Modern Applied Science

www.ccsenet.org/journal.html

Vol. 1, No. 4

November 2007

An Extreme Application of the Theoretical

Prediction Open-end Fund Redemption of Methods

Cheng Wei

Postdoctoral Working Station, Dong Bei University of Finance and Economics

Institute of Business Administration, Shenyang University, Shenyang 110044, China

E-mail: chengw523@163.com

Guifang Ren

Institute of Business Administration, Shenyang University, Shenyang 110044, China

Jinyu Wang

Shenyang Institute of Aeronautical Engineering, Shenyang, 110034, China

This research is sponsored by Education Committee Funds of Liaoning province, 2007.

Abstract

The open-end funds have liquidity risk, one of the main reasons — the open-end fund huge redemption is elaborated, the paper uses the extreme value theory measure the liquidity risk. Through the analysis, we found that the extreme application fit to forecast open-end fund redemption amount of their probability of occurrence, and use maximum likelihood method to estimate the parameters and goodness-of-fit test. This paper also uses the Monte Carlo method to the results for further simulation experiments, and forecast the mean and standard deviation of the redemption of the fund. Fund managers may, under certain probability, predict funds for the redemption, resulting in an appropriate reserve of cash, avoiding reasonably the open-end fund which provides liquidity risk. That is a good prediction method.

Keywords: Open-end funds, Liquidity risk, Redemption, The extreme value theory, The cash reserve, Monte Carlo method

Introduction

The merits of an open-end fund in relation to closed-end funds lies in the size of the fund uncertainty, investors may need to keep the purchase or redeem fund, which may give rise to liquidity risk. That is why part of the current investor's pursuit the immediate and substantial proceeds to redeem fund shares. Investors invest in the liquidity requirements of fund, the higher the mobility corresponding greater the risk. Under the given risk level, open-end fund manager can not restrict to redeem for investors request. what he can do is to consider the prior rate of return among different investors most likely to redeem the amount, which guarantee an open-end fund in the portfolio have sufficient liquidity strong assets to meet investors foreclosure to request.

For fund managers, the key to risk control is the greatest extent to meet investor redemption at any time, predicting the redemption of fund shares accurately, and reserving the cash appropriately. But too much cash reserve fund will affect the ability to invest, thus affecting the value of the Fund. If the cash reserve is too small, and the huge redemption occurs (in a single opening day, only a net redemption of the Fund for shares of the Fund over the previous Fund's total share of 10%, that is, the fund had huge Redemption), fund managers will be faced with the realization losses due to the delay or redeem its credibility and influence, and even the liquidation of the Foundation faces danger. On the issue of cash reserve ratio there has already been some discussion (Wang, Wang & Pan, 2004, pp. 290-293), but the share prediction about redemption is rare. In addition, there are lots of decision-making factors which affect fund managers' decision in China market, there is a lot of short-term behaviours, which do not investment funds as a long-term investment but see Lee on the results, causing fund managers to sell some assets which have good prospects to meet the huge redemption. This will affect the Fund's ability to invest and its benefits, increasing liquidity risk. Predicting a huge amount of ways — through the application of extreme value theory, forecasting huge withdrawal of probability, fund managers will be able to avoid open-end fund liquidity risk.

1. Use extreme value theory to an open-end fund redemption volume model building

1.1Extreme Value Theory

The extreme value usually means that there are very few incident in people's experience, it also means that it occurs rarely. For example, in the natural environment, there are floods, earthquakes, droughts; In the social environment, the economic and financial fields about the stock price volatility display disproportionate changes which is usually smoothing consecutive volatility, such incidents occurring easily plummet in the stock market, soared and so on. From the beginning of the 1930s, many scholars begin to study extreme value theory. The results show: Extreme distribution can be the biggest (small) value distribution for a good description, we can use Frechet, Gumbel distribution to these random variables to propose and study. Jenkinson uses the theory which is applied to extreme risk research, a broad distribution of extreme types, and further made the one-dimensional model of extreme distribution perfectly. Pickands prove that classical limit theorem. Moreover, in the 1980s, many scholars had studied sequence which is not smooth of extreme and its behavior (characteristics) and interdependent phenomena. The mid-1980s, multivariable Extreme Value Theory of Statistical Inference had further development, and which is as the current maximum theoretical study of the hot issues. This paper is primarily discussing a peacekeeping Extreme Value Theory in the open-end fund redemption (Zhu, Zhang & Zhang, 2001, pp.72-76).

First, I'll introduce the concept of the order of Statistics, (X_i, $i=1,2...n$) order statistics, which were caught from the distribution function $F(x)$ which is as the overall sample. We order them from Max to Min such as $X_{(1)} \geq X_{(2)} \geq \cdots X_{(n)}$, called ($X_{(1)}$, $X_{(2)}$ $\cdots$ $X_{(n)}$)as order statistics. And $X_{(1)}$ = max ($X_{(1)}\cdots$ $X_{(n)}$), $X_{(n)}$ = min ($X_{(1)}$ $\cdots$ $X_{(n)}$) will be known as the great value of samples, samples minimum values, collectively known as Extreme samples, and their distribution is called extreme value distribution. That is, the incident occurs at a very small probability, and the incident occurring on the system has a significant impact disturbance. Extreme value distribution is grouped into type I, type II and type III. Study extreme distribution theory, collectively known as Extreme Value Theory. It is an important branch of the Probability theory study, random samples and random process of the extreme probability and statistical inference is its main study object.

In order to facilitate the application of statistics, Jenkinson (1955) generalized extreme value distribution model (GEV) (Zhu, Zhang & Zhang, 2001, pp.72-76).

$$G(x)=\exp\{-[1+\zeta(\frac{x-u}{\sigma})]^{-1/\zeta}\}$$

(1)

order $\{x:1+\zeta(x-u)/\sigma>0\}$

Extreme Distribution Type II and III respectively corresponding these situation $\zeta>0$ and $\zeta<0$. Type I is $\zeta \to 0$ to the limit. ζ is shape parameters, u is the location of the parameters, σ is a measure parameter.

1.2 Forecast open-end fund redemption of model

For the open-end fund managers, they need to predict fund redemption of the largest daily volume, the amount of cash is set aside according to redeem, when they forecast excessive redemption, they should consider liquidating part of their assets. So it is right to redeem the projection necessary. Many studies have shown that investors are redeemed with the characteristics of random acts, that is, the number of investor who wants to redeem is random, investors who want to redeem shares in the fund is also random. If we make each trading day as a unit of time, in every unit time, there will be occur many redemption issues. they can be redeemed on average volume of the order of priority, will have a maximum and minimum values, the great value is the greatest redemption amount in one day, the minimum value of the day is the minimum redemption amount in one day. Order X_i, $i=1,2...n$, this is a certain open-end fund redemption volume in a trading day; it can be viewed as a sample which derived from distribution functions $F(x)$ which is the overall sample. According to the size of its order: $X_{(1)} \geq X_{(2)} \geq \cdots X_{(n)}$. Here what fund managers are most concerned about is the largest amount of redemption -- or redeem the great volume. Take some time to observe (for days), if take a great value every day, there will be plenty of great value, the maximum value that can be distributed with a dimension maximum distribution. This paper selects Jenkinson (1955) which is generalized extreme value distribution model, the distribution function is:

$$G(x_i)=\exp\{-[1+\zeta(\frac{x_i-u}{\sigma})]^{-1/\zeta}\}$$

(1)

This is fitting to the actual distribution of the maximum value. Here is $1+\zeta(x_i-u)/\sigma>0$, x_i is the extreme value in every trading day, ζ is shape parameters, u is the location of the parameters, equivalent to the average value of the sample, σ is a measure parameter, which is a sample standard deviation, $i=1,2...n$.

2. The parameters of the maximum likelihood estimation (mle) and the test

2.1 Parameters of maximum likelihood estimation (MLE)

Extreme distribution model in the application used to be fit sample data sequence characteristics of the tail distribution, for a peacekeeping extreme distribution model, according to the data which is mainly known, estimating ζ, u, σ three parameters, and being to determine this distribution model is the type of extreme distribution.

To determine if this distribution model is the type of extreme distribution, a simulated data is used to conduct experiments. Getting the data which is from 1000 trading days of 1000 largest volume of redemption, which is the great value. Assuming a total of a certain open-end fund is 1.5 billion shares when the redemption amounted to 150 million copies, or that a huge withdrawal. In its daily transactions, there were huge probability of redemption should be minimal, so the simulation data x_i among [1 * 10^7, 1 * 10^8] changes that is the 1000 redemption of the largest samples of observations, $i = 1, 2, ..., n$.We applicant to the maximum likelihood method for parameter estimation.

Using the distribution function

$$G(x_i) = \exp\{-[1+\zeta(\frac{x_i - u}{\sigma})]^{-1/\zeta}\}$$

to get the likelihood function.

$$L = \exp\{-[1+\zeta(\frac{x_1 - u}{\sigma})]^{-1/\zeta}\}.\exp\{-[1+\zeta(\frac{x_2 - u}{\sigma})]^{-1/\zeta}\}\exp\{-[1+\zeta(\frac{x_i - u}{\sigma})]^{-1/\zeta}\}.....\exp\{-[1+\zeta(\frac{x_n - u}{\sigma})]^{-1/\zeta}\} \quad (2)$$

then get the logarithm

$$\ln L = -\sum_{i=1}^{n}[1+\zeta(\frac{x_i - u}{\sigma})]^{-1/\zeta} \quad (3)$$

Seeking the largest value of function $\ln L$, then changing for seeking the smallest value of

$$\sum_{i=1}^{n}[1+\zeta(\frac{x_i - u}{\sigma})]^{-1/\zeta} \quad (4)$$

Using Matlab software to calculate (4) - program, the three parameters were estimated value

ζ = 0.02, u = 1.0e +007×9.5127, σ =1.0e+007×2.0160.

Then putting the estimated value of ζ, u, σ into (1),getting that

$$G(x) = \exp\{-[1+0.02\times(\frac{x - 1.0e+007\times 9.5127}{1.0e+007\times 2.0161})]^{-\frac{1}{0.02}} \quad (5)$$

The estimated value ζ close to 0, this distribution model is Type I extreme value distribution, when $x_i \in$ [1, 2.0 * 10^8], we can look the Figure:

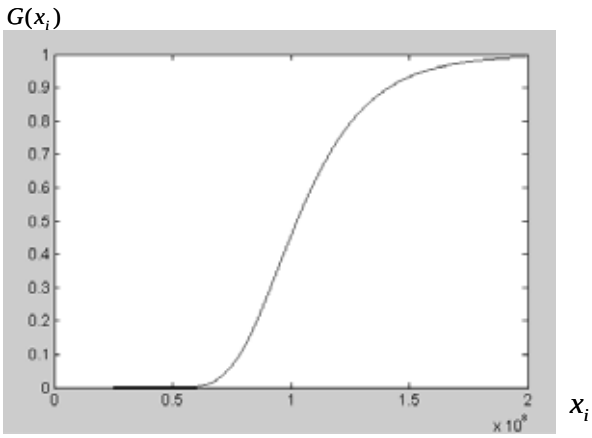

Figure 1. Probability on redemption of open-end fund

Using the matlab language to map program, we can see the probability distribution from Chart 1.

2.2 Distribution of goodness-of-fit test

χ^2 method of inspection is the non-parameter test of goodness-of-fit test(Yu, Wang & Pan,2003,pp.877-879), it is the right of its value in the range of data to group ,then calculating the frequency ,on that base , getting each inspection interval of the actual frequency and theoretical frequency differences and making a judgment. It uses the following statistics

$$\chi^2 = \sum_{i=1}^{l}\frac{(m_i - np_i)^2}{np_i} \quad (6)$$

n is the sample size, l is the number of groups, m_i is the Sample observations fall into the first i group of frequency, p_i is according to the original assumption which was based on the designated distribution obtained samples fall into the first i group of probability.

Statistical studies show: Sample size n is sufficiently large for which the original assumptions is true, the χ^2 statistics is similar to obey the distribution of freedom$l-k-1$, k is the number of the distribution which is to be guessing. In this question: l =15, k =3,we can calculate and obtain that $\chi_0^2 = 15.8 < \chi_{0.05}^2(11) = 19.6751$, therefore accept the original assumptions. That is the view of the more extreme distribution to fit statistical distribution of huge withdrawal is reasonable.

2.3 The issue needs to be clarified

The note of the ζ value:

By $\zeta > 0$, $\zeta < 0$ and ζ ? 0 three of the analysis found: $\zeta > 0$ with the smaller is more realistic. G(x) is distribution function. It is a graphic incremental curve, but the maximum value is smaller to 1. So it is fitting to the character of distribution functions.

The study found, when ζ is in the vicinity of 0 changing, the probability is not changing greater when the ζ is changing, while the graphics are not major changes, and when ζ is to take place after 1000 hours, the obtaining probability remains same.

3. The open-end fund redemption volume forecast

3.1 Predicting the probability of an open-end fund redemption

To put the obtaining three parameters into the distribution model and obtain the distribution function $G(x_i)$.At this point, if it is given a redemption amount, the distribution function can be calculated probability. For example: when x_i =2.0*10 ^{8} , $G(x_i)$ =0.9929.It means when the redemption is more than 2.0 * 10 ^{8} , the probability is p = 1-$G(x_i)$ =0.0071. The huge withdrawal occurred probability is 0.71%which is a very small possibility. The following table is adopting this method; we can see the occurrence probability of the huge redemption value.

Table 1. Probability on redemption of open-end fund

Redemption Shares (billion)	0.08	0.1	0.15	0.2	0.25	0.3
Probability	0.8811	0.4558	0.0682	0.0071	0.0008	0.0001

Through Matlab programming to complete this process. Meanwhile, Figure 1 also shows the probability value.

modulus using Monte Carlo method

In practical problems, there will always be some complex situations, it depends entirely on theoretical analysis of the numerical results to come is often impossible. This can be translated into some kinds of statistical probability model, using statistical simulation method can obtain intuitive numerical results. Statistical simulation calculation method is often called Monte Carlo method, knowing as stochastic simulation method, developing rapidly in recent years, applications become more extensive. It is a statistical probability theory which is applied to the field of numerical calculation method. It consists of two parts: first, it is necessary to solve the needs of practical issues into statistical probability model; secondly, inducing massive random numbers which complied with the required distribution to simulate the actual realization of the process, recording the outcome of each test, through dealing with these data to obtain estimating value.

In this paper, the simulation data may deviate from the actual situation, making the results inaccurate, using the Monte Carlo to correct them.. First, using the inverse transform method to generate random numbers, we can obtain

$$x = \frac{\sigma}{\zeta}\{-1-[\ln G(x)]\} + \mu \tag{7}$$

4. Conclusions

(1) By using maximum likelihood method to estimate parameters, we found that applying to type I Extreme Distribution theory to simulate the open-end fund redemption amount, we can reach a good outcome. When given a redemption amount which can be drawn on the probability of their occurrence or given a probability value, we can calculate the amount of the redemption fund. Fund managers can use Type I extreme value distribution model to predict the occurrence of a huge withdrawal.

(2) Using Monte Carlo methods to induce the "pseudo-random number," which could be better presented with the actual data, we have the data to better reflect the occurrence of the redemption, removing some human factors, making the forecasts accurately.

(3) Adoption of the above probability can see that the occurrence probability of huge withdrawal is very small and can be said to be occurred one time in several years or in hundreds of years. But the event will cause great losses, the fund managers should pay close attention to use this method to predict an open-end fund redemption amount of funds and set aside to do a good job.

References

Daniel, K, Mark, G, Sheridan, T, et al. (1997). Measuring mutual fund performance with characteristic-based benchmarks. *The Journal of Finance*. 52 (3): 1035-1058.

Edelen, RM. (1999).Investor flows and the assessed performance of open-end mutual funds. *Journal of Financial Economics*. 53(3):439-466.

Fisher, R A, Tippett, L H C. (1928). Limiting forms of the frequency distributions of the largest of smallest member of a sample.*Proc.Camb.Phil.Soc*. 24: 180-190.

Goldstein, M & Kavajecz, K. (2000). Eighths, sixteenths, and market depth: changes in tick size and liquidity provision on the NYSE. *Journal of Financial Economics*. 56(1):125-149.

Liu, H L, Zhong, L M & Wu, CH F. (2003). Optimal control of liquidity risk of the open-end fund. *Control and Decision* . 18 (2):217-220.

Russ, W. (2000).Mutual fund performance: An empirical decomposition into stock-picking talent, styie, transactions costs, and expenses. *The Journal of Finance*. 55(4): 1655-1703.

Shi, Daoji. (1995). Fisher information for a multivariate extreme value distribution. *Biometrik*. 82(3):644-649.

Wang, J Y, Wang, W Q & Pan, D H. (2004).Research on cash reserve proportion of open-end funds. *Journal of Systems Engineering*.19(3):290-293.

Weibull W. (1951). A statistical distribution of wide applicability. *J.Appl.Mechanics*. 18: 293-297.

Yu, X F, Wang, J Y & Pan, D H. (2003).*Journal of Northeastern University(Natural Science)*. 24(9):877-879.

Zhu, G Q, Zhang, W, & Zhang, X L. (2001). A review on the process of applications research of the extreme value theory. Journal of Systems Engineering. 16(1):72-76.