ISSN: 2688-9323

Information Content of 50ETF Option Implied Variance

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Abstract

We study the information content of the 50ETF option implied variance in China, and compare with that of the S&P 500 option implied variance in US. We employ Newey-West regression to study the relationship between the risk and the return in China and US, and find the opposite results in the bull markets for two countries. We also study the prediction effect of the option implied variance on the future realized variance, and find that the variation explained by the implied variance in China market is smaller than that in US market.

Keywords

Implied Variance, Equity Premium, 50ETF option.

1. Introduction

With the development of the economy, financial derivatives in China's financial market are constantly evolving. The SSE (Shanghai Stock Exchange) 50ETF option was the first stock index option traded in China, which was listed for trading on February 9, 2015. The underlying asset of SSE 50ETF option is the ChinaAMC 50ETF, which is an exchange traded fund established on December 30, 2004.

The SSE 50ETF option market develops very rapidly. The daily positions were 11720 sheets on February 9, 2015, and grew to 4.7 million sheets on December 13, 2019. Its trading volumes was 18843 sheets on the first day of listing, and grew to 5.13 million sheets on December 13, 2019. However, the option market in China is still in the early stage of development, with the features of lack of varieties, unbalanced development between the exchange-traded options and the OTC options, and high threshold for market participants.

The option price contains a lot of information, such as the market's expectation for the future price fluctuation or trend of the underlying assets. CBOE published the S&P 500 implied volatility index VIX to reflect the market's expectation for the future volatility in the next 30 days. CBOE also provides the VIX options and the VIX futures for investors to hedge the volatility risk. There are also other volatility indices in other financial market, such as Europe, India, Canada, Korea and so on. On November 28, 2016, SSE officially released China's volatility index, that is, the so-called iVX, which was the SSE 50ETF option implied volatility over the next 30 days. And the option implied volatility is the squared root of the option implied variance.

One of the research field for the option implied variance is the information content of the implied variance, such the risk-return trade-off and the prediction for the future risk. In mature financial market, CAPM model proposed by Sharpe (1964) and Lintner (1965) revealed the positive correlation between risk and return. But it was non-trivial. Bollerslev and Zhou (2006) found that the positive correlation between the realized variance and the return may not existed because of the leverage effect and the volatility risk, which was not a problem when evaluating the risk using the option implied variance. Cong (2018) compared the relationship between the option implied variance and the future equity return in the US and China market, and found the opposite results in two countries. The investors in China stock market were mostly small and medium-sized investors, whose attitude to risk was

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affected by the market environment. We studied the relationship between the option implied variance and the future equity premium in different market environments, that is, bull or bear market. We found that the coefficients of regressing the future equity premium to the option implied variance were positive in bear markets, but significantly negative in the bull markets in China, while the coefficients of US market were all significantly positive in the bull and bear markets. If the investors in China and in US are rational and the markets are both effective, the Chinese investors are risk lover in the bull markets, while the American investors are risk averse in the bear and bull markets.

As the market's expectation for the future risk, the implied variance is a good predictor for the future realized variance. Jiang and Tian (2005) compared the information content of the model-free implied variance, the BS implied variance and the historic variance in the prediction of the future realized variance, and found that the model-free implied variance was the most efficient predictors and contained the most information for the future realized variance. We would like to study the prediction power of the 50ETF option implied variance for the future realized variance of 50ETF, and compare the results with that of the US market. We find that the 50ETF option implied variance is an efficient predictor for the future 50ETF realized variance and the proposed implied variance estimation explains the most variation of the future realized variance. But the R-squares of the models for 50ETF are much smaller than the R-squares of the models for the S&P 500.

This paper is organized as follows. Section 2 displays the details of the data we used. The relationship between the implied variance and the future equity return is studied in Section 3. Section 4 reports the relationship between the implied variance and the realized variance. Section 5 concludes.

2. Data

The 50ETF option implied variance estimated by SSE is calculated by the square of iVX. To obtain the equity premium of 50ETF, we need the SSE 50 ETF index data and the risk-free interest rate, which was he one-year treasury bond interest rate in China. The range of the data used in this study is from February 9, 2015 to December 31, 2017. All the data comes from the Wind database.

The VIX data were obtained from the CBOE, and the S&P 500 index data were obtained from the Bloomberg. Daily Treasury bill yields at various maturities were obtained from the U.S. Department of Treasury as proxies to the risk-free rates. The US data are from February 9, 2015 to December 31, 2017.

3. Risk-Return Trade-off

Based on Markowitz's asset selection theory, the capital asset pricing model (CAPM) proposed by Sharpe (1964) and Lintner (1965) studied the relationship between the expected return rate of assets in the stock market and the risk. It revealed that if there was higher expected future risk, the higher excess return was expected by the investors who bore the risk. The positive correlation between the risk and the return is the so-called risk-return trade-off.

How to measure the risk is one of the core issues in financial economics research, because the expected risk is not directly observable. There are many studies on the estimation of the expected risk in the existing literature. The first method is based on the time series model to estimate the conditional variance of return, such as the ARCH model proposed by Engle (1982) and the ARCH-M model proposed by Engle, Lilien, and Robins (1987). Bollerslev and Zhou (2006) showed that the correlation coefficient between the conditional variance and the future equity premium was biased because of the leverage effect, and the symbol of the

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coefficient was uncertain if the volatility risk was considered. They proposed that the symbol of the correlation between the return and the implied variance was determined for all reasonable parameter configurations. Let R_T be the equity premium from time 0 to time T, IV_T be the implied variance form time 0 to time T. Thus, we can study the relationship between the risk and the return via regressing the equity premium on the implied variance,

$$R_T = \beta_0 + \beta_1 IV_T + e_T \quad (1)$$

where e_T is the residual.

Time series data usually have the properties of heteroscedasticity and autocorrelation. Although the unbiased estimation of parameters can still be obtained by the traditional ordinary least square method (OLS), the standard error of the estimated parameters obtained by OLS is biased, which leads to the inaccurate t-test of parameters. In order to avoid this situation, the standard errors of the parameters are often adjusted in econometrics, and the most commonly used method is the Newey-West adjustment (Newey and West, 1987).

Bollerslev and Zhou (2006) also showed that the regression coefficient β_1 equaled to the relative risk aversion of investors, or a positive ratio of the relative risk aversion when there was volatility risk. Let W be the wealth, $u(W)$ be the utility function. Then, the relative risk aversion is

$$RRA = -W\frac{u''(W)}{u'(W)} \quad (2)$$

where $u'(W)$ and $u''(W)$ are the first and second derivatives of the utility function, respectively. If $RRA > 0$, the investor is risk averse. If $RRA < 0$, the investor is risk appetite. And $RRA = 0$ means that the investor is risk neutral.

Table 1 reports the Newey-West regression results of Model (1). IV_{SSE} represents the 50ETF option implied variance obtained from iVX published by SSE, and IV_{CBOE} represents the S&P 500 option implied variance obtained from VIX published by CBOE. The coefficient of IV_{SSE} was significantly negative at 5% level, while the coefficient of IV_{CBOE} was significantly positive. The negative regression coefficient showed that the investors in the Chinese market may be risk lover. Chinese stock market is dominated by individual investors. Cheng and Li (2014) found that 80% of the trading volume of Shanghai Stock Exchange was conducted by individual investors. According to the existing studies, Chinese individual investors show different attitude to the risks in the bull market and bear market. The stock market with a long-term upward trend is called a bull market, and the one with a long-term downward trend is called a bear market. Thus, we analyzed the relationship between the SSE 50ETF option implied variance and the future equity premium of 50ETF in different market conditions. And we also compare the results with the US market.

Following Pagan and Sossounov (2003), we divided the markets into the bull and bear market, and then analyze the relationship between the implied variance of and the future equity premium. Table 2 reports our Newey-West regression results of Model (1) for the bull and bear markets in China. The regression coefficients of IV_{SSE}were negative in bull markets and all positive in bear markets. Table 3 reports the regression results in US. From February 9, 2015 to December 31, 2017, the US stock market was a bull market. The regression coefficient of IV_{CBOE} was significantly positive.

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Table 1: Newey-West regression estimates of Model (1) for 50ETF and S&P 500 from February 9, 2015 to December 31, 2017.

	IV_{SSE}	IV_{CBOE}
Intercept	0.231*	-0.090
	(0.130)	(0.272)
IV	-4.079**	0.123***
	(1.941)	(0.015)
R-square	0.045	0.023

The figures inside the parentheses were the standard errors, and *, ** and *** indicate that the coefficients of the regression were significantly different from zero at the 10%, 5%, 1% level, respectively.

Table 2: Newey-West regression estimates of Model (1) for China

Time Period	Feb 9, 2015-Jun 12, 2015	Jun 13. 2015-Feb 29, 2016	Feb 30, 2016-Dec 31, 2017
Market Condition	Bull	Bear	Bull
Intercept	2.711***	-0.513	0.253
	(0.975)	(0.973)	(0.178)
IV_{SSE}	-20.540***	0.435	-3.928
	(8.691)	(3.582)	(2.874)
R-square	0.501	0.001	0.023

The figures inside the parentheses were the standard errors, and *, **, and *** indicate that the coefficients of the regression were significantly different from zero at the 10%, 5%, 1% level, respectively.

Table 3: Newey-West regression estimates of Model (1) for US.

Time Period	Feb 9, 2015-Dec 31, 2015
Market Condition	Bull
Intercept	-0.285***
	(0.117)
IV_{CBOE}	0.021***
	(0.005)
R-square	0.094

The figures inside the parentheses were the standard errors, and *, **, and *** indicate that the coefficients of the regression were significantly different from zero at the 10%, 5%, 1% level, respectively.

The coefficient of the volatility feedback effect was significantly positive in the bull markets in US, that is, the investors are risk-averse no matter which market condition it is. If the Chinese investors are rational and the market is efficient, the negative coefficients of the volatility

ISSN: 2688-9323

feedback effect in the bull markets show that the Chinese investors are risk preferred. The behavior of the investors in the two countries are different.

4. Forecast Future Realized Variance

As the market's expectation for the future risk, the model-free implied variance is a good predictor for the future realized variance. In this section, we employ following model to compare the information content in the implied variance for the subsequent realized variance in China and US,

$$RV_T = \beta_0 + \beta_1 IV_T + \epsilon_t \quad (3)$$

where ϵ_t is an error term.

Tables 4 report the Newey-West regression results of Model (3) for SSE 50ETF and S&P 500. The coefficient of IV_{SSE} was significantly positive at 10% level, while the coefficient of IV_{CBOE} was significantly positive at 1% level. And the R-squared of the model with IV_{SSE} (0.085) was much smaller than that of the model with IV_{CBOE} (0.508), which means that the implied variance contained more information for the subsequent realized variance in the US market. Thus, comparing the regression results for 50ETF and S&P 500, the implied variance was a more efficient predictor and contained more information for the realized variance in the US market.

Table 4: Newey-West regression estimates of Model (3) for 50ETF and S&P 500 when using IV_{SSE} and IV_{CBOE} as the independent variable.

	IV_{SSE}	IV_{CBOE}
Sample size	445	2002
Intercept	0.024*	-0.002*
	(0.012)	(0.005)
IV	0.306*	0.714***
	(0.181)	(0.143)
R-square	0.085	0.508

The figures inside the parentheses were the standard errors, and *, **, and *** indicate that the coefficients of the regression were significantly different from zero at the 10%, 5%, 1% level, respectively.

5. Conclusion

In the comparative study of China and US markets, we analyzed the information contents of implied variance. The implied variance is the market's expectation for the future risk, which is a predictor for the expected return. We employed the Newey-West regression to study the relationship between the risk and the return in China and US, and found the opposite results in the bull markets for two countries. The coefficients of regressing the equity premium on the implied variance were significantly positive in the bull markets in US, that is, the investors were risk-averse in the bull market. However, the risk-return trade-off was broken in Chinese market. The coefficients of regressing the equity premium on the implied variance were significantly negative in bull markets in China. If the Chinese investors are rational and the market is efficient, the negative coefficients means that the Chinese investors are risk lovers.

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Thus, the behavior of the investors in the two countries were different. The implied variance is a forecast for the future realized variance. Regressing the subsequent realized variance on the implied variance, the coefficients of implied variance were all significantly positive at 10% level and 1% level in China and US markets, respectively. It revealed that the implied variance was a more efficient predictors for the subsequent realized variance in US market than in Chinese market. And the R-square's in the models of US were much larger than those of China, that is, the implied variance contained more information for the subsequent realized variance in US market, compared with China market. The reasons for the difference between the two countries maybe: (1) The 50ETF option market is in the early stage of development, while S&P 500 option is a mature option market. The 50ETF option prices contain less efficient information compared with the S&P 500 option prices. (2) The structure of investors in two countries are different. The investors in US stock and option markets are mainly financial institutions. The information used in the pricing of options is likely to be used in the pricing of stocks. But the investors in China stock market are mainly individual investors, and the investors in 50ETF option market are mostly market makers. Investors may not consider the information contained in the option prices when investing in stocks.

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