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Ranking of Financial and Electronic Debts Using Analytic Hierarchy Process (AHP)

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Abstract
Financial and electronic debts are one of the important issues in Iran's financial scope that are considered by economists due to their role in creating financial instabilities. Therefore, a model was represented in this survey to evaluate and rank financial and electronic debts in Iran including foreign debts, governmental debts, non-governmental debts and banking debts during the period 1999-2012 using analytic hierarchy process (AHP). To this end, four indexes of volume of debt, ability to repay, willingness to repay and return rate of debts were identified and paired comparison of debts was conducted given to the research literature in this scope and interview with experts. Then total weight of each index was calculated, score of each index was exploited and finally ranking of all kinds of financial and electronic debts was determined by sum of the score of indexes. Expert Choice 11 software was used to calculate the weights.

Key words: financial and credit debts, ranking, analytic hierarchy process (AHP)

1- Introduction
Fisher (1682) in his famous study refers that it is possible to claim that economic variables have equilibrium only in imagination. According to him, economic theories could be studied in two frameworks: imaginary ideal equilibrium (that could be stable or instable) and lack of economic equilibrium. Even in balanced status and intention for stability a situation might be created in which the economy leaves the balanced state and will have a special status. Therefore, irreversible instability is obtained and numerous evidences of such crises could be

observed in the history. Financial crises are in a way that when most debtors are bankrupted, it will most probably led to collapse of the economy and not returning to equilibrium. Theoretically, the economy might be encountered with production limit, consumption, saving, investment and so on higher (or lower) than the favorable status. Thus, the important question is that which variables have been led to serious and irreversible instability in the history. Instability related to money, credit and debt is regarded as the most important factor in economic crisis and instability.

Over in debtness that is resulted in economic instability is occurred in financial scope and its opposition with real scope of economy is considerable. Mechanisms and rules have been enacted in financial literature in order to avoid financial instability to some extent. However, such conditions are imposed on the economy due to the fact that control is impossible. These conditions and mechanisms as well as control tools and indexes are referred below (Aiyagari et al, 1997).

1- Debts
2- Money in circulation
3- Velocity of money
4- Value of assets
5- Interest rates
6- Price levels

Regarding the relationship among the above factors, instabilities due to over in debtness that is one of the most important troubles in financial instability could be mentioned as well as its consequences on the economy and price levels. Bankruptcy of debtors, creditors or both will be expected under over in debtness conditions and is led to a chain of serious consequences such as sales under pressure, decreased currency deposit, decreased velocity of money, reduction of price levels and stagnation, decreased value of assets, loss, reduction of production, trade and employment of the labor force, pessimism and lack of trust in future and re-decreasing of velocity of money, reduction of nominal interest of money, decreased value of stocks and assets, increasing of real interest rate, enhanced bankruptcy, diminished trade, unemployment, banking invasion and bankruptcy of banks. Reduction of prices and increasing of real interest rate mean whatever debtors pay debts, they will get in to debt more and this issue is irreversible (Fisher, 1682). Process of total volume of financial debts and gross domestic product of the country during the period 1999-2012 is shown below.

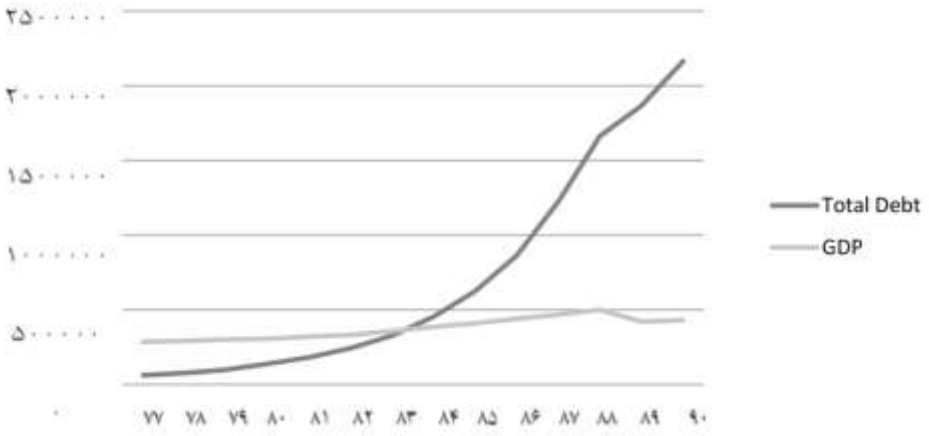

Figure 1- Process of total volume of financial debts and gross domestic product in Iran during the period 1999-2012 (billion Rial)

Source: Central Bank (2012)

As it was illustrated, issue of debt is partial and has time dimension and manner of distribution. In other words, it is not one-dimensional. It means that not only amount of debt but also distribution of debt during a time period is considered based on deadline. Moreover, all kinds of debt including foreign debts, debts of the governmental sector, debts of non-governmental sector and banking debts have a special importance. The above debts were ranked in this survey using analytic hierarchy process (AHP) in Iran for the period 1999-2012 given to the importance of financial and electronic debts. Results of these rankings could be effective on the amount of interest rates related to all of the above debts and prioritization of the existing debts in the country given to the intended indexes in order to enact controlling regulations or modify current rules. In the following indexes of debt evaluation are introduced and identified. Then analytic hierarchy process (AHP) and its steps are mentioned and finally results and conclusion will be proposed.

2- Identifying indexes to evaluate financial and electronic debts

Objective of this paper was to rank financial and electronic debts that was accomplished based on the identified indexes that were confirmed by experts. For this purpose, indexes were classified in four classes including volume of debt, ability to repay, willingness to repay and return rate of debts.

Table 1- indexes to evaluate financial debts

	Evaluation indexes
1	Average volume of each debt during the period 1999-2012
2	Ability to repay each kind of debt
3	Willingness to repay
4	Return rate of debts

Source: research findings

As it was explained, four indexes were determined for evaluation and ranking of financial and electronic debts which were confirmed by experts. It is possible to propose a model to evaluate and rank financial debts through the above indexes and Multiple Criteria Decision-Making (MCDM) especially analytic hierarchy process (AHP). Therefore, AHP method was applied to propose the model and is mentioned in detail in the next section. In this survey different types of financial debts in Iran were selected in four groups and were ranked using analytic hierarchy process (AHP) on the basis of the above indexes. Different groups of debt are displayed in table (2).

Table 2- different types of financial debts

	Type of debt	Explanation
1	Foreign debts	Including foreign short-term and long-term debts
2	Debts of the governmental sector	Including debt of the governmental sector to private banks and non-bank financial credit institutions, debt of the governmental sector to commercial banks, debt of the governmental sector to specialized banks as well as the Central Bank
3	Debts of non-governmental sector	Including debt of non-governmental sector to private banks and non-bank financial credit institutions, debt of non-governmental sector to commercial banks, debt of non-governmental sector to specialized banks

4	Banking debts	Including debt of non-governmental banks and non-bank financial credit institutions to the Central Bank, debt of commercial banks to the Central Bank and other debts of non-governmental and credit institutions, debt of commercial banks and specialized banks

Source: research findings

Several studies have been conducted regarding evaluation and ranking of debts through Multiple Criteria Decision-Making (MCDM) methods especially analytic hierarchy process (AHP). Some of these studies are mentioned briefly in the following.

Table 3- accomplished studies regarding Multiple Criteria Decision-Making methods and analytic hierarchy process (AHP)

Author/year	Objective	The applied approach
Liung et al, 1998	Fishery management	AHP
Shayora et al, 2006	Selection process of seller in new work situation	Multiple criteria decision-making
Solence, 2003	Choosing one option among three options to build a steel melting plant	AHP
Mao Criminsa et al, 2003	A tool to improve public participation	AHP
Jabr et al, 2007	Making semiconductor parts	Fuzzy AHP
Ravi & Reddi, 1999	Ranking Indian coals	Fuzzy MADM
Chan et al, 2004	Determining priority in a safety management system	AHP
Vinjmallen, 2007	Studying an analytical framework of profits, opportunities, costs and risks	AHP-ANP
Geresi & Cacke Oghlu, 2007	Representing a strategic framework for a technology guide	AHP
Bazbura & Beskiss, 2008	Prioritization of indexes to measure organizational capital	Fuzzy AHP
Chiu & Chen, 2007	Validation of patents	AHP
Brant et al, 2006	Building medical services management systems in developing countries	AHP
Wang & Chang, 2007	Evaluation of aircrafts for preliminary flight instruction	TOPSIS
Chung, Chang & Chen, 2006	Evaluation system for army officers	Multiple criteria decision-making
Chung et al, 2006	Optimal-oriented evaluation for strategies of air freight industry	MCDM
Wang & Chen, 2005	Applying relations of fixed fuzzy priority in choosing colleagues	Fixed fuzzy priority
Chu et al, 2007	Comparing group analyses of knowledge associations	MCDM
Narasiman Naidick, Heel & Partovi, 1992; 2001	Problems of selecting sellers	AHP
Tom & Tomalader, 2001	Possibility of using AHP to choose seller of a telecommunications system for a communication company in order to improve group decision-making by a more systematic and reasonable approach	AHP

Source: research findings

3- Analytic hierarchy process (AHP) model

The modeling process of analytic hierarchy process (AHP) includes three stages: structuring the decision problem, measurement and data collection, determining normalized weights and achieving a combinatory solution. Using this three-step approach an AHP model is proposed to evaluate and rank different kinds of financial debts.

3-1 Structuring the problem

This step consists of constituting an appropriate hierarchy through AHP model including objective, criterions and alternatives. Objective of the present survey was to rank financial and electronic debts and this ranking evaluated and prioritized the above debts based on the identified indexes which were confirmed by experts.

The first level of decision hierarchy is objective of the problem as it is shown in diagram (1). The second level includes indexes of decision-making problem which have been proposed as indexes to evaluate and rank debts and includes volume of debt, ability to repay, willingness to repay and return rate of debts. The intended standards in AHP hierarchy could be evaluated through paired comparisons of analytic hierarchy process (AHP) approach at any level. Thus, paired comparisons of volume, repayment ability, willingness to repay and return rate indexes will be conducted given to the objective of decision and relative weight of these indexes with regard to each other will be calculated. These comparisons must be accomplished for all existing factors at any level and then relative weights should be calculated at each level which are called total weights. The lowest level of the hierarchy includes alternatives, i.e. all debts are evaluated for ranking. As it is shown in diagram (1), this survey intended to test and evaluate the proposed model through ranking of four kinds of debts. This is conducted using the proposed method and the exploited indexes.

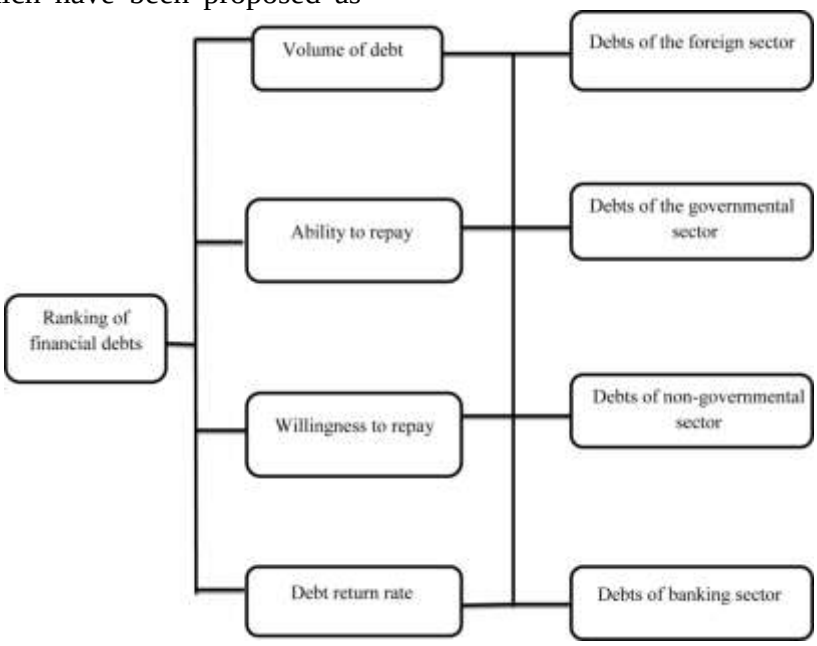

Diagram 2- tree diagram of the problem regarding evaluation and ranking of financial and electronic debts

Source: research findings

3-2 Measurement and data collection

After building AHP hierarchy, the next step is measurement and collection of data that is used in constitution of the evaluation team and conducting paired comparisons in decision hierarchy. Comparisons were conducted by standard AHP questionnaire and its result is represented in the form of paired comparisons matrix. According to theory of Thomas L. Saati (1970), geometric mean approach is used to combine comparators. Four experts (including three faculty members of University of Isfahan and one expert from the Monetary and Banking Research Institute of the Central Bank in Tehran) who have a specific specialty and skill in evaluating different kinds of debt and its related issues were selected to answer paired comparison questionnaires. Higher education related to this topic, work experience and research background were standards of selecting such individuals in debts evaluation unit. A questionnaire including paired comparison matrixes of standards was designed at each level to collect judgments of people about paired comparisons. Reliability of this questionnaire was based on inconsistency ration and should be less than 0.1.

3-3 Calculating normalized weights and obtaining combinatory solution of the problem

As it was mentioned earlier, paired comparisons matrixes obtained by experts were combined at each level of decision hierarchy using geometric mean approach and weight of each intended element along with inconsistency ration of each matrix was calculated using Expert Choice 11 software. These are displayed in table 4.

Table 4- paired comparisons of indexes, total weights and the related consistency rations

Rate incompatibility	Global weighte	Paired comparisons
۰/۰۸۸	۰/۳۴۰	Total Debt
۰/۰۷۳	۰/۱۱٦	.Ability to repay debt
۰/۰۹۰	۰/۰٤۹	Willingness to repay debt
۰/۰٦۷	۰/٤۹٥	Rates of return on debt

Source: research findings

4- Application of AHP in evaluation and ranking of financial and electronic debts

Four indexes of volume of debt, ability to repay, willingness to repay and return rate of debts were identified to evaluate and rank financial and electronic debts and then their significance was calculated using paired comparisons. In order to evaluate and rank different kinds of financial debts given to AHP approach that has been used in the present survey selection is as below considering the standards under study. Given to previous sections, total weights were calculated for the above four indexes that are displayed in table (4). Total score of one kind of debt is calculated through sum of scores of all four indexes about each debt. Therefore, the debt that its total weight or its obtained scores are more than others has priority and ranking is conducted based on descending order of obtained scores. Given to calculation of scores of four kinds of debt, rank of each debt has been determined in table (5). The highest obtained score belongs to foreign debts based on total weights of four kinds of debt.

Table 6- comparing the scores and ranking different kinds of financial debts

Debt Rating	Total Points	Type of Debt
First	۰/۵۷۳	External debt
Second	۰/۱۷۷	NonGovernment debt
Third	۰/۱۲۹	Bank debt
Fourth	۰/۱۲۱	Government debt

Source: research findings

Summarily, results obtained by ranking different kinds of financial and electronic debts based on four identified indexes could be observed in diagram (3).

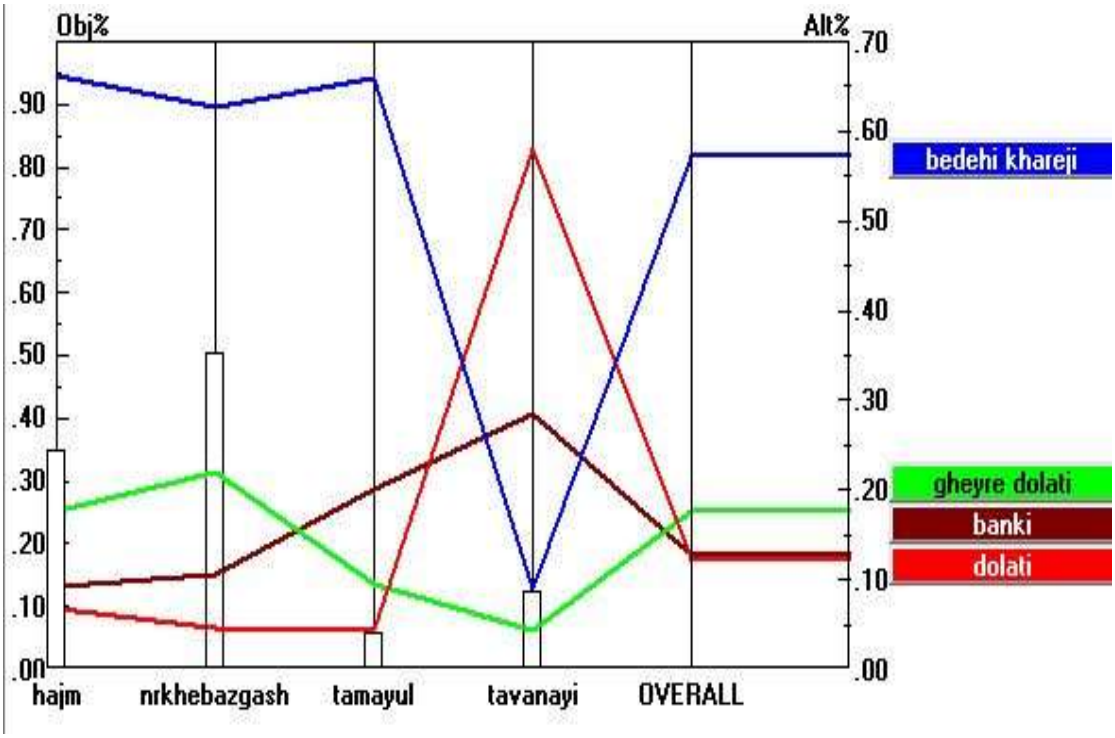

Diagram 3- ranking of financial and electronic debts based on evaluation indexes

Source: research findings

5- Conclusion

Essential indexes for evaluation and ranking of financial and electronic debts have clearly been defined in the present survey and the problem has been structured systematically. This approach enables the decision-maker to consider strengths and weaknesses of traditional assessment systems and adopts an informed decision. A general model was proposed in this survey to evaluate and rank financial and electronic debts by considering four indexes and the intended total priorities were calculated. According to such total weights, four kinds of debts including foreign debts, governmental debts, non-governmental debts and banking debts were ranked. Therefore, it could be concluded that the intended AHP model could help simplify decision-making about interest rates related to each kind of debt as well as more supervision over them.

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