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An Empirical Analysis of Effect on Copper Futures Yield Based on GARCH

Feng Li[1], Ping Xiao[2]*

[1]*(School of Hunan University of Humanities, Science and Technology, Hunan 417000, China)*
[2]*(School of Hunan University of Humanities, Science and Technology, Hunan 417000, China)*
**Corresponding author. applefly13@126.com*

Abstract: This paper firstly sorts out the domestic research literature on copper futures, points out their contribution and shortcomings, and then selects the copper futures closing price data from 2009-2018 to May 31 (data from Shanghai Futures) Exchange), using Eviews software to process the data, and obtain a line graph of copper futures yield, indicating that the yield is stable, and there will be more obvious fluctuations at the end of the year; the histogram of the rate of return and related statistics Quantity, which proves that the copper futures yield series is not a normal distribution. The autocorrelation and partial correlation coefficient plots show that there are no autocorrelation and partial correlation problems in the sequence. In addition, based on the GARCH model learned, it is concluded that the copper futures yield does have a GARCH effect.
Keywords: Copper futures; GARCH; effect yield; stability

I. INTRODUCTION

With the development of the economy, on the one hand, the people's living standards have gradually improved. Unlike the subsistence society, people are now more willing to invest money in securities and futures markets to achieve the preservation and appreciation of assets and avoid the value of assets caused by currency depreciation.; On the other hand, the country's demand for copper is gradually increasing. At present, China has become the world's largest producer of copper. The Shanghai copper traded by China's Shanghai Futures Exchange is the place ranked in the world's second copper futures trading. In recent years, the price changes of Shanghai copper have been relatively fluctuating, especially after the economic crisis, the impact on the price of copper is even greater. In the case of copper futures, many scholars in China have made great contributions to this research. Among them, Song Bo and Xing Tiancai in the "Chinese copper and copper, the comparative study of the influence of the copper market in New York - based on the analysis of the dynamic relationship between price discovery and spillover effects", proved the Shanghai copper, New York copper futures There is indeed a cointegration relationship, and Shanghai Copper should strengthen the exchange of information with the outside world. Wang Wei studied the risk of Shanghai copper futures market and used the GARCH model to find that the peak and thick tail of financial data can be well fitted, and the accuracy of the TGARCH model is the highest. Zhao Ruiqi analyzed the characteristics of China's copper futures price fluctuations, and also used the GARCH model to analyze the accompanying phenomenon between fluctuations and fluctuations, and explored the relationship between the yield and risk of copper futures market. This paper explores copper futures yields, collects the latest data, and conducts empirical analysis based on the GARCH model.

II. EMPIRICAL ANALYSIS

2.1Statistical Analysis of Copper Futures Yield

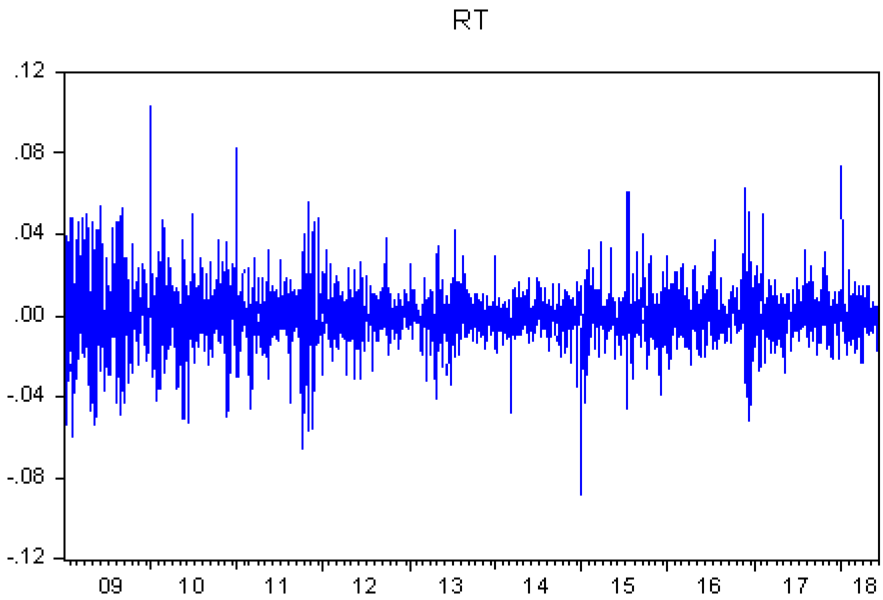

Figure 1.1. Line chart of the copper futures yield sequence rt

As can be seen from Figure 1.1, the copper futures yield series rt has obvious aggregation, followed by a higher rate of return after a high rate of return. In 2009, the highest peak of the yield in recent years, the value of 0.10, in the end of 2014, copper futures yields fell sharply, falling to a low, with a value of -0.08. As can be seen from the above chart, copper futures prices change relatively much at the end of the year. The reason is that investors withdraw funds and redistribute their assets in a new investment period, causing changes in copper futures supply and demand, which in turn affects them. Price and profitability. Overall, copper futures yields are stable.

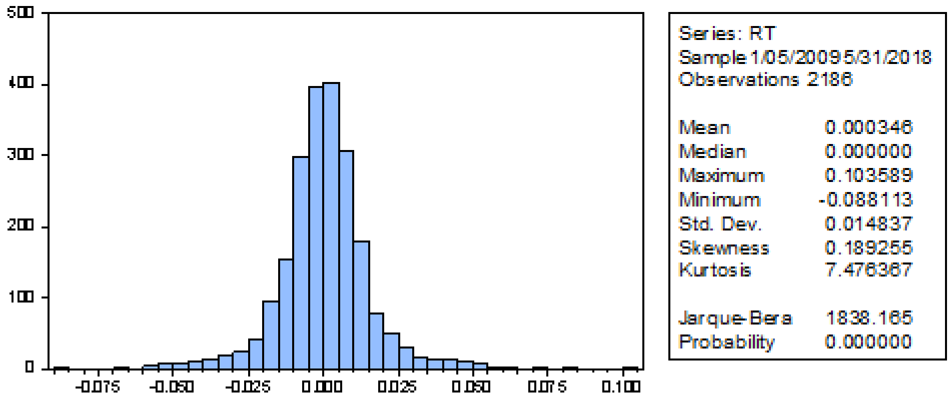

Figure 1.2 Histogram and related statistics of copper futures yield series rt

Using Eviews software to make a bar chart of copper futures yield, the following data information is obtained: the average value is 0.000346, and the median value is 0.000000, indicating that the overall yield of copper futures has not changed much and is in a relatively stable state. The maximum value is 0.103589, the minimum value is -0.088113, and the standard deviation is 0.014837, which is relatively small, indicating that the risk is small. The skewness is 0.189255, which reflects that the deviation of the distribution and the deviation are relatively small, and the skewness coefficient is greater than 0, indicating that the data on the left side of the mean is more, and the distribution of the data is right-biased. The kurtosis is 7.476367. There is a spike in the copper futures yield series, and the value of the JB statistic p-value is 0, indicating that the sequence is not normally distributed.

2.2 Stationarity test

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.040	-0.040	3.5265	0.060
		2	0.047	0.046	8.4590	0.015
		3	-0.017	-0.013	9.0643	0.028
		4	0.008	0.005	9.2199	0.056
		5	-0.012	-0.010	9.5208	0.090
		6	-0.060	-0.062	17.389	0.008
		7	-0.003	-0.007	17.412	0.015
		8	-0.009	-0.004	17.578	0.025
		9	0.007	0.006	17.689	0.039
		10	-0.007	-0.005	17.796	0.059
		11	0.017	0.015	18.452	0.072
		12	-0.005	-0.007	18.517	0.101
		13	-0.002	-0.005	18.523	0.139
		14	0.029	0.029	20.331	0.120
		15	0.037	0.040	23.350	0.077
		16	-0.018	-0.018	24.027	0.089
		17	0.001	-0.001	24.031	0.119
		18	0.046	0.048	28.710	0.052
		19	0.004	0.007	28.744	0.070
		20	-0.008	-0.008	28.883	0.090
		21	-0.057	-0.052	35.951	0.022
		22	-0.008	-0.014	36.085	0.030
		23	-0.021	-0.017	37.100	0.032
		24	-0.060	-0.057	45.088	0.006
		25	0.045	0.044	49.590	0.002
		26	0.004	0.010	49.629	0.003
		27	0.016	0.005	50.210	0.004
		28	0.031	0.032	52.385	0.003
		29	0.035	0.029	55.153	0.002
		30	0.013	0.008	55.542	0.003
		31	-0.031	-0.027	57.666	0.003
		32	0.009	0.006	57.829	0.003
		33	0.048	0.052	63.024	0.001
		34	-0.007	-0.000	63.132	0.002
		35	-0.025	-0.020	64.496	0.002
		36	0.017	0.019	65.132	0.002

Figure 1.3 Futures price autocorrelation and partial correlation graph

From the sequence autocorrelation coefficient (AC), and the partial correlation coefficient (PAC), it can be seen that the p-value of Q-Stat is larger than the significance level of 1%, indicating that there is no autocorrelation and partial correlation in the copper futures yield.

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-48.63277	0.0001
Test critical values:	1% level	-3.433146	
	5% level	-2.862661	
	10% level	-2.567413	

*MacKinnon (1996) one-sided p-values.

Figure 1.4 Unit Root Test Results

From the ADF test results in Figure 1.4, it can be seen that the critical value is -3.433146 when the significance level is 1%, and the critical value is -2.88621 when the significance level is 5%, and when the significance level is 10%, The critical value is -2.567413, all of which are greater than the ADF test value, and p = 0.001, indicating that the probability of committing the first type of error is less than 0.001, so the null hypothesis cannot be rejected: the time series of copper futures yields is stable.

2.3 Estimation of equations

From the analysis of the first two steps, the sequence data of the copper futures yield is a stable time series data, and then the estimation equation can be established:

$$r_t = \mu_t + \varepsilon_t \qquad (1\text{-}1)$$

The equation is estimated by eviews software, and the residual graph is obtained. The residual graph indicates that there would be heteroscedasticity, and then the heteroscedasticity test is performed on the residual. The number of lag periods starts from 10, and the optimal lag period is obtained in turn.

Heteroskedasticity Test: ARCH

F-statistic	33.25449	Prob. F(1,2183)	0.0000
Obs*R-squared	32.78552	Prob. Chi-Square(1)	0.0000

Figure 1.5 Residual ARCH effect test results

Figure 1.5 shows the residual test results. The original hypothesis is that there is an ARCH effect. The F statistic and the statistic P value are all zero. Accepting the null hypothesis indicates that the residual of the estimated equation (1.1) has ARCH effect.

Dependent Variable: RT
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 07/31/18 Time: 10:07
Sample: 1/05/2009 5/31/2018
Included observations: 2186
Convergence achieved after 17 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(5)
*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	0.118607	0.081421	1.456717	0.0252
C	-0.001613	0.001021	-1.580006	0.0141
		Variance Equation		
C(3)	-0.340336	0.032762	-10.38802	0.0000
C(4)	0.163935	0.011544	14.20094	0.0000
C(5)	-0.008098	0.006860	-1.180482	0.2378
C(6)	0.974324	0.003510	277.5895	0.0000

R-squared	0.002521	Mean dependent var	0.000346
Adjusted R-squared	0.002064	S.D. dependent var	0.014837
S.E. of regression	0.014821	Akaike info criterion	-5.76728 1
Sum squared resid	0.479755	Schwarz criterion	-5.75166 4
Log likelihood	6309.638	Hannan-Quinn criter.	-5.76157 3
Durbin-Watson stat	2.084435		

Figure 1.6 Estimation of the copper futures yield series

model	Intercept term	Standard error	Z statistic	P
ARCH	C	0.000285	0.268032	0.7887
GARCH	C	0.001105	-0.950099	0.3421
EGARCH	c	0.001021	-1.580006	0.0141

Table 1: Estimation results of copper futures yield series

Since the ARCH effect of the sequence is obvious, we can consider establishing an ARCH or GARCH model. After a series of analysis, the above data can be seen. The p-value of the intercept term estimated by the ARCH model is equal to 0.7887, which is relatively large. The effect is not significant. The estimated intercept term of GARCH model is p=0.3421, which is slightly more significant than the ARCH model and has obvious GARCH effect. However, it is still not the best choice. After that, using the EGARCH model to estimate, the obtained p is equal to 0.0141, which is less than 5% of the significance level, and the effect is better and fit. Therefore, the EGARCH(1,1) model can be the most fitting model of the GARCH class.

III. CONCLUSION

This paper analyzes the closing price data of copper futures in 2009-2018, based on the time series correlation theory, and tests the GARCH effect. Through the line graph of copper futures yield, it is found that the copper futures yield series may be stable data, and the fluctuation is relatively large at the end of the year, which is easy to be affected by the economic crisis. Through the stationarity test, the sequence is proved to be stable, and the skewness is obtained. The kurtosis, copper futures yield is a spike-thickness phenomenon, and the p-value of the JB statistic is 0, which proves that the sequence is not normally distributed. Through the partial correlation analysis, it is concluded that there is no autocorrelation and partial correlation in the copper futures yield series. The results of the ADF test showed that the sequence was stationary and passed the test at a significance level of 1%, and the sequence was a smooth time series. Through the ARCH and GARCH effects of the software test sequence, the intercept term is not particularly small, the effect is not very significant, and the EGARCH effect of the sequence is tested. The results show that there is a strong effect.

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