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GRANGER CAUSALITY ANALYSIS OF CREDIT RISK AND LIQUIDITY RISK TEHRAN STOCK EXCHANGE

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ABSTRACT

The present study examined Granger Causality (GC) analysis of credit and liquidity risks in the banks active in the stock exchange. The research method was descriptive with regression design. The population was the banks active in the stock exchange with the time domain of 2009-2015 and consisting of 13 banks selected by purposive sampling. Research data is the financial statements. The results indicated no causal relationship from credit risk to liquidity risk ($\alpha > 0.05$). There was a causal relationship from liquidity risk to credit risk ($\alpha = 0.05$). There was a significant relationship from credit risk with three interruptions, ratio of loan, operational efficiency of the bank and margin of net profit on credit risk. There was a significant relationship between liquidity risk with two interruptions, liquidity risk with three interruptions, loan growth, return on assets, loan ratio, operating efficiency of the bank and net profit margin on liquidity risk.

Keywords: GC, Credit Risk, Liquidity Risk, Tehran Stock Exchange, Banking.

INTRODUCTION

Nowadays, compared to the other two sectors of economy (industry and agriculture), a significant share of the total economy belongs to the service sector. Moreover, in the service sector, banks and financial and credit institutions have a significant role. Any activity requiring the acquisition of capital and financial resources necessarily needs the involvement of banks and financial and credit institutions (Meskini and Chavoshirad, 2014). As the main part of the financial system, the banks play the main role in financing the manufacturing, commercial and consumer sectors. Given the economic and financial structure of the country and the lack of development of the capital market, financing economic sectors is mostly the responsibility of the banks in Iran. Banks and financial institutions have to accept some risks affecting repayment of loans following any investment and granting loans (Dinashi, 2015). Various risks affect the efficiency and performance of the banking system. One of the most important reasons for the banks' efficiency, being affected by different risks, is the risks communication with each other and the impossibility of complete distinction of various types of risk. If one of the market parameters such as the inflation rate increases, this change will cause reduction the value of the portfolio of bank assets (due to the impact on future earnings of the loans granted) and the emergence of market risk. Moreover, increase in inflation will reduce the value of bank cash assets causing liquidity risk. The reduction in the exchange rate - reducing the value of currency cash assets and creates the risk of fluctuating exchange rates - on the other hand, reduces export

earnings for a customer receiving the loan, his/her expected earnings, and thus reduces repayment power, so a credit risk will be created. On the other hand, this will reduce the inputs of funds to the bank, creating liquidity risk. In this case, the existence of one of the risks will end in the emergence and strengthening of other risks and the set of risks will affect the profitability and efficiency of the bank (Meskini & Chavoshi Rad, 2014).

Over the recent years, along with the allocation of huge amounts of financial resources through banks around the world, we have seen crises, losses and even bank bankruptcies. Successful banks face several crises given various reasons, including risk or costs due to fluctuations in interest rates, inflation, currency or non-repayment of the loans granted. The social and hidden crises have made the authorities of the supervisory and executive agencies of financial systems, especially the banks, supervise the risk management of financial institutions closely and more cautiously (Shayan Arani, 2001).

One of the goals of the bank management is to increase shareholders' profits by emphasizing the performance of the bank. This is often associated with increase in risk. The banks often face risks such as credit risk, liquidity risk, and so on. Stimulation of the bank to manage a risk begins from the point where the risk in question causes a change in the bank's performance. Risk management has a profound effect not only on the bank's performance but also on a country's economic growth. Any action to improve and enhance the efficiency of the banking system will better the flow of reserves, investments and allocation of resources, so that the potential dispersed potentials of the country are used for the development and welfare. On the other hand, to avoid bankruptcy and losses of the bank, it is necessary to make decisions on the bank risk management, each of which can have a positive or negative effect on the efficiency of the bank (Meskini & Chavoshi Rad, 2014).

Evidence shows that credit risk plays a decisive role in banking activities. This risk is because the contractor will not, or cannot act on the subject of the contract. As the banks' capital is low compared to the total value of their assets, even if a small percentage of loans cannot be cashed, the bank will face a risk of bankruptcy. Although there are other sources of credit risks in the activities of a bank included in the bank office and in the business office and in the items above and below the balance sheet, for most of the banks, loans are the largest and most obvious source of credit risk. One of the most important sources for obtaining liquidity in the banks is the timely collection of loan installments and the income from their corresponding interest. The timely collection of liquidity calls for banks to minimize their bank lending rates. Indeed, one can state that the profitability of the banks is due to the difference between the deposit rate and the borrowing rate. Although profitability alone in banks does not bring about increase in the shareholder's wealth, the lack of profitability will disrupt liquidity and reduce the value of the shareholders (Dinashi, 2015).

Credit risk is a type of risk from the other party; in other words, the risk that the other party will not fulfill according to the contract or commitment. This may be due to a failure in the provision of work and services or due to a failure to discharge the loan or failure to pay the amount borrowed in full and on time (Khalili Iraqi, 2005).

Credit risk is important and sensitive in the monetary and credit institutions because the resources used to allocate are the debt of a monetary entity to shareholders, people and banks that, if does not flow can weaken giving credit and getting the repay delay fine by the monetary institution. This is especially the case because in the balance sheet of the monetary entity, credits



are considered as deposits and deposits of individuals as future debts. This means that the collection of claims is impossible in so many cases, but payment and paying the debts (deposits) are required at each stage; otherwise, the monetary entity will face bankruptcy (Ebrahimi et al., 2009).

Liquidity risk is caused by the inability of a bank to reimburse and reduce debt or to fund resources to raise assets. In cases where the banks do not have sufficient liquidity, they cannot provide reasonable resources by raising debt or converting assets into cash at a reasonable cost, which will affect the profitability of the banks. In critical circumstances, not having sufficient liquidity even ends in bank bankruptcy (Mousavian and Safari, 2012). On the other hand, liquidity management is one of the biggest challenges of the banking system today. The main reason for this is that most banks' resources are financed from short-term deposits. Furthermore, banks' lending loans are used to invest in assets that have a relatively low degree of liquidity (Rostamian and Haji Babaei, 2009).

According to the aforementioned points, considering their type of activities, the banks are exposed to a great range, the most important of which are liquidity and credit risks. Accordingly, risk management through solving financial problems in the banks is one of the most important tasks of financial management. Hence, it is seen that a study on financial problems using the combination of its effective components can manage how much liquidity and credit risk they manage and the success of banks in competition. Thus, the present study tries to answer the fundamental question of “how GC is between credit risk and liquidity risk in the banking industry of Iran” and tries to figure out the mutual effect of banking risks (credit and liquidity) on each other.

Research hypotheses

The main hypothesis

There is a mutual causal relationship between credit and liquidity risks in banks active in Tehran Stock Exchange.

Sub-hypotheses

1. In banks active in the stock market, credit risk has a significant effect on liquidity risk.
2. In banks active in the stock market, liquidity risk has a significant effect on credit risk.

Review of literature

Iranian literature

In a study entitled “Measuring credit risk of the customers with neural network approach in one of the state banks,” Ghasemi and Donyayi Herris (2016) concluded that credit risk could be stated as a probable loss occurred due to a credit event. This happens when the contracting party makes changes to complete his obligations. Credit risk is one of the most important risk factors in the banks, which is caused by the inability of the loan receivers to repay their debts to the bank. The study of the factors affecting the credit risk is critical. According to the aforementioned points, the purpose of the present study is to design a model for ranking customers regarding credit risk using MADM and SOM combined approach. In doing so, in the first step, by reviewing the literature, 29 effective indices were identified in customer credit-risk evaluation and classified according to 6c Model. In the next stage, considering the frequency of indices and experts' opinions, 12 indices were considered as the final indices. Pattern Recognition Algorithm Based on Neural Networks was then used to determine the optimal clustering. By using Self-



Organizing Map (SOM) and K-mean method, the legal clients receiving the loans were classified. Finally, the relative weight of each index involved in the evaluation of credit risk was assigned. In a study entitled “An overview of the liquidity risk management in the banks” with the aim of providing practical solutions for removing banks' inability to provide liquidity in a documentary manner, Goljash and Saeedi (2016) concluded that the banks could face liquidity-related risks. Moreover, it was the inability of these banks to meet liquidity needs due to bank problems or because of the lack of liquidity in the financial crisis. Maintaining a desirable level of liquidity is one of the main tasks of the banks, inattention to it increases the risk of liquidity of the bank, and some solutions should be considered for measuring and managing these risks in banks.

In a study entitled “Study of the relationship between credit risk and liquidity risk with the profitability of banks listed in Tehran Stock Exchange,” Dinashi (2015) concluded that the effect of bad debts allowance indices on all granted credits, the loans granted to the total deposit and long-term deposits to total assets and the control variable, bank size, are inverse and significant and the loans granted to total assets is direct and significant.

In a study entitled, “The effect of credit and liquidity risks on the health of the banking system of Iran using panel data and regression method among the active banks of Tehran Stock Exchange 80s and 90s, Shah Mohammadi et al. (2015) concluded that both types of risks had a significant effect on health indices of the banking system.

In a study entitled “The relationship between liquidity risk and credit risk in banks; Case Study: the banks listed in Tehran Stock Exchange” using regression among 7 Banks during 2009-2013, Sharifi and Faghani Makrani (2015) concluded a direct and direct correlation between liquidity risk and credit risk, and these two risks have a direct impact on non-payment of debts.

In a study, entitled “A review of the relationship between liquidity risk and credit risk in Iran's banks with documentation method,” Larijani and Naderian (2015) concluded that the two important risks threatening the banking industry are the liquidity and credit risks. They also considered other factors as risks; there are other risks, but if the bank or institution managers plan different scenarios in good and bad situations for these risks, they will be less vulnerable to other risks in this regard.

Pendar (2014) examined the relationship between liquidity and credit risks in the banking industry in Iran during 2003-2012. His results showed a negative relationship between credit risk and liquidity risk, which is more severe from credit risk towards liquidity risk. In other words, the effect of credit risk is considered as the dominant variable in this relationship – their effects will appear as a significant phenomenon.

A study entitled “The effect of the global financial crisis on the liquidity ratios of the companies listed in Tehran Stock Exchange” examined the relationship between variables in the global financial crisis using regression method among 110 member firms in the stock exchange during 2008-2011. Here, Kamyabi et al. (2013) concluded that the global financial crisis had a negative and significant effect on current ratio, instant ratio and cash flow ratio.

Khosh Sima and Tash (2012) have used two econometric and nonparametric paradigmatic approaches with mathematical optimization base to evaluate the efficiency and ranking of banks, the choice of optimal model and then the identification of the effect of credit, operational and liquidity risks on the efficiency of the banking system. In doing so, they studied 15 banks as the population during 2005-2010. The results showed the difference between parametric and non-parametric methods in evaluation of the efficiency and ranking of banks and the relative



superiority of parametric method to nonparametric method. Additionally, the results showed a significant relationship between credit, operational, and liquidity risk and efficiency in Iran's banking system.

Shirin Bakhsh et al. (2011) conducted a study entitled "Investigating factors affecting the likelihood of refunding credit facility in the banks" to study the direct and indirect relationships of variables on each other when controlling financial distortions by logit regression method and random sampling among 330 valuable and bad customers in 2008. They concluded that the ratio of liquidity flow, total debt, ratio of assets turnover, current ratio and cash ratio have a reverse effect on credit risk, and the ratio of free cash flow to the ratio of total debt, current debt ratio to eigenvalue has a direct impact on credit risk.

Foreign literature

In their study entitled "Studying the capital and liquidity adequacy of financial distress" to investigate the relationship between variables in financial distresses of the banks using logistic method among 123 banks in 28 European states during 2004-2013, Chiaramonte & Casu (2017) found a positive correlation between liquidity risk and financial distress. There was an inverse relationship between capital quality and risk. There was an inverse relationship between capital quality and financial bankruptcy. Additionally, the results have shown that the risk of liquidity and lack of capital based on Basel 3 could predict the bankruptcy of the bank. Thus, the bankrupt banks face low liquidity and insufficient capital, and banks must seek cash and maintain their assets to help them sustain a competitive environment and help them grow.

Han & Wang (2014) conducted a study entitled "Liquidity and financial impact of financial problems: evidence from the market for bonded bonds" aimed at evaluating the activity and price dynamics of the proposed bonds of the companies to clarify its impact on financial problems commercial liquidity and trade disputes. They used securities trading data for 2002 and 2011, and indicated that bonds, more active trading, experienced a wider range of offers and purchases, and a sharp decline in prices. In addition, liquidity loss and price pressures for assumptions during the financial crisis of 2008-2009 were more severe than other assumptions in the other period. Additionally, according to the results, the seller has been absorbing sales pressure from customers around the default bonds. Overall, financial pressures have strengthened major market shocks for the securities with problem. Recent financial distress has highlighted the importance of finding effective market prices for the stability of the global financial system. Despite this transient nature, price pressures have a significant effect on financial stability, especially in systematic events, which has been a major boost to the financial market. Thus, most investors in bonded securities, supportive funds focus on harmful debts. In this divided market, the new presumptions, especially those in large values, can create shocks in the supply of transaction securities.

Olawale (2014) studied the effect of credit risk on the performance of commercial banks in Nigeria. He reviewed the bank's secondary data for this. Secondary data is derived from the annual report, relevant literature and publication of CBN statistical bulletin. The results showed that the ratio of loans and advances to deposits was negatively related to profitability, though at 5% level and insignificant was the ratio of non-performing loans to loans and advances to negative profitability at 5% level. The study by Olawale shows a significant relationship between bank performance (in terms of profitability) and credit risk management (in terms of loan



performance). Finally, the strengthening of the securities market has a positive effect on the overall development of the banking sector by increasing competition in the financial sector.

Imbierowicz & Rauch (2013) examined the relationship between liquidity and credit risks in banks. Their sample was American commercial banks tested during 1998-2010. Finally, they understood that these two risks did not have a significant relationship at the same time, but they affected the probability of a default of banks, and both risk increased the probability of default, and as they have interaction at all levels of bank risk, they increase and reduce default risk. The results show the banks with an understanding of risk and provide fundamentals for the supervision of banks for strengthening liquidity risk management and credit risk as well.

In a study entitled “How should inventory be funded? Commercial credit in the supply chain with demand uncertainty and costs of financial spending” for verifying business credit as part of a supply contract with internal relationships with a supply chain contract management and inventory management using a model that explicitly interacts operational decisions and the financial risks of companies, Yang & Birge (2013) have tried to deepen a deeper understanding of business credit. On the question of the role of commercial credit in networking and supply, the results showed that, with uncertainty of demand, commercial credit increased effectively as a mechanism for risk sharing. While providing commercial credit, the supplier has compensated for the impact on operating profits and the cost of financial problems. In facing a credit agreement, the retailer uses a set of cash, trade credit, and short-term debt, in which the structure of these inventory packages depends on the need for retailers' financing and bargaining power. In addition, our model showed that financial diversification, i.e. the use of multiple sources, provided an alternative explanation for using agency in managing receivables and decentralizing some supply chains. Finally, using the model data model of Campostat Co., it was found to model financial inventory, modeling the model, and predicting a wide range of companies.

METHODOLOGY

The present study was applied in terms of its purpose because its results can be used in practice. In terms of data collection, the study was descriptive-correlation with longitudinal design. Research data is a type of panel data extracted from the information base and financial statements of selected banks active in Tehran Stock Exchange in 2009-2015. The population was all active banks. Finally, the financial information of banks active during the 7 years period (2009-2015) was collected and analyzed.

The population of the study was the active banks listed in Tehran Stock Exchange that were 13 banks with the following characteristics. First, the information of these banks during 2009-2015 had higher reliability compared with other bank information. Second, their information should be accessible. Thus, by applying these conditions, the member of the study population was 13 banks active in 2009-2015. Hence, in the present study, the method of determining sample was judgment and purposive type. Since the members of the statistical society are low, the entire statistical society was selected as the sample. Therefore, among the population of the banks, the ones holding the necessary conditions are:

1. The end of their fiscal year is March 20 and fiscal year should not change in the time realm of the study. This is due to the control of the effects of other economic variables during different periods of the year and the same effect on the sample.

2. The banks should be active in the Tehran Stock Exchange in the 7 years period and their financial statements should be available.
3. The banks that have been raising funds and financing from 2009 to 2015 through keeping dividends

Table 1: The population of the study

Row	Bank name	Row	Bank name	Row	Bank name	Row	Bank name
1	Eghtesad Novin	5	Hekmat	9	Saderat	13	Karafarini
2	Parsian	6	Saman	10	Ghavamin		
3	Pasargad	7	Sina	11	Mellat		
4	Tejarat	8	Shahr	12	Post Bank		

(Source: Researcher Results)

In this study, library method (documentation) was used for data collection. The information and data required for research literature and theoretical foundations were extracted from library resources, scientific databases, and internal and external papers. The model estimation method also used in this study is based on panel data. To determine the dependent and independent variables of the study, the information of the Tehran Stock Exchange companies and the financial statements of the banks, as well as the site of the Central Bank of Iran (economic time series databases¹) and the Codal site are used. Research data are generally available from financial statements. Classification and initial analysis were performed after collecting data in Excel software, and Eviews9 software was used for statistical analysis and testing of hypotheses after data preparation.

The applied model of this study is based on the model by Imbaraz and Reish (2011). As the relationship between liquidity risk and credit risk is unclear, the following structural equation approach was used.

Equation (3.1) examines the relationship between credit risk as a dependent variable and liquidity risk as the criterion of cash demand cover as an independent variable. The general form of the equation is as follows:

$$CR_{it} = \sum_{j=0}^n LDC_{i,t-j} + \sum_{j=1}^n CR_{i,t-j} + Control\ Variables_{i,t}$$

Equation (3.2) examines the relationship between liquidity risk, the criterion of cash demand cover as a dependent variable and credit risk as an independent variable. The general form of the equation is as follows:

$$LDC_{i,t} = \sum_{j=1}^n LDC_{i,t-j} + \sum_{j=0}^n CR_{i,t-j} + Control\ Variables_{i,t}$$

RESEARCH RESULTS

Descriptive Statistics

¹ www.tsd.cbi.ir



Descriptive indices are divided into two general categories, including central indexes and dispersion. The central indices can describe the aggregation and compression and the focus of the data. These indices include the maximum, minimum, mean and median. The dispersion indices include information on variance, skewness and kurtosis coefficients. Some descriptive statistics for the research variables are calculated and the results are presented in Table (2).

Table 2: Descriptive statistics of the variables

Variables	Symbol	Mean	Median	SD	Max.	Min.
Credit risk	LDC	0.0406	0.0098	0.1164	0.7283	0.0002
Liquidity risk	CR	0.5919	0.6106	0.2008	0.8729	0
Loan growth	O	0.1586	0.1454	0.1012	0.6501	0.0158
Deposit ratio	DR	0.6807	0.7638	0.2477	0.9696	0.0447
Loan ratio	M	0.5565	0.5793	0.1866	0.9642	1019
Profit before interest	Ir	0.01899	0.0138	0.0178	0.0851	-0.0284
Asset returns	ROA	6098	1.2571	1.3956	5.2695	-2.8312
Bank operational efficiency	ER	0.2858	0.1960	0.3078	5131/1	0
Net profit margin	NIM	24.0326	20.5051	21.9256	68.1843	-51.2299

Source: Securities Market Data in million Rials



Presumptions of hypothesis testing

In order to examine the relationship between GC between variables and vector autoregression (VAR) model, it is necessary first to test the static variables by ADF test and then the optimal interruption value is determined using Akaike info criterion (ACA) criteria, Schwarz criterion (SBC), Hannan-Quinn criter (HQ). Then, we examined the stationarity of the residue from the regression equation to determine the long-term or short-run relationship between the variables. The results of these presumptions are presented below.

Table 3: ADF test results for stationarity test of research variables

Variables	Dickey-Fuller Test statistic	Prob Significance level	Test results	Interpretation
Credit risk	-5.1695	0.0000	H ₀ rejected	stationary series
Liquidity risk	-9.5425	0.0000	H ₀ rejected	stationary series
Loan growth	-5.1410 /	0.0000	H ₀ rejected	stationary series
Deposit ratio	-6.7772	0.0000	H ₀ rejected	stationary series
Loan ratio	-4.6329	0.0003	H ₀ rejected	stationary series
Profit before interest	-4.3017	0.0008	H ₀ rejected	stationary series
Asset returns	-4.0041	0.00022	H ₀ rejected	stationary series
Bank operational efficiency	-7.7228	0.0000	H ₀ rejected	stationary series
Net profit margin	-6.4304	0.0000	H ₀ rejected	stationary series

According to Table 3, the significance level of the ADF test for stationarity is less than the significance level of $\alpha = 0.05$, so the null hypothesis stating the non-stationarity of the research variables is rejected.

Table 4: Optimum interruptions of dependent variables for the study of GC and auto-regression model

Variable	Interruption	ACI	SC	HQ	Test results
Credit risk	0	-1.3319	-1.2763	-1.3095	-
	1	-1.3035	-1.2196	-1.2697	-
	2	-1.2750	-1.1624	-1.2296	-
	3	-1.2434	-1.14017	-1.1863	Optimal
Liquidity risk	0	-1.4193	-1.3637	-1.3969	-
	1	-1.3895	-1.3057	-1.3557	-
	2	-1.3614	-1.2488/1	-1.3159	-
	3	-1.3309	-1.1892	-1.2739	Optimal

According to Table 4, the proposed criteria all represent the optimal interruption as the third interruption, so the third interruption is used to fit the models.

Table 5: ADF test results for examining the stationarity of regression residual

Criterion	Dickey-Fuller Test statistic	Prob Significance level	Test results	Interpretation
Regression residual	-7.7616	0.000	H ₀ rejected	stationary series

According to Table 5, the significance level of the augmented Dickey-Fuller (ADF) test for examining stationarity is less than the significance level of $\alpha = 0.05$, so the null hypothesis based on the residual non-stationarity of the result from the regression equation is rejected. Thus, the variables studied are cointegrated and there is a long-term relationship between them.

Inferential results

As in this study we try to investigate the causal interaction between credit risk and liquidity risk of banks active in Tehran Stock Exchange during the 7 year period (2009-2015), we must analyze GC test and vector autoregression (VAR) model.

GC test and studying long-term relationship between the variables

The dependent variables in this study are credit risk and liquidity risk. To examine the causal relationship between them and other variables, GC test was used with the results presented in the following table.

Table 6: GC test for credit risk analysis on liquidity risk

The dependent variable	Credit risk			Liquidity risk		
Independent variables	χ^2 Test statistic	Prob Significance level	T-test result	χ^2 Test statistic	Prob Significance level	T-test result
Credit risk	-	-	-	5.1604	0.0026	Sig.
Liquidity risk	0.4499	0.7180	Insignificant	-	-	-

According to the results of Table 6, the significance level for the causal relationship between credit risk on liquidity risk is higher than the significance level of $\alpha = 0.05$, showing non-significance of these relationships. Thus, the causality ratio of credit risk on liquidity risk is not confirmed with 95% confidence. Additionally, the significance level for the causal relationship between liquidity risk on credit risk is lower than the significance level of $\alpha=0.05$, indicating



the significance of these relationships. Hence, the causality relationship of credit risk on liquidity risk is confirmed with 95% confidence.

Panel-VAR3

For fitting the panel model of VAR, the regression vector for the optimal interruption (interruption 3) will be as follows. Dependent variables (Endogenous) in this study, credit risk are liquidity risk and exogenous variables are the deposit ratio, loan growth, return on assets, loan ratio, earnings ratio before interest, bank operating efficiency, and net margin, the results of which are presented in the table below.

Table 7: The results of fitting the panel model of VAR with optimal three interruptions

Endogenous variable	Credit risk			Liquidity risk		
Exogenous variables	T-test result	Prob Significance level	Test results	T-test result	Prob Significance level	Test results
Liquidity Risk with interruption 1	-2.4566	0.2515	Non-significant	-0.8285	0.0864	Non-significant
Liquidity Risk with interruption2	2.0700	0.2263	Non-significant	0.0279	0.0031	Significant
Liquidity Risk with interruption3	0.7818	0.0898	Non-significant	-0.2924	0.0342	Significant
Credit Risk with interruption 1	3.5877	0.4112	Non-significant	0.4354	0.0508	Non-significant
Credit Risk with interruption2	-0.4402	0.0523	Non-significant	-0.6262	0.0757	Non-significant
Credit Risk with interruption3	0.0610	0.0064	Significant	1.2348	0.1315	Non-significant
Deposit ratio	0.9461	0.0516	Non-significant	-4.0650	0.2259	Non-significant
Loan growth	2.5034	0.4432	Non-significant	0.0785	0.0141	Significant
Asset returns	-1.7480	0.0554	Non-significant	-1.0827	0.0343	Significant
Loan ratio	-0.2143	0.0149	Significant	0.3356	0.0239	Significant
Profit before interest	1.6952	0.5280	Non-significant	0.5256	1.1139	Non-significant
Bank operational efficiency	-0.8679	0.0392	Significant	0.7122	0.0327	Significant
Net profit margin	2.1869	0.0022	Significant	0.5969	0.0006	Significant
F	4.9768			1.7828		
Test statistic	0.4665			0.2385		
R2	0.3727			0.1047		

Considering the results of Table 7 and the value of the test statistic $F = 4.97$ reported for the exogenous variables of credit risk and liquidity risk on other variables, one can conclude a significant linear relationship between independent and dependent variables and the significance hypothesis of relationships is confirmed with 95% level of confidence.

According to Table 7, the significance level for the effect of credit risk variables with interruption 3, loan ratio, operating efficiency of the bank and net profit margin on credit risk is lower than the significance level $\alpha=0.05$, indicating the significant effect of these variables on credit risk. There is a positive and significant relationship between these variables with the dependent

variable of credit risk with 95% confidence. Thus, by increasing credit risk with interruption 3, the ratio of the loan, the operational efficiency of the bank and the net profit margin will increase the risk of credit risk. The value of adjusted coefficient of determination (ACD) is often considered as a good criterion for fitting the validity of the results of regression models. It shows that the variables of credit risk with interruption 3, the ratio of the loan, the operational efficiency of the bank and the net profit margin can simultaneously predict 37% of the variation variances of credit risk.

Moreover, according to the results of Table 7, the level of significance level for the effect of liquidity risk with interruption, liquidity risk with interruption 2, loan growth, asset return, loan ratio, operating efficiency of the bank and net profit margin on liquidity risk is less than the significance level $\alpha = 0.05$. This indicates the significant effect of these variables on liquidity risk. There is a positive and significant relationship between these variables with the dependent variable - liquidity risk - with 95% confidence. Thus, by increasing the risk of liquidity with interruption 2, liquidity risk with interruption 3, loan growth, asset return, loan ratio, operating efficiency of the bank and net profit margin of the liquidity risk will increase. The value of ACD is often considered as a good criterion for fitting the validity of the results of regression models. This indicates that the variables of liquidity risk with interruption 2, liquidity risk with interruption 3, loan growth, return on assets, loan ratio, operating efficiency of the bank and margin net profit at the same time is capable of predicting 11% of variance of variables of liquidity risk.

Explaining and interpreting the hypotheses

Hypothesis 1: There is a causal relationship between liquidity risk and credit risk with other variables, according to GC test

The results of Table 4 show that the significance level for the causal relationship between credit risk and liquidity risk is higher than the significance level of $\alpha=0.05$, showing the insignificance of these relationships. Thus, the causality ratio of credit risk on liquidity risk is not confirmed with 95% confidence. Additionally, the significance level for the causal relationship between liquidity risk on credit risk is less than the significance level $\alpha = 0.05$, which shows the significance of these relationships. Hence, the causality relationship of credit risk on liquidity risk is confirmed with 95% confidence.

The study examined the relationship between liquidity risk and credit risk in banks using the results of Imbaraz and Reish (2014). Their sample was American commercial bank and tested period was 1998-2010. Finally, they found that these two risks did not have a significant simultaneous relationship. The results showed a significant relationship between liquidity risk and credit risk and contradicted the results of their research. In a study entitled "The relationship between liquidity risk and credit risk in banks; a case study: Banks listed in Tehran Stock Exchange," Sharifi and Faghani Makrani (2015) concluded a direct relationship between liquidity risk and credit risk. The results of this study showed a significant relationship between liquidity risk and credit risk, consistent with the results of their research. In explaining this, one can state that liquidity risk comes from the inability of a bank to pay off and reduce debt or provide resources to increase assets. When the bank does not have sufficient liquidity, it cannot provide reasonable resources at the expense of raising debt or converting assets into cash at a reasonable cost, which will affect the profitability of the bank. In critical conditions, lack of sufficient liquidity even ends in bank bankruptcy. On the other hand, liquidity management is



of the greatest challenges that the banking system faces. The main reason for this challenge is that most banks' resources are financed from short-term deposits. Moreover, the banks' loans are used to invest in assets that have a low degree of liquidity. Hence, one of the most important sources for obtaining liquidity in the banks is the timely collection of loan and proceeds and the corresponding interest. Timely collection of liquidity requires banks to minimize their bank lending rates. In fact, one can argue that the profitability of the banks is due to the difference between the deposit rate and the borrowing rate. Although the profitability of banks does not result in an increase in shareholders' equity, the lack of profitability will disrupt liquidity and will reduce the value of the shareholders.

Second hypothesis: There is a significant linear relationship between credit risk, liquidity risk and exogenous variables such as deposit ratio, loan growth, and return on assets, loan ratio, and interest before earnings ratio, bank operating efficiency, and net margin.

The results of Table 5 show that the value of the test statistic is $F=4.97$ for exogenous variables - credit risk and liquidity risk on other variables - so one can conclude a significant linear relationship between independent and dependent variables and the significance hypothesis of relationships is confirmed with 95% confidence. The significance level for the effect of the variables of credit risk with interruption 3, loan ratio, operating efficiency of the bank and net profit margin on credit risk is less than the significance level $\alpha = 0.05$, which shows the significant effect of these variables on credit risk. There is a positive and significant relationship between these variables with the dependent variable of credit risk with 95% confidence. Thus, by increasing credit risk with interruption 3, the ratio of the loan, the operational efficiency of the bank and the net profit margin will increase the risk of credit risk. The value of ACD, often considered as a good criterion for fitting the validity of the results of regression models, shows that credit risk with interruption 3, loan ratio, the operational efficiency of the bank and the net profit margin can simultaneously predict 37% of the changes variances of credit risk. The significance level for the effect of the variables of liquidity risk with interruption 2, liquidity risk with interruption 2, loan growth, return on assets, ratio of the loan, operating efficiency of the bank and the net profit margin on liquidity risk are less than the significance level $\alpha = 0.05$, showing the significance of these variables on liquidity risk. There is a positive and significant relationship between these variables with the dependent variable of liquidity risk with 95% confidence. Therefore, by increasing the risk of liquidity with interruption, liquidity risk with maturity, loan growth, return on asset, loan ratio, operating efficiency of the bank and net profit margin of the liquidity risk will increase. The value of ACD is often considered as a good criterion for fitting the validity of the results of regression models. This value indicates that the variables of liquidity risk with interruption 2, liquidity risk with interruption 3, loan growth, return on assets, loan ratio, operating efficiency of the bank and net profit margin at the same time is capable of predicting 11% of variance of liquidity risk.

The study investigated the relationship between liquidity risk and credit risk in the banking industry of Iran during 2003-2012 with the results of Pendar (2014). His results showed a negative relationship between credit risk and liquidity risk, and this relationship is more severe than credit risk to liquidity risk. The results of this study showed a positive relationship between credit risk and liquidity risk, and therefore the results are contradictory to Pajuhesh Pendar (2014). In a study entitled "A review over the relationship between liquidity risk and credit risk in Iran's banks with the documentary method," Larijani and Nadarian (2015) obtained the



following results. Two important risks threatening the banking industry are liquidity and credit risks, which of course besides these factors, there are other risks, but if the bank or institution managers fail to plan for different scenarios in good and bad situations, they will be less vulnerable to other risks. The results of this study are consistent with their study. In explaining this, one can state that banks play a major role in financing the productive, commercial and consumer sectors as a central part of the financial system. Thus, one of the objectives of bank management is to increase shareholders' profits by emphasizing the performance of the bank. This goal is often accompanied with increased risk. The banks often face risks such as credit risk, liquidity risk, and so on. Stimulating the bank to manage a risk starts from the point where the risk involved causes a change in the bank's performance. The risk management not only has a significant effect on the bank's performance but also has a significant effect on the country's economic growth. Any measure to improve and enhance the efficiency of the banking system will improve the flow of deposit, investments and allocation of resources, and the potential dispersed and lagging potential of the country for the development and welfare. On the other hand, to prevent bank bankruptcy and losses, it is necessary to make decisions on bank risk management, each of which for risk management decisions can have a positive or negative effect on the bank's performance.

Limitations

Every study may have some limitations to the researcher that needs to set the correct assumptions about the research to achieve the best solution and the correct conclusion. The most important limitations in this study were as follows:

1. The lack of a systematic and organized database to access information from all financial and banking institutions has ended in some limitations on the data collection
2. The limited number of members of the population and according to that the sample that may affect the results of the research
3. If the research domain had been considered for a longer period, the results might have been more generalizable. However, if more years had been considered for sampling, the members of the population and the sample would have decreased, which would have reduced the validity of the research rendering the possibility of studying the relationship of the mentioned relationships limited

Suggestions

According to the results of Table 4, the following suggestions are presented:

- As asset returns have a significant impact on the banks' credit risk reduction, it is suggested that banks invest in assets with high returns and low risk. This needs the use of experts and specialists familiar with investment.
- As the efficiency of banks' operations has an effect on the banks' credit risk reduction, it is suggested that the efficiency of bank operations should be measured and compared, and that areas should be made available to improve the efficiency of banks, such as training and diversifying the type of deposits in the customer's tastes.

According to the results of Table 5, the following suggestions are presented:

- The bank managers are advised to manage the control of the financial risks of the banks and for better management of the bank risks pay attention to the aforementioned factors. As these factors are not controllable, they can help manage bank risk by predicting future conditions and factors for future periods and the probable value of these variables.



- Stock brokers and financial advisers, whose role is to analyze the financial situation of the banks listed in the stock exchange and describe the future financial status of financial institutions for shareholders and other stakeholders of the institutions, can determine the model and results of this research in the selection of investing portfolios. Additionally, capital market authorities can calculate the risk level of each financial institution for the time as a criterion for decision-making, and providing it to users.

Future research suggestions

Finally, to continue the research line and develop the literature in this field in Iran, some suggestions are presented as follows for future research:

1. It is suggested that the present study should consider other factors influencing liquidity and credit risk reduction for enhancing and generalizing.
2. It is suggested that the title of the research be reviewed in other companies active on the stock exchange.
3. Sampling should be random and on a specific bank to determine the problem of a particular bank.

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