World Scientific Research Journal (WSRJ) ISSN: 2472-3703
www.wsr-j.org

Analysis of the Impact of Commodity Option Trading on the Volatility of Underlying Assets Price

Qiang Liu

School of Business, Huaihai Institute of Technology, Lianyungang, China

hhit2006@126.com

Abstract: The DCE m option was officially launched in March 31, 2017, which is the first exchange-traded commodity option in China, It has great significance for building diversified open China's financial derivatives market. What is the impact of m option on the volatility of the underlying futures market? We choose the futures data before and after m option listing, and use the virtual variable ARMA-ARCH model and AR-TARCH model to do empirical research. The results show that the listing of m option reduces the volatility and information asymmetry of the underlying futures market, the decline of volatility is not obvious, And the impact of information asymmetry is that the drop of good news is much larger than the impact of bad news. Finally, we explain the results of empirical analysis and put forward some suggestions.
Keywords: m option, futures market, volatility, TARCH model.

---

1. INTRODUCTION

Options are the important tools for investors to conduct flexible risk management and hedging. In many countries, options have developed rapidly, and options trading has become the mainstay of the European and American derivatives markets. China's domestic options market started relatively late. In February 2015, the SSE 50 ETF option was launched. In 2017, the soybean meal option and the white sugar option were launched. The steady development of commodity options will provide more and more flexible risk management tools and trading strategies for various enterprises and institutions in the relevant industry chain, and inject new impetus into the futures market to better serve the real economy.

As the first on-market commodity option in China, the soybean meal option was officially launched on the Dalian Commodity Exchange on March 31, 2017. The listing of soybean meal options filled the gap of China's commodity options, marking the new era of China's financial derivatives market entering commodity options. Since the listing, the trading has become increasingly active and the trading volume has continued to grow. According to the statistics of the DCE, the monthly trading volume of soybean meal options has increased from 601,046 in

April 2017 to 3,128,500 in March 2018, It has increased by 5.2 times in just one year. The cumulative transaction volume of the listing in the past year is 7,721,364 hands, and the transaction amount of the option fee is 4.777 billion yuan.The rapid development of soybean meal options will inevitably have a certain impact on its underlying asset market. Volatility can comprehensively reflect market price behavior, which is one of the effective indicators to measure the quality and efficiency of market operation. The research on the influence of soybean meal option on the futures volatility provides theoretical and empirical support for testing the design of China's derivatives and the risk prevention of the futures market after launch, which is of great significance for the stable development of China's derivatives market.

A large number of studies have been conducted by scholars at home and abroad on the impact of the introduction of options on market volatility. Most scholars believe that option trading will reduce the volatility of the underlying market. The Nansen Report released by the United States in December 1974 analyzed the volatility of the underlying stocks before and after the listing of the first 16 stock options listed on the Chicago Board Options Exchange, and found that the volatility of the underlying stocks decreased as the options went public. In 1984, the CFTC,SEC and the Federal Reserve jointly issued the "Research Report on the Economic Impact of Futures and Options Trading".which considers that the options have stabilized or at least did not increase the level of price volatility in the spot market, both theoretically and empirically.Watt, Yadav, Draper [1] take British options as an example, Raman et al. [2] take Nikkei 225 index options as an example, Cui Xiaojian, Xing Jingping [3] take Korean stock index options as an example, shinhua Liu [4] take S&P100 stock index options as an example, and the results show that the volatility of the underlying securities related to the listing of the options has decreased significantly. There are also some scholars who hold different views and believe that the impact of the introduction of options on the fundamental market volatility is not obvious or increases the volatility. Butterworth [5] studied the impact of the trading of FTSEMid250 index options on the underlying stock market. The study found that stock price volatility continued to increase due to the increase in market information. Selvam et al. [6] studied the Sensex index in India and found that after the introduction of options and futures trading, the fluctuations in the spot market did not change significantly. Xiong Xiong and Zhang Yu [7] studied the impact of the listing of Korean KOSPI200 stock index options on the underlying market, and the results showed that the volatility of the underlying index and the index futures market increased.

Although the mainland China option market started late, some domestic scholars also conducted active research on the impact of option launch on stock market volatility. Zhao Shangmei et al. [8] found that the introduction of options would lead to an increase in the volatility of the stock market by constructing artificial simulation models. Zhang Jing and Song Futie [9] analyzed the volatility characteristics of the sample stocks after the listing of SSE 50 ETF options, and found that the option listing reduced the volatility of the sample stocks. By constructing the counterfactual path, Mao Jie [10] found that the listing of SSE 50 ETF options helped to stabilize the volatility of its underlying index constituents. Su Zhiwei and Wang

Xiaoqing [11] believe that the launch of the SSE 50ET F option can reduce the overall volatility of the stock market, but increase the asymmetry of market volatility. Liu Yaming et al. [12] found that the introduction of China's stock index options increased the volatility of the spot market, in which the positive news reduced the volatility of the spot market and the negative news had an increased impact on the volatility of the spot market. Liu Pang Pang [13] believes that the fluctuation of the SSE 50 ETF yield will decrease on average after the option is listed, but the volatility will increase in the first year after the option is listed.

Through the combing of the existing literature, it is found that in the selection of research objects, mainly focused on stock index options and stock options, the related research on commodity options is relatively rare; in the research methods, Most of them use the GARCH model to compare the volatility changes before and after the option is listed. This paper will take China's first on-site commodity option soybean meal option as the research object, The virtual variable GARCH model is introduced to analyze the influence of option listing on the futures volatility. Then the two-threshold TARCH model is used to compare and analyze the information asymmetry before and after the option is launched. Finally, the empirical results are explained reasonably.

2. MODEL INTRODUCTION

The GARCH model is an excellent model for characterizing the volatility agglomeration. It models the variance of the error and predicts the current variance by using the constant variance, the weighted prediction of the previous variance, and the weighted average of the previous innovation. And use the current variance to reflect market volatility.

GARCH(q,p) model:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_i \sigma_{t-j}^2$$

q,p are the largest lag order of GARCH term and ARCH term respectively,, α_0 is the invariant variance, ε_{t-j}^2 is the previous innovation, σ_{t-i}^2 is the conditional variance of the previous stage.。

In order to ensure the stability of the equation, parameters are satisfied: $\sum_{i=1}^{p} \alpha_i + \sum_{j=1}^{q} \beta_i < 1$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1}$$

d_{t-1} is virtual variables,when $\varepsilon_{t-1} < 0$, d_{t-1} =1； or, d_{t-1} =0. $\gamma = 0$ means that the response of conditional variance to information shock is symmetrical, $\gamma \neq 0$ means the response to conditional variance is asymmetric, α_1 is the positive information coefficient, $\alpha + \gamma$ means the influence coefficient of negative information.

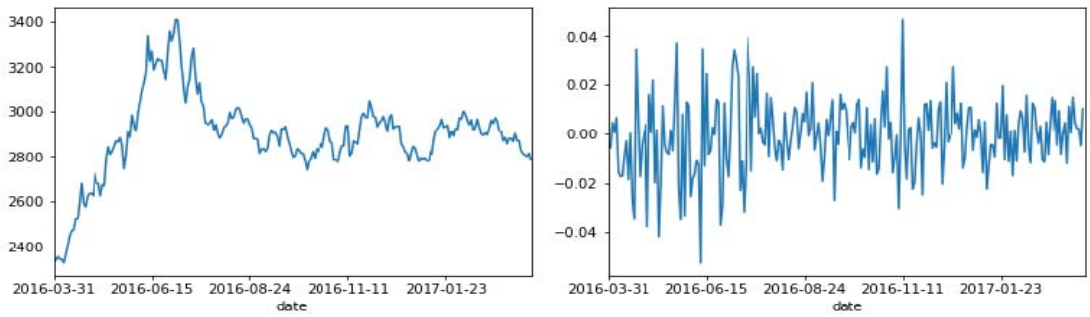
3. EMPIRICAL RESEARCH

3.1 Data

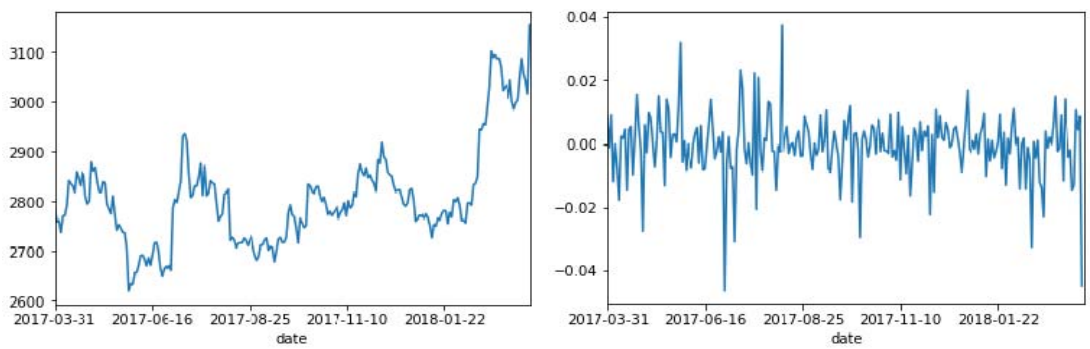
Taking the soybean meal option of DCE as the research object, this paper analyzes the volatility of the commodity option listed on the underlying futures. The soybean meal option was formally listed on March 31, 2017 in Dalian Commodity Exchange. Select one year before the listing in March 31, 2016 to March 30, 2017 and March 31, 2017 to March 30, 2018 listed soybean continuous contract daily closing price data.All data comes from iFinD database.

3.2 Statistical feature analysis

The daily yield of soybean meal futures is calculated by means of logarithmic yield. The formula is that $r_t = \ln p_t - \ln p_{t-1}$, r_t represents the daily logarithmic yield of soybean meal futures, and p_t represents the daily closing price of soybean meal futures. Fig.1(a) Price trend and logarithmic yield fluctuation chart for the year before listing,Fig.1 (b) Price trend and yield fluctuation chart for the year after listing, which show that one year before the option listing, the futures price first appeared a wave of rise, a short pullback and then showed the trend of interval oscillation. One year after the option listing, the futures price first appeared a long-term wide shock, and then a wave of rise. Both of the yield series charts show a more obvious volatility and concentration.



(a)



(b)

Fig 1. Soybean meal index contract day closing price series and logarithmic yield series

Table 1 lists the basic statistics of the logarithmic return series of soybean meal. Table 1 shows that the standard deviation of the logarithmic return series of soybean meal options after listing is obviously smaller than that before listing, and the extreme value also appears before listing,

which indicates that the listing of soybean meal options reduces the volatility of the futures market. The J-B statistic is 94.1079, which reject the normal distribution assumptions significantly.and the volatility has obvious clustering.

Table 1. Basic statistics of the log yield series of soybean meal futures

Name	Sample size	Mean	Deviation	Maximum	Minimum	Skewness	Kurtosis	J-B
before	243	0.0007	0.02288	0.1305	-0.1471	-0.6177	14.8886	1446.5
after	244	0.0005	0.0148	0.0582	-0.0619	0.2031	8.3379	291.36
all	488	0.0006	0.0192	0.1305	-0.1471	-0.4616	16.2597	3592.4

3.3 Stationarity test

Stability is an important prerequisite for the sequence of time series modeling, first, perform a unit root test on the yield series to determine the station's stationarity.The results are shown in Table 2. It can be seen from the test results that the ADF statistic is significantly less than the 1% significance level threshold, indicating that there is no unit root in the soybean meal futures yield series, which is a stationary sequence, which can be analyzed by time series modeling.

Table 2. ADF unit root test results

Name	ADF statistics	1% threshold	P
Before listing	-18.3329	-2.5746	0.0000
After listing	-19.2346	-2.5745	0.0000
All series	-26.3777	-2.5697	0.0000

3.4 ARCH test

The clustering characteristics of the volatility can be characterized by the GARCH model, and the existence of the ARCH effect is the premise of modeling. Therefore, the ARCH effect test of the soybean meal futures yield series is needed, and the LM test method is used. The results are shown in Table 3. When the lag order is 10, the before listing and overall yield series reject the null hypothesis that there is no ARCH effect at the 95% and 99% confidence levels, respectively. When the lag order is 1, the post-marketing yield series rejects the null hypothesis that there is no ARCH effect at the 99% confidence level. Combined with the sequence residual square correlation graph and the LM test results, the sequence has a relatively obvious ARCH effect. GARCH model modeling is possible.

Table 3. ARCH test results

Name	Lag	F statistics	P
Before listing	10	2.2537	0.0159
After listing	1	20.6472	0.0000
All series	10	4.0378	0.0000

3.5 Modeling analysis of GARCH model with virtual variables

In order to study the impact of the soybean meal option listing on the futures market volatility, the dummy variable D was introduced on the GARCH model, Combining the AIC, SC judgment criteria and parameter estimation, the following form of ARMA(1,1)-ARCH(1) model is established:

Mean equation： $\ln p_t = c + \phi_1 \ln p_{t-1} + \varepsilon_t + \theta_1 \varepsilon_{t-1}$

Variance equation： $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma D$

$D = \begin{cases} 0 & \text{before listing} \\ 1 & \text{after listing} \end{cases}$, $\gamma > 0$ Indicates that the option listing has increased the fluctuation of the underlying futures market., $\gamma < 0$ Indicates that the option listing reduces the fluctuation of the underlying futures market.The estimated results are in Table 4:

Table 4. Estimation results with virtual variables ARMA(1,1)-ARCH(1) model

Name	Parameter value	Standard error	Z statistics	P
Mean equation:				
c	7.9871	0.0186	429.88	0.0000
ϕ_1	0.9664	0.0084	115.01	0.0000
θ_1	-0.1283	0.0580	-2.2134	0.0269
Variance equation:				
α_0	0.0004	0.0000	15.606	0.0000
α_1	0.3232	0.0546	5.9164	0.0000
γ	-0.0002	0.0000	-9.7473	0.0000
$R^2 = 0.9470,\ AIC = -5.2653,\ D\text{-}W = 2.0668$				

From the estimation results in Table 4, except for θ_1,the other parameters are statistically significant at 99% confidence, and the degree of fitting of the equation is also good. The coefficient of the dummy variable takes -0.0002, although it is very close to zero, but the level of significance is higher, the coefficient less than zero indicates that the listing of the soybean meal option reduces the volatility of the underlying futures market, but it is not obvious. In view of the different influences of good news and bad news on the volatility of the underlying futures, the TARCH model is used to analyze whether the impact of good news and bad news on the futures of the target is symmetric.

3.6 TARCH model modeling analysis

Good news in the financial market tends to bring positive returns, while bad news generates negative returns. A large number of studies have shown that the impact of different types of news on financial markets is not consistent, showing an asymmetry.Does the listing of soybean meal options affect the different reactions of the underlying futures to good news and bad news? The empirical analysis was carried out using two threshold TARCH models. The results are shown in Table 5.

In the TARCH model, the coefficient of the asymmetric effect term γ_1、γ_2 is significantly different from zero, indicating that the soybean meal futures price fluctuation has obvious asymmetry.Since $\gamma_1 + \gamma_2$ is less than zero, the good news is more fluctuating than the bad news.Before the soybean meal option was listed, when the good news appeared, the impact would bring a shock of α_1 =0.3647 times.When the bad news appears, it will only bring a shock

of $\alpha_1+\gamma_1+\gamma_2$ =0.1212 times;After the soybean meal option is listed, the impact of good news will bring a shock of α_1 =0.0585 times.When the bad news appears, it will only bring a shock of $\alpha_1+\gamma_1+\gamma_2$ =0.0287 times.Both the positive news and the bearish news have dropped significantly, indicating that the listing of soybean meal options has reduced the volatility of the underlying futures market and significantly reduced the asymmetry.

Table 5. TARCH model estimation results

Name	Before listing TARCH model	After listing TARCH model
Mean equation:		
c	8.0174 (294.88) [0.0000]	7.9419 (267.56) [0.0000]
ϕ_1	0.9481 (86.330) [0.0000]	0.9721 (72.546) [0.0000]
Variance equation:		
α_0	0.0002 (2.3152) [0.0206]	0.0000 (2.9652) [0.0030]
α_1	0.3647 (4.1858) [0.0000]	0.0585 (3.9196) [0.0001]
β_1	0.4396 (2.1273) [0.0334]	0.8542 (17.931) [0.0000]
γ_1	-0.1103 (-2.7978) [0.0051]	0.5504 (4.5683) [0.0000]
γ_2	-0.1332 (-2.3746) [0.0176]	-0.5802 (-6.4441) [0.0000]
R^2	0.9438	0.8932

Note: ( ) is the Z statistic value of the corresponding parameter, and [ ] is the P value of the corresponding parameter.

Listed soybean meal options makes the underlying market volatility futures and asymmetry decline may be due to the following points.First, the DCE soybean meal option trading is introduced into the market maker system, and it is continuously adjusted and optimized according to market changes.Professional market maker quotations, close to the market, increasing the depth of the market,it also plays a role in correcting unreasonable prices and suppressing large fluctuations.Second, institutional investors and large investors are the mainstays of the soybean meal futures market. Some large enterprises are related to soybean meal industry chain. They mainly focus on hedging or arbitrage transactions. Their judgment on the market is more accurate and investment behavior is more rational.Finally, the investor moved, the trading volume of the futures market after the soybean meal option was listed decreased by 434.51 million hands, a decrease of 56.92%. The characteristics of the option market “investment + insurance ”will cause some participants in the soybean meal futures

market to transfer to the options market for trading, which reduces the liquidity of the futures market and, stabilizes the fluctuation of soybean meal futures prices to a certain extent.

4. CONCLUSIONS AND RECOMMENDATIONS

In this paper, we use the ARMA (1,1) - ARCH (1) model to study the effect of soybean meal options on the volatility of the underlying futures market in China, and then use the two-threshold TARCH (1,1) model to study the asymmetry of the effect. The empirical results show that the listed soybean meal options reduce the volatility of the underlying futures market, but the decline is not significant. The impact of bad news and good news on the volatility of the soybean meal futures market has declined, the impact of good news is greater, and the asymmetry is significantly reduced. Combined with the conclusion of empirical analysis and the current situation of the development of China's financial derivatives market, this paper puts forward the following suggestions for the development of China's commodity option market.

Firstly, we should learn from the experience of soybean meal option market development of DCE to steadily promote the innovation and development of China's commodity option derivatives. DCE has started the research of option listing since 2002. It has done a lot of effective work in theoretical research, rule-making, system construction, market cultivation and risk prevention and control. It provides guarantee for the smooth operation and market function of soybean meal option after listing. On the premise of guaranteeing the stability of the financial market, more option products will be listed in the future. On the one hand, it can enrich the investment varieties in the securities market and is of great significance to the establishment of China's multi-levels financial capital market. On the other hand, with the further deepening and perfection of the function of commodity derivatives market, the futures market will be further developed. Serving the real economy has injected new impetus.

Secondly, continue to strengthen investor education, and guide more investors to enter the market. The traditional view is that the option market should be dominated by institutional investors, but for the commodity option market, the enterprises and individuals in the relevant commodity industry chain have the inherent demand for hedging and arbitrage. Drawing on the successful experience of the development of the Korean option market, the investors should continue to strengthen their study of the necessary options expertise. To enhance their awareness of risk prevention, improve the overall quality of market participants, and guide more investors into the option derivatives market.

Finally, we should further improve the laws and regulations and constantly improve the market supervision system. Perfect the market maker's operation criterion through perfect laws and regulations, strengthen the strict monitoring of market manipulation, establish the market manipulation early warning mechanism, increase the punishment of market manipulation, and finally make the introduction of option benefit the market function and the perfection of capital market system. Finally, we will promote the steady development of China's financial market.

ACKNOWLEDGEMENTS

This work was supported by grant of No.2018SJA1686, from the 2018 philosophy and Social Science Fund of Jiangsu Provincial Education Department, China.

REFERENCES

[1] Watt W H, Yadav P K, Draper P. The impact of option listing on underlying stock returns:The UK evidence[J].Journal of Business Finance & Accounting, 1992,19(4): 485-503.

[2] Raman Kumar,Atulya Sarin,Kuldeep Shastri.The impact of index options on the underlying stocks: The evidence from the listing of Nikkei Stock Average options[J].Pacific-Basin Finance Journal . 1995 (2):303-317.

[3] Choi Xiaojian, Xing Jingping. A 10-year review and innovation of the development of index options in Korea [J].Securities Market Report, 2008 (1): 42-46.

[4] Shinhua Liu.The impacts of index options on the underlying stocks: The case of the S&P 100[J].Quarterly Review of Economics and Finance. 2009(3):1034-1046.

[5] Darren Butterworth.The Impact of Futures Trading on Underlying Stock Market Volatility: The case of the FTSE Mid 250 Contract [J].Applied Economics Letters,2000(7):439-442.

[6] Selvam M,Babu M,Indhumathi G,Krithiga S.Impact of Index Futures and Options Introduction:A Case of Spot Market Volatility in BSE.Asia-Pacific Business Review. 2009:97-105.

[7] Xiong Xiong, Zhang Yu, Zhang Wei, Zhang Yongjie. The impact of stock index options on stock market and stock index futures market volatility: Taking KOSPI200 stock index options as an example [J].System Engineering Theory and Practice. 2011 (05): 785-791.

[8] Zhao Shangmei, Sun Guiping, Yang Haijun. Volatility Analysis of Stock Options on Stock Market: An Agent-based Computational Experimental Financial Simulation Angle [J].Journal of Management Engineering. 2015 (01): 84-93.

[9] Zhang Jing, Song Futie. The impact of the listing of ETF50 options on underlying stocks in Shanghai Stock Exchange - Based on the perspective of liquidity and volatility [J].Financial Development Research. 2016 (03): 59-65.

[10] The impact of the listing of Maojie Index ETF options on the quality of the underlying index component stock market: empirical evidence from the listing of Shanghai 50ETF options [J].Securities Market Report. 2017 (03): 65-74.

[11] Su Zhiwei, Wang Xiaoqing. Research on the Effect of Stock Options on Stock Market Volatility [J]. Price Theory and Practice. 2016 (11); 118-121.

[12] Liu Yaming, Fan Pengying, Chen Min. Research on the Impact of Stock Index Options on the Volatility of the Spot Market in China [J].Mathematical Practice and Understanding. 2017 (04): 45-51.

[13] An Empirical Analysis of the Impact of the Option Market on the Volatility of the Spot Market--Based on the Comparison of the Pre-and Post-IPO Options of the Shanghai Stock Exchange 50ETF [J]. Statistical and Information Forum. 2017 (10): 50-58.