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Empirical study of speculation roles in international copper price bubble formation

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Abstract: By using GARCH(1,1)-M and EGARCH(1,1)-M models, the relationships among funds speculation transaction, arbitrage transaction and the fluctuation of international copper future price were studied. The news impact curve of copper future price fluctuation respectively introduced funds speculation position and arbitrage position was given, and the result is consistent with the empirical study conclusion. The results show that investment funds are not the factor that causes copper future price fluctuation, but can reduce the copper future price fluctuation; the copper future price fluctuation is more sensitive to negative information, and fund speculative positions can reduce asymmetric effect of copper price fluctuation, while funds arbitrage position influences less.

Key words: commodity investment funds; speculation; arbitrage;copper price bubble; GARCH family models

1 Introduction

In recent years, international copper future price has fluctuated frequently and severely, and the fluctuation range has seriously deviated from its fundamental value. International copper future price fell more than 68% within five months of 2008, and more than 250% in the subsequent 26 months. No matter copper price is too high or too low, economic production will be devastatingly affected. While trend in the international copper future prices staged like a roller coaster, the size of hedge funds, index funds, and commodity funds in the name of the investment fund is rapidly expanding in future market, which has sparked concerns about the existence of the behavior of manipulating copper future prices.

In regard to the action of investment funds in the formation of commodity future price bubble, distinct views have been formed. In the context of commodity financialization, changes in market fundamentals cannot explain the volatility of commodity prices, and many scholars believe that investment funds taking advantage of information and technology to manipulate market are the main reason for the formation of price bubbles. The futures market has lost the function of price discovery and risk aversion. MASTERS and WHITE [1], and TOKIC [2] found that the inflow of funds into commodity markets makes oil and other commodity prices beyond their fundamental values, resulting in a huge price bubble. MCPHAIL [3] analyzed empirically the relative importance of three factors: global demand, speculation, and energy prices/policy in explaining wheat price volatility. It is found that speculation is important, but only in a short run. Using the duration dependence test on abnormal returns, ZHANG and LV [4] tested the speculative bubbles in the metal aluminum market from February 2004 to July 2008, and their results showed that during this period, especially since July 2006, there have been speculative bubbles in the metal aluminum market. ZHOU and HE [5] thought that there was a certain degree of price bubbles in both international and China nonferrous metals market. EMEKTER et al [6] investigated the presence of rational speculative bubbles in the commodities markets using the duration dependence test on the stochastic interest-adjusted basis,

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and it was reported that 11 of 28 commodities experienced some episodes of rational speculative bubble.

According to traditional futures market theory, investment funds active participation in the futures market provides the market with a good liquidity, which is conducive to its value return of the copper future price [7]. Opponents of speculative bubbles ought that we cannot determine whether the futures price is influenced by the fund investment behavior. KRUGMAN [8] believed that commodity prices rose sharply because of the expanding world demand and the lack of flexibility of the world supply. HAMILTON [9] doubted that speculation could have caused the oil bubble in 2008 at all. WRAY [10] considered that the surge in commodity and energy prices is not a bubble, but a direct product of boom-bust cycle. KESICKI [11] found that the impact of speculation during the 2008 oil bubble was little and a short term relates to fundamental trends in supply and demand for physical crude oil. Additional empirical evidence is added regarding cross-sectional market returns and the relative levels of long-only index fund participation in 12 commodity futures markets by SANDERS and IRWIN [12] and the empirical results provide scant evidence that long-only index funds impact returns across commodity futures markets. IRWIN et al [13] pointed out that because of insufficient data used, the conclusion of the masters is only a temporary relationship, and the speculation cannot be regarded as the main source of fluctuations in commodity prices. ÖSTENSSON [14] found that there is very limited basis for the argument that the nature of commodity markets has changed or that speculators, particularly index funds, were responsible for the increase of commodity price in 2008. The empirical results reveal that unexpected inventory changes of crude oil, trading activities of non-commercial traders, and the exchange rate index of the US dollar cannot impact the conditional mean of crude oil returns significantly [15].

Investment fund has two operation modes in futures market-arbitrage trading and speculative trading. To further analyze the role of speculative in price bubble formation, the relationship between operation modes and copper price bubble will be explored separately, and the effect of operation modes on the asymmetric effect of copper price fluctuations will be analyzed.

2 Research frameworks

2.1 Data selection and index design

1) Commitments of Traders (COT)

Commitments of Traders (COT) announced by Commodity Futures Trading Commission (CFTC) can be used to measure the scale of arbitrage trading and speculative trading.

In accordance with whether its open positions are more than the amount of reportable level, the report divides the U.S. copper market participants into two parts: the reportable and the non-reportable positions. Reportable positions can be further divided into the commercial positions and non-commercial positions. Non-commercial positions are the investment fund positions. They are not relevant to the cooper futures production and trading, and are relatively larger. In particular, non-commercial positions can be divided into long, short and spreading ones, while commercial positions and non-reporting positions can be divided into long and short ones. Relationship between these persons is as follows:

$$(N_{CL}+N_{CS}+2N_{CSP})+(C_S+C_L)+(N_{RL}+N_{RS})=2T_{OI} \quad (1)$$

where N_{CL}, N_{CS} and N_{CSP} represent non-commercial long, short, and arbitrage positions, respectively; C_L and C_S refer to commercial long and short positions respectively; N_{RL} and N_{RS} represent non-reportable long and short positions respectively; T_{OI} refers to the total open interest. The sum of reportable and non-reportable positions is the total market positions.

2) Index design

In order to investigate the structure of various types of trader positions, net long percentage (S) and arbitrage percentage (A) were constructed to measure the scale of speculative trading and arbitrage trading. Specific expressions are as follows:

$$S=(N_{CL}-N_{CS})/(N_{CL}+N_{CS}+2N_{CSP}) \quad (2)$$

$$A=2N_{CSP}/(N_{CL}+N_{CS}+2N_{CSP}) \quad (3)$$

Copper future prices income mathematical formula is expressed as follows:

$$R_t=100(\ln P_t-\ln P_{t-1}) \quad (4)$$

where R_t represents the income rate in period t, P_t represents cooper closing price in period t and P_{t-1} represents cooper closing price in the before period.

3) Data selection

This work selected the copper futures weekly data in Commitments of Traders (COT) announced by Commodity Futures Trading Commission (CFTC). The sample period was June 6, 2006 to July 4, 2011 for a total of 265 samples. This range includes the entire process of the financial crisis.

Considering the wide distribution of the funds holdings contracts, copper futures prices were accordingly selected the New York Metal Exchange copper futures weekly index data as an alternative, and time interval was consistent with the CFTC report's selection. New York Metal Exchange copper futures index is the complex of all the price of copper futures contracts being traded, better reflecting the copper futures price movements, and has better correspondence with the funds holdings data selected.

2.2 Research method

Most of the financial assets have leptokurtic, volatility clustering and heteroscedasticity phenomenon. GARCH family models can well describe the feature of the financial assets sequence. On the basis of testing the existence of ARCH effect in copper future price return sequence, the work introduces the fund speculative positions percentage (S) and fund arbitrage positions percentage (A) into the GARCH-M model, to explore the impact of fund copper futures price fluctuations by different types of positions.

Fluctuations of financial assets often have asymmetric effects which mean that the sensitive degree is different to positive and negative news, and the EGARCH-M model which belongs to GARCH model can well test the asymmetric effect of financial assets fluctuations. The model was selected to test it through introducing S and A into EGARCH-M model to examine the impact of the asymmetric effect of copper futures price fluctuations. Finally, by using the News Impact Curve of copper futures price fluctuations, the work describes the asymmetric response to positive, negative news and how speculative positions in the funds, arbitrage positions influence this asymmetric effect.

3 Empirical research

3.1 Data stationary test

Econometric regression method requires that the data used are stationary sequence, so before the use of the data, the ADF test and PP test are used to test the stationary, and test the unstable sequences differential again, until the test results are stable. The test results are shown in Table 1.

Table 1 Data stationary test results

Item	ADF test		PP test	
	T_statistic	Prob figure	Adj t_statistic	Prob figure
S	−2.54	0.31	−2.41	0.37
$D(S)$	−13.08	0.00*	−13.06	0.00*
A	−3.62	0.01*	−3.67	0.01*
R_t	−9.40	0.00*	−18.04	0.00*

* represents the stationary test in the significant level of 1% to be more reliable in follow-up empirical analysis.

Unit root test found, S, is non-smooth, but one of the first difference sequence ($D(S)$) is through a 1% significant level of stability test, which means that S is a first-order single whole sequence; both A and R_t are though the 1% significant level of stability test, indicating that their original sequences are stationary.

3.2 Copper futures price return series ARCH test

Before the ARCH tests conducting, a random walk model of copper future prices sequence should be established, in order to achieve the residual sequence required for the test. The copper price random walk model estimation results are as follows:

$$\ln P_t=1.689969+0.985840 \ln P_{t-1}+U_t$$
$$R^2=0.966886,\ \text{Adjust\_}R^2=0.966759$$

where U_t represents residual; R^2 is the coefficient of determination.

The random walk model residuals sequence diagram is shown in Fig. 1.

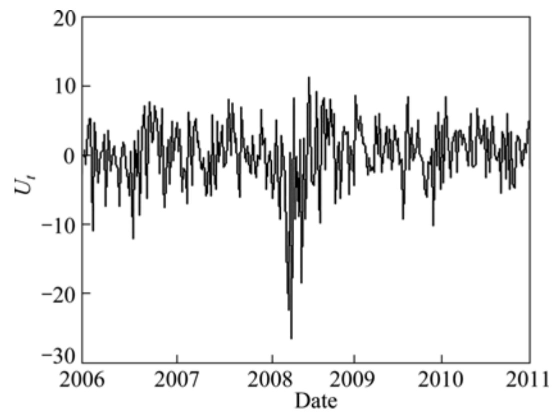

Fig. 1 Residual sequence diagram

It can be seen that the random walk model residual sequences behave as fluctuations aggregation, which are often accompanied by large fluctuations and the small fluctuations. The residuals sequences' characteristics indicate the possible presence of heteroscedasticity.

In order to confirm the existence of ARCH effect in the residual sequences by quantization, price random walk model residual sequences should use LM test and the results are shown in Table 2.

Table 2 ARCH test results

F-statistic		ObsR-squared	
Value	P	Value	P
8.118423	0.000000	63.60826	0.000000

F-statistic is 8.118423, and the probability value P is 0, indicating that all lagged residuals squared terms in the test auxiliary regression equation are jointly significant. ObsR-squared is 63.60826, which corresponds to the probability value P of zero, so the original hypothesis is refused that residuals does not exist ARCH effect, and can consider that the residual series exist heteroscedasticity. When the copper future price residual sequences show conditional hetero-scedasticity, the following part can use GARCH model to describe the characteristics of the copper price.

3.3 Fund investment mode and international copper price fluctuations

In order to investigate how fund's operation influences international copper futures price bubble, the conditional variance of the GARCH-M model is set. We do not introduce any exogenous variables, but introduce the indicator of the fund's holdings accounted $D(S)$ and fund arbitrage the positions accounted indicator A, and gain model 1, model 2 and model 3.

Model 1 Not considering the fund's holdings:

$$\sigma_t^2 = \alpha_0 + \alpha_1 * \mu_{t-1}^2 + \alpha_2 * \sigma_{t-1}^2 \tag{5}$$

Model 2 Joining the Fund proportion of speculative position indicators $D(S)$:

$$\sigma_t^2 = \alpha_0 + \alpha_1 * \mu_{t-1}^2 + \alpha_2 * \sigma_{t-1}^2 + \beta_1 * D(S_t) \tag{6}$$

Model 3 Joining the fund arbitrage positions accounted for indicator A:

$$\sigma_t^2 = \alpha_0 + \alpha_1 * \mu_{t-1}^2 + \alpha_2 * \sigma_{t-1}^2 + \beta_2 * A_t \tag{7}$$

where σ_t^2 represents the conditional variance; σ_{t-1}^2 represents the previous conditional variance, which is GARCH; the coefficient α_2 in front of it portrays the impact of new information on the current copper future price fluctuations; μ_{t-1}^2 represents the previous random error term, which is ARCH; the coefficient α_1 in front of it portrays the impact of old information on the current copper futures price fluctuations; the sum of two coefficients $\alpha_1+\alpha_2$ describes fluctuations transfer degree from prior period to next period. Hereinafter the same variables are defined similarly.

Because most financial income data are in keeping with the distribution of students, the distribution of students during the model to estimate is used. By estimating the three models above, we obtain the mean equation and conditional variance equation estimation results shown in Table 3.

The model estimation shows that the sum, ($\alpha_1+\alpha_2$), of the coefficients between ARCH and GARCH in the conditional variance equation by the three models, representatively is 0.9082, 0.9103 and 0.9064, all above 0.9, which shows the fluctuations of copper futures price have a strong continuity; from the numerical point of view, the three numbers are so close, which means that the introduction of the fund speculative positions and fund arbitrage positions of copper future price haven't improved the continuity. ARCH coefficient values before the three models are 0.1356, 0.1230 and 0.1383, indicating that the introduction of the fund speculative positions weaken the influence of old information on the fluctuations of copper futures price; however, the introduction of the fund arbitrage positions does not significantly improve the influence of the old information on the fluctuations of copper futures price. β_1 of $D(S)$ is −0.4822 in Model 2, the coefficient is negative and the absolute value is much greater than the phase coefficient for A in Model 3, which indicates that the introduction of the fund speculative positions reduces the fluctuations of copper future price compared to the fund arbitrage positions, and fund speculative positions has a significant impact on the copper future price. The coefficient before A in Model 3 is 0.0467; a smaller coefficient value indicates that the influence of the fund arbitrage positions on the copper future price is very weak. Besides, Z-statistic of β_2 is not significant at the 10% significance level, and also means that the fund arbitrage positions have a minimal impact on the copper futures price.

Table 3 Mean equation and conditional variance equation estimation

Item	Model 1	Model 2	Model 3
Mean equation	R_t=0.1012−0.0166 σ_t	R_t=0.9571−0.1917σ_t	R_t=0.0503−0.007σ_t
α_0	2.5672 (1.5940)	2.5233 (1.6830***)	1.108 (0.3983)
α_1	0.1356 (2.3339**)	0.1230 (2.4011**)	0.1383 (2.3366**)
α_2	0.7726 (7.5822*)	0.7873 (8.6779*)	0.7681 (7.6018***)
β_1	–	−0.4822 (−1.777***)	–
β_2	–	–	0.0467 (0.5728)
$\alpha_1+\alpha_2$	0.9082	0.9103	0.9064
Log likelihood	−802.0504	−796.7172	−801.8313
SC value	6.1795	6.1836	6.1989
AIC value	6.0985	6.0888	6.1044

*, ** and *** represent thronging the stationary test in the significant levels of 1%, 5%, 10%, to be more reliable in follow-up empirical analysis. In this work, the more stringent 5% significance level was used.

The basis of fund speculative trading and fund arbitrage trading is different. For fund speculative positions, their essence is to obtain profits in the copper price fluctuation, so there is a link between fund speculative positions and copper futures price volatility inevitably. Fund investors established fund speculative positions after the analysis of the differences between copper futures price and value: when performance for copper price fluctuates more, the fund speculative positions will be more interesting because the possibility of using speculative funds positions to obtain huge profits will be larger. After the establishment of fund speculative positions, copper prices will return to the value gradually, narrowing the discrepancies between price and value, and price volatility will be gradually reduced too. For fund arbitrage position or not, the concern is the price difference between different contracts deviating from the reasonable range of different contracts. If the deviation from the reasonable range is bigger, fund arbitrage positions profit space is bigger too, fund arbitrage positions will also be more intense. Establishment of the copper prices, copper prices fluctuation and fund arbitrage positions has little relevance because in general between different copper contract prices, prices generally remain relatively consistent.

3.4 Influence of fund investment on asymmetric effect of copper futures price fluctuations

1) EGARCH-M model introduction

The EGARCH model is also called exponential GARCH model, which can reflect the characteristics of asymmetry of financial asset price fluctuations on the positive or the negative news, describe the unit positive and negative news on the financial asset price volatility caused by the magnitude of various sizes phenomenon. We generally think EGAHC (1,1) model is able to describe the characteristics of the financial asset price volatility; therefore, it is widely used in practice. In order to characterize the relationship of income and its risk of financial asset prices, the mean equation of the EGARCH (1,1) model was introduced, which yields the conditional variance using EGARCH-M (1,1) model. The model is expressed as follows:

$$R_t = a + \delta\sigma_t + U_t \tag{8}$$

$$\ln\sigma_t^2 = \omega + \alpha\frac{|U_{t-1}|}{\sqrt{\sigma_{t-1}^2}} + \beta\frac{U_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \gamma\ln\left(\sigma_{t-1}^2\right) \tag{9}$$

By the above equation models, even if the parameter estimation is negative, the conditional variance σ_t^2 of any courses is positive. Therefore, EGARCH model does not require the non-negative constraint assumption of the model parameters. As for the coefficient β of $U_{t-1}/\sqrt{\sigma_{t-1}^2}$, if the value is 0, then no matter the good news ($U_{t-1}/\sqrt{\sigma_{t-1}^2}>0$) or bad news ($U_{t-1}/\sqrt{\sigma_{t-1}^2}<0$), its conditional variance has no effect. If the value is greater than 0, then the good news has a greater impact on asset price volatility than bad news in every unit, which means that the price of this finance assets turns out to be asymmetric. If the value is less than 0, then the bad news has a greater impact on asset price volatility than good news in every unit, which means that the price of the finance assets turns out to be asymmetric too.

(2) Set and estimation of EGARCH (1, 1)-M

In order to compare the influence of fund speculative trading and arbitrage trading on the asymmetry effect of international copper futures price fluctuation, we introduce $D(S)$ and A in the establishment of EGARCH (1,1)-M model conditional variance equation, and compare their differences with the model estimation results without the introduction of any exogenous variables. Testing model conditional variance equation is set as follows.

Model 4 Test of copper future prices' asymmetric effect introducing $D(S)$

$$\ln\sigma_t^2 = \omega + \alpha\frac{|U_{t-1}|}{\sqrt{\sigma_{t-1}^2}} + \beta\frac{U_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \gamma\ln\sigma_{t-1}^2 + \eta D(S_{t-1}) \tag{10}$$

Model 5 Test of copper futures prices' asymmetric effect introducing A

$$\ln\sigma_t^2 = \omega + \alpha\frac{|U_{t-1}|}{\sqrt{\sigma_{t-1}^2}} + \beta\frac{U_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \gamma\ln\sigma_{t-1}^2 + \eta A_{t-1} \tag{11}$$

Model 6 Test of copper future prices' asymmetric effect without any introduction

$$\ln\sigma_t^2 = \omega + \alpha\frac{|U_{t-1}|}{\sqrt{\sigma_{t-1}^2}} + \beta\frac{U_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \gamma\ln\sigma_{t-1}^2 \tag{12}$$

where U_t is the residual and σ_t^2 is the conditional variances.

Estimating the GARCH (1,1)-M model, the obtained results are shown in Table 4.

Table 4 EGARCH(1,1)-M model estimation results

Item	Model 4	Model 5	Model 6
Mean equation	R_t=15.3719−3.0403σ_t	R_t=0.8751−0.6447σ_t	R_t=0.8824−0.2674σ_t
ω	6.3351 (21.8064*)	0.1763 (1.2575)	0.1649 (1.4198)
α	−0.069 (−1.7658**)	0.0342 (0.6081)	0.0415 (0.7816)
β	0.0458 (1.6225***)	−0.2121 (−5.0324*)	−0.2129 (5.1562*)
γ	−0.9263 (−25.9767*)	0.9367 (27.7009*)	0.936 (27.3512*)
η	−0.0018 (−0.3118)	−0.0002 (−0.1508)	–
Impact of good news in standard unit	−0.0232	−0.1779	−0.1714
Impact of bad news in standard unit	0.1148	0.2463	0.2545
F statistics	3.3451	0.4735	0.5638
Prob (F_statictic)	0.002	0.8534	0.759
AIC value	6.0719	6.0537	6.0462

*, ** and *** represent thronging the stationary test in the significant levels of 1%, 5%, 10%, to be more reliable in follow-up empirical analysis. In this work the more stringent 5% significance level was used.

3) Test results of copper price volatility asymmetry effect

According to the results of the model estimation, in the three models β values are 0.0458, −0.2121 and −0.2129, and all undergo the 10% significance level and are significantly different from zero, so that there are asymmetric effect of three models of its price fluctuation. When the *D*(*S*) is put into the conditional variance equation, the standard unit of good news can make copper prices less volatile 0.0232 units than before, and the standard unit of bad news copper price volatility can increase 0.1148 units, so the bad news has more effect on copper price fluctuations than the good news. By comparing the results in Model 1 and Model 3, we can find that, when the *D*(*S*) is put into the models, whether it is good or bad news, copper price fluctuations are all reduced. The unit of the good news of the copper price fluctuations has increased by 0.1482, from −0.1714 to −0.0232. The unit of bad news copper price volatility reduces to 0.1148 from 0.2545. It shows that when *D*(*S*) is put into the conditional variance equation, the degree of asymmetry of the copper price fluctuations is weakened. When *D*(*S*) is put into the conditional variance equation, the impacts of standard unit of good news and bad news on copper price volatility are very close to the lack of introduction of any exogenous variables, which shows that the introduction of *A* asymmetric effect of copper price fluctuations is not significant.

Like most financial market, there is an asymmetric effect in the international copper price fluctuations. The reason for the phenomenon is that there is the preference of investors psychological risk aversion, investors are more sensitive to bad news, leading to the fact that the reactions to the negative news too pessimistic. The specific action to the market shows the investors sell shares when the price goes down. For arbitrageurs, its concern is the spread between the different copper contracts, and the fluctuations in the price of a single contract are not the focus of its attention. The motivation fund to establish arbitrage positions is also based on this, so its influence on the copper price fluctuations is smaller, and there is no improvement on the asymmetric effect of copper futures price volatility. The establishment of the speculative positions in fund is to obtain risk income, when there is a violent fluctuation in the price of copper, funds on the basis of price deviating from the direction to establish reverse positions have more sufficient power, which will eventually encourage the rational price regression. Copper price fluctuations on the negative news is more severe response that is asymmetrical features, makes investment funds build be more positive head ushering in the negative impact on copper prices, and finally can slow down the asymmetric effect of copper futures price volatility.

3.5 Information impact curve of fluctuations in copper futures prices

The information impact curve is used to describe the curve of the model "information impact". From the graph, the impact of the future copper prices on the information of the bad or good news, can be clearly observed and whether the fluctuations in the future copper prices have the asymmetric effects can also be observed intuitively. The definition of the "information impact curve", as for the model EGARCH (1, 1)-M, is assumed

$$\ln F\left(\frac{U_{t-1}}{\sqrt{\sigma_{t-1}^2}}\right)=\alpha\frac{|U_{t-1}|}{\sqrt{\sigma_{t-1}^2}}+\gamma\frac{U_{t-1}}{\sqrt{\sigma_{t-1}^2}}$$

If $Z_{t-1}=U_{t-1}/\sqrt{\sigma_{t-1}^2}$, then $F(Z_{t-1})=\alpha Z_{t-1}+\gamma Z_{t-1}$, the function $F(Z_{t-1})$ is called "information impact curve"; U_t is the residual of the model estimation EGARCH(1,1)-M; σ_t^2 is the conditional variance, then $Z_{t-1}=U_{t-1}/\sqrt{\sigma_{t-1}^2}$ is the standardized residuals, that is, the information impact of the standard unit described in the previous section. In the information shocks graph, the abscissa is expressed as the direction (negative or positive) and the size of the amount of information, and the vertical axis indicates the size of the information amount of impact, i.e. the magnitude of the effect of future copper price fluctuations. Considering respectively the information impact curve when the *D*(*S*) and *A* are introduced into the conditional variance equation and when there are not any exogenous variables introduced, and corresponding to Models 4, 5 and 6 in the previous section, impact curve graphs in the three cases can be described in Figs. 2−4.

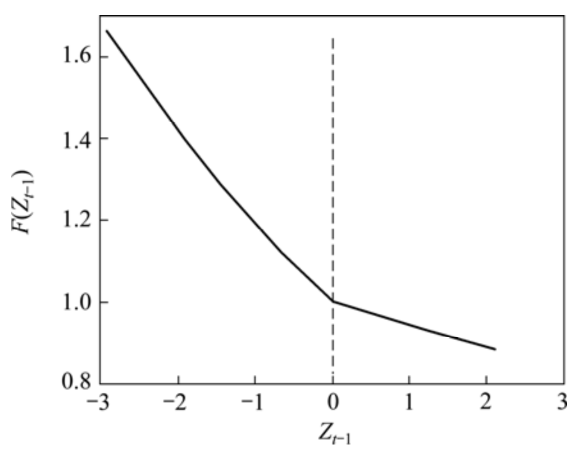

Fig. 2 Information impact curve without other variances

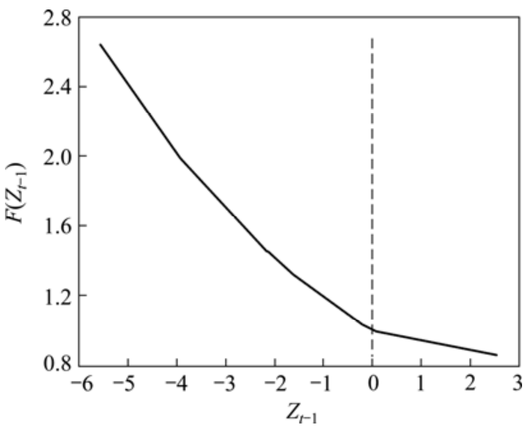

Fig. 3 Information impact curve with *D*(*S*)

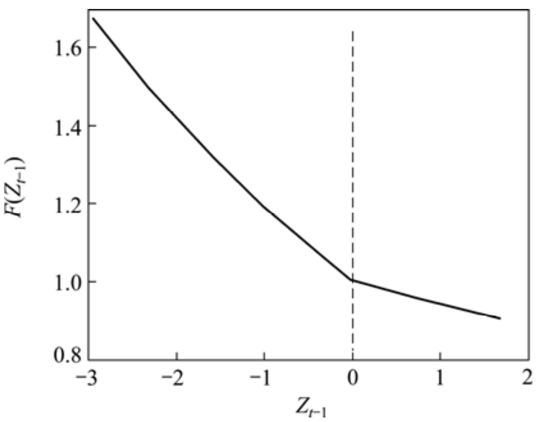

Fig. 4 Information impact curve with *A*

From the three above-mentioned charts, it can be observed that the abscissa 0 scale on the left slope of the curve is greater than the slope of the curve on the right. The definition of the information shock curve shows that the abscissa axis represents the direction and magnitude of the shock of information, accordingly, the vertical axis represents the amount of impact of the relating information. According to the definition, whether *D*(*S*) and *A* are introduced into the conditional variance equation or not, there still exists asymmetric effect in response to the information, and the impact of the negative news on the future copper price bubble formation is greater than that of the positive news.

Observing the horizontal axis value of 0 on the left of the curve in the three graphs, it can be found that the slopes of the curve on the left side are substantially equal and the absolute value of the slope is greater than the absolute value of the left side in the curve of Fig. 2. The slopes of the curve on both the left sides are almost equal, which shows once again that the introduction of the fund arbitrage positions has little effect on the symmetric effect of future copper price fluctuations.

4 Conclusions

1) The investment of the fund is not the main factor causing the copper price fluctuations. The arbitrage trading has little effect on the copper price fluctuations, and its speculative trading can reduce the copper price fluctuations instead.

2) There is an asymmetric effect in the copper price fluctuations; the arbitrage fund holdings have little influence on asymmetric effect, and arbitrage fund holdings can improve the asymmetric effect in the copper price fluctuations.

3) We do not agree that increasing the scrutiny on speculative trading of the copper futures market participants with regulation can be an effective way to stabilize copper prices. Policymakers should take a deeper look into the trading activity of commercial participants in the copper futures market.

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投机行为在国际期铜价格泡沫形成中的作用

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摘 要：采用 GARCH(1,1)-M 及 EGARCH(1,1)-M 模型研究投资基金投机交易、套利交易与国际期铜价格波动的关系，并分别给出引入基金投机持仓、套利持仓后的期铜价格波动信息冲击曲线，其描述结果与实际研究结论的表现一致。结果表明：投资基金不是引起期铜价格波动的原因，基金投机交易能够减小期铜价格波动；期铜价格波动对负面消息的影响更敏感，基金投机持仓能够减缓期铜价格波动的非对称效应，而基金套利持仓对此影响较小。

关键词：商品投资基金；投机；套利；铜价泡沫；GARCH 族模型

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