

The Impact of the Introduction of Stock Index Futures on the CSI 300 Index Fluctuation

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Abstract

In this paper, we study the influence of the introduction of stock index futures on the spot stock market fluctuation by using the log daily returns of the CSI 300 index in 2005-2016. First, we do the empirical test for samples, and found that the sample is smooth and has the ARCH effect; Second, using GARCH model regression, we found that the introduction of stock index futures decreased index volatility; In the end, we found that the volatility of the stock price caused by the bad news is larger than the same degree of fluctuations caused by the good news in TARARCH model regression.

Key words: *stock index futures; CSI 300 index, fluctuation; GARCH model; TARARCH model*

1 Introduction

1.1 Research background

2010, with the margin trading business pilot and the CSI 300 index futures officially listed, China's stock market ushered in the short mechanism, before that China can only make more unilateral stock market model. The introduction of short mechanism provides a new way of investment for investors, and is better to avoid the market systemic risk. However, from the beginning of June 15, 2015, the Shanghai Composite Index fell by 30% during only three weeks. After a fully fledged stock market crash, regulators pointed that the stock index futures was the cause of the stock market crash, and to limit its deal. A trend of studying the influence of the introduction of stock index futures on the spot stock market fluctuation sets off. There exist two opposite attitudes. Some people think that stock market needs short forces and to game to achieve a equilibrium market prices, but some people think that the short will damage the stability of the market. So we need to do further analysis to explore the actual impact.

1.2 Related research at home and abroad

In the existing research, there are two opposite views about the influence of stock index futures on the volatility of the stock market. One view is that stock index futures will affect

the volatility of the stock market; the other is that stock index futures have no significant impact on the volatility of the stock market.

1.1.1 Stock index futures affect stock market fluctuation

In the first view, there are two main effects of stock index futures on stock market. The first view is that stock index futures have a stabilizing effect on the stock market. Domestic scholars Tu et al.¹ built a multi market decision-making model, found that the introduction of stock index futures can reduce the volatility of the market. Wang,² found that there is a long-term equilibrium relationship between futures market and spot market, and the stock index futures market can stabilize the spot market as well as guiding the spot market price; The second view is that stock index futures will increase market volatility. Luo et al.³ think that Stock index futures trading for speculation will increase volatility of the stock market, but the stable stock index futures will have a positive impact on the stock market. Wu et al.⁴ found that the futures market bring greater transfer effect on spot market by the research of turnover rate and volatility, the risk of spot market increases and the price fluctuate obviously, stock index futures have a negative effect on the stock market.

1.1.2 Stock index futures has no impact on the stock market fluctuation

Edwards,⁵ found that there was no obvious fluctuations of stock market before and after the listing S&P500 stock index .Liu et al.⁶ concluded that the stock index futures have no significant impact on the stock market in Taiwan, China through empirical research. Hu,⁷ found that the introduction of stock index futures did not significantly alter the volatility of the stock market by Ex post factor research.

2 Experimental

2.1 Sample selection and statistical description

In this paper, we select the 2005.4.1-2016.3.31 CSI 300 index log daily return rate, a total of 2674 samples. Taking 2010.4.16 (stock index futures appeared) as the node, data is divided into before the stock index futures sample1 and after the stock index futures sample 2. Data are obtained from the Ruisi database. The descriptive statistics of the total sample are shown in *Fig. 1*.

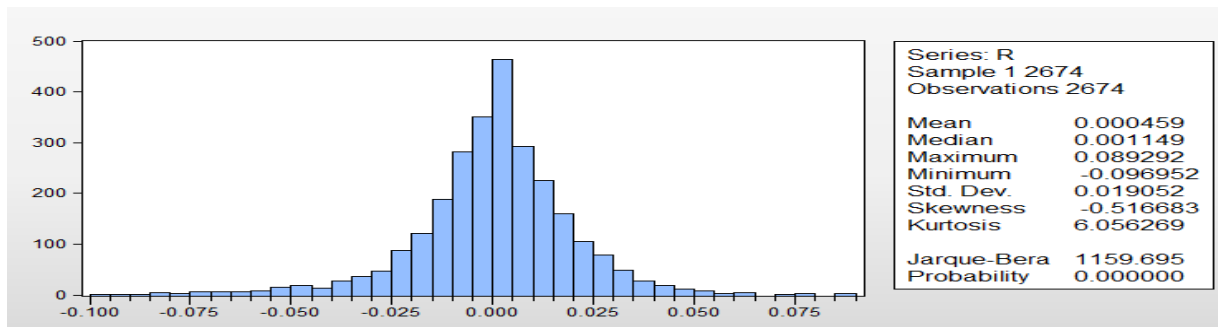


Fig. 1 – the CSI 300 return distribution histograms and descriptive statistics

We can see from Fig. 1 , total sample mean value is 0.000459, standard deviation is 0.019052, but the population does not meet the normal distribution,there is a sharp fat-tail phenomena. Meanwhile, the descriptive statistics of sample 1 and sample 2 are shown in Table 1.

Table 1 – Descriptive statistics of the introduction of stock index futures

Time	Mean	S.d	Skewness	Kurtosis	JBSTA	P-value
Sample 1	0.0010	0.0215	-0.4271	5.1588	275.5643	0.0000
Sample 2	-3.7326e-05	0.0167	-0.7053	6.9871	1.0784e+03	0.0000

From the Table 1 ,first, the two samples yield time-series for the JB statistic values are large, there is a significant spike fat-tail phenomena,which does not meet the normal distribution assumptions; second ,standard deviation of sample 1 is larger than the standard deviation of sample 2,which shows sample 1 fluctuation in yields is larger than sample 2.

2.2 Empirical test

2.2.1 ADF test

In order to ensure the stability of selected time series,and improve the accuracy of estimated parameters, we do ADF test for sample.Results are shown in the following Table 2.

Table 2 –ADF test value of the CSI 300 index daily returns

Sample	ADF test value	Significant level	Critical value
Total sample(2674) 2005.4.1-2016.4.1	-50.2040	1%	-3.4326
		5%	-2.8624
		10%	-2.5672
Sample 1(1227) 2005.4.1-2010.4.15	-34.1824	1%	-3.4355
		5%	-2.8637
		10%	-2.5680
Sample 2(1447) 2010.4.16-2016.4.1	-36.6881	1%	-3.4347
		5%	-2.8633
		10%	-2.5677

From Table 2 , theADF test absolute value of the total sample,ample 1 and sample 2 are larger than their absolute values of the critical value at 1% significance level , so sample should

refuse original assumed and there exists no unit root. The total sample, sample 1 and sample 2 time series is stationary.

2.2.2 ARCH effects test

In order to determine whether the CSI 300 Index yield volatility clustering phenomenon exists, we do ARCH-LM test. Test results are shown in Table 3.

Table 3– Test results of ARCH-LM

Order number	F-statistic	Prob.F	Obs*R-squared	Prob.Chi-Square
1	69.4844	0.0000	67.7727	0.0000
2	57.0291	0.0000	109.5051	0.0000
4	50.1265	0.0000	186.8213	0.0000
8	31.4969	0.0000	230.9217	0.0000

From the above test results, both F-statistic or LM statistic are far less than the critical values at 1% significance level, which means the ARCH effects exist. What's more, ARCH effects still exist when the order is higher. As for financial time series, using GARCH models to fit is needed to eliminate the autoregressive variances when a higher-order ARCH effect exists.

2.3 Analysis based on GARCH mode

Engle first proposed the ARCH model in 1982 whose good features are the constant variance and the ability to deal with the tail. The model can be better used to describe the characteristics of financial time series. But in conditions of limited sample, the estimated effect will be greatly reduced with the more parameters estimation of higher-order ARCH model. In 1986, Bollerslev came up with the GARCH model, which use a lower order of the GARCH model instead of a higher-order ARCH model. This paper will establish GARCH (1,1) model to analyze the fluctuations of the spot market before and after the introduction of the stock index futures market. Model equations are as following (1) (2)

$$R_t = \alpha + \beta * R_{t-1} + \mu_t \tag{1}$$

$$\sigma_t^2 = \omega + \lambda * \mu_{t-1}^2 + \gamma * \sigma_{t-1}^2 \tag{2}$$

In order to determine the impact of index futures on cash market, we introduce a mute variable di into ARMA-GARCH (1,1) model:

$$di = \begin{cases} 0 & \text{before the introduction of the stock index futures} \\ 1 & \text{after the introduction of the stock index futures} \end{cases}$$

Finally we get equation (3), which correct the form of equation (2):

$$\sigma_t^2 = \omega + \lambda * \mu_{t-1}^2 + \gamma * \sigma_{t-1}^2 + \theta * di \tag{3}$$

The " $\lambda+\gamma$ " is to guarantee the stability of model. The influence of the futures market on the spot stock market can use the coefficient θ of dummy variables d_i to reflect, if $\theta < 0$, then the introduction of index futures suppresses fluctuations of the spot stock market; if $\theta > 0$, the introduction of index futures increases fluctuations of the spot stock market; $\theta = 0$ means no reaction to the introduction of stock index futures for spot market.

2.4 Analysis based on TAR_{CH} mode

Many researchers have found that there is an asymmetry--effect on the stocks price volatility. The impact of bad news on the stock market is greater than the good news. TAR_{CH} can measure this asymmetric phenomenon well. The principle of the model is added asymmetric effects $\Phi\mu_{t-1}^2\Gamma_{t-1}$ to the conditional variance equation. Good message ($\mu_{t-1} > 0$) and bad message ($\mu_{t-1} < 0$) for variance equation have different effects: when good news appears ($\mu_{t-1} > 0$), $\Gamma_{t-1} = 0$, the equation has no asymmetric effect, so when there is good news, the stock market will be γ times change; when the bad news appears ($\mu_{t-1} < 0$), $\Gamma_{t-1} = 1$, which means the stock market will be $\gamma + \Phi$ times change. Now we use this model to examine the impact of the CSI 300 stock index futures on the spot stock market.

$$\sigma_t^2 = \omega + \lambda * \mu_{t-1}^2 + \gamma * \sigma_{t-1}^2 + \phi * \mu_{t-1}^2 * \Gamma_{t-1} + \theta * d_i \tag{4}$$

3 Results and Discussion

3.1 GARCH model results

ARMA-GARCH(1,1) model is estimated by Eviews 9.0. The virtual variable d_i is introduced, and the variance equation (3) regression results are shown in Table 4.

Table 4--Estimation results of ARMA-GARCH(1,1) model

	Variance Equation(3)				R ²
	Coefficient	Std. Error	z-Statistic	Prob.	
ω	3.50E-06	8.18E-07	4.280422	0.0000	
λ	0.055628	0.005498	10.11779	0.0000	0.012242
γ	0.937347	0.005719	163.9046	0.0000	
θ	-1.09E-06	6.28E-07	-1.737460	0.0823	

As can be seen from the parameter estimation results, the GARCH coefficient was 0.9373, which is more than ARCH coefficient of 0.0556. This indicates that the CSI 300 index fluctuation in the role of the old information is greater than the role of the new information. The old information is the main cause of the sharp fluctuations in the spot price. Meanwhile, at the 10% significance level, $\theta < 0$ is significant, it indicates that the introduction of index futures suppress fluctuations of the spot stock market. Because the introduction of stock index futures

can balance multi forces and avoid market systemic risk. In addition, $\lambda + \gamma = 0.992975 < 1$, which shows parameters of the model are stable. Doing ARCH-LM test to fit results, finding that there exists no ARCH effect in the model.

3.2 TARARCH model results

Use ARMA-TARARCH model regression on the total sample, and its results is shown in Table 5:

Table 5– Estimation results of ARMA-TARARCH(1,1) mode

	Variance Equation(4)				R ²
	Coefficient	Std. Error	z-Statistic	Prob.	
ω	4.08E-06	8.73E-07	4.677068	0.0000	
λ	0.048493	0.006623	7.321832	0.0000	
Φ	0.013204	0.007474	1.766560	0.0773	0.0096
γ	0.935081	0.005712	163.7064	0.0000	
θ	-1.19E-06	6.40E-07	-1.852186	0.0640	

From the results in Table 6, on the one hand, $\theta < 0$, it is statistically significant, which shows that the introduction of index futures suppresses fluctuations of the spot stock market; on the other hand, $\Phi > 0$, which indicates that the stock market has a leverage effect, the volatility of the stock price caused by the bad news is larger than the good news. The reason is that falling stock prices will decline the shareholders' equity and increase the company's financial leverage.

4 Conclusion

In this paper, the following conclusions are drawn from the GARCH models and TARARCH models based on the 2674 CSI 300 index in 2005-2016:

- *The CSI 300 index fluctuation in the role of the old information is greater than the role of the new information. And the old information is the main cause of the sharp fluctuations in the spot price.*
- *We find that the introduction of index futures suppresses fluctuations of the spot stock market, which plays positive function of risk transfer and stabilizing the market.*
- *We also find that the stock market has a leverage effect in TARARCH model, and the volatility of the stock price caused by the bad news is larger than the same degree of fluctuations caused by the good news.*

In the case of the shorting mechanism imperfect, the bad news will lead to the market price volatility. Therefore, we should combined foreign experience with the conditions of our country to design a more reasonable stock index futures products and perfect our short mechanism gradually.

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