The Accumulation of Index Futures Basis Risk and Its Information Transmission Effect

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Abstract

Exploring the role of basis risk in the volatility spillover process of stock index futures has great significance to improving the trading mechanism and enhances the cross market risk management. By analyzing the basis risk clustering process with self-exciting process and discuss the relationship between basis risk and relative indexes with Granger causality tests, we explored the behavior characteristics of the basis risk in China's stock index futures market. The results show that there is a significant self-exciting process between CSI 300 future's basis risk clustering events. The clustered basis risk has significant impacts on the volatility of CSI 300, but its impacts on relative indexes are varied. The clustering of basis risk may not have the ability to cause an overall shock to the market.
Keywords:stock index futures, volatility spillover, information transmission, self-exciting process

1. Introduction and literature review

China's stock index futures market has become an important part of China's capital market in the recent five years. With the ups and downs of the stock index futures and spot market prices, especially sincethe stock market fluctuation in July 2015, the financial market order has been severely disrupted. The discussion about the stock index futures market volatility spill over to the risk problem in the spot market, become the core of the market participants concerned again and academic research focus.

With the expansion of data access and mathematical analysis method in the field of financial research, scholars have gradually started to use high frequency data of numerical analysis of stock index futures spot price fluctuation; study time span gradually from the week data, daily data of Japanese trading in the time division data refinement, Stochastic Dominance Test (Qiao et al, 2013), Multifractal Detrended Cross-Correlation Analysis(Caoet al, 2014), VECM－GARCH-M (Hou & Li, 2014) and TVP-VAR (Zhou et al, 2014) were introduced research has been greatly enriched.

In short, the present study is lack of in-depth analysis on the volatility spill over problems from the perspective of basis risk. Compared with the existing literature, this paper work is done some useful exploration on the two aspects: one is starting from the basis point of view, analysis of the impact of the basis risk of volatility spill over effect of stock index futures market in China, to provide some new material for the research on the spill over problem of cross market; two is the process of forming the use of Hawkes self-point process description basis risk, make some experience on the accumulation characteristics better reflect the basis risk.

2. Research methods

The self-excitingprocess is used to describe the interaction among the accumulations of basis risk events to reflect the characteristics of the basis risk in the volatility and spillover process in stock index futures market.

2.1Model establishment

Hawkes process is a kind of self-exciting characteristics of the point process, in its definition, occurrence of a specific type of event has a base frequency, once the specific events will occur, based on the frequency of subsequent events occurred jump, stimulation. In this paper, we obtain the following strength function:

$$\lambda(t) = \mu + k \sum_{t_k < t} w e^{-w(t - t_k)}$$

2.2Parameter estimation method in the self-exciting process

Due to the high nonlinear characteristics, the optimization method can only be used to estimate the maximum likelihood estimation method. Therefore, the maximum likelihood estimation method is used to estimate the parameters. Specifically, its maximum likelihood function can be written in the following form:

$$\log L(\mu, k, w \mid t_1, ., t_n) = \sum_{t_i : 2 \le i \le n} \log(\lambda(t_i)) - \int_0^T \lambda(t)\, dt$$

The maximum likelihood function used to estimate is:

$$\log L\left(\mu,k,w \mid t_1,.,t_n\right)=\sum_{t_i:2\le i\le n}\log\left(\mu+k\sum_{t_k<t}we^{-w\left(t-t_k\right)}\right)-\mu T-k\sum_{t_k<t}\left(e^{wt_k}-e^{w\left(t_k-T\right)}\right)$$

3. Empirical analysis

3.1Sample construction

Hawkes self-strength function extraction of stock index futures, the Shanghai and Shenzhen 300 stock index futures contract data, data from Wind consulting financial terminal. The sample interval ranges from the April 16, 2010 to August 13, 2015. In order to calculate the Shanghai and Shenzhen 300 index earnings volatility corresponding to the stock index futures, we use the CSI 300 index daily data. The sample ranges from April 16, 2010 to August 13, 2015. Data is extracted from CSMAR financial database.

3.2 Granger causality test of position data of stock index futures and basis

Table 1 gives the Granger causality test of top twenty institutions of stock index futures and basis.

Table 1Granger causality test of position data of stock index futures and basis

Variable	x	Overall basis		Basis in normal situation		Basis in inverted market	
y	primary hypothesis	F-test	P Value	F-test	P Value	F-test	P Value
Sum of top 20 of position holders							
Position of Stock Index Futures of CSI 300	y<≠x	22.6	Very low	16.42	0.0001	6.95	0.0089
	y≠>x	1.8	0.1799	3.87	0.0498	0.28	0.5996
Securities company of the top 20 of position holders							
x	y	Position of Guotai Junan Securities		Position of Shenyin Wanguo Securities		Position of Zhongxin Jiantou Securities	
Overall basis	y<≠x	6.4	0.0116	0.02	0.8855	1.45	0.2295
	y≠>x	0.13	0.7197	7.31	0.007	0.17	0.6787

From the Table 1, we can find that the basis has significant one-way causal relationship with the number of Shanghai and Shenzhen 300 index futures position in general, but under normal market conditions, both of which will be a two-way causal relationship. The relationship between the three agencies, the number of positions and the basis change is different. There is no causal relationship between consistencies. The result show the important influence on the basis on the stock index futures, but also reflects the relative independence of the basis changes in the relationship between stock index futures price in the amount, in addition to the influence degree of variation between the futures price and spot price basis.

3.3 Features of self-exciting process of abnormal fluctuation of stock index futures

The estimation results are listed in Table 2 on the basis risk accumulation events Hawkes self-process parameters. Different market conditions, parameters of u all samples range from 0.1148 to 0.2123. The parameter u is 0.2123 overall basis risk accumulation, the accumulation of basic risk normal market conditions 0.1148 slightly lower than the market upside down 0.1185. The k value fluctuated from 0.1077 to 0.1477, the parameter k is 0.1477 overall basis risk accumulation. If we do not distinguish the basis risk event accumulation of market background, the response time is the overall accumulation of basis risk events for 18 days, which will occur once every three weeks of extreme events. In the normal market conditions, the response time between the accumulations of basis risk event is 37 days, 50 daysfaster than inverted market.

Table 2 Self-exciting process estimation of accumulation of index futures basis risk

Variable name	u	k	w	Response time	AIC（yes）	AIC（no）	Events number
Overall basis risk	0.2123	0.1477	0.0567	18	9.56E-03	1.13E+301	539
Basis risk in normal market	0.1148	0.1077	0.0267	37	-1.21E+21	-1.1450	269
Basis risk in inverted market	0.1185	0.119	0.02	50	-3.87E+15	-1.1481	270

3.4 Granger causality test of basis risk and index fluctuation

The strength of the basis risk function basis risk overall strength function and normal market conditions, market conditions directly inverted by using Box-Jenkins method. The overall strength of the basis risk function are given in Table 3.All the observation period, the function and the Shanghai and Shenzhen strength basis risk strength basis risk function, inverted and normal market conditions under the market conditions of the 300 index volatility Granger causality test results.

Table 3 Granger causality test

Variable	X	Overall degree function of basis risk		Degree function of basis risk in normal situation		Degree function of basis risk in inverted Market	
y	primary hypothesis	F-test	P value	F-test	P Value	F-test	P Value
Index spot							
Volatility of CSI 300	y<≠x	**3.59**	**0.0582**	1.36	0.2433	**90.71**	**Very low**
	y≠>x	**4.8**	**0.0286**	**64.1**	**Very low**	**227.44**	**Very low**
Connectivity index							
Volatility of Shanghai stock composite index	y<≠x	**3.39**	**0.0657**	**4.82**	**0.0282**	0	0.9788
	y≠>x	**8.03**	**0.0046**	0.4	0.5255	2.32	0.1276
Volatility of Shenzhen composition index	y<≠x	1.45	0.2286	0.04	0.8469	0.05	0.8262
	y≠>x	0.81	0.3686	**3.46**	**0.063**	0.45	0.5018
Volatility of small board index	y<≠x	0.23	0.6289	**58.29**	**Very low**	**2.96**	**0.0856**
	y≠>x	0.56	0.4535	0	0.9512	**2.99**	**0.084**
Volatility of GEM index	y<≠x	**73.61**	**Very low**	**124.3**	**Very low**	**40.29**	**Very low**
	y≠>x	**7.39**	**0.0066**	**4.33**	**0.0374**	**9.21**	**0.0024**

4. Conclusion and implications

Based on the non-parametric Hawkes self-exciting process and Granger causality test, this paper studied the function of the basis risk in stock index futures market in the risk spill over process. The main conclusions are as follows: (1) the CSI 300 stock index futures and spot basis are the important factors to influence the behaviour of market. There are significantaccumulation characteristics of Hawkes self-exciting process. (2) From the perspective of the spot index of stock index futures basis risk return volatility and spot the obvious mutually affect each other. However, from the whole market perspective, there are some differences between the basis risk and main index change of income.

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