

# Operational risk management of commercial bank of China based on the revenue model of the CAPM model

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**Abstract** –By using the revenue model of the CAPM model, the paper focuses on the data of Industrial Bank and Bank of NINGBO, for the estimation of operational risk. The revenue model can reflect the size of the operational risk. The significant positive effect on net profit leverage of the two banks by non-performing loan cannot be neglected. Negative operating result caused by operational risk can be measured by this model. In the end, the paper puts forward the following advices to improve the operational risk management: (1) Specific risk management strategies making; (2) The establishment of an independent risk management framework; (3) Raising the level of interest rate management; (4) Information disclosure system improving.

**Keywords** - Operational risk management; Operational risk process; Risk measurement; New Basel Capital Accord

## 1. Introduction

The commercial bank's risk management refers to the sum of the commercial banks against the risks faced by the policies and procedures and measures taken, and the purpose is to avoid and reduce losses and protect the safe operation of the bank. In the process of risk management, commercial banks need to identify measure and evaluate the various risks involved, and on this basis, through a variety of risk management policies and measures, the implementation of effective risk prevention and control.

The relationship between risk and capital has been argued as the risk preference process going. There are several important policy implications. The recent modification in the capital requirement regulation (Basel II) is a structural change that places far more emphasis on the range of capital that may be required given the specific risks faced by each bank. It has been argued that a more risk sensitive capital adequacy regulation may reduce banks' willingness to take risk. However, if banks already risk adjust their total capital, i.e. minimum capital plus buffer capital, more than implied by Basel I, then replacing Basel I with Basel II may not affect the capital to asset ratio or risk profile of banks' portfolio as much as feared.

In contrast to the predictions of the moral hazard theory, banks no longer hold the minimum allowable amount of capital; rather, they have their own preferred level of capitalization. If this level is exceeded by regulatory requirements, then there is no longer a relationship between capital and risk.

The general view is that credit risk is the biggest problem of commercial banks. Any loss events are not due to single risk, so credit loss is not caused by credit risk alone. Credit losses cases show that the loss is due to the lack of diligence, fraud, favors, loans, illegal operations, and loose internal control system. Operational

risk events mostly occurred in the credit sector, which largely triggered and amplified the credit risk.

Bank operational risk management framework under the new Basel Capital Accord: Basel Committee released the stability of the Guidelines on operational risk management and regulatory practices in February 2003. The guidelines include 10 principles, including 4 aspects: building the proper operation risk management environment; operational risk identification, assessment, monitoring and sustained release or control; supervisory role; and information disclosure. The Ordinance is also a completed operational risk management process. The environment of operational risk management, operational risk identification, measurement, monitoring and control and information disclosure requirements all belong to operational risk measurement methods on the internal management mechanism. These 10 principles can be called operational risk management framework.

China banking industry's operational risk management is still at the identification stage, and has yet to find a good way to more accurately filter out the operational risk from a number of risks. When it narrows down to research on operational risk measure, while the Basel has proposed three kinds of operational risk capital charge method, China's banking and regulatory bodies for the adaptability of these methods in China is still at the exploratory stage. How to apply it to the special environment of the China banking industry remains a challenge in practice. Monitoring and control of operational risk is even not linked up with the former 2 processes for systematic analysis of research. Moreover, since the banking industry's research for each process is isolated, it cannot play an important part in operational risk management. While separate study for each operational risk processes are under studying, each process should be linked together to achieve the effect of risk management.

## 2. Early Research

Company Algorithmics founded the risk of observation (Risk Watch) model, which integrated a variety of risk management as a model. Risk Watch model, for the main features, used single risk engine, a single data structure and a single management system. It further developed the “non-bundled pricing” method based on market pricing, with the core engine AlgoSuite (ASE). This is was an earlier model of a comprehensive risk management.

AXIOM software companies established a new risk-management model called Risk Monitor model. It integrated several risk calculation methods, including: variance, Covariance, Monte Carlo simulation, historical simulation and multi-fact. It provide a sustained, consistent measurement to measurement for all markets, business lines and the risk of financial instruments, predicting and controlling of the whole bank credit and market risk. It also determined the traders, business line, counterparty, country risk limits.

Jack L. King released its “Operational Risk: Measurement and modeling” paper, presented to the Delta. EVT used factor model to measure the loss of high frequency and low-risk. This model also effectively compensate for the limitations based on the generalized Pareto distribution parameter method which can only be used to measure low-frequency high event.

The Risk IQ model, founded by Financial Systems, Inc., is based on Bankers Trust’ RAROC approach, and under the guidance of the bank. This system provides a comprehensive analysis of market risk, credit risk, and liquidity risk. And it cannot be only used for single, multiple portfolio, individual transactions, but also for the whole bank.

## 3. The modified revenue model of the CAPM model

As recommended by the Basel Committee, in line with their current situation, developing countries should design a simpler, more practical measure of operational risk model. The following analyze is based on two models: the Basic Indicator Approach and the revenue model of the CAPM model.

Fluctuations in income caused by operational risk:

$$\sigma^2 = \sigma_{total}^2 (1 - R^2) \quad (1)$$

For a comparison point, the data of Bank of NINGBO and Industrial Bank are used in evaluation of operational risk. Bank of NINGBO and Industrial Bank are located in the same area, operating the same business.

As to the factors which influence the revenue, there are 4 aspects: (1) Economic growth. The trend of the development of the banks is same as that of economic growth. (2) Asset Quality. The revenue and risk level are influenced by asset quality. (3) Profitability. Most profits of Chinese banks are gain by interest. (4) Stock-index. Stock-index shows the development of economic condition.

The explanatory variable of analyze are GDP/CPI, Stock-index, Loan-Deposit and Non-performing Loans.

The multiple linear regression models of the 4 explanatory variables and bank profits are as followed:

$$P_i = b_0 + b_1 (\text{GDP/CPI}) + b_2 (\text{Loan-Deposit}) + b_3 \text{NPL}_i + b_4 (\text{Stock-Index}) \quad (2)$$

The target banks are Bank of NINGBO and Industrial Bank, which were listed in A Stock Market. (SZ.002142 and SH.601166). The following data are from annual reports.

Profits before tax, NPLR (Non-performing Loans Ratio), One-year lending and deposit rates, Stock Market Index, GDP and CPI of the year 2007-2011 are as followed:

**Table 1** Data of Bank of NINGBO and Industrial Bank

	Profits before tax of Bank of NINGBO (Million RMB)	NPLR of Bank of NINGBO (%)	Profits before tax of Industrial Bank (Million RMB)	NPLR of Industrial Bank (%)
2007	1184.80	0.36	10910	1.15
2008	1522.88	0.92	14037	0.83
2009	1749.71	0.79	17229	0.54
2010	2948.00	0.69	24005	0.42
2011	4035.28	0.68	33664	0.38

From: Annual reports of Bank of NINGBO and Industrial Bank

Risk factors of model:

**Table 2** Data of 4 factors

Year	GDP growth	CPI growth	One-year lending and deposit rates (%)	A Stock Market Index
2007	11.40%	104.80%	3.51	5261.56
2008	9.00%	105.90%	3.06	1820.81
2009	8.70%	99.30%	3.06	2760.83
2010	10.30%	103.3%	2.75	2700.13
2011	9.20%	105.4%	3.50	2315.21

From: Statistics Bulletin of the National Economic and Social Development of the People's Republic of China and deposit and lending interest rates table of People's Bank of China

The multiple regression analysis is supported by SPSS16.0 software. In consideration of the condition that different dimensions of data may affect the results, before analyzing, the data should be standardized.

Then, stepwise regression is used in the analysis, which is a combination of forward selection method and the backward removed method, according to the judgment set to meet the judgment of the independent variables into the regression equation and the largest contribution to the dependent variable factors.

According to backward regression, the model F value of the minimum and in accordance removed from the model excluding the variable of judgment, repeated until the independent variable in the regression equation are eligible to enter the model judgment do not meet outside of the model into the model of judgmental.

The analysis of Bank of NINGBO:

**Table 3** Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.973 <sup>a</sup>	.942	.921	.21345911

a. Predictors: (Constant), Zscore (NPLR of Bank of NINGBO)

**Table 4 ANOVA<sup>b</sup>**

Model	Sum of Square	df	Mean Square	F	Sig.
Regression	3.614	1	3.614	39.401	.006 <sup>a</sup>
1 Residual	.386	3	.192		
Total	4.000	4			

a. Predictors: (Constant), Zscore (NPLR of Bank of NINGBO)

b. Dependent Variable: Zscore (Profits before tax of Bank of NINGBO)

**Table 5 Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error			
1 (Constant)	-4.012E-16	.151		.000	1.000
Zscore (NPLR of Bank of NINGBO)	-.973	.142	-.973	-4.203	.006

a. Dependent Variable: Zscore (Profits before tax of Bank of NINGBO)

Based on the table above, choose NPLR as the effective independent variables of the regression equation.  $R^2=0.942$ ,  $F=39.401$ ,  $P=0.006<0.05$ , Equation has statistical significance.

Established regression equation of Bank of NINGBO:  
 $P_1 = -0.973NPL_1$

The analysis of Industrial Bank:

**Table 6 Model Summary**

Model	R	R Square <sup>b</sup>	Adjusted R Square	Std. Error of the Estimate
1	.866 <sup>a</sup>	.821	.331	.73348211

a. Predictors: Zscore (NPLR of Industrial Bank)

**Table 7 ANOVA<sup>b</sup>**

Model	Sum of Square	df	Mean Square	F	Sig.
Regression	2.312	1	2.312	20.296	.012 <sup>b</sup>
1 Residual	1.688	3	.417		
Total	4.000	4			

a. Predictors: (Constant), Zscore (NPLR of Industrial Bank)

b. Dependent Variable: Zscore (Profits before tax of Industrial Bank)

**Table 8 Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error			
1 (Constant)	-7.4312E-17	.258		.000	1.000
Zscore (NPLR of Bank of NINGBO)	-.812	.217	-.812	-1.726	.044

a. Dependent Variable: Zscore (Profits before tax of Industrial Bank)

Based on the tables above, the model chooses NPLR as the effective independent variables of the regression equation.  $R^2=0.956$ ,  $F=20.296$ ,  $P=0.044<0.05$ , Equation has statistical significance. Constants shall be eliminated due to low significance of F value and P value.

**Table 9 Model Summary**

Model	R	R Square <sup>b</sup>	Adjusted R Square	Std. Error of the Estimate
1	.912 <sup>a</sup>	.956	.314	.63288426

a. Predictors: Zscore (NPLR of Industrial Bank)

**Table 10 ANOVA<sup>c, d</sup>**

Model	Sum of Square	df	Mean Square	F	Sig.
Regression	2.312	1	2.312	32.104	.021 <sup>a</sup>
1 Residual	1.688	4	.417		
Total	4.000	5			

a. Predictors: Zscore (NPLR of Industrial Bank)

b. This total sum of squares is not corrected for the constant because the constant is zero for regression through the origin

c. Dependent Variable: Zscore (Profits before tax of Industrial Bank)

d. Linear Regression through the Origin

**Table 11 Coefficients<sup>a, b</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error			
1 Zscore (NPLR of Bank of NINGBO)	-.812	.164	-.812	-2.162	.021

a. Dependent Variable: Zscore (Profits before tax of Industrial Bank)

b. Linear Regression through the Origin

After constants being eliminated, the regression equation chooses NPLR as independent variable.  $R^2$  value changes to 0.956, F value to 32.104,  $P=0.021<0.05$ . The equation has more statistical significance.

Established regression equation of Industrial Bank:  
 $P_2 = -0.812NPL_2$

$R^2$  value represents how much the dependent variable variance can be explained by the model. The

more value is closer to 1, the stronger the explanatory power of the model is. In this model, the variance which can't be explained by the model is recognized as a result caused by operational risk, whose value is  $1-R$ . According to the model, R Square value of Bank of NINGBO and Industrial Bank are 0.942 and 0.956. The proportion of operational risk is 5.8% and 4.4% of these two banks. These two banks have low operational risk level. Bank of NINGBO faces more operational risk.

Based on the standardized regression coefficient beta value, non-performing loan has an influence up on dependent variable under both P1 and P2 analysis, which is in accordance with economic theory. This result reflects the important role played by asset quality factors on bank income. As the NPLR value change for 1 unit, the net profits of two banks change for RMB 97.3 million and 81.2 million. The significant positive effect on net profit leverage of two banks by non-performing loan cannot be neglected. For the up analysis, the revenue model can reflect the size of the operational risk.

## 4. Conclusion

### 4.1 Specific risk management strategies making

A well-defined business strategy and risk management strategy should be formulated by the board of directors, including the risk management objectives, risk of affordable asked, the principles of risk management and so on. Besides, the board is responsible for the management of the capital, that is estimating the development goals, forecasting the gap between economic capital and regulatory capital, planning a optimum structure of the capital and provide financing plan, determining the capital allocation between different economic areas, business lines and industries configuration.

### 4.2 The establishment of an independent risk management framework

Establish a independent, vertical risk management framework basing on a sound corporate governance structure and implement a risk management system with the board of directors and senior management layer independent of each other, in other words, the owner will monitor the management behavior from outside, while the senior management will monitor the business and management risk of branches base on Real-time control.

Board of Directors is the supreme power of the banks' risk management and decision-making bodies, which is responsible for the development of risk management strategies, risk-oriented and volume, and leading risk management committee directly. Risk management committee is responsible for the design of risk management policies, procedures and monitoring the overall level of risk, including risk management department, which implement a vertical management of whole bank, according to the policies established by the risk management committee. Business department has risk control personnel, with staff reporting directly to

upper level, instead of business department manager. Audit committee is established under board of supervisors. Its responsibility consists of the bank's overall risk monitoring, risk management efficiency evaluation and urged the establishment of perfecting the system of risk management mechanisms and organizations, through the standing department of audit risk. It also monitors moral risk of board members, senior management and other key staff of the bank.

### 4.3 Raising the level of interest rate management

Master interest rate risk management techniques are not only the requirements of future, but also the needs of reality. On one hand, commercial Banks may use several methods like gap analysis report, net duration analysis and net present value analysis to simulate the influence of bank assets, liabilities when market interest rates changed. And then, the bank could analyze the degree of the interest rate risk that existing assets and liabilities are bearing now, giving optimal adjustment programs with minimal risk and best benefits. On the other hand, the bank should explore the off-balance-sheet business risk control method, strengthen the research and application of forward rate agreement, interest rate futures, interest rate swaps and other financial derivative products, what is more important is to grasp the basic theory and technology of using them.

### 4.4 Information disclosure system improving

New Basel Capital Accord recognizes market discipline as the third backbone of bank risk management, with a particular emphasis on the bank information disclosure requirements. Bank information disclosure should not only consider strengthening the market discipline, standardizing the operation and management factors, but also consider the feasibility and safety of information disclosure. In order to regulate the information disclosure work; Chinese commercial banks should further modify the information disclosure system.

1. According to the new capital agreement, the bank should do accurate calculation on key field, such as risk management systems and programs, capital structure, risk assessment and management programs, capital adequacy ratio, promoting the information disclosure of commercial bank steadily.

2. Promote the internationalization of accounting system actively and improve the consistency and comparability of accounting information. The internal audit department of bank must develop strict discipline, exercise audit and inspection functions, so as to improve the accuracy of accounting information.

3. In order to improve the risk management system and carry out the risk assessment standard, junior internal law and internal law smoothly, the bank should improve disclosure standards and strict disclosure procedures, enhancing the quality of the information at the same time.

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