{Min } Z \\ & = \rho \times \left(\sum_i \sum_j \sum_k s_{ikt} + \sum_t \sum_j \sum_k u_{jkt} \right) / \sum_t \sum_k \left(\frac{d_{kt(1)} + d_{kt(2)} + d_{kt(3)} + d_{kt(4)}}{4} \right) \\ & + (1 - \rho) \times \sum_t \sum_l \sum_o f_{lot} / \sum_t \sum_o d_{ot} \end{aligned} \quad (36)$$

$$\begin{aligned} \sum_i s_{ikt} + \sum_j u_{jkt} & \leq (1 - \alpha) d_{kt(1)} + \alpha d_{kt(2)} \quad \forall k, t \\ \sum_i s_{ikt} + \sum_j u_{jkt} & \geq (1 - \alpha) d_{kt(4)} + \alpha d_{kt(3)} \quad \forall k, t \end{aligned} \quad (37)$$

Validation with Constraint-Epsilon

The empowered constraint-epsilon method provides efficient, optimized responses of Pareto. One of the target functions is considered the main target function in the constraint-epsilon method to optimize, while the other target function is considered a constraint in the model. The empowered constraint-epsilon model can be presented as follow:

$$\text{Min/Max}(f_1(x) + \vartheta * \left(\frac{s_2}{r_2} + \frac{s_3}{r_3} + \dots + \frac{s_i}{r_i} \dots + \frac{s_n}{r_n} \right))$$

St:

$$f_2(x) - s_2 = \varepsilon_2$$

$$f_3(x) - s_3 = \varepsilon_3$$

....

$$i \in [2, n]$$

$$s_i \in R^+$$

The optimized solutions of Pareto are obtained based on the above equation in which r_i is the domain of the target function of I , ϑ is a very small number between .001 to .000001, and s_i is a non-negative surplus variable. First, the measurement of NIS_{*fi*} (the worst measurement) and PIS_{*fi*} (the best measurement) is obtained for each target function, then the measurement of the domain of target function I is calculated as follows:

$$r_i = PIS_{fi} - NIS_{fi}$$

After that, r_i is divided into equal intervals of l_i . Then $l_i + 1$ points are obtained by which the equation under epsilon is calculated based on a Grid point. In this method, the model should be solved for all obtained epsilon in which η numbers of Grid points have been obtained according to the equation.

$$\varepsilon_i^n = NIS_{fi} + \frac{r_i}{l_i} * \eta$$

Validation of Accuracy based on Empowered Constraint-Epsilon

To validate the accuracy and credit of the proposed model, a problem with a smaller dimension is solved by GAMS software. Then the provided mathematical model is solved by GAMS software which is operation research software, and we assess the proposed model by solving a numerical example.

One of the accurate methods to obtain Pareto solutions is using the constrain-epsilon method. The main advantage of this method is the multi-objective optimization of its application for non-convex solving spaces rather than other methods because methods, including a composition by weight targets, lose their functionality. Calculating the time of an algorithm is among the important characteristics of every algorithm for assessing it since one of the main weaknesses of algorithms based on exact searches, such as constraint-epsilon, is its high calculating time; it is obvious that using a meta-heuristic algorithm will lead in intense reduction of calculating time.

We always attempt to optimize one of the goals in this method if we introduce the greatest accepted extent for other goals in the dominant constraints, which will be for a two-objective mathematical representation of this problem as:

$$\text{Min } f_1(x) \quad (38)$$

$$\text{Subject to } f_2(x) \leq \varepsilon_2, f_3(x) \leq \varepsilon_3, \dots, f_p(x) \leq \varepsilon_p, x \in S$$

The Pareto edge of the problem will be obtained by changing the right side of new constraints ε_s . One of the main problems of constraint-epsilon is the high volumes of calculations because for every target function becoming a constraint (as the number of p-1), different amounts of ε_i should be tested. One of the most common approaches to implementing constraint-epsilon is that first, the maximum and minimum amounts of all target functions are calculated without considering target functions and in $x \in S$ space. The interval one related to every target function is calculated by obtained amounts from the previous phase. If maximum and minimum amounts of target functions are called f_i^{\max} , and f_i^{\min} respectively, then their interval of them is calculated as follows:

$$(39)$$

$r_i = f_i^{\max} - f_i^{\min}$ Interval r_i is divided by interval q_i . Then ε_i , the different amount can be obtained equal to $q_i + 1$ those calculated as follow:

$$\varepsilon_i^k = f_i^{\max} - \frac{r_i}{q_i} \times k \quad k = 0, 1, \dots, q_i \quad (40)$$

In the above equation, k shows the new point related to ε_i . By the constraint-epsilon method, the multi-objective optimization problem can be converted to $\prod_{i=2}^p (q_i + 1)$ numbers of one-objective optimization sub-problem. Each sub-problem has the space response of S according to this fact that the unequal related to target functions f_2, \dots, f_p will be more limited. Each sub-problem results in a candidate response for the intended multi-objective optimization problem of the so-called optimized Pareto frontier. Sometimes, some of the sub-problems create an unjustified space of 1. Finally, after obtaining an optimized Pareto frontier, decision maker two can choose the most appropriate response from his/her point of view and uses it.

In this paper, we seek to design a five-level closed-loop network including producers, distributors, costumers, recycle centers, and the customers of recycling.

In order to do this, 12 problems are considered in different dimensions in this paper; this data have shown in table 1.

Table 1. Problems in different dimensions

Number of problems	I	J	K	L	M
1	3	4	3	4	2
2	5	7	5	7	4
3	7	10	7	10	6
4	9	13	9	13	8
5	15	22	15	22	14
6	17	25	17	25	16
7	19	28	19	28	18
8	25	37	25	37	24
9	35	52	35	52	34
10	37	55	37	55	36
11	39	58	39	58	38
12	41	61	41	61	40

Sub-problem 1 is the case study of this research which has been used to evaluate the proposed model and methods. Chosen towns for each place in this problem are in table 2. Also, used transportation costs between towns for all problems have been obtained from table 3.

Table 2. Chosen towns for each place

O	L	k	j	I
City 1	City 3	City 7	City 10	City 14
City 2	City 4	City 8	City 11	City 15
	City 5	City 9	City 12	City 16
	City 6		City 13	

Table 3. Transportation cost between towns (dollar/kilometer)

	town 1	town 2	town 3	town 4	town 5	town 6	Town7	town 8	town 9	town10	town 11	town 12	town 13	town 14	town15	town16
town1	3.7	4.9	9.0	12.5	12.8	19.4	20.8	17.8	15.2	20.5	19.2	21.3	30.4	34.1	43.7	47.7
town 2	4.9	3.7	5.3	8.7	9.0	17.3	17.3	30.1	11.4	17.0	17.1	17.8	23.8	30.7	40.3	44.2
town 3	9.0	5.3	3.7	4.6	4.9	13.1	13.8	11.4	8.0	9.5	13.0	17.2	11.8	26.9	36.5	39.8
town 4	12.5	8.7	4.6	3.7	7.1	13.1	14.5	7.0	8.5	9.9	13.5	18.3	13.1	24.7	34.3	40.9
town 5	12.8	9.0	4.9	7.1	3.7	9.4	12.3	8.0	8.2	9.7	12.8	17.3	12.6	23.5	33.4	40.4
town 6	19.4	17.3	13.1	13.1	9.4	3.7	4.4	16.6	13.1	18.1	18.1	19.1	18.7	31.6	41.2	45.1
town 7	20.8	17.3	13.8	14.5	12.3	4.4	3.7	17.8	16.4	20.2	19.7	22.0	21.7	33.8	42.5	46.4
town 8	17.8	30.1	11.4	7.0	8.0	16.6	17.8	3.7	4.6	3.9	7.8	5.9	5.6	19.4	29.0	32.9
town 9	15.2	11.4	8.0	8.5	8.2	13.1	16.4	4.6	3.7	7.3	6.1	8.9	9.0	20.6	30.1	34.1
town 10	20.5	17.0	9.5	9.9	9.7	18.1	20.2	3.9	7.3	3.7	2.9	3.9	4.1	18.1	27.4	28.2
town 11	19.2	17.1	13.0	13.5	12.8	18.1	19.7	7.8	6.1	2.9	3.7	5.6	5.8	17.4	25.7	29.6
town 12	21.3	17.8	17.2	18.3	17.3	19.1	22.0	5.9	8.9	3.9	5.6	3.7	3.2	15.2	18.3	27.9
town 13	30.4	23.8	11.8	13.1	12.6	18.7	21.7	5.6	9.0	4.1	5.8	3.2	3.7	13.3	20.2	29.1
town 14	34.1	30.7	26.9	24.7	23.5	31.6	33.8	19.4	20.6	18.1	17.4	15.2	13.3	3.7	10.9	15.2
town 15	43.7	40.3	36.5	34.3	33.4	41.2	42.5	29.0	30.1	27.4	25.7	18.3	20.2	10.9	3.7	5.4
town 16	47.7	44.2	39.8	40.9	40.4	45.1	46.4	32.9	34.1	28.2	29.6	27.9	29.1	15.2	5.4	3.7

Also, other parameters of the model form the first problem are presented in table 4. In addition to these amounts, ϕ , p and M are considered equal to 1.1 and 0.6, and 1015 respectively. Also, cp' is assumed to be equal to 170 and fj is equal to 0, 0, 114290, 180000, and fl is equal to 0, 0, 14285, 20000 in this problem.

Table 4. Parameters related to the first problem

Parameter	Indices	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8
ch_t	-	58	58	60	63	63	66	68	72
cp_t	-	86	89	89	91	94	94	100	103
cr_t	-	86	86	100	100	100	115	129	137
d_{kt}	k_1	3	4	3	7	8	5	10	8
	k_2	3	3.5	3.8	6	7.5	4.8	4.8	6.5
	k_3	3	3.2	3.5	5	5.5	4	10	5
λc_{it}	i_1	30	20	70	0	0	0	0	0

Parameter	Indices	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8
	i_2	90	11	45	0	0	0	0	0
	i_3	95	50	80	0	0	0	0	0
λh_{jt}	j_1	10	10	10	0	0	0	0	0
	j_2	20	20	20	0	0	0	0	0
	j_3	10	10	10	0	0	0	0	0
	j_4	30	30	30	0	0	0	0	0
λr_{lt}	l_1	4	4	5	4.3	4.8	5.3	5.2	10
	l_2	5.3	4	4.9	5.3	5.7	4.1	6.9	7.1
	l_3	8.3	4	4.6	7.3	4.5	6.3	4.7	10
	l_4	6.41	4.35	5	6	5.5	10	9.2	8.31
α_t	-	0.1	0.12	0.15	0	0	0	0	0
β_t	-	0.02	0.02	0.03	0.03	0.035	0.04	0.045	0.05
θ_t	-	0.02	0.03	0.04	0.045	0.045	0.048	0.05	0.05
d'_{ot}	o_1	10	20	18	15	14	6	7.9	8.5
	o_2	15	20	16	15.3	14.36	20	6.78	7

After introducing data related to the first problem, the remaining parameters of the model for the other problems are presented in table 5.

Table 5. The remaining parameters of the model

Unit	Amount	Parameter
period) month(Λ	T
period) month(3	t'
percentage	[0.1, 0.12, 0.15, 0, 0, 0, 0, 0]	At
percentage	[0.02, 0.02, 0.03, 0.03, 0.035, 0.04, 0.045, 0.05]	Bt
percentage	[0.02, 0.03, 0.04, 0.045, 0.045, 0.048, 0.05, 0.05]	Θt
percentage	1.1	Φ
percentage	0.6	P
percentage	0.4	$\lambda - p$
ton	Uniform ~ [30, 100]	Λ_{cit}
dollar	Uniform ~ [114290, 185715]	Fj
dollar	Uniform ~ [14285, 22855]	Fl
Dollar/ton	[58, 58, 60, 63, 63, 66, 68, 72]	Cht
Dollar/ton	[86, 89, 89, 91, 94, 94, 100, 103]	Cpt
Dollar/ton	[86, 86, 100, 100, 100, 115, 129, 137]	Crt
Dollar/ton	Uniform ~ [143, 172]	cp'
ton	Uniform ~ [3, 10]	Dkt
ton	10 or 20 or 30	Δh_j
ton	Uniform ~ [4, 10]	Λ_{rt}
ton	Uniform ~ [5, 20]	d'ot
Billion RIals	Uniform ~ [10, 20]	ben_i
percentage	Uniform ~ [15, 35]	off_{ik}

Unit	Amount	Parameter
percentage	Uniform ~ [45, 60]	sal_{ik}
Billion Rials	Uniform ~ [3, 5]	otf_{ilt}

Validation with Constraint-Epsilon

The empowered constraint-epsilon method provides efficient, optimized responses of Pareto. One of the target functions is considered the main target function in the constraint-epsilon method to optimize, while the other target function is considered a constraint in the model. The empowered constraint-epsilon model can be presented as follow:

$$(41) \text{ Min/Max}(f_1(x) + \vartheta * (\frac{s_2}{r_2} + \frac{s_3}{r_3} + \dots + \frac{s_i}{r_i} \dots + \frac{s_n}{r_n}))$$

St:

$$f_2(x) - s_2 = \varepsilon_2$$

$$f_3(x) - s_3 = \varepsilon_3$$

$$i \in [2, n]$$

$$s_i \in R^+$$

The optimized solutions of Pareto are obtained based on the above equation in which r_i is the domain of the target function of I , ϑ is a very small number between .001 to .000001, and s_i is a non-negative surplus variable. First, the measurement of NIS_{fi} (the worst measurement) and PISFI (the best measurement) is obtained for each target function, then the measurement of the domain of target function I is calculated as follows:

$$r_i = PIS_{fi} - NIS_{fi}$$

After that, r_i is divided into equal intervals of l_i . Then $l_i + 1$ points are obtained by which the equation under epsilons is calculated based on a Grid point. In this method, the model should be solved for all obtained epsilons in which η numbers of Grid points have been obtained according to the equation.

$$\varepsilon_i^\eta = NIS_{fi} + \frac{r_i}{l_i} * \eta$$

Now, after programming in GAMS, first, the obtained results are presented as follows. At last, the following amounts are obtained for every variable:

r2	18848
Li	10
NIS2	52
PISF2	18900
Θ	0.0001

Then, the number of epsilons is calculated by the following equation.

$$\varepsilon_i^\eta = NIS_{fi} + \frac{r_i}{l_i} * \eta \quad (43)$$

Finally, the empowered epsilon model was solved by using GAMS software for each epsilon. The set of responses of optimized Pareto are as follows as table 6.

Tablev6. Set of responses of optimized Pareto

ε	The amount of the first target function	The amount of second target function
1936	46269	1958
3820	68663	3850
5704	83403	5707
7588	170559	7597
9472	22055	9478
11356	33435	11363
13240	25311	13253
15124	58039	15144
17008	62257	17009
18900	80016	18900

Also, the Pareto paradigm is obtained as:

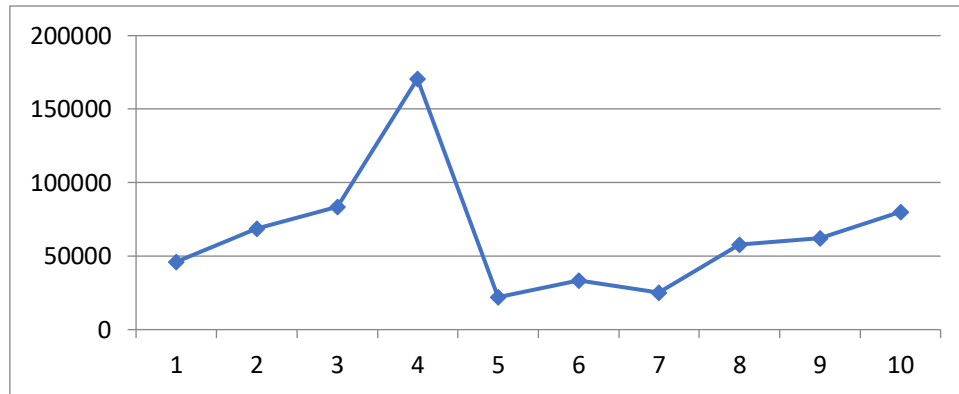


Figure 1. The ratio of the first target function to the amounts of epsilon

As it can be seen, the ratio of the first target function to the amounts of epsilon is shown that failure impact occurred in the optimization process in the first target function, and according to the conducted analysis, in this dimension is shown that in this dimension the optimized profit is reduced and the second target function also has the same trend is consistent with the increase in the amounts of epsilons. Therefore, the Pareto frontier of optimized responses is as follows:

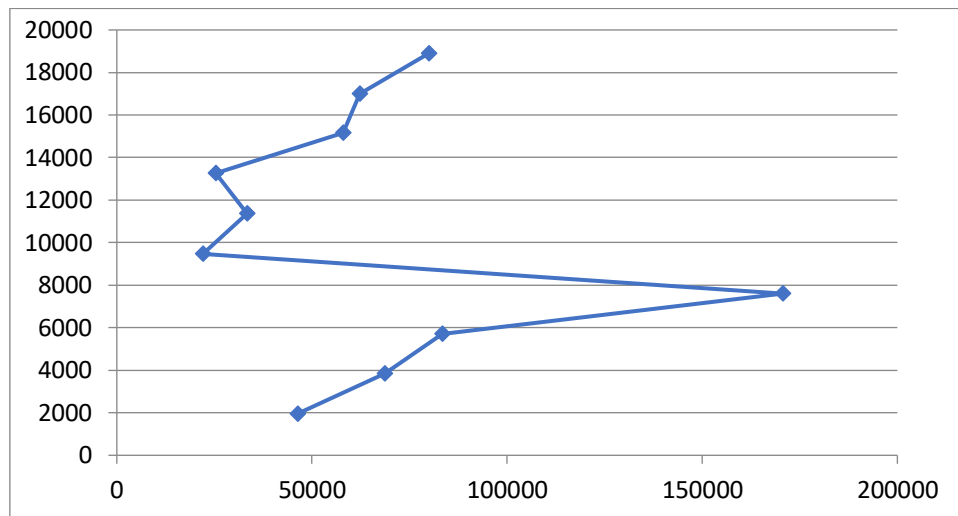


Figure 2. The Pareto frontier of the mathematical model optimized responses

Table 7. Amounts of sent products from producer to customer and distributor

T	i	X_{ijt}				S_{ikt}		
		J				K		
		1	2	2	4	1	2	3
1	1	0	0	0	18.0974	0	0	0
	2	14.363	28.726	14.363	24.9916	4.3089	4.3089	4.3089
	3	0	0	0	0	0	0	0
2	1	0	0	7.58367	0	0	0	0
	2	5.54412	0	2.06827	0	0	5.02705	0
	3	0	28.726	4.71107	0	5.7452	0	0
3	1	0	22.6217	0	0	4.3089	0	2.3699
	2	0	0	0	28.0797	0	0	0
	3	14.363	0	14.363	15.0093	0	0	2.65716

The amounts are related to the amounts of sent products from producer to customer and distributor.

Table 8. Amounts of inventory of distributors in every time period

t	J			
	1.47279	2.94558	4.41837	5.89116
1	14.7279	29.4558	14.7279	44.1837
2	20.0046	57.7334	28.8667	38.6814
3	28.2618	78.5019	42.2867	80.3791
4	27.4139	76.1469	41.0181	52.2528
5	26.4545	73.4818	39.5826	20.5778
6	25.3963	70.5425	37.9992	0.2433
7	24.2535	32.4865	36.2893	0.23226
8	23.0408	3.57873	34.4748	0.22062

Also, table 8. shows the amounts of inventory of distributors in every time period, which, as obviously, these amounts have an upward trend until the first three time periods, and after the 4th period, these amounts are going to be reduced gradually. This is due to the fact that we have only produced products in the first three time periods.

Results of Numerical Problems

Now the appropriate parameters in each algorithm are specified after designing the experiment and arranging parameters, and it is time to implement and compare the algorithm for produced problems. Therefore, 12 problems are implemented by the MOKA algorithm.

Period	Part 1							Part 2				Part 3								Part 4							
	<i>i</i>			<i>j+k</i>				<i>j</i>		<i>k</i>		<i>i+j+k</i>						<i>l</i>		<i>l</i>		<i>o</i>					
1	0.072	0.132	0.876	0.988	0.799	0.641	0.385	0.650	0.897	0.674	0.115	0.243	0.122	0.490	0.986	0.218	0.516	0.026	0.346	0.961	0.352	0.310	0.288	0.581	0.581	0.401	0.776
2	0.526	0.268	0.209	0.562	0.123	0.544	0.738	0.726	0.783	0.860	0.168	0.469	0.989	0.716	0.289	0.239	0.457	0.723	0.199	0.144	0.830	0.023	0.976	0.939	0.688	0.663	0.093
3	0.099	0.332	0.034	0.383	0.339	0.431	0.997	0.350	0.792	0.313	0.852	0.512	0.391	0.382	0.472	0.304	0.894	0.471	0.635	0.043	0.534	0.494	0.120	0.854	0.904	0.140	0.209
4	0.317	0.877	0.995	0.492	0.892	0.321	0.982	0.195	0.760	0.302	0.678	0.900	0.010	0.787	0.448	0.700	0.246	0.913	0.203	0.211	0.919	0.449	0.949	0.109	0.425	0.252	0.467
5	0.077	0.771	0.215	0.814	0.055	0.230	0.934	0.830	0.240	0.606	0.543	0.721	0.773	0.991	0.513	0.001	0.611	0.156	0.458	0.465	0.5445	0.097	0.316	0.860	0.894	0.256	0.417
6	0.286	0.983	0.252	0.185	0.587	0.861	0.454	0.649	0.090	0.951	0.958	0.598	0.067	0.602	0.593	0.467	0.307	0.548	0.523	0.845	0.231	0.070	0.57	0.198	0.281	0.099	0.617
7	0.227	0.941	0.936	0.965	0.178	0.777	0.637	0.004	0.336	0.366	0.251	0.206	0.234	0.201	0.193	0.929	0.647	0.755	0.553	0.638	0.955	0.746	0.936	0.805	0.721	0.230	0.947
8	0.222	0.906	0.89*4	0.777	0.339	0.757	0.617	0.296	0.205	0.771	0.258	0.236	0.347	0.862	0.402	0.901	0.777	0.607	0.733	0.687	0.331	0.238	0.988	0.588	0.387	0.601	0.016

Figure 3. The scheme of the Chromosome of problem

As it is obvious in figure 3, every chromosome of a problem consists of four parts, and all its number fill with random numbers between (1, 0). Then we order them and use their obtained sequences as allocation sequences. It should be mentioned that this research has used programming based on priority 1.

The first part of the chromosome is related to the allocation between two levels of “producer” and “distributor +costumer” in 8 time periods. The second part of the chromosome is related to the allocation between two levels of “distributor” and “customer” in 8 time periods. The third part of the chromosome is related to the allocation between two levels of “producer+distributor+costumer” and “compost centers” in 8 time periods. The fourth part of the chromosome is related to the allocation between two levels of “compost center” and “compost customers” in 8 time periods.

After solving the proposed mathematical model by using called methods, finally, table 9 shows obtained results for the problem.

Table 9. Calculating results from algorithms for 12 sub-problem

Problem	<i>NPS</i>	<i>CPU Time</i>	<i>MID</i>	<i>MS</i>	<i>SNS</i>
1	21	156	2	623121	485650
2	21	411	2	1189956	1218274
3	10	411	3	733666	999478
4	25	1135	4	1104737	2078257
5	16	2249	5	822806	2569381
6	15	2552	4	2355135	3480543
7	18	2781	5	1320039	3523399
8	19	7601	9	1855992	5933444
9	23	16387	13	1691351	9355409
10	13	14721	15	2142852	7974907
11	22	25452	8	3165274	9224106
12	13	21475	6	1581891	6604672

The Pareto diagram is obtained in figure 4 after solving the first problem by using mentioned methods and the exact method of constraint-epsilon; we can find out, according to the figure4., that the Pareto responses are close to the constraint-epsilon method for these proposed methods.

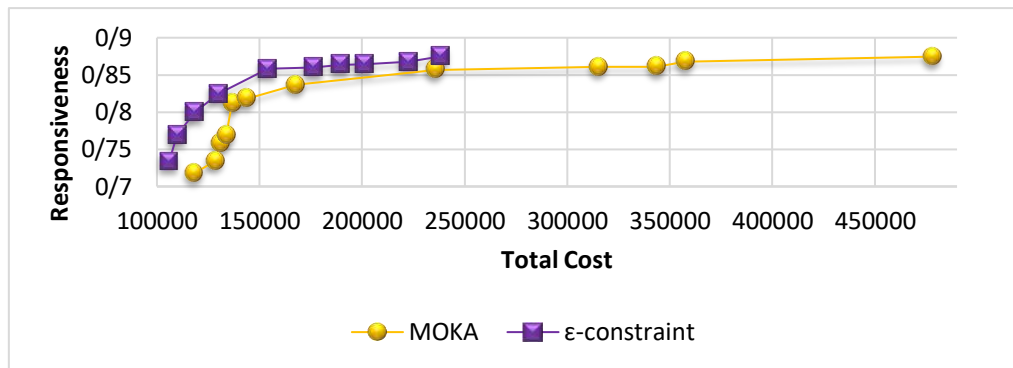


Figure 4. Pareto diagram related to the first problem

On the other hand, after calculating standard indexes for these methods, it can be seen that the results of the proposed algorithm are close to the constraint-epsilon method or even better in some cases. Table 10 shows this issue.

Table 10. Results of evaluating model

Methods	NPS↑		CPU time↓		MID↓		MS↑		SNS↑	
	value	gap	value	gap	value	gap	value	gap	Value	gap
ε-constraint	10	0.17	261.94	15.86	1.38	0	369174.0	0	296471.86	0.18
MOKA	12	0	90.14	4.80	1.41	0.02	360138.19	0.024	280685.49	0.23

That the following formula is used to calculate the gap.

$$gap = \left| \frac{a \lg - best}{best} \right| \quad (44)$$

Discussion and Conclusion

The analysts of the supply chain area always investigate published information by companies about financial performance, which is known as the annual report. The annual report is a required legal document that should be published by all public companies. The aim of this report is that the stakeholders are presented with exact and reliable financial statements which provide the financial performance of the company. Moreover, the statements by the manager or managers of the company are confirmed and signed with a number of disclosure documents. Therefore, annual reporting shows the most comprehensive information resource about financial performance, which is available for investors annually. Annual reporting includes three parts financial statement, balance sheet, and income and cash flow statement. The financial supply chain has an important role in operational and financial activities, and academic and industrial attention has been paid to it increasingly. The history of financial supply chain research is for the years of 1970 decade, before the popularity of the term supply chain management. Badian and Ipen studied the net cash flow produced in the business operation period in a cash planning period and how net flows are influenced by changing policies related to trade and inventory credits. Holly and Higgins investigated the relationships between inventory policies and trade credit policies. The first official definition of financial supply chains appeared in 2000. the key features of the financial supply chain are the integration of financial flows in the physical supply chain, and the financial supply chain can be introduced as the necessary part of supply chain management. financial supply chain as a place for the intersection of logistics, management supply chain, and financial financing and introduced it as a method for two or more organizations in the supply chain, including external service providers, to create a mutual value by planning, guiding, and controlling the flow of financial resource in internal to the organization level . Full and Gum introduced a financial supply chain as the internal company optimization and the integrator of the financing process with customers, suppliers, and service suppliers in order to increase the value of all participating companies. Gum stated that the aim of the financial supply chain is to optimize financing within the boundaries of the company in order to reduce the accelerator capital cost to cash flow. Swafford et al. stated that key factors in logistics included sourcing, preparing, producing, logistics, and distributing. They showed in their research that the agility of a company's supply chain is influenced by the amount of flexibility and sourcing procurement and the efficiency of financial logistics positively and directly. Therefore, according to the importance of financing the

supply chain, the problem of supplying materials and financing was discussed and investigated in this research, but this issue has not been investigated and analyzed in an integrated manner yet. So, first mathematical research and modeling gap in the literature review was analyzed, and it was shown that the nature of assessing components of cash flow and materials in the supply chain and what strategy was investigated in this regard, and research gaps were introduced. Then two-objective mathematical models maximizing profits (the factors of financing income and cost) in supplying materials and minimizing the financial risk of the supply chain were argued, and the most important constraints considered in this research can be mentioned as the constraints of the capacity of suppliers, the capacity of supply warehouse and the return route of perishable products in the green supply chain. Then the composed mathematical model became close to a real situation based on constraint chance fuzzy-uncertain strategy and based on two constraint-epsilon algorithms were introduced to exact solving problem and meta-heuristic algorithm MOKA to approximate solving and finally it was shown according to conducted assessment that constraint-epsilon algorithm was more efficient in small scale and in large scale, meta-heuristic algorithm MOKA had more efficiency.

According to the research findings in regard to developing financing and materials in green supply chain topics, practical and research suggestions were introduced in this section which will be mentioned below.

Practical Suggestion of the Research

In regards to realizing the financial purposes of the organization, it is suggested to consider the problem of credit purchase in order to reduce returned costs of damaged goods to suppliers and increase the quality level of suppliers.

In regards to developing the factors of purchasing equipment, it is suggested to set resilience components as the criteria for assessing suppliers to reduce the level of occurring bullwhip in the supply chain.

It is suggested to observe the assessing and investigating issues of quality and presenting positive documents about complete compliance to the quality plan of the employer in concluded contracts with suppliers in order to improve the financial conditions of supply and quality noncompliance penalty is considered in the contracts in order to reduce the risk of financing.

Suggestions for future research are as follows:

1. Using a possibility programming approach in the produced problem to investigate the level of non-compliance of robust and fuzzy and comparing obtained responses from these two algorithms.
2. Considering lost sales in the mathematical model.

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Original Research

A Conceptual Framework of the Business Model Disclosure

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Abstract

The term business model (BM) is one of the topics that has recently been addressed in the area of accounting literature and seeks to explore how to improve the information content of financial statements. The present study is a qualitative research, in the first step in order to collect qualitative data, a framework for semi-structured queries with experts was developed after examining the scope of financial reporting literature and business model. Subsequently, 23 well-known academic and executive experts in the field of financial reporting and business were selected through purposeful sampling (snowball). The transcribed interviews were coded in the second phase using inductive thematic analysis. In inductive theme analysis, patterns emerge during the analysis by placing open source or sub-themes together in one main theme. In summary, in the current study out of a total of 350 open source codes and 24 sub-themes, 6 main themes were identified as transparency and narrative, social accountability, users, key drivers, justice and fairness in reporting and presentation and disclosure. All of these are as components of financial reporting based on the concept of business model. Financial reporting and information disclosure are important management tools for effectively transferring information to stakeholders. Reliable and timely financial reporting enables individuals to accurately assess their future prospects. Therefore, by re-engineering the financial statements, six key components of financial reporting, inspired by the business model approach, can be a major step in re-engineering financial statements to improve the information content of financial statements.

Keywords: Financial Reporting, Information Disclosure, Business Model, Value Creation, Stakeholders' Management.

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Introduction

Disclosing financial reports by companies is one of the important and valuable information resources for stakeholders, credit providers and other beneficiary groups in the process of conscious economic decision-making (Rahmani & Bashiri, 2014). Providing information helps the stakeholders to evaluate their advisory duty or auditing the managers' accounts about the resources available to them (Nasirzadeh et al., 2017). In case the quality of disclosing information increase, the presented information will be more reliable and decrease information asymmetry (Kordestani et al, 2014). Moreover, the framework of disclosing information for every industry is different in terms of laws, ground rules, guidelines and other environmental conditions dominating each industry; in other words, there should be consistency between the Business model of the commercial unit (BM) and its reporting form (EFRAG, 2013). The accounting as well as financial reporting should not only be reflective of preferences of the stakeholders, but also should be able to make a balance between various uses of accounting system. In addition, whenever it's not possible to identify the functional preferences of the society, selection of an accounting system, inevitably, turns into a political procedure (Demski, 1973).

Business Model (BM) for various subjects of accounting is a key concept for both financial reporting and financial statements (such as: balance sheet, profit and loss statement, and cash flow statements) as well as non-finance reports which address narrow dimension of financial report (such as: management notes or other voluntary reports) (Leisenring et al., 2012; International Integrated Reporting Council (IIRC)., 2013; Singleton-Green, 2014; Page, 2014). Some of the researchers, organizations, and professional and specialized associations such as the International Standards (like the International Accounting Standard Board (IASB), Financial Accounting Standard Board (FASB), the legislators of financial laws such as Financial Reporting Council (FRC), and the vocational organizations which are members of international associations such as the Institute of Chartered Accountants in England and Wales (ICAEW) have displayed their interest in use of the concept Business model (BM) in their researches (Mechelli et al., 2017). The legislators of financial laws and the academy of accounting standards are trying to provide the grounds for disclosing Business model information in their notes on narrow fiscal financial reports.

Literature review

Relationships of the stakeholders

The relations of stakeholders should be sought for in two elements namely, the contribution of the stakeholders and the expectations or interests of them:

Contribution of the stakeholders

Recently, there has been a great inclination towards the issue of engagement of stakeholders. This concept could be considered as an approach that the companies could make use of in dismantling their capability of strategic management in transaction level. The companies could deploy different strategies in terms of the amount of their

cooperation. The classification of stakeholders is done on the basis of the importance of their level and its impact. Other than classification of the stakeholders in various levels of importance, there is a need to take their level of cooperation into account. The importance of the degree of attention to stakeholders as the center of decision-making in the process of management and tracing, indicates the amount of ability of the stakeholder in controlling the result of decision-making (Vartiainen, 2003). Cooperation could also be regarded as an empirical method in the relationships with stakeholders (Simard & West, 2006) and a key in creating values.

The expectations or interests of the stakeholders

Most of the researchers emphasize on making balance among the stakeholders and some others support a replacing relation; but what actually happens in practice most often is omission of one stakeholder to the benefit of another or ignoring the expectations of some stakeholders to fulfilling some others'. Finding a clue which could be in accordance with interests of all the stakeholders is not always easy and replacing one with another is almost the easiest way (Freeman, 1984). Of course, there are oppositions among the interests of the stakeholders but these oppositions should be eliminated so that the stakeholders do not leave the deals or in worse situations, do not make use of political processes for designating values to themselves or controlling the created values for others (Freeman et al., 2004).

Business Model (BM)

There have been various interpretations extracted from the words, business model. Interpretations such as Statement (Stewart & Zhao, 2000), Description (Applegate, 2000; Weill & Vitale, 2001), Display or Representation (Morris et al., 2005; Shafer et al., 2005; Timmers, 1998), Architecture (Dubosson-Torbay, M. et al., 2002; Osterwalder & Pigneur, 2010), Conceptual Tool or Model (Osterwalder et al., 2005; Teece, 2010), Structural Template (Amit & Zott, 2001), Method (Afuah & Tucci, 2003), framework (Afuah, 2004), Image or Pattern (Brousseau & Penard, 2006) and set (Seelos & Mair, 2007).

The definitions of business model, viewed in terms of central attention, could be classified considering three approaches namely: economic, operational, and strategic. The economic approach is concentrated on the profits of the companies and its main variables are income sources, expense structure and the expected profit. This approach has focused on profitability and preserving its existence. The operational approach is focused on domestic procedures of the company and the infrastructures that provide the opportunity for creating value for the company. Its main elements are the procedures of delivering goods and services, official procedures, streams of income, and managing knowledge. The aim of these relevant systems is to design competitive businesses for preserving the organization. In structural approach, the focus is on creating and developing opportunities which supports the quality of customers' choices as well as determining and distinguishing the value attached to them, creating desirability for the customers and determining the assigned duties inside the organization or outside of it. In addition, it emphasizes decision-making variables in identifying stakeholders, determining

perspectives, values, networks, and the confederate of configuration of resources, and finally profit-making (Kujala et al., 2013).

Applications of Business Model (BM)

There are tools and numerical concepts for managers in order to understand the logic of organizational business, as well as to convey, design, analyze, and make changes. According to a great number of researchers in this field, the concept 'business model' can compensate for some of these losses and assist them in conditions of lack of trust (Osterwalder et al., 2005). The application and use of Business model could be divided into four important categories which are listed below:

- *Understanding and sharing:* Business models play a role in understanding and sharing the rational of business of the organization. They assist in mental imaging and understanding, conveying, and sharing the logic of business by holding mental models which reside as abstract entities in the minds of individuals.
- *Analysis:* the meaning of Business model has a role in analyzing the rational of commercial works of the company. Measurement, observation, and comparison all improve the rational of business; that is, which spheres of the Business model needs supervision and which parts of it have undergone changes over time. In addition, it makes possible to compare the Business model with other competing models.
- *Management:* improvement of the Business model of the organization causes development of procedures of designing, scheduling, changing, and performing the models of business. Moreover, by adopting the Business model it will be possible to react more rapidly to environmental changes. The concept, Business model, also improves strategic orientation, the organization of the business, and technology. In other words, it facilitates the coordination of these three by creating a kind of conceptual bridge.
- *Prophecy:* the concept, Business model, could contribute to creating innovations in the organization and increasing preparedness for future by means of Business model portfolios, that is, having a model of business in stock for the sake of responding to changes and simulation (Osterwalder et al., 2005)

According to (Hamel, 2000), any organization has a particular model of business which simply demonstrates its process of activities. Whenever a new business starts to be established, it presents its model explicitly or implicitly and the architecture of business designs the mechanisms of distribution as well as creation of values. In fact, Business model is a methodology through which the broker presents the created value to customers particularly and to the stakeholders in general; and cajoles them into paying for such values in order to change them into profits. It is crucial for a company to have a clear understanding about its business model since it is considered as a source of competitive advantage for the companies (Osterwalder & Pigneur, 2010). Business model in commercial units is regarded as one of the key fatal factors in success (Success Critical Factor or SCF) and, in fact, without having a desirable business model, the competitive advantage and economic success, ultimately, will not be accomplished for the companies (Osterwalder & Pigneur, 2010; Amit & Zott, 2001; Teece, 2010).

The importance and status of the concept Business Model in a commercial unit

The companies, in order to preserve their created values in previous levels or exert effort to increase the level of the created value, decide to carry out innovation in their business model (Grabowska, 2015). Therefore, the most crucial issue in contemporary management is creating and architecting business model in a way that it would cause increase in value, make it possible for achieving stability in chaotic situations, and help in success in the market. Thus, a comprehensive, active, and innovative business model is about to being transformed into an important factor in creating value for the businesses. Evaluating business models could also play a key role in delineating the performance of the company (Zott et al., 2011).

Since the business model embarks on establishing a Business Concept, a great number of people believe that success or failure of a business depends on the particular model of the business. That's why they consider business model as a single structure in explicating the competitive advantage and the performance of a company (Afuah & Tucci, 2003).

In another dimension, the business model of business units has close affinity with stakeholders' relations and it is crucial to pay serious attention to these relations in order to design a desirable business model (Halsam et al., 2015). What is of great importance is that the business model of the business units cannot cause competition advantage for the units without considering all interested parties as well as understanding the relations among them (Halsam et al., 2015). In fact, the business model of the business unit is structured on the basis of the integrity of its constituent interest parties (Halsam et al., 2015). The primary relations of the business unit could be taken into consideration in two ways: contractual and marketable; the relations of secondary interest parties could be defined in an advisory or regulatory way despite the fact that they don't have enough cooperation in designing the business model of the business unit, their presence, policy-making, the way of their operation in the society and the relations they make with the business model, in a sense, can affect the activities of the project (Halsam et al., 2015).

In short, in order to design a desirable model of business in business units, care should be taken to all interest parties and their relations with the business unit. Cooperation of all interested parties and making utmost use of their potential capacities in designing and performing a business model and an effectual work requires accountability and providing useful information about the business unit. It is expected that the accounting department would accurately play its main role in this respect by financial reporting and providing financial statements as the most important source of information for reflecting the results of operation, financial status and cash flow of the business units.

Research methodology

The current research is developmental in terms of aiming since identifying financial reporting elements with a business model approach has exploratory characteristics; besides, it is a qualitative research in terms of the type of data. From among the various methods of collecting information in qualitative research (such as interview, focus group, Delphi technique, and other methods) interview was selected due to lack of possibility of making appointments with some of the experts in order to attend a same meeting

coincidentally and lack of awareness of the researcher about the amount of knowledge and mentality of the domestic experts in relation to the issues such as financial reporting and business models. Due to the quality of semi-structured interview, in addition to analyzing the responses and in order to clarify the presented explanations put forward by the experts, some other questions were added. At the end of each interview, it was solicited from the individuals to declare their total opinions and inferences from the subject under discussion. All the interviews took place in a formal time and place (office) approved by the experts. The average interview time was an hour considering the obsession of the individuals with their occupations and the limitedness of their pre-scheduled programs. In the beginning of each interview, other than stating the aim of the research, it was emphasized that the interviews were held merely for the sake of conducting the research and the interviewee's identity will never be stated in research reports or articles. After getting the permission and agreement of the interviewees, the interviews were recorded and were drafted and coded in the same day.

The contributors in the present study were 23 people including 5 faculty members, 8 financial and executive managers of the state and private companies, 5 accounting managers and experts, and 5 experts of the stock market all of which enjoy adequate amount of knowledge and experience in the realm of financial reporting and business in business units. On account of this, the process of interviews with one of the faculty members of an accredited state university got started; meanwhile, there were other subjects introduced considering familiarity with other activists in this realm. Thus, the number of interviewees were gradually increasing and this process continued till the data reached a sufficient amount. Data collection was continued after 23 interviews and by reaching a saturation point, i.e. when there was no other new ideology created out of the new interviews, it ended. Finally, thematic analysis was used for analyzing the interviews.

Thematic analysis

Thematic analysis is a flexible, rather easy and fast way for identification, analysis, and stating the models existing in the data. This method compiles and organizes the data and describe them in precious details (Braun & Clarke, 2006). Every theme includes important things about the data relevant with the research question and indicates a level of response or meaningfulness of the model in the set of data (Braun & Clarke, 2006). In this research the six-phase inductive theme analysis of Clark and Brown has been used the procedures of which are as below: 1. Familiarity of the researcher with the collected data 2. Creation of primary (first class) codes: in this phase 350 codes were collected from the interviews 3. Searching for the themes 4. Inspection of the themes: after putting all the themes of a relevant category in a bigger secondary theme, 24 secondary themes were identified 5. Definition and naming the themes: in this phase, finally, after manipulating the secondary themes, six main themes were identified 6. Reporting.

The data collected in this project were gathered using the following procedures:

✓ Investigating texts: there were 25 texts chosen for analysis which are numbered from T01 to T25.

✓ Interviews: the interviews were held in two phases. At first stage, there were three exploratory interviews taken place with three individuals who were well-known in terms of commenting on financial reporting and the field of business from the perspective of the researcher. The exploratory interviews which were all held by personal attendance of the interviewees and were recorded as for their texts, were numbered from EI01 to EI03. In the second stage there were 20 main interviews held. The main interviews were numbered from MI01 to MI20, were held by personal attendance of the individuals, and their relevant texts were recorded.

Results

Analysis on the basis of methodology of thematic exploration

The qualitative data extracted from reviewing the texts and interviews were coded and classified in order to find themes. Then the themes of the data were determined and named. Grouping the codes has eventually lead to creation of six main themes. These six themes themselves include 24 secondary themes in which the main themes are introduced and analyzed in the framework of secondary themes. As for each of the themes, samples of the qualitative data as well as views and interpretations of some of the researchers (which is part of the qualitative research) will be presented.

The first main theme: Transparency and Narrative

This main theme is composed of six secondary themes namely: “complete disclosure of key resources of business models”, “complete disclosure of key activities of business models”, “complete disclosure of the consequences of business models”, “disclosure of value creation (the positive effect of using resources)”, “coherence of the information”, and “separation and classification”. Transparency and narrative are the central basis of modern financial reporting that helps users in making familiarity with the business unit. One of the most important factors in attractiveness of the company from the view-points of the stakeholders, particularly the investors, is transparency. Transparency in financial reporting can provide safe conditions and increase trust in the society especially in non-trustworthy attitudes towards accounting occupation.

Complete disclosure of key resources of business models

In order to make economic decisions, there is a need for information with the help of which it could be possible to designate the existing and available resources in a desirable way. Recognition of the key resources in business models of the business units and their disclosure enjoys special importance. Therefore, when it was asked from the experts that what resources need to be disclosed in business models of the business units, the following statements were obtained:

In the present time, human, intellectual, natural, and social resources along with financial resources are the incentives of creating value and a source of replacement for static capitals. Most people believe that there should be made use of the reporting and voluntary disclosures (MI02016).

Another expert mentions some inconspicuous properties that are neglected in business units:

In my opinion, today, the companies don't solely make use of financial resources for performing their business models. In addition to financial and manufacturing resources, human, intellectual, natural, and social resources are the inconspicuous and key properties which play an important role in profiting and generating income (MI0464).

Complete disclosure of key activities of business models

Identifying unnecessary activities and void of any value add tax is the first step in the process of organization improvement. The activities void of value add is indicative of consumption of resources of the brokerage for performing activities for which the brokerage or customers do not provide value. Hence, one of the experts stated about the subject of disclosure of information related to the activities that are done in each of the business models:

To my mind, since the key activities is one of the major elements of business models and each business model cause the various resources (financial, manufacturing, human or natural) change into accomplishments and positive results, i.e. generating values, via their own key activities, thus, presenting information with more details of this kind could provide useful information for the users (MI0636).

Complete disclosure of the consequences of business models

In order to be able to well evaluate and analyze a business model, the consequences emanating from performing such analyses should be taken into consideration. Economic, social and environmental consequences are three main consequences that could be used in evaluating business models. In this respect, one of the experts declared that:

If we accept that the society is moving towards a path that the domain of its users will develop more and more; therefore, the accountants should reach the idea that they should provide a more complete flow of information at the disposal of groups of various types. The disclosure of environmental, social, or even moral information along with financial information related to each of the realms of profiting (the business models of business units), and more importantly the disclosure of the consequences resulted from performing them and the activities they do, will bring more interest to the society and will increase people's trust on accounting occupation (MI0919).

Value Creation

In recent years, focus on the subject, value creation, has increased and has been expressed generally in the field of accounting and particularly in the field of reporting. This subject, according to what Holland and British Financial Reporting Council (FRC) acknowledge, is regarded as the kernel of voluntary disclosure of information. Hence, a good and fair fiscal report should include a single story if it is seeking to show how money is earned that money-making has been accomplished in an adequate and clear way without any agitation (Financial Reporting Council (FRC), 2010). The process of convincing the effectuality of business models should help the test of existing hypotheses in business

models. In this respect, the viewpoints of one of the experts in emphasizing and necessitating the value Creating nature of business models, is presented below:

Nowadays, the success of businesses and their preservation and stability fulfils only by considering the desirable values of all interested parties. In fact, values in the process of accepting, durability, and institutionalization demand value generation. Value generation means creation of values emanating from human acts and management which pursues generation of wealth. In a sense, value generation and success in business have close inter-relations as well as an all-out interaction with each other. Businesses are conducted via business models. Hence, the existence of the property, value generation or lack of it in business models and ultimate evaluation of them is so important for interested parties (EI0308).

Coherence of the information

One of the principals considered in Financial Accounting Standards Board (FASB) and International Accounting Standards Board (IASB) in the proposed model of the year 2008 (in order to enhance the comparability of financial statements) which was finally sanctioned in 2010, is the coherence principal or illustrating a cohesive image of the business units. The coherence principal is, in fact, produced via an organized structure among the financial statements. Some of the experts have also emphasized this principal in their statements:

Accounting should not solely be based on numbers. Non-financial and validity reporting related to each of the business models are also important. There should be complete coherence among the disclosed information regarding each of the business models of the business unit in various sections of the financial statements. Presenting non-financial and validity accounts related to business models such as information related to applicability and effectuality of them in index notes is a complement to the information and could be helpful in solidarity and coherence of the information (MI0543).

Separation and classification of the information

Another principal considered in Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB) in the proposed model is separation and classification principal. The process of separation and classification of the information related to business models could play a key role in effectuality on the informational content of financial statements. For example, one of the experts stated that:

Cooperation of the interested parties will result in efficiency and effectiveness of the business models. In fact, cooperation will increase only when the interested parties get informed that what they share in the business models of the business unit and how they could make profit by appropriately performing them. Therefore, separation and classification of the shares of each of the interested parties from the business models will enhance the quality of financial reporting (MI1315).

The second main theme: Social Accountability

This main theme is composed of four secondary themes namely: ‘Corporate Social Responsibility (CSR)’, ‘Green accounting (environmental)’, ‘Corporate governance (Co Go)’, and ‘Sustainable development’. The difference between social accountability and social responsibility lies in the way of responding and the way of treating with general issues. In social accountability, the organizations are like partners accompanying community institutions and try to solve the problems of the society and ultimately to enhance people’s welfare and their social lifestyle by observing fulfilment of the needs of all interested parties.

Corporate Social Responsibility (CSR)

Corporate Social Responsibility (CSR) is an essential element in building and maintaining the companies’ reputation which is called ‘competitive advantage’ in strategic resources. Accordingly, one expert believed that:

Corporate Social Responsibility (CSR) and the relevant disclosures are essential factors that lead to corporate continuity because all companies are inter-related with their community; they affect it and are influenced by it. In fact, the society gets profited by activities and behaviors of the corporation. Identifying key activities, key resources, and key incentives in each of the business models and reporting them to business stakeholders can play a role in corporate social responsibility (CSR) (MI0150).

Green (Environmental) Accounting

The growing population of the world, on the one hand, and the scarcity of natural resources, on the other hand, have made environmental protection one of the most important challenges for human-beings today. Nowadays, many companies are facing bio-challenges and are looking for appropriate ways to report and disclose information to the general public. Therefore, reporting business models is a way that can be effective in achieving green accounting goals. In this regard, one of the experts stated that:

In my opinion, most companies nowadays work for their managers, and the activities performed in them are not productive. They care more about the form of the work than the content of the work. In other words, most companies do non-environmental-friendly reporting by presenting tricky reports. Presenting reports based on the implications of implementing business models can prevent such business and produce criteria of intrinsic credit worthiness (MI1867).

In fact, many experts believed that the financial reporting style of business models that emphasize environmental impacts would be an important factor in achieving green accounting or environmental accounting goals.

Corporate Governance (Co Go)

Corporate governance is a set of rules and procedures that define the relationship between shareholders, management, and board members and impact how they affect the company. At the elementary level, corporate governance faces issues arising from the

separation of ownership and management of the company, but this concept goes beyond just establishing a transparent relationship between managers and shareholders. Most interviewees acknowledged that special attention should be paid to how these business models are effectively implemented. For example:

Relationships between company management, board of directors, shareholders, and other interested parties are highly effective when the business unit provides quality information to each of them. Stakeholder engagement, support, cohesion and collaboration will come about only when they know how much they are contributing to the implementation of the business model of the business unit and understand how efficient or effective they are in the business models (MI2059).

Sustainable Development

Sustainable development means integrating economic, social, and environmental goals to maximize the well-being of the current human being without damaging the ability of future generations to meet their needs. Particular attention should also be paid to how sustainable business models are implemented in the business unit. Most experts believed, facing the question that what relation there should be between sustainable development and business unit patterns, that the implementation of any business model is not fair at all costs and that companies should consider all aspects of the business, both internal and external, or short and long term. Examples of expert opinions are as follows:

Implementing business models should not compromise the interests and resources of future generations (MI0843).

Sometimes a company may cause environmental and social damage by implementing a particular type of business model that is incompatible with social and environmental issues. This incompatibility will cause the business unit not to be able to continue operating. Companies should consider these points (MI0922).

The third Main Theme: Users (Stakeholders)

This core group itself consists of three sub-themes: "Managing and Analyzing Key Stakeholders", "Stakeholder Interests or Expectations" and "Stakeholder Engagement". One of the most important issues in the conceptual framework of financial reporting that has long been discussed and still debated by professional bodies is the purpose and uses of financial reporting (Zeff, 1999). In the context of the concept of financial reporting based on the concept of business model, the operators or users should be considered as one of the main components.

Management and stakeholder analysis (key partners)

Ignoring the people who are influential as well as impressionable on the environment can lead to reduced performance and even failure of programs (Hill & Jones, 1992). The goal is to achieve results that provide the best balance of benefits and costs for all stakeholders, but the goal cannot be achieved unless by identifying and engaging all key stakeholders who stay in contact with each other in one system (Stavros & Sprangel, 2008).

One of the questions asked by experts in the interview was: Who are the main users who get benefitted by financial reports? Do you respect stakeholder management and stakeholder analysis issues? Almost all experts supported the theory of stakeholders and expansion of the circle of operators and users of current financial reporting. For instance, one of the experts stated that:

In my opinion, the beneficiaries are those who are directly or indirectly affected by the activities of the organization. Their scope is broad. In the future, the range of users of financial reporting will expand. In fact, we are passing. The world of cyberspace has expanded, access to it has increased, and the cost of access to it has decreased. Hence, this very fact will cause need for training and seeking for answer. In the meantime, stakeholder management will become more and more important than ever before (MI0857).

Stakeholder interests and expectations

There is no doubt that there is a conflict between the interests of stakeholders, customers, suppliers, employees, and associations and other stakeholders of an organization. But just as there is a conflict between some stakeholder expectations and interests, they may have some common expectations and interests as well. If managers understand the needs, interests, and expectations of the corporate stakeholders, then they can develop a more informed corporate strategy. An expert said on stakeholder interests that:

From the perspective of economists, there is always a substitutionary stakeholder relationship, but we cannot keep them all satisfied due to the limited resources we have. Obviously, in the meantime, some will benefit more than others, but what is of importance is the art of making balance among the stakeholders through stakeholder management and taking their interests into consideration. Otherwise, management may never be able to find the critical points that represent the common interests of all key stakeholders (MI1561).

Stakeholder Engagement

Given the intensified competitive environment of activity and the empowerment of stakeholder groups on corporate orientation, today the goal of maximizing profits has given way to a satisfying profit which will be achieved in the light of the interaction and participation of the forces governing the organization's activities such as the stakeholders and investors, employees, customers, suppliers of raw materials, etc. and the company will be able to create continuous and dynamic interaction in an organic relationship with its environment. This feature will increase the competitiveness of companies to achieve important goals such as greater market share and higher flexibility. Several experts, in their interviews, emphasized stakeholder engagement and its importance in advancing the affairs of the organization. For example, one of the experts believed that:

In future, partnering with stakeholders and building loyal relationships with customers, employees, shareholders, and other interested parties will be one of the determinants of

business success and economic benefit for companies. Increasing shareholder value is best achieved by supporting all the groups that are affected (MI1233).

The fourth main theme: Key incentives

This core group consists of 4 sub-themes: "asset, debt, and stakeholder equity earnings stimulus", "incentives and costs structure", "income incentives and flows" and "value proposition (financial, non-financial)". Every organization consumes resources and accomplishes activities (for example: production, sales, marketing) in order to achieve its goals and fulfil its organizational mission; in total, these consumed resources bring about accomplishments as a result of its activities. One of the most important issues is how these consumed resources are allocated. Resources (financial, productive, intellectual, social) must be distributed and allocated through a rational mechanism. One of the ways to optimize the allocation is incentives.

Asset, debt, and stakeholder equity earnings incentives

If firms use different business models, in which multiple activities take place, in order to generate revenue and profit, allocation of costs related to assets, debts, and proprietary rights to each of these business models will provide transparency in the financial statements. Accordingly, a clear definition of the incentives intended to allocate assets, liabilities, and proprietary rights should be provided. Below are some expert opinions:

The value of the assets, liabilities, and rights of the owners of each business model must be explicitly stated (MI0136).

The assets are capitals that are shared by two or more business models. In this case, the method of allocating items to business models depends on factors such as the nature of the items, activities performed in accordance with business models, and relative independence (MI1038).

Incentives and cost structure

Cost structure describes all the costs associated with implementing a business model. This component describes the most significant costs incurred during the implementation of a particular business model. Creating and delivering value, maintaining customer relationships, and generating revenue all have their own costs. After defining the key resources, activities, and partners such costs can be easily calculated. One of the experts on cost structure in implementing business models stated that:

In any business model, obviously, costs should be reduced as much as possible. But cutting costs for some businesses is much more important than others. Thus, it is useful to distinguish between two categories of cost structures in business models: cost-based and value-based (MI0938).

Another expert stated on how to allocate costs in business models that:

Identifying the costs incurred in each of the business models and separating and allocating them accurately will make the reports more effective. These separations and

allocations of cost are possible through incentives and there must be meticulous and special care taken in defining them (MI1257).

Income incentives and flows

If business models are the heart of the organization and customers are the heart of business models, revenue streams form its arteries. The company has to ask itself, what segment of business models does each customer really want to pay for? In the interview, experts were asked what components should be taken into consideration if a company wants to design and execute a business model for itself, and which component was more important? In this regard, all experts acknowledged monetization and revenue streams as one of the most important components of business models. Here are some experts' opinions:

Implementing different business models will also have different revenue streams. The produced income must be reported separately (MI0869).

In order to comply with the principle of reconciliation of revenues to expenses in accounting, it is necessary to identify precisely the earnings of each business model on the basis of the activities performed and match the costs incurred in the same business model (MI1145).

Value proposition (financial, non-financial)

If the business model of the business unit is properly designed and implemented, it will eventually lead to formation of the proposed (financial, non-financial) value which is the firm's preference factor by stakeholders. One of the components of a business model (BM) is the value proposition that represents the products and services that create value for particular stakeholders or interested parties (Osterwalder & Pigneur, 2010). Examples of financially proposed value include the ratio of price to sustainable income, stable liquidity, stable repayable debt and sustainable profit margin (Halsam et al., 2015). Examples of non-financial value proposition include the quality of the products and their after-sales services. One expert suggested, on the value proposition of business models, that:

Another component of the business model is proposed values. It is worth noting that a proposed value is a distinct combination of elements that meet the needs of a part of the customers and thereby create value. If a company wants to differentiate itself from others, it must focus on the proposed values (MI1333).

The fifth main theme: justice and fairness in reporting

This main body consists of three sub-themes: "attention to economically interested parties", "attention to socially interested parties", "attention to politically interested parties". One type of justice is called 'distributive justice'. The distributive justice that Aristotle speaks of means that justice must be in a way that public welfare could be available to the people of the community on an equal basis from day one. This definition focuses on the point that everyone must first be provided with equal facilities and social opportunities. Some people may be sluggish to take advantage of these facilities and

opportunities or neglect to get well benefitted, but at the beginning, the division of good should be public. In accounting, there should as well be the dominance of the distributive justice either in giving reports or presenting information to the people.

Attention to economically interested parties

‘Interested parties’ refer to a group of people who have common interests and do not have political goals. In fact, economically interested parties are those who pursue purely economic goals. They follow economic indicators such as GDP, EPS, inflation rate and so on. In stakeholder theory, the emphasis is on homogeneous distribution of resources among stakeholders. If stakeholder relationships are based on equitable resource allocation, the company's wealth potential will increase. In this respect, an expert in the interview said that:

Stakeholders and creditors are economically interested groups who are largely unaware of social and environmental issues. These are the people who pursue their monetary interests. Providing disaggregated information on economic indicators such as P to E ratio, EPS and other financial ratios in each of the business models will enhance transparency in reporting and improve reporting quality (MI1531).

Attention to socially interested parties

Some authors, in a large subdivision, divide stakeholders into promotion and support groups.

The first groups are those who seek to propagate and promote a particular idea. If this goal is specific, the propagating group may have a temporary presence. The goals that these groups typically strive to achieve are more concerned with general or immaterial good of the society or parts of it. Environmentalists are a prominent example of this group of stakeholders. Most of the experts in the interviews mentioned of paying particular attention to this group of people. For example:

Countries and organizations have no choice but to disclose the information about the costs of their environmental business models and incorporating them into their accounts and decisions in order to reduce their environmental costs (MI01225).

Or another expert believed that:

Managing environmental and social costs has enormous benefits to society and to the success of the business unit. In fact, an understanding of these costs in the business process can improve product costing and pricing (MI0344).

Attention to politically interested parties

Having a political relationship with the government, not only does affect the financial position of business units, it can also influence the motivation and ability of executives in preparing financial statements and make a significant difference in the quality of financial reporting (Rezazadeh & Mohammadi, 2019). A number of experts believed that

it is not possible to present a desirable account of standards and financial reporting without attention to political stakeholders.

Political economic theory is a social, political, and economic framework in which politics and economy are not separate, and economic issues cannot be dealt with separately from social and political considerations. In this theory, reports of business models chosen by the company are viewed as social, political, and economic evidence (MI1951).

The sixth main theme: presentation and disclosure

This core theme consists of 4 sub-themes "financial statements reengineering", "business analytics (SWOT) method for analyzing business patterns", "use of statistics and comparative information on business patterns" and "use of canvas in business model". Obviously, the decision on how to disclose information and when to publish it is important since the method and timing of information disclosure can affect usefulness of this information.

Financial statements reengineering

Financial statements are the primary and central product of financial reporting. A research conducted by Alex and Suresh (2004) indicated that current financial statements have lost their value due to a shift from the traditional capital-based economy to a high-tech and service-based economy. These findings are based on life-cycle theory, high-speed technology, and rapid changes in the business environment (Alex & Suresh, 2004). In this regard, one of the experts commented that:

In my opinion, the current financial statements are not sufficient enough. We need to have not only modernization but reengineering in the area of financial reporting so that the financial statements can tell exactly what business units are operating, how their revenue streams are, and how to design financial statements in general in order to meet the information needs of all stakeholders (MI1457).

SWOT strategic analyzing method for business model analysis

Organizations and institutions that inevitably compete and strive for survival in highly turbulent, unstable, and changing environments, in order to deal with such environmental factors and events impacting their activities, adopt a strategic analysis method named SWOT (Strength, Weaknesses, Opportunities, Threats) for identifying and compiling optimal strategies, which consist of four types: strengths-opportunities, weaknesses-opportunities, strengths-threats, and weaknesses-threats. In this regard, the British Financial Reporting Council (FRC) has acknowledged in its evaluation and researches that:

Some investors have also suggested that SWOT analysis will improve the quality of business model disclosure. They have found that a balanced SWOT analysis by the company for each business model can provide additional information to analyses that is often performed by sales analysts. (T1248).

Use of comparative statistics and information on business models

Today, in the field of data collection, storage and retrieval, the topic of "making sense of data" and facilitating the "decision-making" process are at the center of attention of accounting, management, and business experts. The work is done. One of the most effective tools for making optimal decisions in organizations is business intelligence. Business intelligence is the analysis of statistical data related to business situation and the environment around the organization. The UK Financial Reporting Council (FRC) acknowledged in its evaluation and researches that:

All investors are of the opinion that using statistics to disclose a business model can lead to a more effective and useful improvement of the interactional value of the disclosure. Statistics can more effectively explain the size, importance, or concept of the elements of a business model. Companies do this in a variety of ways, including:

- Using statistics along with relevant information and
- Providing a summary of the relevant statistics in the form of tables and charts (T1248).

Use of Business Model Canvas

Business Model Canvas (BMC) is a strategic and entrepreneurial management tool that allows you to describe, design and invent your own business model or challenge and change it. The Business Model Canvas is a simple yet powerful visualization tool that describes the nine components of the business model. These components include customer segment(s), proposed value(s), distribution channel(s), customer relationship, revenue stream, core activities, main resources, key business partners, and cost structure (Osterwalder & Pigneur, 2010). According to some experts in interviews:

The business model canvas is a common language for describing, visualizing, evaluating and changing business models. This canvas describes the logic of how to create, deliver, and capture the value of an organization. Therefore, presenting it as supplemental information, if not beneficial to some, will not result in their loss or mislead (MI1478).

Some experts also disagreed:

I think this information will confuse the reader of financial reports. Canvas business model analysis requires expertise that not everyone has (MI2053).

Conclusion

The present study has achieved a framework for financial reporting by identifying the components of financial reporting using the Business Model (BM) approach with a qualitative paradigm. One of the advantages of this research is the interdisciplinary view in the two areas of accounting and management. An interdisciplinary field is the "integration of knowledge, methods and experiences of two or more scientific and specialized fields to identify and solve a complex problem or a multifaceted social

problem". In the first section, after an in-depth review of the financial reporting literature and business models of business unit and studying the views of foreign experts on the relationship between financial reporting and business models, special programming took place in order to ask direct questions and conduct semi-structured interviews with Iranian experts. After transcribing the interviews in Section II, the collected qualitative data were coded and categorized by inductive thematic analysis. Research findings show that financial reporting based on the concept of business model is determinable on the basis of six main themes namely: "transparency and narrative", "social accountability", "users (stakeholders)", "key incentives", "justice and fairness in the distribution of reports", and "the way of presentation and disclosure".

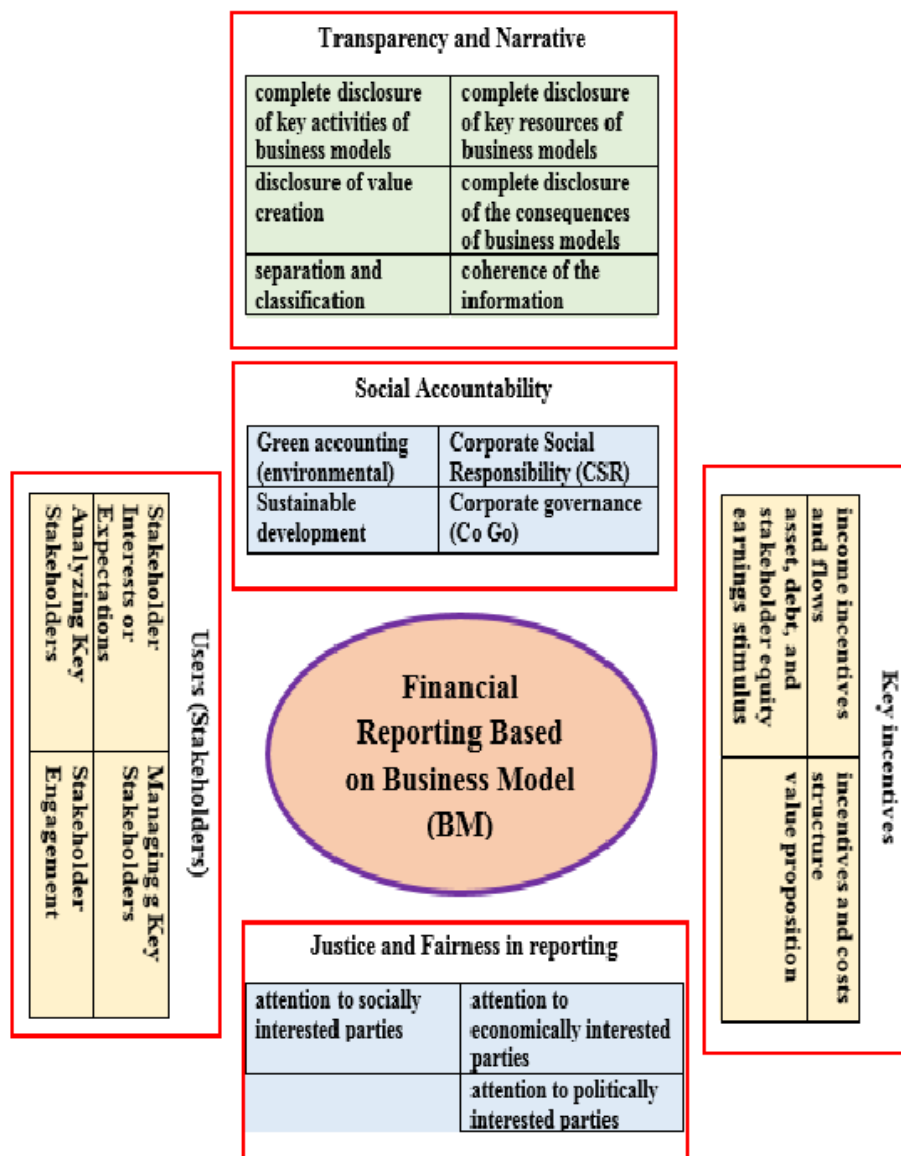


Figure 1- Financial Reporting Based on Business Model (BM)

Transparency and narrative, as the first core components, are central to modern financial reporting which helps users understand the business unit. Transparency in financial reporting can create trustworthy conditions and increase public confidence, especially in uncertainty conditions regarding accounting profession. In order to increase transparency and narrative in financial reporting based on the concept of business model, components such as: "full disclosure of key sources of business models", "full disclosure of business model consequences", "full disclosure of key business activities", "information coherence", "information segregation and classification", and "disclosure of value creation (positive effects of using resources)" should be taken into consideration.

The second major component, namely social accountability, consists of "Corporate Social Responsibility (CSR)", "Green Accounting (Eco)", "Corporate Governing (Co Go)", and "Sustainable Development". In the last decade, the accountability of organizations to citizens has become a sensitive issue, and organizations are trying to be more efficient and social due to public pressures. Organizations must feel the responsibility that community problems are part of their own problems and must work towards resolving them and allocate part of their financial and human resources for this purpose. Corporate Social Responsibility (CSR) is an essential element in building and maintaining a corporate reputation, which in strategic resources is referred to as the competitive advantage of a company.

The third main component, namely users (stakeholders), includes: "management and analysis of interested parties (key stakeholders)", "interests and expectations of stakeholders", and "stakeholder engagement". Since stakeholder relationships need to be considered in the effective and influential implementation of business models of business entities, stakeholder theory has been adopted as the dominant theory in this approach. The goal is to achieve results that provide the best balance of benefits and costs to all interested parties, but the goal cannot be achieved unless by identifying and engaging all key stakeholders in contact with each other in one system (Stavros & Sprangel, 2008).

The key incentives as the fourth key component are the rational distribution and allocation of various resources between business models on the one hand and the key activities of the business models on the other. Some of these components also play a role in evaluating the performance of the business unit. Business units can allocate and distribute these resources through incentives such as "cost structure incentives", "revenue flow incentives", "value propositions (financial and non-financial) ", and "use of asset, debt and equity capital incentives".

In the fifth principal component, an important issue, namely justice and equity in reporting, has been raised. Distributive justice means that justice must be in a way that public good be made available to the individuals on an equal basis from day one. Economic, social and political stakeholders should be given full attention when it comes to distributing financial reporting with a business model approach.

And finally, in how to report and disclose information related to business models of the business unit, as the sixth main element, the components "financial statement reengineering", "SWOT strategic analysis for analyzing business models", "use of statistics and comparative information on business models" and "use of business model

canvas" should be considered. Research by Alex and Suresh (2004) indicated that current financial statements have lost their value due to a shift from the traditional capital-based economy to high-tech and service-based economy (Alex & Suresh, 2004). Accordingly, it is necessary to re-engineer the financial statements using the business model approach. Analyzing business models using SWOT strategic approach has a significant impact on organizational success. Business Model Canvas (BMC) is a strategic management and entrepreneurship tool that allows you to describe, design and invent a business model or challenge or change it.

In sum, the findings of the present study show that an interdisciplinary approach in the two areas of accounting and management and the business model approach could be utilized in order to mitigate the weaknesses in current financial reporting. The main concern in Accounting Narratives (reporting) is that there is currently a problem with the duplication of unnecessary information that usually expresses general features and uses non-special language. Therefore, there has been strong criticism against the disclosure of duplicate and unnecessary information, which is why some believe that describing a business model (BM) is a different perspective that will improve financial reporting.



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Original Research

Studying the Impact of Exchange Rate Fluctuations on Tax Revenues in Iran's Economy

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Abstract

One of the most significant sources of government funding that has an impact on social and economic trends is tax income. One of the most significant elements impacting macroeconomic variables, particularly tax income, are exchange rate swings. In this regard, the current study has looked at the impact of currency rate changes on tax receipts in the Iranian economy from 1979 to 2018. The World Bank, the Iranian Statistics Center, and the Central Bank of the Islamic Republic of Iran's economic time series databases were used to extract the necessary data. To do this, the actual exchange rate fluctuation was first calculated using the Generalized Autoregressive Conditional Heterogeneity Variance (GARCH) model, and the required relationships were then estimated using the Autoregressive Distributed Lag (ARDL). The study's findings indicated that increased exchange rate swings when a firm is open and have an impact on tax income and put it at risk, which causes a short-term decline in tax revenue.

Keywords: Exchange rate fluctuations, tax revenues, Iran's economy.

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Introduction

Taxes make up a sizable portion of the government's funding in the majority of nations. The amount of taxes as a percentage of total public revenues vary among nations and is influenced by both their economic structure and degree of development. In a strong economy, taxes are one of the primary and most ethical sources of funding (Lazgi, Amini, Shomali, & Najafi, 2008). Taxes are regarded as the most prevalent and significant source of public funding as well as one of the world's most efficient and effective instruments for implementing financial policies. With the help of taxes, the government can invest in the direction of economic prosperity, growth, and prosperity, offer a wide range of social and welfare services, and control the course of numerous economic and social activities and flows. At the international level, there are three ways to look at the function of taxes: 1) Taxes are the primary source of funding for the central government, hence their collection is required and consistent; 2) By providing public goods and services, taxes assist governments in meeting social and public demands; 3) Governments depend on tax money to maintain the security of the military forces and judicial systems and to establish justice in society (Kim, 2008). The general status of taxes and their contribution to government income is quite important in Iran. This aspect has significantly influenced scientific and experimental investigations because of how it affects the overall economy. Taxes may be seen as one of the government's significant income items when looking at Iran's economy in general and the makeup of the government's income (Jalalund, Shahiki, & Nabi, 2013).

It is crucial to look at the tax situation since it has several implications for Iran's economy from the standpoint of social and economic justice. This includes minimizing the government's reliance on oil income and implementing economic stabilization measures (Aminkhaki, 2012). Despite this, the tax system in Iran has numerous difficulties and has not yet reached its full potential as a source of funding for the government budget because the country relied on oil income. Between 1973 and 2016, the average percentage of oil and tax income in total government receipts was around 55 and 31 percent, respectively. One measure of the contribution of taxes to funding the government budget, the percentage of tax from public budget resources, shows that between 2013 and 2016, the percentage of taxes climbed from around 31% in 2016 to 42% in 2017. This demonstrates that the structure of the Iranian economy and the combination of government budget resources are dependent on non-tax revenues, with oil sales providing a sizable portion of the budget resources while the average tax share of the total government revenues in several countries has been higher than 64% in various years (Totunchi-Melki, Mousavi Jahormi, & Mehrara, 2020). In addition to the unfortunate complications such as the country's income dependence on the export of a commodity, the high share of resources from the sale of oil and the low share of tax collections in the composition of the government's general budget resources have prevented the country's economy from being able to use taxes to implement fiscal policy more effectively. Therefore, to increase the proportion of tax revenues to GDP, the planners and policymakers of the tax system should be able to identify the most significant influential variables in this field and recognize the direction of their influence. This is because of the effective factors that increase or decrease taxes in the structure of Iran's economy (Shahson & Mousavi Shahroudi, 2011).

By fostering an unstable and uncertain situation in the area of profits from foreign exchanges, frequent swings and ongoing uncertainty in real exchange rates might result in a decline in tax collections. The performance of the nation's economy may be impacted by the actual exchange rate shift due to the variety and competing changes it causes in both local and international sectors. The process of saving and investing will often become irrational when the stability of the real exchange rate is disrupted, and the best potential allocation of resources won't be achievable. In an international system, the national currency's value will be crucial in determining the costs associated with investments, exports, and imports, as well as its effect on economic growth. Frequent exchange rate changes reduce commerce by making the economy unpredictable and limiting the flow of money by causing a decline in foreign investment and the collapse of the portfolio of financial assets. Additionally, when the real exchange rate fluctuates more frequently and with greater intensity, the cost of tradable products rises as well as the risk of having to cover unanticipated changes in the actual exchange rate (Shiri, Hosseini, & Ashtiani, 2017).

According to what was said, the major goal of the present study is to look at how exchange rate changes affect tax collections in the Iranian economy. In this regard, the impact of the economy's level of openness, the industrial production-to-GDP ratio, per capita GDP, and the inflation rate on tax revenues are all examined. There are five sections to this research. The second section of the essay provides a summary of the domestic and international research that has been done on the topic after the introduction's basic discussion of tax income. The third section introduces the study's model, methodology, data-gathering strategy, and testing. The model is estimated and examined in the fourth section, and then findings and useful recommendations are offered in the fifth section based on the estimates.

Literature review

Numerous research has been done in the area of variables that affect tax income. These studies have extensively looked at structural and institutional variables such as GDP per capita, foreign aid, foreign direct investment, inflation, real exchange rate, free trade, participation ratio in GDP, debt to GDP, corruption, and legality. Exchange rate variations are one of the primary variables affecting tax collection in the interim. The exchange rate, one of the most significant and vital economic factors, has a significant influence on how economic players behave and make decisions about how to allocate resources (Nakhjavani, 2014). Demand and supply across the whole economy are impacted by exchange rate variations or positive or negative exchange rate shocks. Positive exchange rate shocks will drive up export prices while driving up import prices, increasing local demand for products. Because abnormal exchange rate fluctuations raise the cost of imported commodities, which in turn raises inflation, there is a cause-and-effect link between abnormal exchange rate fluctuations and reduced buying power. The significant exchange rate changes force exporters to either cease operations or seek more profits in return for greater risk. The rise in profit desired by exporters and importers will be reimbursed to purchasers through more costly sales as a result of the country's incapacity to establish global pricing; as a result, there will only be a price increase and inflation (Engle & Ng, 1993). Several studies have been undertaken in the area of examining

variables impacting tax revenues and the effect of exchange rate variations on financial performance; the most significant of them are highlighted here.

In a study, Totunchi-Melki et al, assessed the variables influencing tax receipts in the Iranian economy from 2010 to 2016. They adopted the strategy of dynamic averaging models for this (TVPDMA). According to the study's findings, the factors that have the most influence on the rise of direct taxes in the Iranian economy are the economy's degree of openness, the development of the construction budget, inflation, the average tax rate, and the increase of real earnings. In addition, the most significant factors influencing the growth of indirect tax revenues are, in order, real income growth, the growth of the construction budget, inflation, the size of the black market, the exchange rate of the informal market, and the value-added ratio of the service sector to the GDP (Totunchi-Melki et al., 2020). A study entitled "Investigating the Impact of Government Tax Revenues on the Prosperity of Iran's Economy for the Period of 2013-2015" was undertaken by (Fuladi, Kakai, & Khairdast, 2018), They applied the Autoregressive Distributed Lag (ARDL) in this case. The findings of this study demonstrated a correlation between the variables that were investigated. Additionally, it was confirmed that all of the model's variables had a significant and favorable relationship in the short term, with the income from import taxes having the greatest impact on economic growth. Wealth tax, income tax, and value-added tax do not, however, appear to have a substantial long-term effect on Iran's economic growth (Fuladi, Kakai, & Khairdast, 2018). In a research published in 2018, Aqiqi (2018) examined the effects of tax collections and their variations on economic development from 2019 to 2026. In this work, the modified least squares approach was used to estimate the economic-growth model. The findings suggest that as each of the three variables—population growth, openness level, and changes in national production—increases, so will economic growth. The outcomes also demonstrated that the variable representing government tax income and its variations lacks the requisite importance in this model (Aqiqi, 2018).

In 2017, Akbari et al. looked at the connection between tax collections and economic security in Iran. They employed the Winston-Price regression estimation approach and data from the 1361 to 1395 time period to achieve this. The analysis' findings show that giving economic stability leads to increased investment opportunities (particularly for the private sector) and higher tax revenues. As a consequence, it is advised that doing so will enhance both of these (Akbari, Al-Raji, & Shams-Esfandabadi, 2017). In a research published in 2017, Tamizi used a Bayesian econometric methodology and the technique of moving averages (MBA) to examine the factors influencing tax receipts in Iran between the years 2010 and 2012. The findings of this study demonstrated a positive relationship between the variables of literacy rate, GDP growth, population growth, the added value of the industry sector, and government expenditures, as well as a negative relationship between the variables of the exchange rate, Gini coefficient, the added value of the agricultural sector, revenues, and added value of the oil sector. Additionally, the results showed that altering the economic structure, raising the proportion of the industry, industrializing the agricultural sector, reforming tax laws, and offering effective implementation options to lower large investors' tax evasion will all play a significant role in raising the effectiveness and efficiency of the tax system (Tamizi, 2018). To better understand the connection between exchange rates and taxes in emerging nations, Atayyeh and Taftani Eskoui performed research. They examined the relationship between

exchange rate variables, GDP, population, government consumption expenditure, and government investment expenditure with tax revenues in 9 selected developing countries from 2002 to 2015 using the panel co-integration technique and the ordinary least squares (OLS) approach. According to the findings, there was a significant correlation between the aforementioned factors and tax receipts during the research (Atayyeh & Taftani Eskoui, 2016) Kwesi et al, analyzed the effect of exchange rate variations on tax revenue in research. They employed the GARCH approach and the Autoregressive Distributed Lag (ARDL) in this respect. The study's findings demonstrated that exchange rate variations have an impact on tax revenue both in the short and long term, but that the long-term impact is bigger than the short-term impact. This paper makes the recommendation that planners and policymakers step up their exchange rate stability efforts to lessen the currency risk placed on global commerce (Kwesi Ofori, Obeng, & Armah, 2018).

Research by Tracy and Blagg examined how Kansas's income tax reductions affected job growth in the short run. Using the information on the number of workers and owners, they used a difference-in-differences (DID) technique to analyze the impact of changes to Kansas' private sector employment tax in comparison to border states. Additionally, they discovered the effects of taxes by applying the sector boundary matching method and the multi-state fixed effect model. Their findings demonstrate that two years following the tax law's enactment, revisions made to it did not result in a net rise in the number of jobs in the private sector (Turner & Blagg, 2018).

Lagat & Nyandema, investigated how changes in foreign currency rates affected the financial performance of commercial banks listed on Kenya's Nairobi Stock Exchange. Additionally, data on cases from the years 2006 to 2013 was gathered. Pearson's correlation coefficient was employed in this study to examine the correlation between the study variables. The study's findings revealed a substantial positive association between financial performance measures and exchange rates, indicating that the volatility of the exchange rate has aided in the rise in bank profitability (Lagat & Nyandema, 2016).

Using data from 261 multinational firms between the years 1984 and 2002, Lee and Sun researched the changes in the exchange rate and the operational performance of multinational corporations. The findings demonstrated that, in the majority of the examined industries, the impact of exchange rate changes on the profitability of foreign operations is not statistically significant, and in the majority of these industries, the profitability of foreign operations was less than 2% when exchange rate changes were taken into account. Additionally, the impact of currency exchange rate fluctuations on the profitability of overseas operations has been minimal for non-American multinational corporations including those in Australia, Canada, Japan, and the United Kingdom. The findings of the studies show that exchange rate changes, as one of the significant and crucial factors of the economy, have a significant influence on how economic players behave and make decisions about how to allocate resources. Changes in exchange rates can affect tax collection in both the short and long terms. Widespread exchange rate swings, which are a feature of emerging nations, make it difficult for business and production choices to be made, which has an impact on macroeconomic factors, particularly the government's revenue sources (Lee & Suh, 2012).

Methodology

The real variation of the exchange rate was determined in this study utilizing the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model. The following analyses time series data using an Autoregressive Distributed Lag (ARDL) to examine how exchange rate variations affect tax receipts in the Iranian economy. The variables considered in this study include the tax revenue to GDP ratio, the inflation rate, the industrial production to GDP ratio, the GDP per capita, the degree of economic openness, and exchange rate volatility. The World Bank, the Iran Statistics Center, and the Central Bank of the Islamic Republic of Iran's economic time series database were used to compile the necessary data for the variables for the years 1979 to 2018.

Unit root test

The unit root test, in particular, is employed for this purpose. Observing a variable's time series graph is the first step in establishing its mean, however, for some variables, the mean cannot be determined from the graph alone. The unit root test, to put it simply, is a test used to determine whether a time series is normal. Being invisible means having a single root. Dicky and Fuller introduced one of the most well-known tests to determine if a series contains a unit root in 1976, and (1979). In the first-order self-explanatory process (AR(1)) shown in equation (1), the test's primary goal is to compare the null hypothesis $\phi=1$ (the existence of a single root and variable indeterminacy) against the hypothesis $\phi<1$:

$$y_t = \phi y_{t-1} + u_t \quad \text{Equation (1)}$$

We shall infer that the variable is mean if the null hypothesis (H_0), which rules out the presence of a unit root, is rejected. The generic model (2) presents the unit root (root = 1) or invariance, which can take one of three forms: (1) without width from origin and trend; (2) with width from origin and trend; or (3) with width from origin and trend:

$$y_t = \mu + \beta t + \phi y_{t-1} + u_t \quad \text{Equation (2)}$$

The time series is considered to be a first-order self-explanatory process in the Dickey-Fuller test. If the time series under examination has an order n self-explanatory process and this assumption is false, the relationship calculated for test n will not have the proper mean specification. This will result in the autocorrelation of the regression error sentences, making it impossible to utilize this test in this situation. Instead, the Augmented Dickey-Fuller test (ADF) should be applied. The Dickey-Fuller test is expanded upon in the ADF test used Δy_{t-i} for higher-order self-explanatory processes (Nofarsti, 2012).

Durbin-Watson test

When using time series analysis with an autocorrelation model, the residuals of the unit lag model or AR(1) model should be independent from one another. Durbin-Watson (DW) test is a method to detect correlation in residuals of regression model analysis. DW testing may be used to verify this. A model's parameters may not be estimated accurately if there is autocorrelation since it makes it difficult to estimate variance and standard

deviation. In this manner, the DW test is efficient and helps to ensure the accuracy of the analysis findings. The Durbin-Watson test's presuppositions are as follows:

Null hypothesis: Here, there is a first-order absence of autoregression. In terms of the autocorrelation function, or ACF, this indicates that for the data (residuals), there is either no correlation between the residuals at time t and $t-1$ or it is zero.

Counter hypothesis: Serial correlation exists between observations or residuals of unit lag in the Durbin-Watson test. As a result, even if this dependency is defined by ACF (1) 0, the correlation between the residuals of time t and $t-1$ is opposite to zero. The model's residuals need to be average, which denotes that neither the mean nor the residuals' direction should vary over time. This is another prerequisite for time series analysis.

Generalized Autoregressive Conditional Heteroscedasticity Model (GARCH)

As previously indicated, this Generalized Autoregressive Conditional Heteroscedasticity model is used to calculate the real exchange rate variation (GARCH). Generalized Autoregressive Conditional Heteroscedasticity (ARCH) model was first presented by Engel (1982). The conditional variance may be estimated using this model, which is used to calculate uncertainty changes over time. The following equation serves as a representation of the ARCH(q) model:

$$h_t = \alpha_0 + \sum_{j=1}^q a_{1j} u_{t-j}^2 \quad \text{Equation (3)}$$

Equation (3) was provided as equation (4) by Ballerslow (1986), who created the conditional variance model by including h_t intermittent values:

$$h_t = \alpha_0 + \sum_{j=1}^q a_{1j} u_{t-j}^2 + \sum_{j=1}^p a_{2j} h_{t-j} \quad \text{Equation (4)}$$

The pattern in Equation (4) is GARCH (p, q). To identify the GARCH model, the coefficients a_{1j} and a_{2j} must establish the requirement of being non-negative and the equation $\sum_{j=1}^q a_{1j} + \sum_{j=1}^p a_{2j}$ must meet the criterion of significance.

Autoregressive Distributed Lag (ARDL) model

The description of this approach is provided in this portion because the goal of the study is to examine how exchange rate variations affect tax revenues in the Iranian economy using the time series analysis method of the Autoregressive Distributed Lag (ARDL) model (Pesaran & Shin, 1995) demonstrate that if Autoregressive Distributed Lag (ARDL) model whose intervals are well described is created as a covariate vector using the least squares approach. The least squares estimator will have a normal distribution in addition to being less biased and more effective in small samples. The $ARDL(p, q_1, q_2, \dots, q_k)$ pattern may be stated in the general form as follows:

$$\begin{aligned}\phi(L, P)Y_t &= \sum_{i=1}^k \beta_i(L, q_i)X_{it} + \delta' W_t + \alpha_t \\ Q(L, P) &= 1 - \phi_1 L - \phi_2 L^2 - \dots - \phi_p L^p \\ \beta_i(L, q_i) &= \beta_{i0} + \beta_{i1} L + \dots + \beta_{iq_i} L^{q_i}\end{aligned}\quad \text{Equation (5)}$$

In equation (5), L is the first-order time delay operator $LY_t = Y_{t-1}$, Y_t is the dependent variable, X_{it} is the vector of explanatory variables, k is the number of explanatory variables, (q_1, \dots, q_i) is the number of optimal lags related to each of the explanatory variables, p is the number of optimal lags related to the dependent variable, and W_t is the vector of deterministic variables such as latitude from the origin, seasonal variables, time trends or exogenous variables with constant lags. Microfit software can be used to estimate Equation (5). This software determines the number of $(m+1)^{k+1}$ distinct regression estimates for the aforementioned equation using the ordinary least squares approach for all values of $p=0, 1, 2, \dots, m$ and $q_i=0, 1, 2, \dots, k$ and $i=1, 2, \dots, k$. All models are estimated throughout the same time $(t = m+1, \dots, n)$, with the researcher first determining the maximum number of interruptions, or d . This indicates that the resulting model loses m degrees of freedom since m primary data were discarded during estimation. The following stage involves choosing the model's optimum intervals using one of the Akaike (AIC), Schwartz-Baysin (SBC), Hanan-Quinn (HQC), or modified coefficient of determination \bar{R}^2 criteria. Pesaran and Shin provide the Schwartz-Bayesian (SBC) criterion as an alternative to the aforementioned standards for the optimal model interval definition. This criterion reduces the number of lags due to the limited sample size, which reduces the number of degrees of freedom. This criterion is employed in this study to establish the ideal number of lags. The Microfit software computes the long-term coefficients and their lateral standard error while providing the diagnostic test results based on the estimated coefficients of the chosen ARDL model. It offers an error correction model (ECM) in addition to the program in question, depending on the model chosen. The variables X_{1t}, \dots, X_{kt} , Y_t , and W_t are considered in terms of values with a first-order interval and difference to extract the ECM pattern based on the ARDL pattern $ARDL(p, \hat{q}_1, \dots, \hat{q}_k)$, and the ECM pattern is obtained as follows:

$$\begin{aligned}\Delta Y_t &= -\phi(L, \hat{P})EC_{t-1} \\ &+ \sum_{i=1}^k \beta_{i0} \Delta X_{it} + \delta' \Delta W_t \\ &- \sum_{j=1}^{\hat{p}-1} \phi_j^* \Delta Y_{t-j} - \sum_{i=1}^k \sum_{j=1}^{\hat{q}_t} \beta_{ij}^* \Delta X_{i,t-j} + U_t\end{aligned}\quad \text{Equation (6)}$$

To connect short-term fluctuations of variables with their long-term variations, the ECM model of equation (6) is employed. The error sentence arising from the estimation of equation (5), which is entered with a time interval, is known as the error correction sentence (EC_{t-1}). The short-term dynamic structure of the model is established by carrying out the relevant tests after estimating the aforementioned equation using the OLS technique. The parameter EC_{t-1} in the aforementioned error correction model represents the rate at which long-term equilibrium is approaching. This coefficient displays the

percentage of the dependent variable Y_t 's imbalance from the prior period that has been made up in the present period.

This variable is anticipated to have a negative sign and a value shift from zero to one. In general, the ARDL technique suggests the following two-stage modeling approach:

Step 1: The hypothesis that there is no auto-regression between the variables of the pattern is evaluated after first calculating the index connected to the long-term pattern using statistics related to the level of the variables. By doing this, we will be able to produce a group of variables that work well together and offer a long-term equilibrium connection.

Step 2: The long-term mean model's regression error term, also known as the error correction term, is utilized in the ECM model as an explanatory variable. The ECT coefficient displays the rate of equilibrium adjustment.

Specifying the experimental model

According to Ofori (2018), the regression model below is used in this study to examine the impact of exchange rate variations on tax collections in Iran's economy:

$$\ln\left(\frac{TR}{GDP}\right)_t = \beta_0 + \beta_1 \ln INF_t + \beta_2 \ln IND_t + \beta_3 \ln GPC_t + \beta_4 \ln OPN_t + \beta_5 \ln EXV_t + \varepsilon_t \quad \text{Equation (7)}$$

In equation (7), TR/GDP stands for the tax revenue to GDP ratio, INF for the inflation rate, IND for the industrial output to GDP ratio, GPC for the per-capita GDP, OPN for the economy's degree of openness, and EXV for exchange rate volatility. Within the context of the ARDL approach, the regression equation (7) is expressed as follows:

$$\begin{aligned} \Delta \ln\left(\frac{TR}{GDP}\right)_t = & \delta_0 + \phi \ln\left(\frac{TR}{GDP}\right)_{t-1} + \alpha_1 \ln INF_{t-1} + \alpha_2 \ln IND_{t-1} \\ & + \alpha_3 \ln GPC_{t-1} + \alpha_4 \ln OPN_{t-1} + \alpha_5 \ln EXV_{t-1} \\ & + \alpha_6 \ln RER_{t-1} + \sum_{i=1}^p \beta_1 \Delta \ln\left(\frac{TR}{GDP}\right)_{t-i} \\ & + \sum_{i=1}^p \beta_2 \Delta \ln(INF)_{t-i} + \sum_{i=1}^p \beta_3 \Delta \ln(IND)_{t-i} \\ & + \sum_{i=1}^p \beta_4 \Delta \ln(GPC)_{t-i} + \sum_{i=1}^p \beta_5 \Delta \ln(OPN)_{t-i} \\ & + \sum_{i=1}^p \beta_6 \Delta \ln(EXV)_{t-i} + \sum_{i=1}^p \beta_7 \Delta \ln(RER)_{t-i} \varepsilon_t \end{aligned} \quad \text{Equation (8)}$$

As shown, Long-term tensions are represented by ϕ and α_i and short-term tensions by β_i .

Results

In this study, time series data from the years 1979 to 2018 were utilized to examine how changes in the exchange rate affected tax collections in the Iranian economy. The time series of the examined period's GDP, tax revenue, industrial output to GDP ratio, level of economic openness, inflation rate, and real exchange rate at the base price of the year (1390) are depicted in graphs (1) through (6), respectively. It is vital to clarify that the nominal exchange rate and the ratio of the consumer price index (CPI) between Iran and the United States are used to compute the actual exchange rate. The figures show that the GDP variable initially had a steady trend and varied between 2001 and 2018. Beginning with a stable trend, the variable TR then had an increase trend from 2010 to 2017. The variables IND, OPN, and INF display varying trends across the examined time. The RER variable likewise exhibits an increasing tendency, however, since 2019, the variable's behavior has been erratic.

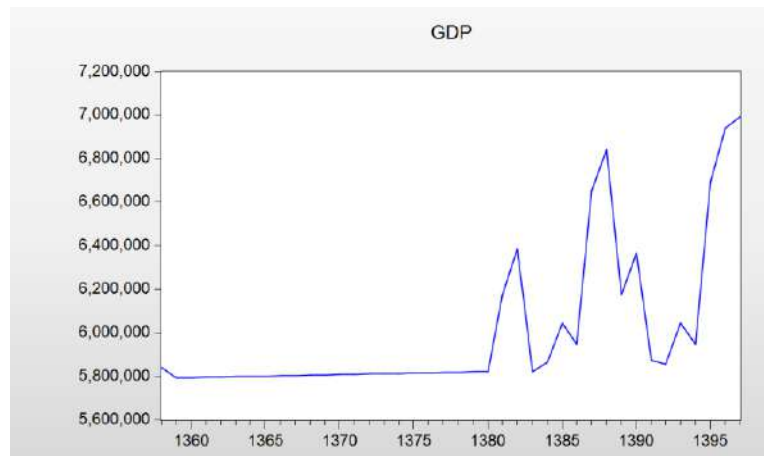


Chart 1. The trend of the gross domestic product during 1979-2018

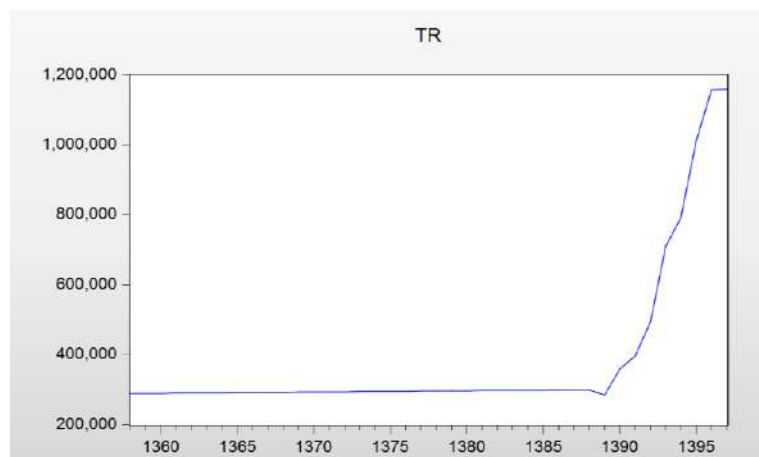


Chart 2. The trend of tax revenue during 1979-2018

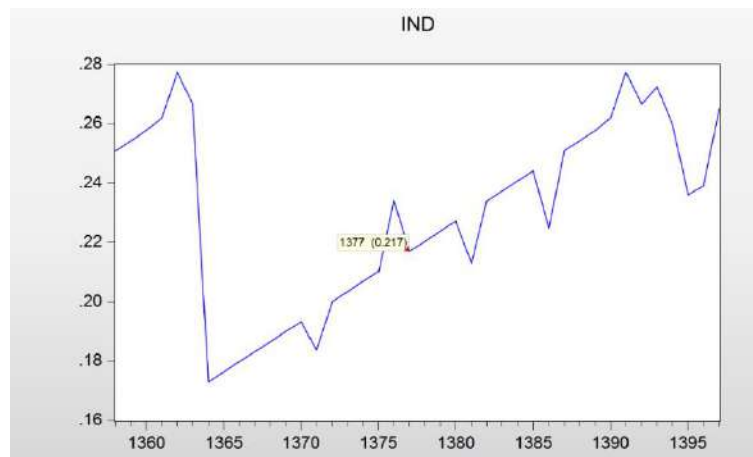


Chart 3. The trend of the ratio of industrial production to GDP during 1979-2018

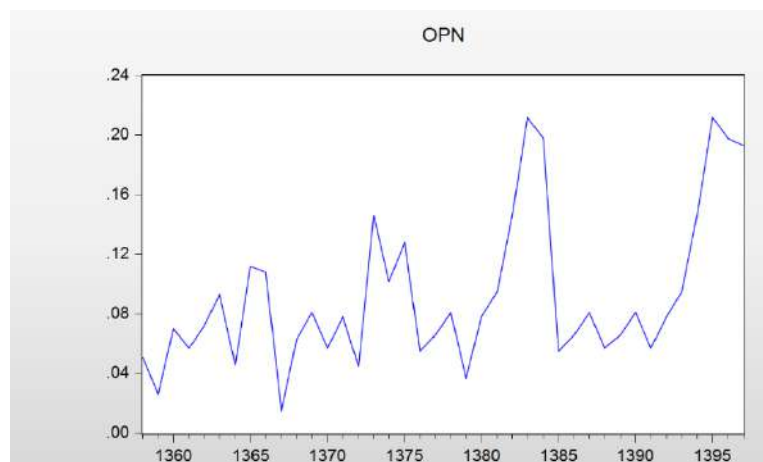


Chart 4. The trend of the degree of economic openness during 1979-2018

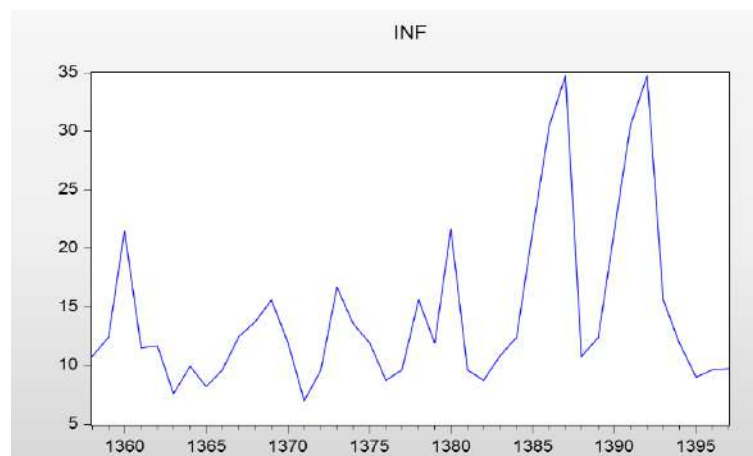


Chart 5. Inflation rate trend during 1979-2018

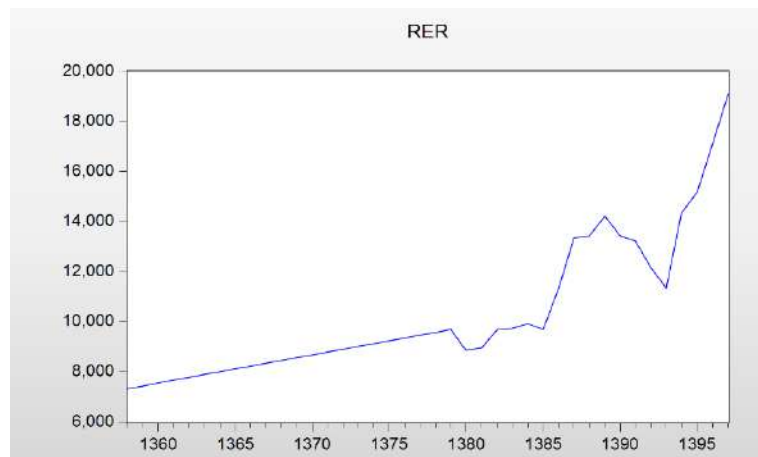


Chart 6. Real exchange rate trend during 1979-2018

Statistical features of variables

The statistical features of the analyzed variables, including kurtosis, skewness, mean, standard deviation, maximum, and minimum, are described in the table below before the research's hypotheses are put to the test. Table 1. shows that all of the data are non-normal, hence the variables needed to be transformed into a normal form using the logarithm of the variables.

Table 1. The statistical features of the studied variables

	GDP	The ratio of industrial production to GDP	Inflation rate	Degree of economic openness	Real exchange rate	tax income
Mean	5855406	0.230	14.428	0.093	10309.04	387564.7
Median	5818736	0.235	11.9	0.078	9299.49	295927.7
Maximum	6990834	0.277	34.7	0.12	19085.23	1159562
Minimum	5791904	0.173	7	0.015	7337.24	284527.9
SD	4.349475	0.031	0.235	0.052	2811.266	234317.9
Skewness	1.751059	-0.305	1.637	1.066	1.352	2.507
Kurtosis	4.720308	1.875	4.757	3.226	4.181	7.877
Jarque-Bera	25.37381	2.728	23.007	7.663	14.513	81.369
Probability	0.000003	0.256	0.00001	0.217	0.0007	0

Model implementation and tests analysis

Testing the importance of each of the employed variables is important before estimating the model that is provided. The significance was examined using the Autoregressive Dickey-Fuller (ADF) test, as described in the part above. This test's null hypothesis reveals that the variables are non-stationary. In this instance, the null hypothesis will be rejected if the probability values are less than 0.05. In this approach, Table 2. displays the results of the stationary test for the data.

Table 2. The results of the stationary test for variables using ADF

Variable name	test ADF		Result
	Statistics	Critical statistic at 5%	The variable is stationary at the level:
tax income	-5.617***	-3.610	I(0)
Degree of economic openness	-2.799**	-2.607	I(0)
Inflation rate	-4.528***	-3.615	I(0)
The ratio of industrial production to GDP	-3.328**	2.948	I(1)
GDP per capita	-6.455***	3.610	I(0)
Real exchange rate	-6.686***	3.610	I(0)
Exchange rate	-4.948***	-3.615	I(1)

As Table 2. shows, the Autoregressive Dickey-Fuller statistic (ADF) calculated for all variables, except the variables industrial production to GDP ratio (IND) and exchange rate volatility (EXV), is greater in absolute value than the critical statistic, rejecting the H_0 hypothesis or the idea that these variables have a single root. With just one difference, the ADF statistic associated with the two variables IND and EXV, which are at the unimportant level, is bigger than the crucial statistic, demonstrating the variables' significance.

Extracting the currency volatility index

The existence of conditional heterogeneity variance is assessed in this part to look at the possibility of ARCH effects. The ARCH-LM statistic was utilized for this purpose, and the results are shown in Table. The equality of variances, the null hypothesis of the test, has been rejected based on the probability level of the F statistic, hence the results indicate that there is conditional heterogeneity variance. Since the intended variance, or the variance of exchange rate swings, cannot be constant, the presence of ARCH effects is acknowledged at a confidence level of 1%.

Table 3. Results of the ARCH-LM test for the residuals of the exchange rate time series

Statistics	Probability level
F statistics	0.000
observational R^2 statistic	0.000

The relevant model may be calculated in this way. The GARCH (1,2) model was shown to perform better than other models in describing the variance of the heteroskedasticity after a review of the ARCH family models. To predict exchange rate variations, this model was utilized; the results are shown in Table 4.

Table 4. GARCH estimation for the residuals of the exchange rate time series

Variable	Coefficients	Z statistics
C	65.92	8.02
Variance equation		
C	0.00137	0.390
RESID (-1)^2	2.007	4.001
GARCH (-1)	0.453	0.241

The model is shown in Table 4.'s findings as equation (9), and it is evident from the DW statistic that the residuals do not exhibit any correlation:

$$\sigma_t^2 = 0.00137 + 0.453\sigma_{t-1}^2 + 2.007\varepsilon_{t-1}^2$$

$$R^2 = 0.8 \quad DW = 2.1$$

Equation (9)

Model estimation by ARDL method

The ideal interval should be chosen to estimate the model. The Schwartz-Baysin criteria have been applied for this purpose. The findings of this statistic indicated that two is the ideal interval. First, the short-term ARDL coefficients were calculated with the difference in factors in mind; the results are shown in Table 5.

Table 5. Short-term coefficients of the ARDL model (1,0,0,0,0,1,1) (dependent variable: the difference in the ratio of tax revenue to GDP)

Variable	Coefficient	Standard error	T statistics
TR/GDP(-1)	0.282***	0.173	1.627
EXV	-3.63**	1.48	-2.453
GPC	1.45	8.13	0.177
IND	-0.782*	0.604	-1.294
INF	-0.002**	0.001	1.288
OPN	-0.493**	0.384	-2.455
OPN(-1)	-0.719*	0.409	1.757
RER	0.014	0.104	0.134
RER(-1)	-1.54*	1.08	-1.43
C	0.216*	0.152	1.416
S.E. of regression	0.0838	Akaike info criterion	-1.902
Sum squared resid	0.203	Schwarz criterion	-1.476
Log likelihood	47.104	Hannan-Quinn criter.	-1.749
F-statistic	1.473	Durbin-Watson stat	2.15
Prob(F-statistic)	0		

***: significance level of 1%, **: significance level of 5% and *: significance level of 10%

The findings of Table 5. indicate that the per capita gross domestic product (GPC) is not statistically significant. At 10%, there is a significant negative correlation between industrial production as a percentage of GDP (IND) and tax revenue. At 5%, the inflation

rate (INF) also significantly negatively affects tax income. In both periods, there is a significant inverse relationship between tax revenue and the openness of the economy (OPN) variable. At a level of 10%, the real exchange rate variable (RER) and tax revenue have a significant negative relationship in the second period but a non-significant positive relationship in the first. Tax income is impacted by the rise in exchange rate fluctuations (EXV) in the context of openness of trade (OPN), and because of the risk it poses, it suffers in the near term.

The long-term form and F-Bounds test are used in the following to demonstrate the presence of a long-term relationship and co-accumulation between variables. The table contains the test's findings at a significance level of 5%. For 31 to 80 observations, the computational limits of Narian (2004) are simulated and determined. The findings of Narian banks are displayed in the following table for a total of 40 variables.

Table 6. Long-term relationship test between variables

	F-statistic	Limited sample = 45	
		I(0)	I(1)
(Number of actual samples = 40)	5.190	3.15	4.43

There are two upper and lower bands on this exam. If the F-statistic is higher than the upper band, the co-accumulation connection is verified; if it is lower than the lower band, there is no co-accumulation; and if it is in the middle of these two bands, it is unclear with certainty whether there is or is not an autoregressive relationship. It is possible to extract the long-term relationship between the variables based on the acquired F statistic since its value is larger than the upper band and confirms the presence of co-accumulation vectors. The findings are shown in Table 7.

Table 7. Long-term coefficients of the ARDL model (dependent variable: ratio of tax revenue to GDP)

Variable	Coefficients	Standard error	t-statistics
EXV	0.000004**	0.00001	2.561
GPC	0.0002	0.001	0.177
IND	0.804*	0.591	1.361
INF	-0.002*	0.0017	-1.33
OPN	-0.230	0.408	-0.564
RER	-0.000002	0.000002	-0.869
C	0.222*	0.146	1.522

** : significance level of 5% and * : significance level of 10%

Findings shown in Table 7., make it evident that over the long run, there is a large direct link between exchange rate variation (EXV) and tax revenue. The computed coefficient states that a one percent increase in this variable results in a 0.000004% increase in tax income. In the long run, there is no significant relationship between GDP per capita (GPC) and tax revenue. At a level of 10 percent, there is a large direct and inverse link between the ratio of industrial output to gross domestic product (IND) and the inflation rate (INF) to tax revenue. An error correction model was calculated to see if

short-term imbalances will balance out over time, and the findings are displayed in Table. The short-term model's estimated $Ecm(-1)$ coefficient, which is statistically significant and represents the rate at which the short-term balance adjusts toward the long-term balance, is 0.79, according to the findings of Table 8.

Table 8. Coefficients of the error correction model (dependent variable: the difference in the ratio of tax revenue to GDP)

Variable	Coefficients	Standard error	t-statistics
EXV	0.0004**	0.0001	2.453
GPC	0.0002	0.001	0.271
IND	0.782**	0.604	1.294
INF	0.002*	0.001	1.288
OPN	-0.943**	0.384	-2.455
RER	0.0000001	0.000001	0.013
$Ecm(-1)$	-0.791***	0.173	-5.596

***: significance level of 1%, **: significance level of 5% and *: significance level of 10%

Discussion and conclusion

This study aims to investigate the impact of currency fluctuations on tax receipts in the Iranian economy. This information was gathered from the Central Bank of the Islamic Republic of Iran, the Iran Statistics Center, and the World Bank and relates to the variables of the ratio of tax revenue to GDP, inflation rate, the ratio of industrial production to GDP, GDP per capita, the degree of economic openness, and exchange rate fluctuations between 1979 and 2018. Following, the Generalized Autoregressive Conditional Heterogeneity Variance (GARCH) was used to determine the real exchange rate fluctuation, and the Autoregressive Distributed Lag (ARDL) model was used to estimate the relationships between the tax income variable and the aforementioned variables. According to the results, the actual exchange rate's short-term fluctuations have a delayed impact on tax collection. The statistical evidence demonstrates that the increase in exchange rate fluctuations when the business is open has an effect on tax revenue and due to the risk it imposes on it, it results in a decrease in tax revenue in the short term. This is significant given that the import of capital and intermediate goods is one of the primary sources of tax revenue. To put it another way, frequent volatility and ongoing ambiguity in real exchange rates might result in a decline in tax revenues by causing an ambiguous and unstable situation in terms of the benefit from global exchanges. The findings of this study are in line with those of Totunchi-Melki et al. (2016), Lagat & Nyandema (2016), Osandina et al. (2016), Isak et al. (2018), and Ataiyeh and Paitakhti Oskoie (2017).

It may be said that if government expenditures are financed by the production of new money, it will not have any long-term influence on the real exchange rate when describing the long-term impact of exchange rate variations on tax collections. In actuality, this situation reflects the true nature of fiscal policy, which primarily focuses on the breakdown of the government's demand for tradable and non-tradable commodities. The price of non-tradable commodities rises in response to an increase in government

expenditure on non-tradable items that are funded by a lump-sum tax, which also works to support the long-term real exchange rate. The findings of this study are in line with those of Kwesi et al (2018).

The results show that better steps should be taken by monetary policymakers in the short term to control exchange rate swings. For instance, the short-term interest rate can be adjusted to reflect the efficiency of the actual economy's sectors, which in turn reduces the demand for money from speculators in circumstances when the exchange rate is significantly rising. To lessen exchange rate swings, it is also essential to manage the factors (budget deficit, trade imbalance, and liquidity growth) that contribute to these changes.


To enhance tax revenues while avoiding a rise in production costs, the government can lower the inflation rate by employing workable alternatives, such as limiting a fast increase in societal liquidity and restricting the conversion of oil dollars into Rials. To connect with international organizations and lift sanctions, the government should also work to stabilize the value of the national currency and boost tax collections. By studying the commercial and economic environment of the nation and drawing on the experience of other nations, the auditing organization, the organization in charge of compiling accounting and auditing standards, should provide a comprehensive reporting environment, ensuring that the minimum information requirements of exchange rate fluctuations are met.

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