Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2015/01/jls.htm
2015 Vol.5 (S1), pp. 4732-4740/Saadatnasab et al.
Research Article

EFFECTIVENESS OF USING INDICATORS (VARIABLES) IN ASSESSING CREDIT RISK OF SHORT-TERM LOANS FORM BANK OF INDUSTRY AND MINE BY HELP OF DATA ENVELOPMENT ANALYSIS (DEA)

Reza Saadatnasab[1], *Hamideh Ranjbar[2] and Abdolkhalegh Gholami[2]
[1]Department of Management, Yasouj Branch, Islamic Azad University, Yasouj, Iran
Department of Management, Kohkiluyeh and Boyerahmad Science and Research Branch ,Islamic Azad University, Yasouj, Iran
[2]Department of Mathematics, Yasouj Branch, Islamic Azad University, Yasouj, Iran
**Author for Correspondence*

ABSTRACT
The main aim of this study is to determine and examine the efficacy of indicators considered in assessing credit risk of applicant receivers of short-term loans from Bank of Industry and Mine. In other words, two questions are responded: Can these indicators be a suitable model for assessing applicants' credit based on allocated scores or is a revision needed in the process? How these indicators can be effective by DEA. Having accounted in Industry and Mining Bank and using its facility, 50 companies are under investigation in present study. Necessary information for this research provided from financial statement of every company keeping in Bank confidentially, and the information was analyzed by GAMS software. Examination method of information is kind of data envelopment network examination which work as two phase network analysis in outgoing axis and finally the result shows that among these companies only 15 with higher efficacy of 0.5 were efficient and half efficient and the risk of Bank for granting facility to other companies considering their inefficacy was high. Mangers should make more serious decisions for granting these facilities and reimbursement and put financial resources under more consideration and revision.

Keywords: *Data Development Analysis, Risk Assessment, Effectiveness, Bank of Industry and Mine*

INTRODUCTION
The correct relationship between financial and product systems is the most important financial growth factor in every country. Banks as the main part of financial system play the basic role in providing finance for commercial, consumer and governmental parts (Gutman, 1994).Financial statements show the summery of operation activities, financial recourses and investment during a financial period. Financial statement analysis makes it possible for decision makers (loaners, investors, managers) to have a general viewpoint toward the safety and competitive position of company. Managers should recognize capacity and opportunity of the company which may lead to keeping the desirable condition. Also they should determine weaknesses need refinement action. Using financial statement analysis, potential creditors make decision about lending or granting credit or about its period (Malhotra and Malhotra, 2008). Thus, Banks grant facilities to the low risky companies which are able to pay their loan to the Bank. This will be possible when Banks be able to identify their credit customers such as actual and juridical and can classify them based on their ability and eagerness to reimburse subscriptions using financial and non-financial criteria. Facilities will be granted to applicants with low credit risk and on schedule reimbursement. These funds can be used as financial resource for granting later facilities, so have the important role in increasing investment, growth and development of the country (Safari *et al.*, 2011). DEA is a powerful tool use vastly in assessing the performance of systems with multiple input and outputs. Continuous growth and application of DEA technique has been salient in theoretical and practical areas even to the commentators in 30 recent years. Allocating the resources is one of the main activities of the banks. The most threatening risk for these activities is the risk of ignoring subscriptions by these companies. Banks and other financial institutions try to decrease these risks by various methods. Industry

and Mining Bank which the research has been done about belongs to developmental banks and includes two kinds of tasks for financial development: 1) facilitating and allocating long-term and cheap resources as a financial media 2) applause and enforcement of non-governmental part according to financial development.

Considering the fact that this research as a case study examine the credit assessment model of short-term facilities of applicants and make these models effective using DEA in Industry and Mining Bank. Goals of this research are as bellow:

a) Determining and examining the effectiveness of indicators considered in assessing credit risk of short-term facilities of applicants in Industry and Mining Bank.

b) Making used indicators effective in assessing credit risk of short-term facilities of applicants in Industry and Mining Bank by DEA.

c) If needed, presenting suggestions for revising the assessing credit risk of short-term facilities of applicants in Industry and Mining Bank.

The present study aims to study the efficacy of credit assessing model of applicants in Industry and Mining Bank for paying short-term facilities and by comparing the effectiveness of every indicator on the way they do commitment conclude that whether these indicators regarding the allocated scores can be a suitable model for assessing credit of applicants or need revision in current process? How can make these indicators effective by DEA?

Literature Review

Liquidity Ratios

Liquidity ratios are ratios that show the ability of commercial unit in settling short-term loans. These ratios include quick and current ratios (Akbari, 2008).

Activity Ratios

Any fraction named activity ratio when the amount of sales be above the fraction line and one of elements of balanced sheet in its denominator. It shows the ratio of effective activity in application of assets. The most important activity ratios include the period of receiving demands, flow rate of goods, ratio of goods to flow capital and the ratio of current capital flow (Akbari, 2008).

Investment Ratios

Ratio investments indicate when operations of a commercial unit fail and the companies have to settle its accounts, how much of their loan they pay back to the bank. Investment ratios represent financial resource components of investment ratios. In other words investment ratios compare what belongs to shareholders with others' investments in commercial unit. The mentioned ratios usually obtain from division of current debt, long-term debt or total debt with special value. Some prefer to apply the reverse of this ratio, it means that they put special value above the fraction line and put the debt bellow the fraction line. These ratios have had the basic role in emerging of financial managing theory (Akbari, 2008).

Profitable Ratios

The goal of applying profitable ratios is determining the success rate of commercial unit in gaining profit. Success in gaining profit obtains from determining profit ratio to sale or assets or by measuring profit with investment of shareholders in commercial units and depending on the compared case call it sale output, assets output or output of finance in flow (Akbari, 2008).

Definition of Risk

Risk means possibility of emerging danger or facing danger, damaging, decreasing income, loss etc. according to the definitions risk is every factor that causes failing the predictions and every factor will be called agent of risk. In positions we face with risk that firstly our action leads to more than one result, secondly till the tangibility of the result we don't know which one will be the right one, thirdly one of the results may have unpleasant consequences. Risk is an actual act, means that it is independent of our knowledge and threats us with its unpleasant financial results.

To have a suitable reaction against risks, we have to concord our mind with existing risks, so obtaining information and exact knowledge about risks is needed (Shayan, 2001).

Performance Evaluation

Performance evaluation systems help managers in operating business strategies by comparing actual results and strategic goals. System of performance evaluation was considered as a main structure with making tools and communications clear for operating the strategies (Mack *et al.*, 2008). Setting goal and performance evaluation plays a pivotal role in current theories of management and this role state under the title of "whatever has been done will be measured" (Tatichi, 2009). Credit assessment means assessing the ability disability of applicants to reimburse loans. Designing a model to assess and grading the credit risk was done for the first time by John More bonds on 1909 (France, 2003). Multiple statues position was presented for anticipating the bankrupting companies. Using mathematical models in many studies were mentioned in 1980 and 1990. The main goal of these models was improving the credit and correction of classifying and removing hypothesizes and existing limitations in previous techniques. In beginnings of 1990, supportive systems of decision making were used in composition with multiple systems of decision making for solving the problem of financial classification. Other studies in this field include works of Roy in applying electro in 1991, Demitasses in 1999 for applying Roughest, Morgan in 1998 for designing assessing model and Tracy in 1998 for designing value model exposure to risk to obtain the likely function density of not to reimburse (Merton, 1974; Dimitras, 1999; Roy,1991). In credit assessment studies applying the pricing theory of credential dealing roots in primary model of Breton, Black and Shultz. Basing thought of this model is about similar debts of loaner and ability to sale which is written for assets of loan taker, so the price of assets is equal to the debs. Thus Nichol occurs when the value of company assets is lower than its debts. In this model Nichol possibility infer from swaying price of assets which reflect in swaying share price of company.

Two Phase Technique and its Compilation with DEA

Considering that today many product and service processes are dependent to each other so should be able to analyze these dependencies by scientific techniques. Two phase technique is conceptual that can analyze these relations. Two phases apply in many processes such as two phases fuel, two phases simplex solving etc. which means that from the beginning a process divide into two parts: first phase and second phase. Sometimes it occurs that computation of efficacy of total process in DEA form from some directions. By doing the first phase, the second phase will begin. DEA is searching outputs and inputs. In two phases technique the inputs of the first phase are independent of second phase but the inputs of the second phase are equal to outputs of first phase. DEA in two phases' technique doesn't have any limitation in the number of phases and there is only one concept that shows input of later phase is the output of previous phase and this analysis continues to the end (Kao and Hwang, 2007). As can be seen in bellow input of second phase is the output of first phase. In two phases model we deal with calculation of efficacy in every unit and the total efficacy.

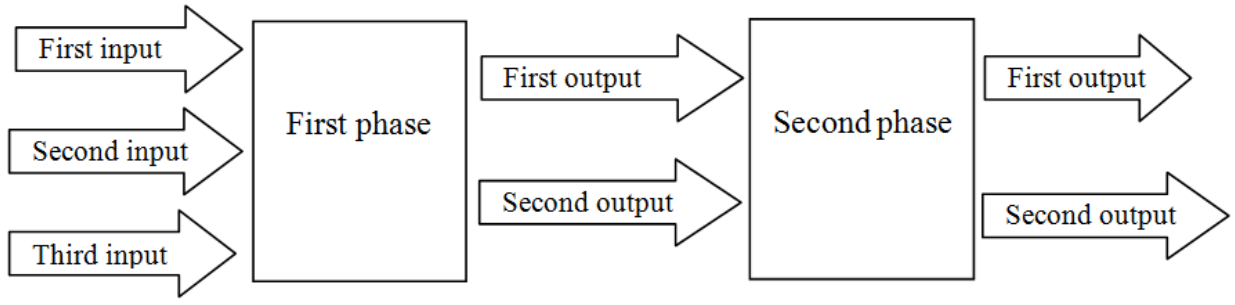

Figure 1: DEA in two phases' technique

Two phases' systems in which two processes are related to each other. Primarily, the efficacy of two phases' systems was calculated for every phase as a DMU. First attempt for solving the processes was related to calculating the efficacy of systems by Färe (1991). Then include works of Färe and Whittaker (1995), Färe and Grosskopf (1996) and Löthgren and Tambour (1999). In these studies the outputs of the

process must be calculated separately. This was until the time that the output of system and process had been calculated simultaneously and their relationship with output of system was the product of processes. In two phases system the first input provide products for second phases and then change into final product. Characteristic of these systems is that the first phase doesn't produce the external outputs and the second phases don't consume external inputs.

DEA Models of Two Phases

As we know by assuming that output by scale of CCR was constant so the DEA model is as follow:

$$maxZ = \frac{\sum_{r=1}^{s} U_r Y_{rk}}{\sum_{i=1}^{m} V_i X_{ik}}$$

s.t

$$\frac{\sum_{r=1}^{s} U_r Y_{rj}}{\sum_{i=1}^{m} V_i X_{ij}} \leq 1 \quad j = 1, \dots, n$$

$$U_r, V_i \geq 0 \qquad r = 1, 2, \dots, si = 1, 2, \dots, m$$

In this model there is n unit of decision making every has m input and s output and by this model we are going to calculate k. if the efficacy number be the same that unit is effective otherwise is not effective as its goal function.

Seiford and Zhu utilized first model of assessing efficacy to assess the total efficacy of multiple phases process and calculated the assessing efficacy of every phases by considering the models of number 2 and 3 (Seiford and Zhu, 1999).

$$maxZ = \frac{\sum_{p=1}^{q} \eta p Z_{pk}}{\sum_{i=1}^{m} V_i X_{ik}} \tag{2}$$

s.t

$$\frac{\sum_{p=1}^{q} \eta p Z_{pk}}{\sum_{i=1}^{m} V_i X_{ik}} \leq 1 \quad j = 1, \dots, n$$

$$\eta p, V_i \geq 0 \tag{3}$$

$$maxZ = \frac{\sum_{r=1}^{s} U_r Y_{rk}}{\sum_{p=1}^{q} \eta p Z_{pk}}$$

S.t

$$\frac{\sum_{r=1}^{s} U_r Y_{rj}}{\sum_{p=1}^{q} \eta p Z_{pj}} \leq 1 \quad j = 1, \dots, n$$

$$U_r, V_i \geq 0$$

As can be seen we are going to calculate the efficacy of unit k according to figure 1 in model of number 1 and in model 3 we calculate efficacy of k in phase two.

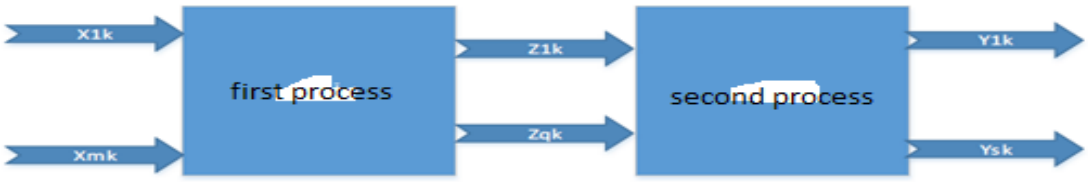

Figure 2: Two phases process

In as essay, Kao and Huang represented Seaford and Zhu model questionable and said that for exact calculation of total we need to calculate the efficacy of all units continuously (Kao, C and Hwang, SN 2007). The linear model of Kao and Huang is as bellow:

$\mathbf{Y_{ij}}$output value unit j	$\boldsymbol{\eta p}$weight of media variablep	$\boldsymbol{V_i}$weight of inputs i
$\mathbf{Z_{pj}}$value of variable media unit j	X_{ij}input value unit j	$\mathbf{U_r}$output weight r

$$maxZ = \sum_{r=1}^{s} U_r Y_{rk} \quad (5)$$

S.t

$$\sum_{i=1}^{m} V_i X_{ik} = 1$$

$$\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i X_{ik} \leq 0$$

$$\sum_{p=1}^{m} \eta p Z_{pj} - \sum_{i=1}^{m} V_i X_{ik} \leq 0$$

$$\sum_{r=1}^{s} U_r Y_{rj} - \sum_{p=1}^{m} \eta p Z_{pj} \leq 0$$

$$\eta U_r, V_i \geq 0$$

As it seems model number 5 is linear and can use it as a two phases' model. So by model 6 can calculate efficacy based on linear model.

$$E_k^1 = \left(\sum_{p=1}^{m} \eta_p^* Z_{pj}\right) \Big/ \left(\sum_{i=1}^{m} V_i^* X_{ij}\right)$$

$$E_k^2 = \left(\sum_{r=1}^{s} U_r^* Y_{rj}\right) \Big/ \left(\sum_{p=1}^{m} \eta_p^* Z_{pj}\right)$$

$$E_k = \left(\sum_{r=1}^{s} U_r^* Y_{rj}\right)$$

$$E_k = E_k^1 * E_k^2$$

MATERIALS AND METHODS

The aim of this research is developing the applied science in a specific field. This research done for applying the resultfor solvig the specific problems within the organization and tries to respond a complex problem in actual world. This study is descriptive and non-experimental. Data used in this study is extracted from companies, individuals and financial statemnts of companies and applicants of receiving facility in Industy and Mining Bank of Kohkiloye and Bouyer Ahmad province. According to the literature of the study the research method is two phases DEA. Gathering quantitative data of bank, customers and present statues was done by examining the documents.

GAMS software was used for analyzing the data and obtaining the efficacy. A sample of 50 was considered based on the twice of number of indicators.

This research done in two phases and totally variables divide into two parts: 1) input variables 2) output variables.

✓ Input variables include: 1. the average account of 6 recent months 2. History of company activities 3. Flow of total assets 4. Quick ratio 5. Current ratio 6. Detail of impure profit 7. Output of assets

- ✓ Output variable: amount of debt to bank
- ✓ Input variable include: 1. Common industry 2. Expected profits 3. amount of debt to bank
- ✓ Output variable include: obtained profit

According to the research and examinations collected information and used model in this work is base on the type of output and by determining the inputs and outputs for every phase done by GAMS software.
The decision maker unit in examined DEA unit or company named DMU. Generally DMU is a company or existence that change input to output and the assessing of operation is considered. In figure 3 output, input and the phases are shown to reflect a clear image into the mind of reader.

Figure 3: Phases of research

RESULTS AND DISCUSSION

In this research our aim is to assess the performance of Industry and Mining Bank. According to the presented model of above we have series of input and output named using data for research. According to the obtained data in this phase we examine 50 companies which had account in Industry and Mining Bank and utilized facilities of bank. In first phase we have 7 inputs (average account of 6 recent months, history of company activity, and flow of total assets, quick ratio, current ratio, detailed impure profit, and output of assets) and choosing these input and outputs is an instruction for assessing credit of applicants of receiving facilities announced by the experts of Industry and Mining Bank and the relevant data given above is extracted from one year financial accounting flow (financial year ends with Shahriver, 2004) of companies kept by bank as private doctrines. This information is saved in Excel and finally regarding inputs and outputs used in the research, will be analyzed in first phase. What is recognizes as output in figure 3 is as a mediator output is used in second phase as input. Efficacy of assessing DMUs obtained from first phase can be seen in table 1. In second phase, two inputs (common industry and expected profits) are as centric inputs of second process and also we have the input amount of debt to the bank obtained from first phase and finally one output (obtained profit) named final output. According to the policy of banks for having income and decreasing risk, developing the internal industry, lowering dependency to import goods and high steps for attaining development it's necessary for bank to assess credit, decrease the risk of not paying the loans by companies and apply exact criteria not lead to bankrupting of bank. So it's necessary to assess the efficacy of companies in exact and scientific way and recognize which input or output criteria are acceptable and make clear which customers pay their loan and vice versa. In table 1 efficacy of second phase and final efficacy of these two phases is given.

Table 1: Efficacy in every phase of research for examined DMUs

Company	Efficacy of first phase	Grade based on efficacy	Efficacy of second phase	Grade based on efficacy	Final efficacy	Grade based on efficacy
A1	0.44511	8	0.01693	44	0.23102	32
A2	0.05957	21	0.99989	9	0.52973	7
A3	1	1	0.06572	37	0.53286	6
A4	1	1	0.07876	34	0.53938	5
A5	0.00698	30	0.00992	45	0.00845	49
A6	1	1	0.86511	14	0.932555	1
A7	0.01834	28	0.78614	17	0.40224	23
A8	0.03156	24	0.02688	41	0.02922	45

A9	0.02606	25	0.68991	20	0.357985	26
A10	0	34	1	1	0.5	11
A11	1	1	0.11903	30	0.559515	4
A12	0.02313	26	0.49721	23	0.26017	31
A13	0.01826	29	0.02498	42	0.02162	46
A14	0.10456	16	0.00443	47	0.054495	43
A15	0.05728	22	0.07356	35	0.06542	41
A16	0.17555	13	0.06836	36	0.121955	35
A17	0.00550	31	0.89678	13	0.45114	20
A18	1	1	0.04279	38	0.521395	8
A19	0	34	0.18059	28	0.090295	37
A20	0	34	1	1	0.5	12
A21	0	34	1	1	0.5	13
A22	0	34	1	1	0.5	14
A23	0	34	0.11414	31	0.05707	42
A24	0.26573	10	0.90632	12	0.586025	3
A25	0.54107	7	0.82685	15	0.68396	2
A26	0.08067	17	0.09129	33	0.08598	40
A27	0.05249	23	0.02361	43	0.03805	44
A28	0	34	0.62988	21	0.31494	27
A29	0	34	0.00751	46	0.003755	50
A30	0	34	0.93683	11	0.468415	19
A31	0.13768	14	0.48434	25	0.31101	28
A32	0.07899	18	0.49496	24	0.286975	30
A33	0	34	0.77934	18	0.38967	24
A34	0	34	0.80515	16	0.402575	22
A35	0.07590	19	0.21954	27	0.14772	33
A36	0	34	1	1	0.5	15
A37	0	34	0.95218	10	0.47609	18
A38	0.00531	32	1	1	0.502655	10
A39	0.18294	12	0	48	0.09147	36
A40	0.11696	15	0.48377	26	0.300365	29
A41	0	34	0.03279	39	0.016395	48
A42	0	34	1	1	0.5	16
A43	0	34	0.77934	18	0.38967	25
A44	0.33920	9	0.53708	22	0.43814	21
A45	0.07103	20	0.10720	32	0.089115	38
A46	0.25380	11	0	48	0.1269	34
A47	1	1	0	48	0.5	17
A48	0.00057	33	0.03279	40	0.01668	47
A49	0.02182	27	1	1	0.51091	9
A50	0	34	0.17487	29	0.087435	39

Result

First Phase of Research

In this stage, according to input and output of examined companies in this research and obtaining efficacy of each, Bank can assess the risk which exists in not paying the loan and based on that grant facilities to companies. In this phase A3, A4, A6, A11, A18, A47 companies are effective companies and granting facility to them is less risky but regarding the effective number of units in relation to examined equity their number is low and shows the unsuitable choosing of input and output.

Second Phase of Research

Second stage has been independent of first stage and regarding the input and output for every facility by obtaining final efficacy the 8 company of A10, A20, A21, A22, A38, A36, A42, A49 had effective performance evaluation.

In relation to other 42 companies had lower credit risk and bank can grant facility to them with more security and receive the profit on scheduled time. Totally, according to the lower number of units presented facility to them means 15 companies with higher efficacy of 0.5 we conclude that choosing criteria of assessing current credit risk was not a suitable criteria. Examination of this subject and its sensitivity shows that the income of Bank is from helping to other industries with granting facility to them and gaining profit of them. These results are very helpful in presenting the strategic decisions to Banking experts.

Suggestions

- Value of presented collateral by applicant can be one of the most effective indicators in assessing the performance of applicants of facilities.
- A history of cooperation with bank is a suitable indicator for assessing performance.
- The existing number of competitors as an indicator for assessing the credit risk.
- The market should be focused more seriously.
- Resource of needed raw material by applicants as one of the indicators of assessing credit risk should be considered.
- In addition to examined indicators other indicators can be added to assessing credit and after passing one period the result of that indicator be examined such as inflation and recession.
- The result of this research can be use by managers of companies and by predicting the financial statues of future do the necessary arrangement for improvement and avoiding financial crisis.
- In addition to financial ratio of loss and gain and balance sheet of obtained ratio, the cash flow can be effective in improvement of anticipated models of non-fulfillment of obligations under the loan. So it is suggested that in the case of financial statement, its information be used.
- Value of provided collateral by applicant can be used as an effective indicator in assessing the performance of applicant of received facility and decrease the risk of non-fulfillment of obligations under the loan.
- Its suggested that a research the same as this research be done for long-term facilities to make possible the assessment of existing indicators for determining the new indicators for assessing long-term facilities.
- Its suggested that a research the same as this research be done for different financial indicators (industry, mining, farming and services) in order to access a suitable model for every part.

ACKNOWLEDGEMENT

We are grateful to Islamic Azad University, Yasouj branch authorities, for their useful collaboration.

REFERENCES

Akbari F (2007). *Analyzing the Financial Statement*, 11th publication (Terme Publication).

Dimitras AI (1999). Business failure prediction using rough sets. *European Journal of Operational Research* **7**(3) 263-280.

Gutman R (1994). How credit money shapes the economy: the united state in a global system. Armonk N.Y:M.E sharp 10.

Kao C and Hwang SN (2007). Efficiency decomposition in two-stage data envelopment analysis: an application to non-life insurance companies in Taiwan. *European Journal of Operational Research* **185** (15) 418- 29.

Kiss France (2003). Credit rating process from a knowledge management prospective. *Budapest University of Technology and Economics* **5**(6) 96-97.

Malhotra DK and Malhotra R (2008). Analyzing Financial Statements Using Data Envelopment Analysis. *Commercial Lending Review* **6**(5) 25-31.

McAdam R, Hazlett SA and Gillespie KA (2008). Developing a conceptual model of lead performance measurement and benchmarking: A multiple case analysis. *International Journal of Operations & Production Management* **28**(12) 1153-1185.
Merton R (1974). On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *Journal of Finance* **29**(6) 449-470.
Roy B (1991). The outranking approach and the foundation of ELECTRE methods. *Theory and Decision* **31**(4) 49-73.
Seiford LM and Zhu J (1999). Profitability and marketability of the top 55 U.S. commercial banks. *Management Science* **45**(9) 1270-88.
Taticchi P, Tonelli F and Cagnazzo L (2009). A decomposition and hierarchical approach for business performance measurement and management. *Measuring Business Excellence* **13**(4) 47-57.
Safari S, Ebrahimi M and Taheri Fard M (2001). Managing credit risk in bank system with a comparative approach in DEA network and neurotic network. *Two monthly Scientific-Research Journal of Shahed University* **20**(47).
Shayan Arani SH (2001). Risk managing and non-governmental Islamic bank. Series of speeches and essays, *12th Conference of Islamic Banking, High Banking Institute of Iran*.