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The Construction Research of Inventory Portfolio Pledge Rate Model

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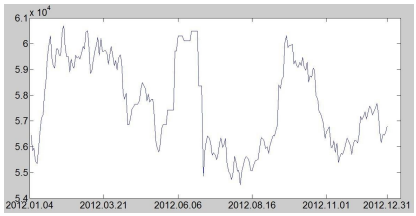

Abstract: **This paper has a deep analysis and research on the inventory portfolio pledge rate. It emphasis on the relationship between inventory portfolio pledge of price changes, constructs inventory combination of pledge rate model, to analyze the correlation of copper and zinc futures rate data, lays the foundation for the following research portfolio.**

Keywords: Inventory portfolio; Pledge rate; Copula; VaR

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1. Introduction

Lenders face many risks in inventory pledge loan, such as the establishment of the right of pledge of collateral risk, pledge management risk , risk of pledge turning cash , regulatory risk etc. The pledge of assets is a major risk lending institutions face. When prices fall, pledge value may be lower than mortgage loans. When there is a strong correlation between the inventory price changes, and the stock is also used to pledge loans, risk of pledge turning cash loan institutions face is greater. Therefore, lenders should consider these price related pledge as a portfolio, set a unified pledge rate the portfolio.

Inventory financing originated from abroad, so there are many literatures on the basis of the problem, including the development history, business model and business process.

With the exploration and innovation mode of logistics finance, China started to research on inventory financing, Huai Chen (1987) [1] first proposed the idea of material bank, as the main function of material will be adjust material bank, and the circulation of goods and monetary financing together. Wenchao Ren (2006) [2] published article and in-depth exposition on the material bank, discusses the use of production materials, inventory and goods of chattel pledge financing process, and clarify the business should be signed the relevant agreement by the banks, enterprises and storage enterprises three parties. Qi Luo (2002) [3] first defines the concept and operation mode of financing warehouse. Warehouse financing is a comprehensive third party logistics service platform, as the core of pledge material storage management, supervision, evaluation, public warehousing, and logistics distribution. At the same time also introduces two operation modes of financing storehouse obtain bank credit and the establishment of independent credit guarantee institutions. Jinbo Zheng (2003)[4] elaborated on the concept and business process of warehouse receipt pledge, analyzes warehouse receipt pledge advantages and risk, put forward focus of carrying out warehouse management of receipt pledge. Yang Yu (2003) [5] analyzes the origin and the importance of material bank, introduces two business models of rights pledge and flow goods pledge. In a word, there are many literatures research based on inventory financing pledge in the domestic, the scholars have gradually begun to study business risk, mostly qualitative classification and description of the risk, and then puts forward the risk control measures.

2. The Model of Stock Portfolio Pledge Rate

Banks in the inventory financing business, often do not consider the correlation between pledge price changes, so that each pledge is a separate operation, separate given mortgage rate, and often rely on the experience of valuation. But in many cases, price changes in inventories are interrelated, even a strong correlation. For example, the correlation between changes in prices of raw materials and finished products is more obvious, when the prices of raw materials rise, finished goods prices also rise, when raw material prices fell, product prices often also fell. If we do not consider the correlation of price changes, but were respectively determined pledge, pledge rate, when a pledge prices fell, another pledge prices also fell, it will increase the overall inventory risk business. This study based on the existence of such a situation, research

mortgage financing in inventory portfolio which price changes associates with various inventory of mortgage rate.

Based on the above analysis and the basic definition of pledge rate, the pledge rate is loan to pledge value ratio. Pledge rate model is as follows.

$$\theta = \frac{\sum p_{n,t} q_{n,t} - VaR_t}{\sum p_{n,t} q_{n,t}} \times \beta \quad (1)$$

Assuming the pledge material combination has n kinds of inventories, under the pledge price changes with the relationship. Where, θ is the pledge rate, $P_{n,t}$ is the n th pledge value at t moment, $q_{n,t}$ is pledge quantity at t moment, VaR_t is the risk value of pledge combination at moment. In practice, banks often according to the security rating of the borrowing enterprises to join a correction factor β, to improve the business risk coverage, according to the borrower's credit ratings, accurate reference data needs to be further improved.

From the formula (1) can be seen, as long as the pledge financing point of time t determined, according to the stock market information is not difficult to obtain their price $P_{n,t}$, inventory quantity $q_{n,t}$ is measurable, then the key to calculate the pledge rate is computed VaR in time.

The calculation in the traditional VaR, usually assume that the asset return follows a normal distribution, but in fact the financial data with heavy tail distribution, such as the return of securities. The tail is thicker than the normal distribution, peak is more spikes. Directly to say is the probability of extreme values to probability extreme value larger than normal distribution data. Therefore, using the normal distribution to the distribution fitting these data for statistical inference is not accurate. At the same time, the correlation between stock prices changes often uses the correlation coefficient to describe. The condition of calculating the correlation coefficient is the expectation and variance of each variable is present. But a lot of data in the financial market is heavy tailed distribution, and then variance does not exist. In this case, it cannot use correlation coefficient to describe the correlation of variables. In addition, the correlation coefficient is only a description of linear correlation; nonlinear correlation cannot use correlation coefficient to describe. This paper introduced the Copula function to describe the relationship between stock price changes. The Copula function has the following advantages in describing the stock price changes relation. The Copula function can be directly modeling the correlation structure between variables directly, and it doesn't matter with edge distribution. After the variables of nonlinear monotone increasing transformation, using Copula function measured invariant line measurement is unchanged. Copula function can capture the nonlinear and asymmetric distribution of variables information.

Computed inventory combination of VaR based on the Copula function, by the joint distribution of the marginal distribution of inventory and the appropriate Copula function can get stock portfolio. But in this case, the expression of VaR is more difficult to get, so using Monte Carlo simulation to calculate VaR, need to get the relevant parameters of the return distribution through historical data. For the pledge of goods return rate, calculate the logarithmic rate of return, assuming is the n-th pledge value at moment, $p_{n,t+1}$ is the n-th pledge value at $t+1$ moment the price at the time of the pledge, $y_{n,t+1}$ is the n-th pledge return from t to t+1 moment then

$$y_{n,t+1} = \ln \frac{p_{n,t+1}}{p_{n,t}} = \ln p_{n,t+1} - \ln p_{n,t} \quad (2)$$

Do the exponentiation on both sides of formula (2), have the equation $P_{n,t+1} = P_{n,t} \times \exp(y_{n,t+1})$. Assuming the n-th pledge loss rate from t to $t+1$ moment is $l_{n,t+1}$, then

$$l_{n,t+1} = \frac{p_{n,t} - p_{n,t+1}}{p_{n,t}} = 1 - \exp(y_{n,t+1}) \quad (3)$$

Further can get the n th pledge loss from to $t+1$ moment is

$$x_{n,t+1} = p_{n,t} q_{n,t} \times l_{n,t+1} = p_{n,t} \times (1 - \exp(y_{n,t+1})) \quad (4)$$

Taking into account the inventory portfolio loss X_{t+1}, then

$$X_{t+1} = \sum_{n=1}^{n=N} q_{n,t} p_{n,t} (1 - \exp(y_{n,t+1})) \quad (5)$$

At the given confidence level of c, $\Pr ob(X_{t+1} \le VaR_{t+1}^c) = c$, where is Value at risk of inventory portfolio under the confidence level of c.

3. Model Assumptions and Sample Data Analysis

3.1. The Pledge Selection

This paper selects copper and zinc as a inventory portfolio of mortgage financing. On the one hand, both in the spot market and future market, each contract variety price is continuous, easy to collect and analysis. On the other hand, there is a certain correlation between the two kinds of non-ferrous metals market demand. Copper is widely used in automobile manufacturing, construction industry, machinery manufacturing, defense industry, light industry etc.. Total consumption of zinc in approximately half of the proportion is used in galvanized industry, while zinc is also widely used in automobile manufacturing, ship building industry, light industry, etc. Zinc itself strength and hardness is not

enough, so often join copper and other alloy elements, in order to improve the strength and hardness, which used in automotive, construction, electrical, mechanical manufacturing etc., The copper and zinc are also used in many industries, so when the demand for zinc is increased, the demand for copper will increase, leading to zinc prices, copper prices will rise; when the zinc demand reduction, the demand for copper will be reduced, resulting in zinc and copper prices will fall. Copper and zinc prices is not only affected by the political environment, market demand, industry policy, international market factors can influence of two kinds of product prices, therefore, the price trend will not be exactly the same, but has a strong correlation.

3.2. Model Assumptions

The model is built based on the following assumptions.

Hypothesis 1: using the spot 1# copper and 1# zinc as a combination of inventory portfolio financing, and financing in the loan period beginning $t=0$. $p_{1,0}$ is the average price of 1# copper in time $t=0$, $p_{2,0}$ is the average price of 1# zinc in time $t=0$, $q_{1,0}$ is the number of 1# copper, $q_{2,0}$ is the number of 1# zinc, take bit as the number of units of pledge t=1, and $q_{2,0}$ =1.

Hypothesis 2: for a period of 1 year loans, bank loan interest rates unchanged during mortgage period;

Hypothesis 3: the good faith management of logistics enterprises, there is no risk of default.

Hypothesis 4: storage management costs negligible.

Hypothesis 5: do not consider the correlation of the spot 1# copper and 1# zinc price;

Based on these assumptions, the calculation steps of Copula-VaR method is applied to the portfolio of inventory will gradually be calculated.

4. Data Processing and Inspection

4.1. Analysis on the Trend of Pledge Price Fluctuation

The empirical study selects standard matter stock 1# copper and zinc as 1# a pledge portfolio. The sample data take the maximum daily price of zinc and copper provides by Changjiang nonferrous metal net (http://www.ccmn.cn/), the length of time from the January 1, 2012 to December 31, 2012, a total of 482 sets of data, and its price fluctuation curve is shown in figure 1.

Figure 1 and 2 can be seen visually, in the period from January 1, 2012 to December 31, 2012, the trend of fluctuations in the price of copper and zinc are consistent, and when a pledge prices fell, another pledge prices also fell, also when rise, indicating that the two pledges have a strong correlation.

4.2. Test of Normality

Empirical data show that assets of financial market rate of return and the normal distribution are significantly different, and showed a peak and fat tail characteristic, so this section of two pledge rate of return is normal distribution test. First, calculate two pledge yield statistics such as the mean, median, standard deviation, variance, skewness and kurtosis, observe and analyze the statistics, and then use the K-S test method for copper and zinc rate of return to normality test.

4.3. Statistics Characteristic Description

Because VaR is difference of the asset initial value and the assets value when the yield reached minimum value. It need calculate and analyze return rate of copper and zinc. Let y as the pledge rate of return and p as the pledge price, then

$$y=\ln(p_{t+1}/p_t) \tag{6}$$

Using the above formula to calculate the rate of return of copper and zinc, and their yields statistics are calculated using SPSS software list in table 1. The histogram of the two return rate distribution are shown in figure 3 and figure 4.

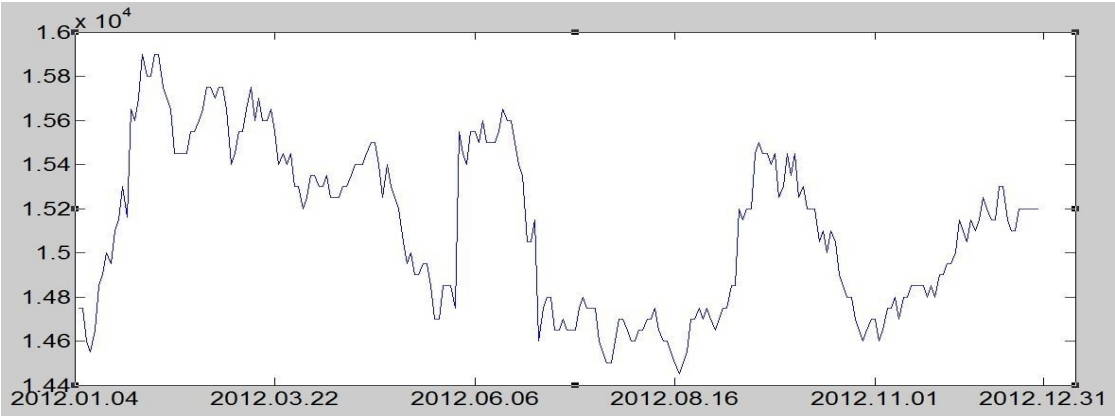

Figure 1. Zinc price fluctuation curve in 2012 year.

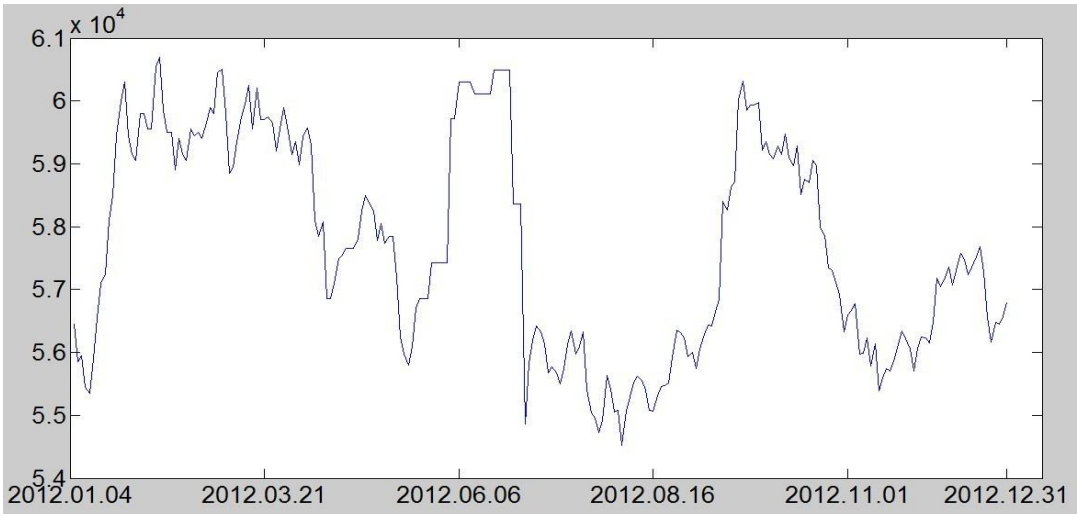

Figure 2. Copper price fluctuation curve in 2012 year.

Table 1 Statistical characterization of return rate

Statistics	N	Mean	Median	Std	Skewness	Kurtosis	Minimum	Maximum
Zinc	240	0.000125	0	0.007355	1.322	14.081	-0.037	0.0528
Copper	240	-0.00041	0.000177	0.007205	0.001	6.931	-0.0214	0.0271

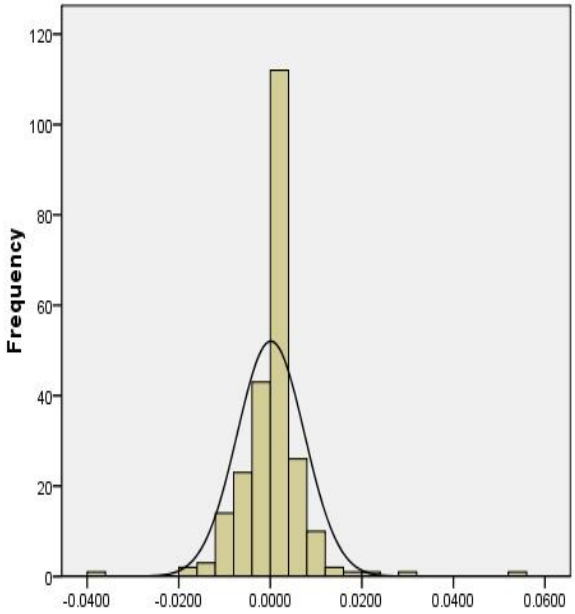

Figure 3. The histogram of zinc return rate distribution.

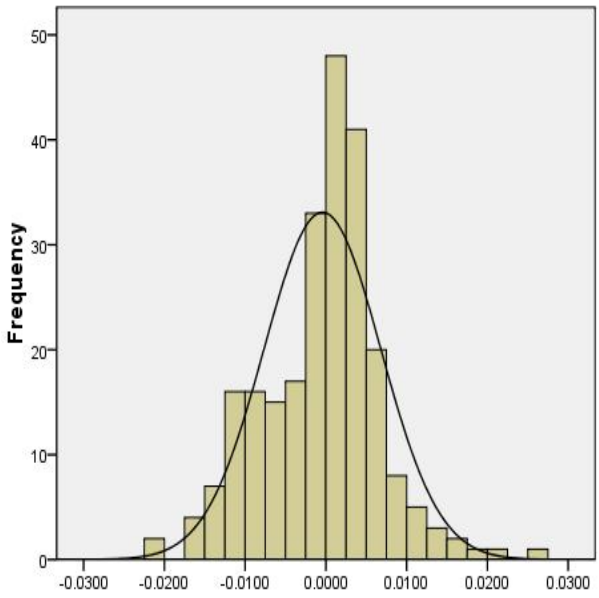

Figure 4. The histogram of copper return rate distribution.

It can be seen from table 1, kurtosis of zinc return rate is 14.081, which is far larger than 3 which is normal distribution kurtosis value. The probability of zinc yield has a maximum or minimum values are more than the normal distribution, the rate of return does not obey the normal distribution. Copper return rate kurtosis is 6.931, are not normal distribution. From figure 3 and figure 4 can be seen both zinc and copper yield distribution with peak thick tail characteristics directly, not in conformity with the graphical features of normal distribution.

5. Conclusion

This paper constructs the calculation model of inventory pledge portfolio rate. It selects about 500 groups of data, the calculation model was realized by

SPSS and Matlab, describe the main calculation results and validation. First carries on the statistical analysis to the collected data, and then make normality test to the combination of pledge return rate. The results show that two rates do not conform to normal distribution thus cannot directly use VaR method to calculate the value of risk mortgage portfolio. Zinc and copper yield rate does not accord with normal distribution, does not conform to calculate inventory portfolio value at risk by using the VaR method of the conditions. So we would introduce the Copula function in future research , give the joint distribution function, and calculate more precise portfolio value at risk.

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