



## Investigating impact of Enterprise Risk Management (ERM) on the bankruptcy risk, using weed and particles swarm optimization algorithms

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### ABSTRACT

Enterprise risk management has a high impact on the improvement of a high-risk an organized culture of an organization in such a way, that it creates a transparent responsibility in relation to the enterprise risks like bankruptcy risk. Risk management operations, shift from a controlling role toward operative role and coordinator of risk management activities in such a way that the risks are clearly accepted by those who are responsible for decision making in the risk.

Therefore, in this study has been paid to the assessment of Enterprise Risk Management (ERM) effect on bankruptcy risk using weed optimization and particles swarm optimization algorithms. To do this research a sample of 107 enterprises which are accepted in Tehran Stock Exchange are selected using sampling method. This study has been done in Tehran stock exchange in the period of 1392-1397. Multivariable regression using data panel and optimized algorithm is the implemented statistical method in this research. The result of this research shows that weed optimization and particles swarm optimization algorithms are capable of predicting bankruptcy risk using elements of ERM. In addition, comparing these two methods of optimization, particles swarm optimization is more efficient in the prediction of bankruptcy risk using ERM variable

### Keywords:

Enterprise Risk Management (ERM), bankruptcy risk, weed optimization algorithm, particles swarm optimization.

## 1. Introduction

The aim of this study is to investigate the effect of enterprise risk management on the bankruptcy risk, using weed and particles swarm optimization algorithms. Recent financial crisis started in the US since 2007, put the risk management on the top of affairs. The basis of risk management is founded on the principle that since the intrinsic duty of each enterprise is creating more value for the shares of the shareholders and at the same time, is facing lots of uncertainties in its business environment, the major manager of the enterprise should be able to recognize how much of these uncertainties to be accepted in order to reach the expected value for the shares of the shareholders and how much to be discarded. The uncertainties in the business can be considered either as fortune or as a threat. Then, enterprise risks typically will have fortunes and risks with themselves. The process of enterprise risk management is based on the goal of identifying the uncertainties, outside and inside of the enterprise, and managing them effectively.

## 2. Theoretical basis and literature review

Value creation of an enterprise becomes maximal, when, the manager is capable of implementing proper targets and strategies to make suitable equilibrium between the growth targets and income, and the corresponding risks. Therefore it can be stated, enterprise risk management causes that the enterprise to be able to move in the determined direction to achieve to the perceived goals despite the events, changes and uncertainties preventing it from happening.

Organizations, governmental legislators, stock exchanges, advisor organizations, rating agencies and universities, all started to consider ERM as a method to eradicate economic complexities. Despite the traditional risk management in which, each group of risks is handled separately in risk bottlenecks, ERM gives the enterprise the possibility of managing the risks as a whole, on a large scale.

With the growth of competition among today organizations and threats and opportunities which has entangled all the organizations in different levels of domestic and international, the concept of risk has gained lots of importance. The mentioned threats can

be in an extent that to cause failure to the organizations. Therefore, the managers, in order to keep and develop an organization, should think about the ways to decrease the undesired risks (walker,2003). Enterprise risk management, with a systematic approach, creates a maximum fortune in an industry and business firm (Porter, 2008). In the production business environment, active industries in pharmaceutical, food and also, clothing sections are facing with higher risk and impact coefficient. Therefore, the importance of executing risk management techniques in these firms is crucial (yon, 2012).

At the present, Iranian enterprises and businesses are under specific economic and social conditions. As the complexity of the environment of these enterprises grow, the businesses are facing with more different kinds of risks that have formerly less confronted with them. Risk management of the firm is designed to the better functioning of the organization (brous, 2010). Firm risk management, with a holistic approach plays a role in the field of optimal control. Researches, show that executing firm risk management, will improve the value creation of the enterprises (niko,2006) and will promote the situation of the organization proportional to the growth of active competitors and industries. Hence, executing the general system of risk management of the firm, for the competition in today's economy is as unsegregable part in the field of enterprises' risk management.

Regarding to the new economic systems and nonstop changes in environmental factors, in specific after the economic crisis in the years 2007, 2008 and bankruptcy of big enterprises, the issue of enterprise risk management (EREM) has been of great importance in managing way of enterprises.

Enterprise risk management (ERM), should support financial solvency and capital management of enterprises and assure the efficiency and effectiveness of the system. Policy makers of the enterprises, In line with the establishment of basic pillars of enterprise risk management (strategic risk management, operational risk managements, reporting risk managements, rules disobeying risk management), should set rules required to the establishment of ERM in order to decrease bankruptcy and financial solvency (financial solvency is an old word, according to the Webster dictionary, it originates to year 1727 and it means: quality or the situation without debt) risk.

Implementation of enterprise risk management, forces enterprise managers to identify, evaluate, control or even reduce their important risks and by this way, control their bankruptcy risk and finally save the rights of shareholders and other beneficiaries. However, in Iran, has not taken yet any effective action in establishing enterprise risk management. Supervisor organizations such as stock exchange organization and audit organization have not legislated any rule in the implementation of risk management in the enterprises. But regarding to the enterprises risk management (strategic risk management, operational risk managements, reporting risk managements, rules disobeying risk management), new actions are needed.

Nowadays, with ever-increase of competition among economic firms, achieving to the limited profit and possible bankruptcy has raised (). In such conditions, reinforcement of the competition advantage and risk management of enterprises (strategic risk management, operational risk managements, reporting risk managements, rules disobeying risk management) can be an important factor in increase of profit and decrease of possible bankruptcy. In the based on “Resources” theory point of view, which is one of the mostly applied theories in describing the difference between performance and outcomes of the organization; management capability is as an invaluable resource which make possible achieving to a sustainable competitive advantage (). In this theory, enterprises are considered as heterogeneous units which are distinguished from each other based on their unique resources and specific properties. This means that strategists, for the success of the enterprise, should coordinate extra-organizational opportunities with resources and capabilities of the enterprise. On this basis, in the view of resources theory, has been emphasized a lot on the enterprises risk management role. Therefore, it is expected that manager’s ability in risk management of the enterprises, through creation of sustainable competitive advantage, to be a factor for commercial success and so decrease the likelihood of bankruptcy of enterprises in today competitive market ().

Bankruptcy risk prediction is one of the most important subjects in the field of financial decision making of the enterprises. In this regard, several models, each one to be different in predictor variables and techniques are introduced but no research yet has been done on the effect of enterprise risk management

(ERM) on the bankruptcy risk using weed and particles swarm optimization algorithms. Therefore, in this research, we aim to investigate the impact of enterprise risk management (ERM) on the bankruptcy risk using weed and particles swarm optimization algorithm to answer, whether or not, implementation of enterprise risk management (ERM); impacts on the bankruptcy risk of Iranian enterprises. To answer this question, all the elements proposed in research model should be considered and then test all the research’s hypothesis. At the end, we would be able to make comment about the effect of enterprise risk management, on bankruptcy risk using weed and particles swarm optimization swarm algorithm.

In the present study, to measure the bankruptcy risk, Richard-Tofler model (2007) will be used. To measure enterprise risk management a collection of techniques suggested by COSO which is built for the risk management and Gordon et al model for measurement and quantification of ERM is implemented.

Now, according to what stated in the above, in this research, we aim to the evaluation of enterprise risk management (ERM) on the bankruptcy risk using weed and particles swarm optimization algorithms.

### **3. Literature review**

Yu et al, in a study, with the title of “the value of implementing enterprise risk management: evidences from finance industry of Taiwan”, with the main intention of investigating to see whether or not Taiwan finance industry reaches a benefit from the approval of enterprise risk management (ERM), and how much enterprise risk management creates value. The result shows, that a finance enterprise, by using the advantage of implementation of ERM, increased the value of the enterprise to the extent of 37.5%. ERM approval also helps enterprise revenue and costs to be improved with the amount of 22.9% and 34.16%. Analysis of finance industry’s subsystem, reveals that, banks and property/liability insurance (P/L), which conform from ERM, create more advantages in cost saving and revenue turnover.

Kashif Shad et al, 2019 in a study with the title “Integrating sustainability reporting into enterprise risk management and its relationship with business performance: A conceptual framework”, investigated the conceptual framework which studies moderating effects of sustainability reporting, in relationship

between execution of enterprise risk management (ERM) and business performance. Performance of enterprises is calculated through the measurement of value added; i.e. Economic Value Added (EVA) is calculated. The results have shown that effective approval of ERM has a considerable effect on the general performance of business.

Saeidi et al in a study with the title of "The impact of enterprise risk management on competitive advantage by moderating role of information technology" mainly investigated the effect of Enterprise Risk Management (ERM) on competitive Advantage (CA) by moderating role of information technology aspects such as information technology (IT), information technology structure. Totally, 84 valid questionnaires are gathered by the method of self-care at financial institutions in Iran. For analyzing data and testing hypotheses, partial least square-structural equation method (PLS-SEM) is used. The findings of this study showed that the ERM has a positive relationship with competitive advantage of the enterprise. The results also showed that information technology strategy and information technology structure has had a direct effect on competitive advantage and moderating effect on competitive advantage of ERM as well. This paper creates insights into the value of the execution of ERM among the organizations that can result into the promotion of competitive advantage. Moreover, this study, respecting to the planning and decision making of managers, as one of the critical success factors, considers ERM.

Tang et al, 2018, in a study, with the title of "The relationship between external financing activities and earnings management: Evidence from enterprise risk management" investigated the impact of external financing activities on income management decisions and the role of Enterprise Risk Management (ERM), as possible inhibitor in this issue". They found that managers use of real activities (real earning management) and the income management based on accrual income (accrual earning management) whereas, participate in enterprise stock investment activities. In addition, when the enterprises have weaker ERM systems, we see that managers in using real activities in their own investment activities make use of real earning management. Therefore, findings corresponding to our policies show that weak ERM systems can display weak controlling mechanisms and

attract more supervisors on investment. Thus, limiting manager's use of manipulating real activities which damage the enterprise value in the long term is possible by using enterprise risk management.

Raei et al, 1397 in a study with the title of "investigating market power and income structure on the earning and bankruptcy risk in banking system of Iran" state that financial crises, often, after forming, by entrapping banking system cause crises in this section of economic system and can put a country in the verge of bankruptcy. Therefore, investigating different aspects of banking system and supervision on these performance aspects can prevent happening destructive incidents and in cases of crises, facilitate confronting with it. In this research, while examining theoretical bases of market power and income structure in banking system, the effect of both of them on Profitability and bankruptcy, has been noticed. The results of this survey obtained by using the information 17 banks in the period of 1386-1394, shows that higher market power gives rise to more profit of the banks and in this condition, banks have had less bankruptcy risk. On the other hand, increase in the part of non-interest incomes from the total incomes of the bank has had more profit but these effects have been reversed after year 1391 and these incomes has caused decrease of profit. Increase in the part of non-interest incomes has made the risk to increase. And these effects have not changed after 1391.

Mehrabanpoor et al, 1396, investigated the relationship between risk management (environmental uncertainty) and enterprise value, emphasizing on the role of board of directors and audit committee. The results of the study show, with the increase of risk management (environmental uncertainty), the value of the enterprises will increase. Also, in institutional ownerships, the relationship between risk management and enterprise value is more than other ones, but, is not meaningful statistically. The results also show, more Independence of board of directors, risk management (environmental uncertainty) will not have a considerable increase on the enterprise value. Also, existence of audit committee in accepted enterprises in the stock exchange does not noticeably change the effect of risk management (environmental uncertainty) on enterprise value.

Regarding the inquiries of the researcher, these hypotheses are proposed:

**First hypothesis:**

Weed optimization algorithm is able to predict the bankruptcy risk using the elements of enterprise risk management (ERM).

**Second hypothesis:**

Particles swarm optimization algorithm is able to predict the bankruptcy risk using the elements of enterprise risk management (ERM).

## Research method

To be classified scientifically, this research, from the aspect of the goal of the research is of applied kind of research. And since, the subject of this research is to investigate the enterprise risk management (ERM) on the bankruptcy risk, using weed and particles swarm optimization algorithms, so, this research can be put in the group of descriptive researches. From the theoretical aspect, is of positive researches and in terms of reasoning method, is of deductive-inductive. Also, methodology of the research is retrospective, meaning that the research is done based on the past information.

## Data gathering

Having perfect and accessible information is of right conditions for doing a suitable research. Regarding this issue that stock exchange, is the only trustable reference to gather financial data, in this research, library method is used in data gathering. In this method, papers in reputable publications, taken from scientific internet sites, adding scientific magazines, indexes, graduate thesis and the books, corresponding to the subject, will be used. In this research, information, required to test hypothesizes, will be gathered by referring to the research and development of Islamic studies management and software RAH-AAVARD-E-NOVIN as well. Then by using Excel, data will be processed and required variables to test statistical tests, will be extracted and at the end, for the statistical analyzing softwares Matlab and EViews will be implemented.

## Research variables:

ERM=enterprise risk management

Enterprise risk management is one of the proposed techniques by COSO, for the management of the risk.

In this research Gordon et al 2009 model is used for the measurement and quantifying of ERM in the enterprises. Enterprise risk management, presented by committee of sponsoring organizations (COSO) is related to Treadway commission and has defined, based on 2004 Coso Enterprise Risk Management model, four goals including strategic risks management, operative risks management, reporting risks management, compliance risks management (Moller 2007). Definition of each tools of enterprise risk management is as follows:

## Strategic risk management (strategy):

In production corporates of every industry, the methods of production, financing, etc. is the same. In this situation, the only strategy which can help a corporate in creating competitive advantage is the strategy of selling and customer orientation. Therefore, in an organization, the higher selling and customer orientation than other competitors of that industry means that, this organization will have a better performance with regard to other ones. Hence, strategy factor is considered as the ratio of selling to the selling average (Gordon et al., 2009).

$$strategy = \frac{sales - \mu sales}{\sigma sales}$$

Sales: is the selling and services income

$\mu$ sales: shows the average of selling and services income in every year in every industry

$\sigma$ sales: shows the standard deviation of selling and services income in every year and every industry

Operative risk management (operation)

The process of enterprise risk management follows the decrease in operative risks which finally cause the increase in the efficiency and the performance of an organization (Banker and Niren, 2005). Better performance is one of the results of better implementation of enterprise risk and should decrease the general risks leading to the failure of an organization and as a result, increase the efficiency and value of the organization. Hence, asset turnover ratio is defined as the sales divided by total assets and

is used as criterion for assessing the performance efficiency (Kiyamaz, 2006). Higher performance efficiency should decrease general bankruptcy risk of the enterprise and increase the performance and the value of the enterprise (Gordon et al, 2009).

$$\text{operation} = \frac{\text{sales}}{\text{total assets}}$$

Sales: indicate the selling

Total assets: shows the total amounts of the assets.

Reporting risk management (reporting):

Here, the concept of reporting has the meaning of reliability of the reporting (Gordon et al, 2009). Right and accurate reporting for the success of an organization in all aspects is vital. The aim of the right and accurate reporting should be main guidance of all the ERM activities. To measure the quality of financial reporting, total value of non-accrual and abnormal items is used (Johnson et al, 2002). In this case, reporting reliability criterion is the ratio of total (absolute) value normal accrual items to the sum of the normal and abnormal accrual items. The reason for the use of both of items is that normal and abnormal accrual items can have negative values. Therefore, relative power of them can better be measured by their total values.

$$\text{reporting} = \frac{|\text{NormalAccruals}|}{|\text{NormalAccruals}| + |\text{ABNormalAccruals}|}$$

Abnormal non-accrual items is estimated by Jones model as follows:

$$\text{TA}_{it}/\text{A}_{it-1} = \beta_0 [1/\text{A}_{it-1}] + \beta_1 [\Delta\text{REV}_{it}/\text{A}_{it-1}] + \beta_2 [\text{PPE}_{it}/\text{A}_{it-1}] + \varepsilon_{it}$$

TA: is the sum of accrual items for the enterprise I in industry j which is the profit before unexpected items minus operative cash flows

Ait-1: is the sum of total assets for enterprise i in industry j

ΔREVit: the change in revenues for enterprise I in industry j.

PPEit: gross assets, machineries and equipments for the enterprise i in industry j.

Cit : is the error part for enterprise I in industry j or so called Abnormal Accruals

In this regard, normal accrual items, is the sum of accrual items minus abnormal accrual items.

Noncompliance risk managements (Compliance):

With the entry of the organization to a complex environment and the increase in the interactions of it with external environment, that organization has no choice but to comply with the laws and rules governing the relations with the external environment. For this reason, organizations are facing a wide range of noncompliance risks. Enterprise risk management suggests the evaluation of risks related to noncomplying the laws and rules in every constituent of the framework of the enterprise risk management process, such as internal environment textures, targeting, risk control and in all of the organization (COSO, 2004).

In this regard, one of the efficient tools, are the accepted standards in auditing (O’Keefe et al., 1994). Auditor and audit process, is considered as representative of external environment supervisor; therefore, in this study, the criterion for the measurement of implemented laws and rules is the ratio of auditor fee to the total assets.

$$\text{Compliance} = \frac{\text{Auditor Fees}}{\text{Total Assets}}$$

Bankruptcy risk prediction using the elements of the enterprise risk management (ERM) by weed optimization algorithm

At first, using the MATLAB toolbox tool, we design the neural network plan proposed in chapter 3. We introduce and identify input data of the network which are the elements of the enterprise risk management (ERM) as well.

Now, with the use of this toolbox tool, the network should be trained. The training if the network is done by using weed optimization algorithm.

Neural network model includes two steps:

Training

### Testing of Weights, and calculating of the error.

Based on the weed optimization algorithm, we define 70% of X variable (enterprise risk management (ERM)) and Y variable (bankruptcy risk) in input and output layers. The network, by training and using of artificial intelligence defines a list of weights and in the next step it tests these weights with remaining 30% of Xs (elements of enterprise risk management (ERM)) and obtains the bankruptcy risk and tests to identify how much the predicted value is close to real value i.e. to calculate the error.

The network, continues training to reach the optimal point in training, (the optimal point in training is a level of training in which the network has been able, by using training, to estimate the best

weights). when we test the weights with the 30% remaining Xs, the predicted values have the least difference with the real values.

To prevent the excessive training of the network, some retraining are gradually done and then the test is evaluated by data at least several errors to be found in the page and from these ones, the lowest ones are considered and according to them, the optimal training of the network is selected.

After, the training in several times, the best one is chosen. Here, the training has been done for 50 times and in 47th time the training has been better compare to other ones. Therefore, the set 47 is chosen as network training.

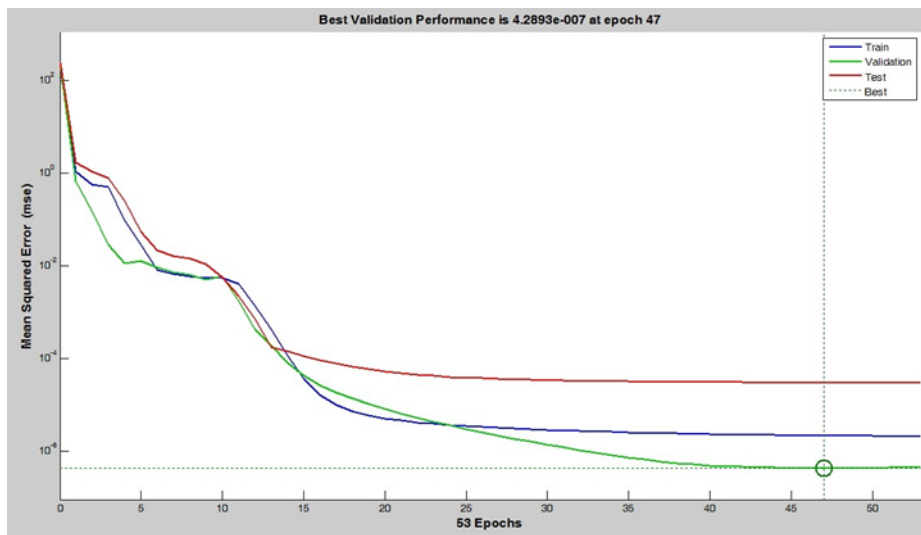


Figure 1 Graph of neural network weed optimization algorithm training

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