

# Application of VaR Model in the Market Risk Management of Commercial Bank in China

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## Abstract

**VaR is one of the international mainstream market risk measurement tools and is widely used abroad. With the comprehensive opening of China's financial market, regulators learn from Basel to encourage commercial banks to use VaR model to measure market risks. According to the annual reports of listed banks, China's commercial banks have been constantly learning the methods and modes of market risk management in recent years, and mainly use value at risk, sensitivity analysis, exposure analysis, stress test and other methods in risk measurement methods. The market risk measurement mode and model of large banks have been continuously improved. At this stage, the market risk measurement and management system with VaR as the core has been established.**

## Keywords

**VaR; Commercial Bank; Market Risk; Basel; Financial Risk Management.**

## 1. Overview of the VaR Model

The basic work of risk management is to measure risk, and the choice of appropriate risk measurement indicators and scientific calculation methods is the basis of the correct measure of risk, and it is also the premise of establishing an effective risk management system.

### 1.1. Generation of the VaR Model

The development of risk measurement theory has gone through three stages: the traditional risk measurement phase with variance and risk factors, the modern risk measurement phase represented by the current international standard risk measurement tool VaR, and the consistent risk measurement phase represented by ES.

As traditional asset-liability management ALM is too dependent on report analysis and lacks timeliness; traditional risk sensitivity measures such as variance, half-variance, lower deviation moment and other measures can only describe the uncertainty of income, difficult to comprehensively measure risk; and CAPM (Capital Asset Pricing Model) is difficult to measure financial derivatives. When several of the above traditional methods are not able to accurately define and measure financial risk, G30 Group proposed the VaR (Value at Risk) model for measuring market risk based on the study of financial derivatives. The Risk Metrics risk control model launched by JP Morgan in 1994 to calculate VaR is widely adopted by many financial institutions. At present, financial institutions not only use VaR as a tool to measure market risk, but also establish the VaR market risk management system to raise VaR to the management level.

### 1.2. The Basic Principle of VaR

VaR (Value at Risk), known as the risk value model, also in the risk value method, literally means "valuation by risk", is the maximum loss value an asset or portfolio may suffer during a given period, at a given confidence. Assuming that the earnings distribution of a given asset or portfolio is  $P/L$ , with a given confidence level of  $\alpha$ , and  $P=1-\alpha$ , if  $q_p$  represents the  $p$ -quantile of the portfolio income distribution ( $P/L$ ) during a certain holding period, then during a certain

confidence and holding period, the portfolio VaR is expressed as  $VaR = -q_p$ . For example, the securities portfolio held by an investment company will have 95% confidence in the next 24 hours, with the VaR value of 6 million in the normal fluctuations of the securities market. Its meaning is that the company's securities portfolio within 24 hours of the maximum loss of more than 6 million due to market price changes a day, or 95% sure to judge the probability of the investment company's loss within the next trading day within 6 million.

## 2. Applicability of VaR in Market Risk Management

Market risk refers to the risk of loss of on balance sheet business and off balance sheet business of banks due to adverse changes in market prices (interest rate, exchange rate, stock price and commodity price). Market risk is one of the three major risks for commercial banks. The underlying reason for financial market risk is the reduced value of financial assets due to unstable financial price factors. The loss of value of financial assets exceeds a certain limit, which will consume the venture capital of financial institutions, causing a credit crisis, thus forming credit risk. In order to avoid this risk, financial institutions usually adopt financing or transaction methods, which is easy to produce unexpected liquidity demand. A little careless, they will face other liquidity risks, operational risks and other financial risks. It can be seen that market risks are often the basis of other financial risks, and have a special status in the whole financial risk system. Therefore, the market risk has gradually become the main risk facing commercial banks. Once launched, the VaR model was widely welcomed by the international financial community and rapidly developed into a standard for market risk management and was adopted by many financial institutions. The application of VaR model in the risk management of commercial banks market is mainly manifested in the following aspects.

### 2.1. VaR Serves as A Tool for Setting Position Limits and Asset Allocation

In commercial banks, management can use VaR to set position limits for business units or traders, thus avoiding increased bank market risk due to excessive speculation by traders. Since VaR is a simple value, commercial banks can use this simple value to set a position limit so that traders or management can intuitively feel or understand about it.

### 2.2. VaR Serves as A Tool for Trader Performance Evaluation

Evaluation trader performance is also part of market risk management. At present, for the performance evaluation of traders, the method of risk adjusted return is more popular in the world. If traders engage in high-risk investments, even with high earnings, risk-adjusted personal performance will not. Using the VaR method to performance evaluation can truly reflect the trader's operating performance and limit its excessive speculation.

### 2.3. VaR Is Able to Achieve Quantitative Analysis of Market Risks and Facilitate Regulation

It is a very important step to quantify risk in the management of market risk. VaR can realize the quantification of market risk, and can have an objective and prior estimate of the potential losses incurred by the market risk borne by the portfolio or institution, which makes an objective basis for market risk management decisions. At present, the Basel Committee on international banking supervision, the Federal Reserve Bank of the United States and the financial authorities of European countries all use the VaR model as a risk measurement tool to measure the risk of regulated banks and require them to report the value of VaR. The use of VaR in China's Banking Industry also provides a strong basis for regulators to promote the progress of comprehensive risk management of commercial banks.

### 3. The Application of VaR Model in Market Risk Supervision

The focus of risk management in China's commercial banks has long been credit risk as the core, while market risk is due from the long-term control of market fluctuation factors such as interest rate and exchange rate and is relatively ignored. Before 2010, Chinese commercial banks did not widely use scientific quantitative methods such as VaR model to measure market risk. With the international financial market after a series of crises gradually strengthen the market risk supervision and control, and the marketization and openness of the financial system in China, China's financial regulatory authorities began to learn from the Basel Accord, pay attention to the market risk control and requires standard method and internal model method to improve the comprehensive risk management of commercial banks.

In order to establish a preliminary framework applicable to the market risk prudential supervision of China's commercial banks, the former CBRC published the management methods of capital adequacy ratio of commercial banks and the guidelines for market risk management of commercial banks as early as 2004. The management method for capital adequacy ratio of commercial banks clearly stipulates the regulatory requirements for market risk capital, requiring commercial banks whose total position in the trading account is higher than 10% of the total assets on and off the balance sheet or more than RMB 8.5 billion to withdraw corresponding regulatory capital for market risk, It is stipulated that commercial banks can use the standard method or the internal model method to measure market risk capital with the approval of the CBRC.

In 2010, on the basis of the preliminary framework, the former CBRC issued the regulatory guidelines for the internal model method of market risk capital measurement of commercial banks, fully absorbed the new changes in the revision of the Basel market risk regulatory framework in 2009, and provided guidance for commercial banks to measure market risk capital based on VaR model method from both qualitative requirements and quantitative standards. It defines the basic standards and regulatory requirements that commercial banks should meet when using the internal model method to measure market venture capital. For example, commercial banks calculate the normal VaR with a holding period of 10 days and 99% single tail confidence interval at least once every trading day.

Since 2011, the former CBRC has drawn on and absorbed the experience of Basel II and III and combined with the reality of China's banking industry, formulated the measures for the capital management of commercial banks, which was officially promulgated in June 2012 to further make clear requirements and detailed provisions on the standard law and internal model law of market risk. Among them, commercial banks that require the internal model method to measure specific risks should use the internal model to measure the new venture capital requirements. The holding period of the model is set as 1 year, the confidence interval is 99.9%, which is calculated at least once a week, and the liquidity period of the product or portfolio needs to be fully considered.

With the implementation of the measures for capital management of commercial banks, China's commercial banks have been learning the methods, models and corporate governance mechanisms of market risk management in recent years. From the annual reports and capital adequacy reports of listed banks, many large banks (such as the ICBC and the CMB) have begun to use VaR model to effectively identify and manage market risks. At this stage, they have begun to establish a market risk measurement and management system with VaR as the core.

According to the capital adequacy report of ICBC in 2020, ICBC adopts the historical simulation method (99% confidence interval, 10-day holding period and 250 day historical data) to measure VaR and applies it to the internal model method for capital measurement. In addition, ICBC carries out return inspection every day to verify the accuracy of VaR model. In the past 250 trading days as of the end of the reporting period in 2020, the group's number of

breakthroughs in return inspection was within the Green Zone specified by the China Banking and Insurance Regulatory Commission. The bank's market risk measurement model can timely capture the fluctuations in the financial market and objectively reflect the market risks faced by the bank.

**Table 1.** ICBC General Value at Risk (VaR) situation

Project	2019 (Unit: Million RMB)			
	End of Term	Average	Maximum	Minimum
VaR	1824	2249	3522	987
Interest risk	133	174	263	93
Exchange risk	1845	2297	3564	1044
Commodity risk	96	69	133	15
Project	2020 (Unit: Million RMB)			
	End of Term	Average	Maximum	Minimum
VaR	696	1487	2107	597
Interest risk	451	247	711	92
Exchange risk	846	1483	1996	767
Commodity risk	142	169	536	40

Data source: annual reports of the company in 2019 and 2020

According to the capital adequacy ratio report of CMB in 2020, CMB adopts the historical simulation method to calculate, the confidence is 99%, the observation period is 250 days and the holding period is 10 days. All interest rate risk factors cover all businesses of the trading account and are composed of about 154 interest rate or bond yield curves. All exchange rate risk factors cover the spot and forward prices and volatility of all transaction currencies in the transaction account. In addition, CMB carries out return test every day to verify the accuracy of VaR model. As of the last 250 trading days at the end of the reporting period of capital adequacy ratio in 2020, the number of breakthroughs in return inspection is within the Green Zone specified by the CBRC. The bank's market risk measurement model can timely capture the fluctuations in the financial market and objectively reflect the market risks faced by the bank.

**Table 2.** CMB General Value at Risk (VaR) situation

Project	2019 (Unit: Million RMB)			
	End of Term	Average	Maximum	Minimum
VaR	161	200	278	133
Interest risk	135	180	252	129
Exchange risk	115	133	213	54
Commodity risk	28	19	91	1
Project	2020 (Unit: Million RMB)			
	End of Term	Average	Maximum	Minimum
VaR	515	361	585	140
Interest risk	254	279	421	68
Exchange risk	482	228	628	98
Commodity risk	78	49	280	6

Data source: annual reports of the company in 2019 and 2020

In conclusion, the VaR model is beneficial to measuring risk, and then lays a good foundation for financial risk management. With the development of interest rate liberalization, financial

opening and the development of derivative financial instruments in China, the financial risks faced by commercial banks and other institutions are increasingly complex. To comprehensively consider and measure credit risk and market risk including interest rate risk and exchange rate risk, which provides a broad space for development space for VaR application. At present, the VaR model has been widely used in the market risk management practice of large commercial banks in China. However, due to the limitations of VaR itself, the use of VaR should be combined with other risk measurement and management technologies and methods. In addition, in the practice of risk management, we should also effectively combine scientific measurement methods and rigorous management ideas, emphasizing both science and experience, so as to effectively play the role of VaR in the financial risk management of commercial banks in China.

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