SUITABLE RISK MEASUREMENT OF CHINESE STOCK MARKET IN HIGH VOLATILITY PERIODS

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ABSTRACT

Chinese economy nowadays receives impacts from various economic activities internationally and accordingly the risk measurement and management system is worthy of discussion. In the past two decades, the VaR and ES have been widely introduced and discussed. However, in a recent consultative document, the Basel Committee on Banking Supervision suggests replacing Value-at-Risk (VaR) by expected shortfall (ES) for setting capital requirements for banks' trading books because ES better captures tail risk than VaR. However, besides ES, another risk measure called median shortfall (MS) also captures tail risk by taking into account both the size and likelihood of losses. The study argues that MS is a better alternative than ES as a risk measure for setting capital requirements in China because: (1) MS is elicitable but ES is not; (2) MS has distributional robustness with respect to model misspecification but ES does not; (3) MS is easy to implement but ES is not.

In this paper, properties of VaR, MS and ES (e.g. elicibility, robustness and sub-additivity) are critically compared. Together with comparison of properties, backdatings are used to give reference of accuracy. By the approach of backtesting (traffic light) of MS and VaR, we could see many similarities but differences from ES in the paper. This paper adopts the test statistics Z2 for ES backtesting.

This study aims to study high-volatile periods of Chinese stock market and use conditional EVT which can capture tail risks incisively as an indicator to estimate VaR, MS and ES. Also, this study seeks to suggest a more suitable risk measure and management system for Chinese stock market especially in a high-risk period in line with the properties and accuracy.

KEYWORDS

Risk Measurement, Chinese Stock Market, VaR.

1. INTRODUCTION

1.1 Background

Extensive globalization and trade freedom deepen the economic interdependence and mutual impact day by day. But they also company with frequent financial crises, which are susceptible, "infectious" and destructive. The Japan's "Lost Decade" in 1990-2000, the Banker's Panic Black Monday in 1907, the Ruble Crisis in 1998, the East Asian Financial Crisis in 1997, the European Sovereign Debt Crisis in 2009, the Oil Crisis in 1973, the German Hyperinflation in 1918-1924, The Great Recession, all had catastrophic impacts.

While China has been more and more involved in economic activities, it imminently needs a complete and mature risk measurement and management system and takes foreign risk measure methods as lessons. In the 1990s, Value-at-risk (VaR) was a popular risk measure that was initially used by a researcher and became the industry standard for institutional risk management [1].

Since the sub-prime mortgage market crisis in 2007, there has been an impellent need for revamping the market risk measurement as VaR. While it was not until 2012 that Basel III recommended alternative risk measure-expected shortfall (ES). Although the Basel Committee on Basel Committee for Banking Supervision (BCBS) was optimistic about future ES, the implementation is still of many challenges. There are many debates on the

choice of regulatory capital requirement- either VaR or ES. Both of them have their own merits and demerits. In 2014, a group of researchers put forward that median shortfall (MS) is a better choice to substitute VaR than ES [2].

Due to many cultural and historical factors, Chinese stock market has its own characteristics. What's decisive to the whole economy is that Chinese government put too much intervention on the stock market. From 1993 to 2012, China had experienced 5 transitions between bull and bear market, all related to policies to some extent. Nevertheless, what cause most damages to investors are policies. Too many policies have been applied and many of them are malfunctioned, attrition government's credit. In addition, In the 90s last century, legal institution was destroyed vastly; people have had a resistance to rely on laws. China has been a country of low trust which is a base stone of economic exchanges.

1.2 Motivation of study

With above situations, the temporary risk management system in China is incomplete. China needs a highly trustable risk management system. In controversy of VaR and ES, there are mainly several following contentions. VaR enables capturing 'tail risk'. While, ES is not elicitable and robust. MS has superior characteristics over VaR and ES.

As China's stock market is depressed by the extremely high market

volatility [1], there is a pressing need for an effective risk measurement in Chinese market for risk management, for “whom” my reach can be of value. And this paper is to compare ES and MS in respect of their accuracy and priority in replacing VaR in Chinese stock market. In comparison of accuracy, back testing of a group of researchers will be applied to MS and ES respectively. By holding daily stock prices of the CSI 300 index (CSI300) and the Shanghai Stock Exchange Composite Index (SSE) [3,4]. Composite INDEX which are most typical in Chinese stock market from 2002 to 2016,

There are many models, methods and confidence levels for risk measures. Some models and methods are suitable for low confidence levels, while some are applicable only for high confidence levels. In addition, risk lovers may be confident with low confidence levels, whereas risk-averse investors can accept only high confidence levels. And taking other properties of risk measures such as Elicitability and robustness, the article aims to find out which risk measurement is most suitable for Chinese stock market.

2. STRUCTURE

The rest of the paper will be organized as follows. Section 3 compares some properties of MS, VaR and ES and their compliance of axioms and discusses their feasibility in replacing VaR in Chinese stock market. Section 4 introduces analogy of back testing of a group of researchers. And the back tests will be applied to 2 major stock indexes, the CSI300 and the SSE (make a small summary). In section 5, literature review will be provided. In section 6, a conclusion will be made. In section 7, some limitations will be pointed out.

3. COMPARISON OF PROPERTIES VAR, MS AND ES

3.1 Elicitability

As explicitly explained by researchers, elicibility is essential for back testing [5]. Another researcher indicated that minimization of the expectation of a forecasting objective function can yield optimal risk measure, which is the definition of elicibility [6]. By this definition, elicibility and back testing are closely interrelated, because the optimal risk forecasting model (procedure) of back testing should be derived from the objective function in elicibility.

In the verification of a researchers that ES is not elicitable, which makes the implementation of ES much challengeable. What's more, another researcher proposed that the elicibility and “consistency” of a risk measure are also correlated [7]. They also show that VaR and MS are elicitable.

3.2 Robustness

A group of researchers [2] made the definition:

“A risk measure is said to be robust if:

- (i) it can accommodate model misspecification (possibly by incorporating multiple scenarios and models) and
- (ii) it has statistical robustness, which means that a small deviation in the model or small changes in the data only results in a small change in the risk measurement.”

Recently, Robust risk measurement is included in more and more requirements. A group of researchers made a simple empirical study about the robustness of MS and ES, using data of S&P 500 daily return and model of IGARCH (1,1). They concluded that MS is more robust than ES.

3.3 Sub-additivity

Summarized by a researcher, VaR has been crucial to banks' risk management systems [8]. While another researcher critically pointed out that VaR is not sub-additive, which means that VaR of a portfolio can be higher than the sum of VaRs of the individual assets in the portfolio [9]. Thus, VaR is not a coherent risk measure, which can lead to a fake sense of security and lead a financial institution to make a sub-optimal investment choice as serious consequences. Emphasized by a researchers, ES and MS are coherent and thus sub-additive [2].

While, when the tails are not super fat, VaR is sub additive for all fat tailed distributions.

3.4 Judgement

For ES's non-elicibility and non-robustness discussed specifically by a researcher, VaR and MS seem much more prior as a regulatory risk

measure. However, VaR is incapable to capture ‘tail risk’ and does not satisfy the sub-additivity principle which is somewhat controversial.

The researchers concluded that means functional and the MS is the only risk measure that satisfies both the 5 axioms proposed by another researcher and the statistical requirement of elicibility [10].

4. APPLICATION

4.1 Data Choice

To test the accuracy of ES and MS, I used daily close prices of Chinese stock market from 2005 to 2016 and compared the actual loss each day with the predicted ES and MS for that day, that were calculated from previous 500 data close prices before that day.

To comprehensively capture the changes of Chinese market prices, I chose these two representative composite indexes to describe it. The CSI300 is a capitalization-weighted stock market index, following the performance of 300 stocks traded in the Shanghai and Shenzhen stock exchanges. The SSE is a stock market index of all stocks that are traded at the Shanghai Stock Exchange. They are the two most representative indexes to Chinese stock market.

4.2 Conditional Extreme Value Theory (EVT) MODEL

The Peak Over Threshold model (POT) is an advanced approach to complete EVT. A group of researchers suggested that EVT can be effective in measuring the size of extreme events [11]. In practice, several methods can implement this problem, based on the data availability and frequency, the time horizon and the level of complexity in the model. In their complementation, the POT method proved superior as it better captured the information in the data sample.

Other group of researchers also include that POT has become the most popular extreme value approach in risk management [12]. POT unravels the problem of information loss that exists in traditional EVT, as it uses losses larger than some predetermined threshold in samples.

Let variable v be the loss on a portfolio over a certain period of time, u be a value of v in right tail, which can be called the threshold value, $F(v)$ be the cumulative density function of the loss variable v , ℓ be the excesses losses.

The probability that v is located between u and $(u + \ell)$ is $F(u + \ell) - F(u)$, The probability that $v > u$ is $1 - F(u)$ so probability that v is located between u and $(u + \ell)$ conditioned on that $v > u$ is $\frac{F(u + \ell) - F(u)}{1 - F(u)}$, which is denoted by $F_u(\ell)$.

When u is increased, the $F_u(\ell)$ will converge to the cumulative density function of Generalized Pareto distribution (GPD) $G\xi, \beta(\ell)$, which has the formula:

$$G\xi, \beta(\ell) = 1 - (1 + \xi * \frac{\mu}{\beta})^{-(1/\xi)}$$

So the probability density function of GPD would be:

$$g\xi, \beta(\ell) = \frac{1}{\beta} * (1 + (\xi * \ell)/\beta)^{-1/\xi}$$

where the parameter ξ is the shape parameter that controls the heaviness of the tail and the parameter β is a scale parameter. These two parameters can be estimated by maximum likelihood models.

To calculate parameter ξ and β , firstly, the value of threshold u should be predetermined. Usually the value that is mostly close to 95th percentile would conduct good performance. Secondly, rank the data of returns from the largest to the lowest, and filtrate the data that exceed the threshold u . Theses filtrated data will be denoted as v_i and have a total number of nu . Thirdly, maximize the likelihood function

$$\prod_{i=1}^{nu} \frac{1}{\beta} * (1 + \xi * \frac{v_i - u}{\beta})^{-1/(\xi-1)}$$

Which can be implemented more conveniently by maximizing its logarithm:

$$\sum_{i=1}^{nu} \ln(\frac{1}{\beta} * (1 + \frac{\xi(v_i - u)}{\beta})^{-\frac{1}{\xi-1}})$$

then we get the parameters ξ and β .

Having got the parameters of GPD, the GPD model can be used to estimate VaR MS and ES.

The probability of $v > u + \ell$ conditioned on that $v > u$ is $1 - G_{\xi, \beta}(\ell)$, the probability of $v > u$ is $1 - F(u)$ can be approximated to $\frac{nu}{n}$. So the probability that $\ell > x$ conditioned on that $x > u$ is $\text{prob}(\ell > x)$:

$$\begin{aligned} \text{prob}(\ell > x) &= (1 - F(u)) * (1 - G_{\xi, \beta}(\ell)) \\ &= \frac{nu}{n} * [1 - G_{\xi, \beta}(x - u)] \\ &= \frac{nu}{n} (1 + \xi * (x - u) / \beta)^{-1/\xi}, \end{aligned}$$

Solve the question $F(\text{VaR}) = q$, $F(\text{MS}) = q'$, $F(x) = 1 - \text{prob}(\ell > x)$.

$$\begin{aligned} q &= 1 - \frac{nu}{n} (1 + \xi * (x - u) / \beta)^{-1/\xi} \\ \text{VaR} &= u + \frac{\beta}{\xi} * \left\{ \left[\frac{nu}{n} (1 - q) \right]^{-\xi} - 1 \right\} \\ \text{ME} &= u + \frac{\beta}{\xi} * \left\{ \left[\frac{nu}{n} (1 - q') \right]^{-\xi} - 1 \right\} \\ \text{ES} &= \frac{\text{VaR} + \beta - u * \xi}{1 - \xi} \end{aligned}$$

Table 1: Traffic light zones (VaR and MS)

Zone	definition	Breach,x	$\Psi_{\alpha}^N(x)$
Green	Numbers of breaches where $\Psi_{\alpha}^N(x) \leq 95\%$	0 1 2 3 4	8.11% 28.58% 54.32% 75.81% 89.22%
Yellow	Numbers of breaches where $95\% \leq \Psi_{\alpha}^N(x) \leq 99\%$	5 6 7 8 9	95.88% 98.63% 99.60% 99.89% 99.97%
Red	Numbers of breaches where $\Psi_{\alpha}^N(x) \geq 99.99\%$	10 or more	99.99%

($\alpha = 1\%$, $N = 250$)

4.4 Back testing ES

Unlike the researchers that in the position of elicibility, another researcher proved that elicibility is unnecessary for model testing although it is relevant for model selection [13]. As a result, elicibility is unnecessary for the choice of a regulatory risk standard. They also introduced three non-parametric methodologies to back test ES that are easy to implement and would display better power than the standard Basel VaR test. These methodologies are free from distributional assumptions other than continuity, which is a necessary condition for any applications in banking regulations.

In this paper, the second methodology of three methodologies of back testing ES will be applied.

According to a researcher, the final results of their research tell that amongst all nine models (HS model, conditional and unconditional N-distribution, conditional and unconditional t-distribution, conditional EVT with $\xi = 0$ and $\xi \neq 0$, as well as unconditional EVT with $\xi = 0$ and $\xi \neq 0$), the *conditional EVT model* and the *unconditional EVT model* seem more suitable model for bad economy period [14].

In the second methodology of three methodologies of back testing ES put forward by a researcher, the traffic light method is included. The test statistics Z_2 is defined as [15]:

$$\begin{aligned} Z_2(L) &= - \sum_{t=1}^T \frac{L_t * I_t}{T * (1 - \alpha) ES_{\alpha,t}} + 1 \\ I_t &= 1(L_t > VaR_{\alpha,t}) = \begin{cases} 1, & L_t > VaR_{\alpha,t} \\ 0, & \text{otherwise} \end{cases} \end{aligned}$$

4.3 Back testing VaR and MS

As $MS_{\alpha} = VaR_{\frac{1+\alpha}{2}}$, the back testing of MS is exactly the same as that of VaR. Lopez (1999) established the traffic light approach.

$$VaR(\alpha) := \inf\{z \in R: F(z) \geq \alpha\}$$

the VaR breach indicator in time t

$$x_t(\alpha) := 1(L_t \leq VaR) = \begin{cases} 0, & \text{otherwise} \\ 1, & L_t \leq VaR \end{cases}$$

which keeps track of whether a breach occurred for trading time t.

$$X^N := \sum_{t=1}^N 1(L_t \leq VaR_t)$$

is the total number of breaches over all N trading days. The null

$$H_0: E\{X^N(\alpha)\} = N\alpha,$$

For $\alpha = 1\%$ and $N = 250$, 2.5 breaches are expected to occur. The cumulative probability of obtaining x or fewer breached is

$$\Psi_{\alpha}^N(x) := P\{X^N(\alpha) \leq x\}$$

There is statistical significance of VaR breaches proposed by BCBS in 1996 document. They defined 3 color zones of cumulative probabilities of VaR breaches.

Where L_t is the loss at time t, $ES_{\alpha,t}$ is the estimated ES at time t, defined as followed:

$$ES_{\alpha,t} = E[L_t | L_t > VaR_{\alpha,t}] = E\left[\frac{L_t * I_t}{1 - \alpha}\right]$$

The hypotheses for the test Z_2 are:

$$H_0: G_t^{[\alpha]} = F_t^{[\alpha]}, \forall t$$

$$H_1: ES_{\alpha,t}^F \geq ES_{\alpha,t}^G, \text{ for all } t \text{ and } > \text{ for some } t$$

$$MS_{\alpha,t}^F \geq MS_{\alpha,t}^G, \forall t$$

The null hypothesis, H_0 , means that the tail of model exactly fits into the true but unknown distribution. The alternative hypothesis H_1 means that ES is underestimated by the model.

Then the followed could be conducted:

$$E_{H_0}[Z_2(L)] = E_{H_0}\left[- \sum_{t=1}^T \frac{L_t * I_t}{T * (1 - \alpha) ES_{\alpha,t}} + 1\right] = - \frac{1}{T} \sum_{t=1}^T E\left[\frac{L_t * I_t}{1 - \alpha}\right] \frac{1}{ES_{\alpha,t}} + 1 = 0$$

$$E_{H_1}[Z_2(L)] < 0,$$

When the significance level is 5%, the suitable corresponding fixed level in traffic level is -0.7,

Therefore, overestimation of risk, represented by positive Z_2 does not lead to a rejection of the null hypothesis

Table 2: Traffic light zones (ES)

Zone	confidence Interval of Z_2	Meaning
Green	$[0,1]$	overestimation
Yellow	$[-0,7, 0]$	underestimation
Red	$[-\infty, -0,7]$	rejection

4.5 Empirical results

I have known that there were about two main stock market crashes in China from 2005 to 2016. The earlier one began in December of 2007 and ended in June of 2009, on the base of global financial crisis. The other one began on 15th June 2015 and ended in September 2015. The above date statistics were collected from U.S. National Bureau of Economic Research [16]. Companioned with historical records, GARCH (1,1) was used to verify that the two periods were high-volatile periods. Figure 1&2 show that SSE and CSI300 had very high volatility in the two periods.

Figure 1: Daily volatility of SSE from 2004 to 2016 **Figure 2:** daily volatility of CSI300 from 2004 to 2016

Because the paper is to study risk measurement in high-risk periods, I just reserved the following study specifically in the two periods and deleted those in other periods.

Figure 3: VaR, MS, ES and daily return of SSE by conditional EVT in 2008

crash

Figure 4: VaR, MS, ES and daily return of CSI300 by conditional EVT in 2008 crash **Figure 5:** VaR, MS, ES and daily return of SSE by conditional EVT in 2015 crash **Figure 6:** VaR, MS, ES and daily return of CSI300 by conditional EVT in 2015 crash

In 2008, VaR and ES by EVT overestimated the risk, and ES was not as conservative as VaR and ES but good enough. A researcher pointed out that government put so much intervention that Chinese stock market was not totally developed by itself [17]. In that period, the control of government was the main force driving the market. While, in the 2015 crash, ES poorly underestimated risk and VaR and MS were just suitable. Actually, there is no one traditional tool that can thoroughly explain the abnormal fluctuations in 2015, implied by a researcher [18]. They also said that the main reason was related to the whole financial market designed by government and social background.

Table 3: Backtest results of VaR

PortfolioID	Confidence level	TL	Probability	Type	Observations	Failures
CSI300	95%	green	6.6681e-62	1	2844	1
CSI300-2008	95%	green	2.6521e-09	1	385	0
CSI300-2015	95%	green	6.6681e-62	1	75	2
SSE	95%	green	2.1963e-56	1	3025	7
SSE-2008	95%	green	2.1963e-56	1	407	0
SSE-2015	95%	green	2.1963e-56	1	78	0

Table 4: Backtest results of MS

PortfolioID	Confidence level	TL	Probability	Type	Observations	Failures
CSI300	97.5%	green	3.9619e-30	1	2844	1
CSI300-2008	97.5%	green	5.8449e-05	1	385	0
CSI300-2015	97.5%	green	0.14974	1	75	0
SSE	97.5%	green	2.0031e-24	1	3025	7
SSE-2008	97.5%	green	3.3487e-05	1	407	0
SSE-2015	97.5%	green	0.13879	1	78	0

Table 5: Backtest results of ES

PortfolioID	$E[Z_2(L)]$	TL
CSI300	0.9999	Green
CSI300-2008	0.9995	Green
CSI300-2015	0.9993	Green
SSE	0.9981	Green
SSE-2008	0.9999	Green
SSE-2015	0.9997	Green

I get the expectation of Z_2 test for CSI300, $E_{csi}[Z_2(L)] = 0.9999$, and expectation of Z_2 test for SSE $E_{sse}[Z_2(L)] = 0.9981$, which means that they are all overestimated, and the null hypothesis can't be denied.

SSE2015 0.9997 2008 0.9999

The above tables are the back tests of VaR, MS and VaR. They all show good performances.

CSI2015 0.9993 2008 0.9995

ans =

PortfolioID	VaRID	VaRLevel	TL	Probability	TypeI	Increase	Observations	Failures
"CSI-2008"	"Normal95"	0.95	red	1	0	1	385	368
"CSI-2008"	"Normal99"	0.99	red	1	0	1	385	376

ans =

PortfolioID	VaRID	VaRLevel	TL	Probability	TypeI	Increase	Observations	Failures
"CSI-2008"	"Normal95"	0.95	red	1	1.5305e-69	1	75	63
"CSI-2008"	"Normal99"	0.99	red	1	1.8958e-130	1	75	69

ans =

PortfolioID	VaRID	VaRLevel	TL	Probability	TypeI	Increase	Observations	Failures
"sse-2008"	"Normal95"	0.95	red	1	0	1	407	380
"sse-2008"	"Normal99"	0.99	red	1	0	1	407	393

ans =

PortfolioID	VaRID	VaRLevel	TL	Probability	TypeI	Increase	Observations	Failures
"sse-2015"	"Normal95"	0.95	red	1	1.3176e-81	1	78	70
"sse-2015"	"Normal99"	0.99	red	1	1.3702e-142	1	78	74

ans =

PortfolioID	VaRID	VaRLevel	TL	Probability	TypeI	Increase	Observations	Failures
"CSI"	"Normal95"	0.95	red	1	0	1	2844	2679
"CSI"	"Normal99"	0.99	red	1	0	1	2844	2786

5. LITERATURE REVIEW

VaR was an effective risk measure that was popularized by a researcher in the 1990s. Later on, major banks were required to disclose derivatives activity and potential risks by Securities and Exchange Commission, which means most of banks were led to use VaR as their risk assessment [6]. VaR then became the industry standard for institutional risk management. But VaR doesn't satisfy the statistically coherent properties for portfolio risk aggregation (i.e., sub-additivity) and can't capture the tail risk of the loss distribution. Besides, the market emerges different kinds of unpredictable patterns and the limitation of VaR's normal market conditions becomes prominent. Risk management with only VaR is inadequate. In the meantime, ES was put forward to disclose tail risk distribution better and offer sub-additivity that VaR doesn't do. Nevertheless, ES was criticized that it doesn't hold elicibility which allows evaluating forecasting risk procedure. There has been a debate between VaR and ES for about 18 years.

The Traffic Light approach to back testing VaR was firstly put forward by the BCBS.

VaR is a method of risk management using confidence level to get quantiles which is easy to understand and get approach to. It was figured out that VaR and the tail behavior can't be validly described [2]. While, MS seems a more newly-presented topic first discussed by a researcher, which is easy to implement, captures the tail loss distribution and offers elicibility, combining merits of VaR and ES. Moreover, as indicated by the researcher, MS also has distributional robustness with respect to model misspecification.

Contrary to the group of researchers, the Executive Director and Senior Researcher of MSCI announced unnecessary of elicibility and have successfully developed three sophisticated methodologies to back test ES [7]. These methods are available for public through their publication called Backtesting ES.

In light of the researchers, made empirical applications of ES back testing and concluded the most suitable model of ES.

The reason why I choose Chinese market as research background is that Chinese market is a high-volatility market, which can be a good illustration for nowadays' market changeable patterns. Due to the properties, MS and ES may take advantages over VaR. As China's stock market is depressed by the extremely high market volatility, there is a pressing need for an effective risk measurement in Chinese market for risk management, for "whom" my reach can be of value.

In 1943, a researcher established the famous Extreme Value Theory (EVT), which has been applied widely in climatology and agriculture. It was not until 1999 that EVT started to be applied in financial research by Login. He used EVT to study extreme variation of American stock market, which was also the first application of EVT in risk management.

6. CONCLUSION

Since China has been a relatively low-trust country, high confidence levels are preferred comprehensively. Risk measures, with higher confidence levels, used in risk management by financial institutions can absolutely alleviate pressure of social trust crisis, remedy the imperfect Securities Law and cater the requirement of higher market liberalization. The 2015 crash reflect characters of Chinese stock market much better than the 2008 crash. In this case, MS and VaR are much better.

Although EVT may overestimate risk, the empirical results show that conditional EVT (EVT) captures tail risks incisively, a pivotal property for a conservative economy like China.

When confidence level is high, the differences between MS and VaR are negligible, but the differences between MS and ES are obvious. Using EVT, risk managers can capture tail risk with MS and VaR than with ES. While, MS has much better properties that VaR doesn't have, like elicibility, robustness and capability of tail risk catching. These properties cannot be shown in the experiment of this paper, but they are the properties that a safe risk measurement should have, especially in China, which has low trust and high volatility in stock market. EVT is not the only model to value risk. Many other models may be applied in Chinese stock market, so these properties can be fatal.

7. LIMITATIONS

A group of researchers clarified that CSI300 had brought out reverse effects, rising the Information asymmetry level in Chinese stock market and adding adverse selection problem. From this point, the

representability of CSI300 for Chinese stock market is attributed. The Empirical results above show that risk measures are overestimated, which may not be referable for risk lovers.

As for EVT, the pre-specified threshold value u can affect the risk measures to a great extent. Since a researcher indicated that the 95th percentile point of distribution chosen as the threshold value usually works well, I just applied this experience. But different thresholds can have large effect on the risk measure level. Following are some experiment results, where different thresholds for VaR as 0.01, 0.5 and 0.0001 are the only variable that changed from risk measures for CSI300.

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