

Measuring the risk of an Iranian banking system using Value at Risk (VaR) Model

Sudabeh Morshedian Rafiee^{a*}, Zahra Houshmand Neghabi^b and Ali Feizollahei^c

^aAssist. Prof. & Faculty Member, Department of Commercial Management, Islamshahr Branch, Islamic Azad University (IAU), Tehran, Iran

^bFaculty member, Department of Commercial Management, Islamshahr Branch, Islamic Azad University (IAU), Iran

^cM.A. Student, Department of Management, School of Management, Tehran North Branch, Islamic Azad University (IAU), Tehran, Iran

ARTICLE INFO

Article history:

Received May 20, 2012
Received in Revised form
July, 29, 2012
Accepted 15 August 2012
Available online
21 August 2012

Keywords:

Market Risk
Foreign currency liquidity
Value at Risk
Historical simulation
Linear regression

ABSTRACT

Measuring risk of financial institutes and banks plays an important role on managing them. Recent financial turmoil in United States banking system has motivated banking industry to monitor risk factors more closely. In this paper, we present an empirical study to measure the risk of some private banks in Iran called Bank Mellat using Value at Risk (VaR) method. The proposed study collects the necessary information for the fiscal year of 2010 and analyses them using regression analysis. The study divides the financial data into two groups where the financial data of the first half of year is considered in the first group and the remaining information for the second half of year 2010 is considered in the second group. The implementation of VaR method indicates that financial risks increase during the time horizon. The study also uses linear regression method where independent variable is time, dependent variable is the financial risk, and the results confirm what we have found in the previous part of the survey.

© 2012 Growing Science Ltd. All rights reserved.

1. Introduction

Financial crises of the late seventies, early eighties and late nineties have created a huge chaos in the world. United Kingdom banking crisis in the mid 1970, falling world market in 1987, Swedish banking crisis in early 1990, banking crisis of Mexico 1994-1995, banking crisis of Turkey in 2000 have caused to losses of financial resources and liquidity of institutions. These crises caused to increases awareness of banks and investors for more control over the types of risks in the banking and financial institutions. Following the occurrence of banking crises, countries who are members of “Group 10” have formed the “Basel Committee” in order to prevent such crises. The Basel Committee on Banking Supervision in the field of standards, Core Principles of Effective Supervision in the form of Article 25 was provided. Today, with globalization of the economy and extreme competition among banks, the profit margin of the activities of traditional banking has been decreased and consequently the risk of banking system has increased.

* Corresponding author. Tel: +98-912-3443139

E-mail addresses: morshedian_rafee@yahoo.co (S. Morshedian Rafiee)

Weaknesses in the banking system and the possibility of sanctions in the international community have motivated many people to use the Basel Committee requirement. In addition, reduction in government support, risk of crisis and attack to banks, assets and fluctuation of liabilities in foreign exchange rates, increase the uncertainty in the market, increase the risk agents in banks and credit institutions have threaten economic circumstance. The present article presents an estimation and risk measurement method in market in an Iranian bank called Mellat bank. The proposed model investigates whether during different periods, the market risk in Bank Mellat was increased or not.

The Bank for International Settlements and Basel Committee have obliged the members to identify, to measure and to control the size of financial risk, risk management and to create a comprehensive process under the supervision of board of directors. In addition, one of the conditions and requirements of privatization is to create the risk management and report them in banks' annual financial statements. Thus, it is essential to measure the bank's risks of institutions.

Financial risk directly affects the profitability of finance and credit institutions and it includes risks of balance sheet structure, the structure of revenue and profitability, capital adequacy, credit risk, liquidity risk, interest rate risk, market risk and currency risk. The main risks from the perspective of Joel Bessis in the banking industry include interest rate and credit risk, liquidity and market risk, currency and risk of inability to pay the debts (Bessis, 1999). According to Basel model, the most important risks most banks are faced include country risk, risk associated with transferring funds, market, interest rate, liquidity, operational, legal and reputation risks. We may also categorize risk in terms of two general categories including product market and market risk capital associated with the infrastructure of the risk financial services classification. Product market risk includes credit, strategic, operational, regulatory, commodity, human resources and legal risks. Market risk includes interest rate, liquidity, and currency risks (Peter & Rose, 1999).

According to Islamic Financial Services Board's (IFSB), the nature of risk facing banks of this type is different from conventional banks and it includes credit, investment, participatory, market, liquidity, credit and operational risks. Its components also include equity, exchange rate, goods price and profit risk rate. Dowd (2000) used Bayesian's Value Model Rate Risk in financial markets. Based on the "Asset Liability Management Theory", the difference in size of assets and liabilities and the bank were determined based on their risks. The domain of debt-asset management theory includes different categories. The first category is associated with measuring and controlling the interest rate risk and liquidity through different techniques. The first one regulates the purposes for revenues and operations rate and the second one regulates interest risk rate. The second one recognizes and controls the limit of balance sheet items through 1) limits of liquidity, 2) policy of loans, 3) capital adequacy ratio, 4) ability to pay debt,) conservation practices and programs, for the interest rate and liquidity rate. The third one is protective procedures and programs for interest rate risk and liquidity risk (Bessis, 1999). Commercial Loan Theory focuses on asset management and is associated with credit policy. According to this theory, banks take action to give short-term credit, and thus they put themselves in an adequate state of liquidity. Based on "Shift Ability Theory", any cash asset can be used to respond to liquidity needs. Some banks prefer to keep cash asset such as government negotiable papers to provide liquidity when they need by selling such papers and this makes it possible to have long-term credits.

In "Anticipated Income Theory" cash requirements and repayment of loans from expected incomes are provided and banks are encouraged to invest cash assets, so that, the due-date of loans and assets are at the same time. The basic principle of this theory is based on input flow characteristics and output of cash assets and loans. Khodaei Valahzagh et al. (2012) presented an empirical investigation to measure the effects of various factors on operating loss in one of major Iranian banks called Bank Mellat. They used a standard questionnaire and distributes it among 57 people who are mainly in top management levels. The results of their survey confirmed that the loss associated with events was related to the processes and methods increased operating risk meaningfully, the loss

associated with business disruptions and system failure increase operating risk meaningfully and the loss associated with related events within the organization increases operating risk meaningfully. However, the study did not confirm that the loss associated with events outside the organization increase operating, risk meaningfully. They also showed that there was not enough evidence to believe that the effects of business disruption and internal affairs are significantly different from the other event. Khodaei Valahzagh et al. (2012) presented an empirical investigation to measure the effect of various items on risk of foreign currency using value at risk (VaR) and regression methods. The proposed model of their paper investigated whether the risk of open positions of six foreign currencies including US dollar, Euro, British Pound, Switzerland Frank, Norwegian Kroner and United Emirate Dirham increase during the time horizon or not. The study implemented historical daily prices of these currencies for a fiscal year of 2011 in one of private banks located in Iran and measured the relative risk. The results of the implementation of two methods of VaR and linear regression indicated that the risk of open positions increased during the time horizon.

2. The proposed study

In this paper, we propose a method to measure the risk associated with one of Iranian banks called bank Mellat. We gather the necessary data from officials' financial statements of this bank for the fiscal year of 2010 as well as performing random sampling. Schematic risk models are from real world where in them the possible events and processes can be analyzed. Basis of these models and statistical theories are possible.

A model of risk includes predicting the pre probability distribution of the various events and the size of the losses from them. Risk models have different data, processing them and they will produce a measure of sizing. In order to assess risks such as fluctuation in interest rates or market risk in the banking industry-standard models can be used. The proposed study of this paper uses Value at Risk Model to analyze different risks associated with this bank. Data of research includes the necessary data for fiscal year of 2011 associated with a private bank collected on daily basis. Research data was selected by using non-probability targeted sampling method and volume sample was determined based on judgment of researcher. The information was collected from financial statistical system of private banks and according to goals of research and applying suitable formula, it was turned into variables of research. In order to measure and estimate risk of open position, VAR method has been adopted and they are analyzed using SPSS software. Risk model is general scheme for analyzing real-world problems, which is based on statistical and probability theories. A risk model consists of predicting distribution of probability for different events and studying level of their loss. Risk models process different data and create measurement criteria. In order to evaluate risks including: open position risk or market risk, it is possible to use from available standard models in the field of banking industry. Models for measuring risk are selected according to qualitative or quantitative degrees of statistical data. The proposed study uses VAR method to measure the risk of open position of private banks. A general mathematical model of VAR can be described as follows,

$$\Pr \{p_0 - p_1 \geq \text{VaR}\} \leq \alpha,$$

where P_0 is portfolio value at time zero, P_1 is portfolio value at time 1 and α is level of statistical error. This formula shows that probability of decreasing portfolio value in future period is higher than VAR and its maximum level is α i.e. probability of portfolio loss in future period is less than VAR as $1 - \alpha$. If cumulative distribution function of portfolio value in future period is shown as $F(p)$, its inverse mode i.e. $F_p^{-1}(\alpha)$ shows centile of portfolio value during progressive period. Therefore, VAR is calculated based on $\text{VaR} = P_0 - F_p^{-1}(\alpha)$, where $F_p^{-1}(\alpha)$ is centile alpha for distributing value of portfolio. VAR refers to maximum expected loss of assets or investment during specified period (one day, one week, one month) under ordinary market condition and certainty level i.e. this criterion is

interpreted as follows: Based on this formula we make sure that during N future days surely investor does not lose more than V (Onak et al., 1998; Pearson, 2002). In VAR method, there are two parameters of N and X representing time period and certainty level, respectively.

$$VaR \times \sqrt{N} \text{ 1 day} = VaR \text{ during N days}$$

Under some cases where change at investment during successive days has equal independent normal distribution with zero average, the aforesaid formula is exactly correct and under other conditions, aforesaid formula is nearly correct. VAR summarizes different types of risks and senior management from many calculations of risk. Nowadays this method is greatly applied in companies and managers of banks and financial institutes. Through VAR, it is possible to target risk and determine budget for risk. Supervision organizations including: central bank, by using VAR determines their required capital for banks based on real nature of transaction tools and level of risk taking. Generally, 2 methods are defined for measuring VAR including: historical simulation and parametric model method; in which, the present research applies from historical simulation method. In this part, the risk of Foreign Exchange Liquidity Market of Bank Mellat is being examined. At first, we must understand the overall status of the variable to be achieved. For this work, its descriptive indicators are examined. Foreign Exchange Liquidity of Bank Mellat is extracted daily. The survey uses time series changes of Foreign Exchange Liquidity of Bank Mellat during 274 days of 2010. Value at risk is calculated using historical simulation. In this study, taking about 274 days of the 2010 market risk in 2011 is estimated for the coming days. Given that the 274 kinds of effects can be applied daily, so 273 is the scenario for changing foreign currency liquidity. Scenarios were calculated in Excel software. Each of the scenarios will provide a value for the bank's foreign exchange liquidity.

Main hypothesis: It seems that by passing the time, the market risk in Bank Mellat because of fluctuations of foreign exchange increases. Therefore, the hypothesis of research is planned as follows.

H₀: The risk in Bank Mellat does not increase during the time horizon.

H₁: The risk in Bank Mellat increases during the time horizon.

3. The results

In order to test this hypothesis, two halves of the values of foreign currency liquidity risk of bank are compared. Fig. 1 shows that changes in risk during the half year have been different.

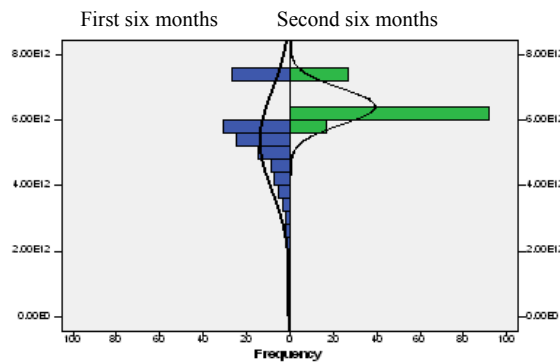


Fig. 1. Diagram of Market Risk in the two periods of six months

The statistics of T-test of two independent samples show that the average risk in the second half was significantly higher than average risk of the first half of 2010. The results of t-test are shown in Table 1.

Table 1

The results of comparison of risk between the two half-time studies

Test of comparing the average of two groups				TEST OF COMPARING THE VARIANCE OF TWO GROUPS		THE AVERAGE OF VALUE AT RISK OF MARKET	
AVERAGE DIFFERENCE	SIG	FD	T	SIG	F	2 ND SIX MONTHS	1 ST SIX MONTHS
-1337	0.000	164	-7.481	0.000	44.32	6429	5092

Considering the significant probable amount of testing two independent groups, it can be said that the risk market of Bank Mellat has an increasing trend. Thus, the researcher's hypothesis is confirmed and we can conclude that the risk increases during the time horizon. We have also repeated similar test on a monthly basis and Table 2 shows details of our findings. According to the significant probable amount of comparison testing of 12 months, the value at risk of Table 2 can also be claimed that there's a difference between Market Risk in different months.

Table 2

Results of comparison of risk during a case study of 12 months

COMPONENTS	FD	AVERAGE SQUARES	F	PROBABILITY
BETWEEN GROUP	11	166	18.242	0.000
INSIDE OF GROUP	256	9		
TOTAL	267			

We have performed Kruskal-Wallis test and the test yields a Chi-Square value of 118.402 with 11 degrees of freedom and Sig value of 0.000. Therefore, we can conclude that the risk in this bank increases during the time horizon. Next, we have used regression analysis to find a relationship between time and the risk associated with financial figures of the proposed cases study as follows,

$$Y_i = \beta_0 + \beta_1 t_i + \varepsilon_i, \quad (1)$$

where β_0 and β_1 represent the coefficients, Y_i is the risk and t_i is the time horizon. Table 3 shows the results of regression analysis.

Table 3

Results of regression analysis between the value at risk of foreign exchange liquidity and time

	NO-STANDARDIZED COEFFICIENTS		STANDARDIZED COEFFICIENTS			
	B	STANDARDIZED ERROR	Beta	t-statistics	Sig.	R ²
CONSONANT	4342	265		19.717	0.000	0.174
TIME	1232	128	0.421	7.568	0.000	

The fitted regression model is represented as Market risk (Value at Risk) = 4342 + 1232 (index time).

Based on the results of regression analysis, there is a meaningful relationship between independent variable and dependent variable and both t-value observations are valid when the level of significance is five percent. The positive sign associated with independent variable, time horizon, means that as time travels there will be an increase on financial risk associated with this bank. In addition, Durbin-Watson ratio was calculated as 1.562, which means there is no autocorrelation between residuals. Finally, F-value calculated through ANOVA test is 57.269 with the significance level of 0.000, which means the regression model is well defined.

4. Conclusion and Recommendations

In this paper, we have presented an empirical investigation to evaluate the bank's market risk using value at risk during the fiscal year of 2010. In this study, the total of bank offices in the Bank Mellat system was studied and the necessary information was collected. The primary hypothesis of this survey was to find out whether there was any increasing trend during the time horizon and the results of our survey confirmed this positive relationship using Value at Risk method as well as using a

regression analysis. Therefore, we can conclude that banks could use different actions to immune their position against any possible risks such as currency risk. These actions could also use some sophisticated methods such as using derivatives, converting loans to securities, etc.

Acknowledgment

The authors would like to thank the anonymous referees for their insights on earlier version of this work.

References

- Basel Committee on Banking Supervision (2003). *The New Basel Capital Accord*. Consultative Document.
- Basis, J. (1999). *Risk Management in Banking*. John Wiley & Sons.
- Bessis J. (2005). *Risk Management in Banking*. John Wiley & Sons Ltd, 5th ed.
- Core Principles for Effective Banking Supervision, Basel Committee on Banking Supervision, BIS, February 2006.
- Down, K. (2003). *Beyond Value at Risk – The new Science of Risk Management*. John Wiley & Sons.
- Dowd, K. (2005). *Measuring Market Risk*. Sussex: John Wiley and Sons Ltd, 2nd ed.
- Glyn, A., Holton (2004). *Value at Risk: Theory and Practice*. Academic press.
- Islamic Financial Services Board (IFSB)(2005). Exposure Draft NO. 1-2: March 2005.
- Khodaei Valahzaghari, M., Khalili Araghi, M., Golampour Papkiyadeh, S.M., & Khodaei Valahzaghari, S. (2012). An empirical study to measure the effects of various factors on operating loss. *Management Science Letters*, 2(6), 1895-1900.
- Khodaei Valahzaghari, M., Ghavidel, M., Heidar, M., & Mahmoudzadeh, E. (2012). An empirical study on open position risk assessment using VAR and regression analysis: A case study of Iranian banking industry. *Management Science Letters*, 2(6), 2135-2140.