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Research on the Optimal Hedging Ratio of Futures

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Abstract: Futures, also known as futures contracts, is a type of financial instrument that trades at a futures exchange, buyers and sellers at a prescribed time, and delivers a certain quantity and quality in accordance with the conditions of the previously agreed transaction price, delivery method, etc. A standardized contract that can be listed for trading after approval by the regulatory authority. The most important thing in the futures market is to avoid risks, and hedging is the best measure to achieve this function. This paper takes aluminum futures as an example, analyzes the data through OLS and ECM models, explores the optimal hedging ratio, and better avoids risks.
Keywords: futures contract; hedging ratio; OLS; ECM.

INTRODUCTION

Hedging, also known as "risk hedging," is a futures trading act aimed at circumventing the spot price risk, and is achieved through the same number of transactions in the opposite direction in the spot market and the futures market. The price trend of the spot market and the futures market are basically the same. When one market is profitable, the other market loses money. After offsetting the gains and losses, the trader's income is basically stable at the expected level. Hedging is the basis for the existence and development of the futures market, which is conducive to the effective avoidance of market price fluctuations and steady development. In the process of realizing hedging, the most important thing is to determine the optimal hedging ratio [1].

The hedging ratio is the ratio of the total value of the futures contract determined by the hedger when establishing the trading position to the total value of the spot contract value to be hedged in order to avoid the spot market risk. Determining the right hedging ratio is the key to reduce the risk of price fluctuations and maximize the effectiveness of hedging. Metal aluminum is one of the representatives of non-ferrous metal futures and has typical analytical significance. Therefore, this paper focuses on aluminum futures to study the optimal hedging ratio.

The research theory of determining the optimal hedge ratio

Traditional hedging theory

The first method to study the hedging ratio came from the research of Keynes and Hicks, the method of 1.0, which is also now called the "naive law". The methods used to calculate the hedging ratio are different for the different financial derivatives studied. For hedging for futures trading, the first thing that comes to mind is that one unit of spot and one unit of futures are used for hedging. The method considers that, when the basis error is equal to zero, the direction and magnitude of changes in the spot market and the futures market are basically the same, so when the futures market held by the hedger and the spot market are in the opposite but in the same quantity, the spot market The profit or loss will be completely offset by the loss or profit of the futures market, thereby avoiding the risk of price fluctuations and achieving the effect of hedging. However, this method is too idealistic, does not take into account the factors of market changes, and does not conform to reality, so it is considered undesirable and is considered to be a "naive method" [3].

Basis of hedging theory

In the fifties and sixties of the 21st century, Woking believed that because of the existence of the basis, there was no such perfect hedging in the market [2]. Woking stressed the need to change the traditional hedging ideas, he believes that the focus of hedging is not to transfer or reduce price risk, but from the volatility of futures prices and spot prices to obtain opportunity profits, from the basis of profit, making Hedgers can obtain maximum returns under a given risk, or they can minimize the risk under the premise of expected return. This method is also called speculation on basis difference. The trading characteristics of this method are no longer as rigid as the traditional hedging theory, and the required varieties are not the same, but there must be some relevance.

Modern Hedging Theory

The modern hedging theory is mainly explained by Johnson and Ederington through Markowitz's portfolio investment theory. The theory is that hedgers actually invest in portfolios of futures and spot market assets, based on portfolio investment. The expected returns and variances determine the spot market and futures market trading positions, which will minimize the risk of investment returns and maximize utility. The modern hedging theory mainly has three propositions: the scale of hedging, the effectiveness of hedging, and the cost of hedging, which are reduced by hedging rate, hedging, and the reduction of exchange rate risk and hedging [5]. The degree to which the company expects profit is measured. For the determination of hedging, the core problem of hedging, under the modern hedging theory, scholars believe that the hedge ratio is mainly divided into static hedging ratio and dynamic hedging ratio. Many effective researches were also born. For example, under the principle of minimizing the risk of portfolio returns, a simple regression model for constructing futures yield and spot yield was used to measure the minimum variance hedge ratio; using OLS, B-VAR, ARIMA, ARCH, GARCH and other models estimate the optimal hedge ratio [4].

Empirical analysis

Establish OLS simple regression model

Such as Diagram 1, Establish OLS simple regression model for futures price and spot price of aluminum futures:

Dependent Variable: IS
Method: Least Squares
Date: 04/27/18 Time: 10:30
Sample: 2 246
Included observations: 245

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.177591	2.041175	0.087004	0.9307
IF	0.928624	0.028263	32.85613	0.0000

R-squared	0.816261	Mean dependent var	4.612245
Adjusted R-squared	0.815505	S.D. dependent var	74.21966
S.E. of regression	31.87952	Akaike info criterion	9.769935
Sum squared resid	246961.9	Schwarz criterion	9.798516
Log likelihood	-1194.817	Hannan-Quinn criter.	9.781445
F-statistic	1079.526	Durbin-Watson stat	2.370603
Prob(F-statistic)	0.000000		

Diagram-1: OLS estimation result

Based on the results of the above figure, the regression equation for the difference sequence of the futures price if the spot price differential series is:

$$\Delta S_t = 0.177591 + 0.928624\Delta F_t + \mu_t$$
$$t \quad (0.0870) \quad (32.8561) \qquad \textit{(Formula-2)}$$
$$p \quad (0.9307) \quad (0.0000)$$

Observing the equation, it can be seen that the overall and explanatory variable coefficients are significant (P value is zero). From the regression results, it can be seen that each unit of the stock position is hedged with 0.928624 units of opposite futures positions, and the optimal hedge ratio is 0.928624.

Estimating the optimal hedge ratio using the ECM model

Such as Diagram-2 to establish an error correction model between ΔF and ΔS with the error correction term:

Dependent Variable: IS
Method: Least Squares
Date: 04/27/18 Time: 11:12
Sample: 2 246
Included observations: 245

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.043983	2.005375	0.021933	0.9825
IF	0.956702	0.029165	32.80317	0.0000
E(-1)	-0.102497	0.032630	-3.141187	0.0019

R-squared	0.823459	Mean dependent var	4.612245
Adjusted R-squared	0.822000	S.D. dependent var	74.21966
S.E. of regression	31.31333	Akaike info criterion	9.738134
Sum squared resid	237287.0	Schwarz criterion	9.781007
Log likelihood	-1189.921	Hannan-Quinn criter.	9.755399
F-statistic	564.3922	Durbin-Watson stat	2.253711
Prob(F-statistic)	0.000000		

Diagram-2: Cointegration equation of futures price and spot price

Cointegration equation:

$$\Delta S_t = 0.043983 + 0.956702\Delta F_t - 0.012497 ECM_{t-1} + \mu_t$$
$$t\,(0.021933)\quad(32.80317) \qquad \textit{(Formula-2)}$$
$$p\,(0.9825)\quad\;(0.0000)$$

It can be seen that the equation is overall significant. The regression results show that each unit of the spot position should be hedged with 0.956702 units of the opposite futures position, and the optimal hedge ratio is 0.956702.

Evaluate using the minimum variance hedge ratio

According to the results of the optimal hedging ratios for the aluminum futures based on the above model, the OLS model and the ECM model are estimated to be 0.928624 and 0.956702, respectively. The combination of the above two types of hedging and spot income without hedging the rate compares the variance, analyzes the volatility of the yield, and evaluates the utility. As shown below:

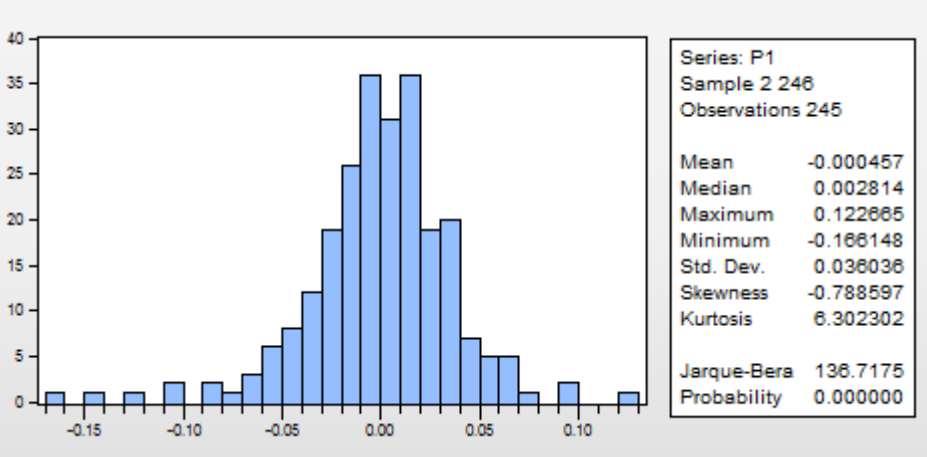

Diagram-3: Hurry effect under OLS model conditions

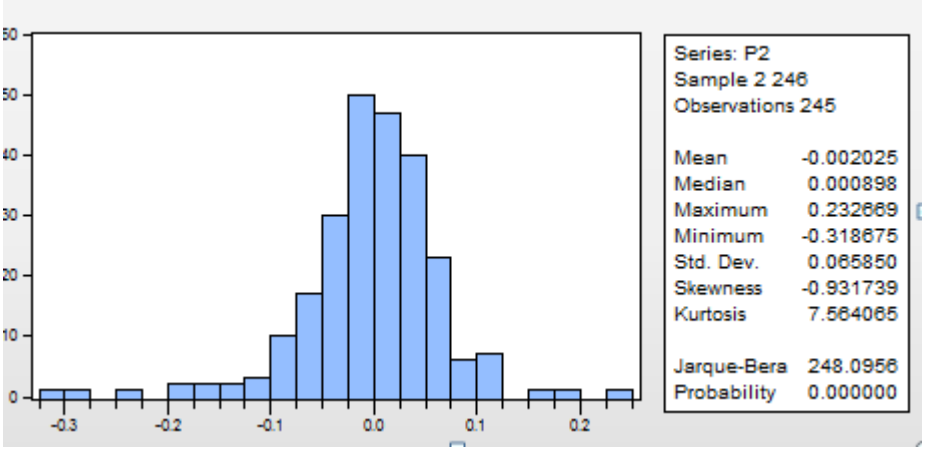

Diagram-4: Hedging effect under ECM model conditions

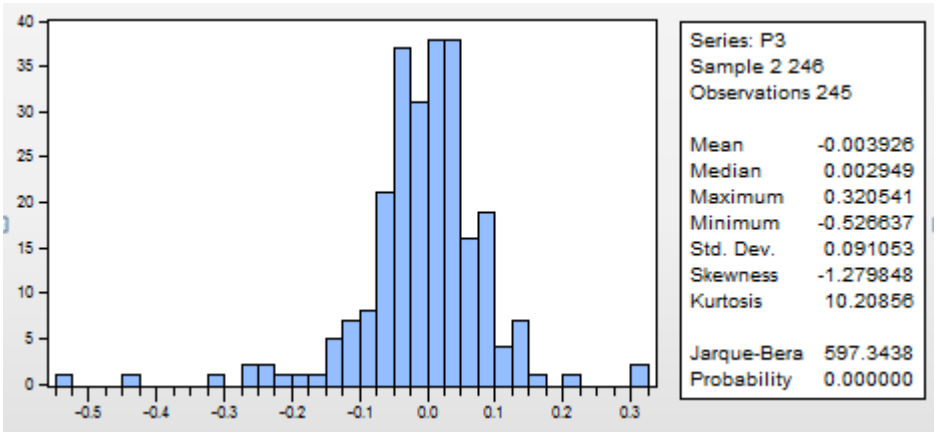

Diagram-5: Non-hedging effect description

Based on the above results, establish a utility comparison table:

Table-1: Comparison of Hedging Effects under Different Methods

	OLS model	ECM model	Unprotected combination
Hedging ratio	0.928624	0.956702	0
Portfolio standard deviation	0.036036	0.065850	0.091053

CONCLUSION

Observe Table-1 and compare the data calculated from the above model operations with those without hedging, and find that the risk of risk reduction through hedging is reduced, indicating that futures hedging is effective. Compared with the OLS model, the ECM model has a better hedging effect.

The error correction term was taken into account in the ECM model, taking into account the non-stationary, long-term equilibrium, and short-term dynamic relationships between futures prices and spot prices. The greater the market risk, the more effective the hedging effect. As futures markets and spot markets continue to mature, continue to improve, and effectiveness continues to increase, future hedging effects of futures will be more pronounced. Choosing the right method to calculate the hedging ratio is helpful for investors to correctly understand the hedging function and better use of hedging to obtain profits, and it is also of great significance for promoting the development of China's futures, spot markets and even the entire capital market system. .

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